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ABSTRACT

Economic Origins of Cultural Norms: The Case of Animal Husbandry and Bastardy*

This paper explores the historical origins of the cultural norm regarding illegitimacy (formerly known as bastardy). We test the hypothesis that traditional agricultural production structures influenced the historical illegitimacy ratio, and have had a lasting effect until today. Based on data from the Austro-Hungarian Empire and modern Austria, we show that regions that focused on animal husbandry (as compared to crop farming) had significantly higher illegitimacy ratios in the past, and female descendants of these societies are still more likely to approve illegitimacy and give birth outside of marriage today. To establish causality, we exploit, within an IV approach, variation in the local agricultural suitability, which determined the historical dominance of animal husbandry. Since differences in the agricultural production structure are completely obsolete in today's economy, we suggest interpreting the persistence in revealed and stated preferences as a cultural norm. Complementary evidence from an 'epidemiological approach' suggests that this norm is passed down through generations, and the family is the most important transmission channel. Our findings point to a more general phenomenon that cultural norms can be shaped by economic conditions, and may persist, even if economic conditions become irrelevant.

JEL Classification: Z1, A13, J12, J13, J43, N33
Keywords: cultural norms, persistence, animal husbandry, illegitimacy

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1 Introduction

It is widely acknowledged among economic scholars that individuals' decisions are not only based on economic incentives, but also on prevailing cultural norms.[1] This fact is documented in numerous experimental and empirical settings and has led to a revision of economic decision models. In contrast, very little is known about how cultural norms are formed, and how they change over time (Giuliano and Nunn, 2017). In this paper, we aim to contribute to the burgeoning literature on the origins of cultural norms. We study the case of illegitimacy (formerly known as bastardy), which describes the status of being born to an unmarried mother.

Virtually all societies distinguish between legitimate and illegitimate births (Hartley, 1975). This explicit distinction is related to the widespread concern over the welfare of unmarried mothers and their children. In the absence of a clear paternal link, the physical, emotional, and economic support for mother and child may be inefficiently low. This concern is confirmed by a robust negative correlation between illegitimacy and a wide array of child outcomes.[2] There is substantial variation in the incidence and acceptance of legitimacy across societies and over time. Today, the social acceptance of illegitimacy is typically linked to cultural differences (such as the religiosity of the population). Relatedly, the rise in extramarital births in Western countries is often associated with the ongoing secularization and (sexual) emancipation of women. In the US, race has traditionally been the most important factor (see, e. g., the controversially discussed *Moynihan Report*) and continues to be at the center of the debate, as Black-White disparities in illegitimacy are rising (Martin *et al.*, 2015). Typically, these debates stress the idea that illegitimacy is, besides economic factors, also determined by cultural norms (e. g. Kearney and Wilson, 2017). Our interest is in explaining the origins of this cultural norm.

We test the hypothesis that differences in this cultural norm have their origins in the form of agricultural production structures traditionally employed in pre-industrial periods. For our empirical analysis, we link data from the Austro-Hungarian Empire to today's Austria. Our estimation sample covers a period of more than a century. We show that regions that focused on animal husbandry (as compared to crop farming) had significantly higher illegitimacy ratios in the past, and female descendants of these societies are still more likely to approve illegitimacy and give birth outside of marriage today. To establish causality, we exploit variation in the local agricultural suitability, which determined the historical dominance of animal husbandry. Over our sample period, the agricultural sector has declined in terms of employment from 50 percent in 1900 to 5 percent today. At the same time, the effect of agricultural production structures on illegitimacy has remained strong. We interpret our findings as an example of a more general phenomenon whereby cultural norms can be shaped by economic conditions, and may persist, even if economic conditions become irrelevant (Giuliano, 2017).

[1] See, for instance, Guiso *et al.* (2006); Fernández (2011); Alesina and Giuliano (2015). We use the terms 'cultural norm', 'culture' and 'social norm' interchangeably.

[2] See, for instance, von Borosini (1913) for evidence in historical data and Shah *et al.* (2011); Buckles and Price (2013) for contemporaneous data.

An important distinction among rural societies is whether the focus is on crop farming or animal husbandry. In crop farming, the work load and the resulting demand for additional labor, is determined by the rhythm of the seasons. While fluctuation can be partially offset by secondary works in the 'dead season', additional manpower is needed in the harvest season. In contrast, in animal husbandry the workload is distributed relatively evenly throughout the year. A further important difference is the required skills. Animal husbandry requires a sound knowledge of the peculiarities of each animal (analogous to firm-specific human capital), while harvesting is less specific. As a result, in rural societies dominated by animal husbandry, most workers in the 18th and 19th centuries had long-term labor contracts as farmhands, while in rural societies dominated by crop farming most workers had short-term labor contracts as day laborers. Farmhands were regarded as household members, who lived permanently at the farm, and were predominantly paid in kind. The lack of cash income prevented farmhands from establishing their own households or from marrying. As a result, their offspring were born illegitimately and were tolerated by society as a pool of disenfranchised cheap labor. Since children born out of wedlock grew up as servant members to the household, their chances of marrying were almost zero, and they were thus likely to produce another generation of illegitimate children. In contrast, day laborers typically lived as cottagers, meaning they had simple dwellings (cottages), but typically lacked sufficient land to sustain their livelihood. Therefore, they supplemented their income as day laborers on bigger farms (and with craft and trade) for which they received cash. This additional cash income enabled young couples to establish their own households, which led to marital fertility.[3]

Clearly, no region focused exclusively on either crop farming or animal husbandry. Thus, one cannot find *farmhand societies* or *day laborer societies* in their pure form. Nevertheless, societies dominated by animal husbandry, and the resulting clustering of farmhands with their illegitimate children, may have developed the belief that illegitimate births are a natural event. This belief may have persisted even if the economy shifted its focus from agriculture to manufacturing and services, and became a long-lasting cultural norm. We derive the hypothesis that women residing today in regions that were historically farmhand societies, are more likely to give birth outside marriage, compared to those residing in former day laborer societies.

To test this hypothesis, we link the *current* incidence of non-marital births to variation in the *historical* agricultural production structures. Such an analysis requires exceptionally rich historical data sources that can be linked to recent birth registers. For this purpose, we find the context of the Austro-Hungarian Empire well-suited. Starting from the mid-19th century, detailed official statistics exist, which include, among others, regional information on the agricultural sector and on the incidence of non-marital births. The former allows us to categorize a region as either a predominantly farmhand society or a day laborer society. We can thus compile a dataset that links (either on a municipality or district level) this historical

[3]The historical correlation between agricultural production structures and illegitimacy has been discussed by Austrian historians, such as Mitterauer (1983, 1986, 1992); Ortmayr (1989); Ehmer (1991).

information with recent administrative data sources from Austria. We also exploit data from the *Austrian Birth Register*, which comprises individual-level information on all births since 1971.

The starting point for our empirical analysis comprises three strong and robust correlations. First, we find a positive relationship between the relative dominance of animal husbandry versus crop farming and the ratio of farmhands to day laborers in 1900. Thus, our data confirm that workers in animal husbandry predominantly had long-term contracts, while workers in crop farming had short-term contracts. Second, in the historical data, we find a clear pattern of high illegitimacy ratios in farmhand societies and comparably low ratios in day laborer societies. This reflects the origin of the cultural norm regarding illegitimacy. During this period, behavior was driven by the prevailing economic conditions. Third, we find a positive relationship between the local historical and current illegitimacy ratios. This regional persistence in behavior covers a time-period of over 100 years. During this period, a transformation from a pre-industrial agricultural society to a post-industrial society took place. Today, the agricultural production structure from the 19th century is obsolete. This latter fact supports our interpretation of this persistence as a cultural norm.

In our main analysis, we document the direct relationship between the historical agricultural production structure and the current likelihood of a non-marital birth. To be able to make causal statements, we use variation in the local agricultural suitability, which determined the historical agricultural production structure. The potential yield of crop farming versus animal husbandry is determined by different biophysical factors (mainly climate, soil, and terrain). These factors are not readily amenable to change by human activity or institutions and as such are exogenous. Since Austria's topography comprises alpine mountains as well as lowlands, we focus on the strong variability in terrain. Sloping terrain is more difficult to cultivate than flatland, and is subject to higher rates of water runoff and soil erosion (van Velthuizen *et al.*, 2007). While this applies to both crop farming and animal husbandry, the productivity constraints of a higher slope gradient are comparably higher for crop farming. In line with this, we find a higher historical dominance of animal husbandry (and farmhand societies) in Austrian regions characterized by steep slopes. We offer two different causal estimates. First, our instrumental variable estimate relates the variation in historical agricultural production structure (due to the slope of terrain) to the current likelihood of an illegitimate birth. This estimate shows that the existing cultural norm regarding non-marital births has its origins in the form of agricultural production structures traditionally employed in pre-industrial periods. We replicate our analysis by using exogenous variation in local climate. This alternative IV-strategy provides very comparable estimates. Second, our reduced form estimate — relating the current likelihood of an illegitimate birth to the terrain slope — shows that biophysical factors structurally affect demographic outcomes in modern societies. Figure 1 summarizes the suggested theory of change, the empirical variables, and our instrumental variable approach.

To support our causal interpretation, we complement our analysis with two further ap-

proaches. First, we provide evidence based on stated preferences. We link recent survey responses on attitude towards illegitimacy to the historical illegitimacy ratio and the historical agricultural production structure in the respondent's region of residence. This analysis shows equivalent links for stated preferences and corroborates our conclusion derived from our main analysis. Second, we provide an analysis of so-called shotgun weddings. In line with our main results, we find that the historical agricultural production structure affects the likelihood that an illegitimate birth today is averted by a wedding between conception and birth. In supplementary analyses, we explore the effect of historical agricultural production structure on several other historic demographic outcomes. While we find no evidence for any impact of the dominance of animal husbandry on the *level* of marital fertility, we find a significant positive effect on the level of non-marital fertility. The latter finding suggests that a higher acceptance of illegitimacy, increases the demand for these children.

Finally, we examine the behavior of immigrants to Austria (and their descendants). We find that their propensity to have an illegitimate birth is only very weakly related to the historical illegitimacy ratio of their current place of residence in Austria. In contrast, the historical illegitimacy ratio in their (ancestors') country of origin is a very powerful predictor for their behavior. We interpret this result from this so-called 'epidemiological approach' as evidence for the importance of the family as a transmission channel for the cultural norm regarding illegitimacy. Put differently, the norm seems to be passed down through generations, while other (past or present) institutions at the current place of residence are only of second order importance.

Five guideposts can be used to situate this analysis within the context of the existing literature. First, we add to the growing literature on the persistence of cultural attitudes over long periods of time (see, e. g., Voigtländer and Voth, 2012; Grosjean, 2014). One previous study pays attention to illegitimacy. Ragan (2012) demonstrates that regional historical illegitimacy ratios in Sweden are very persistent over time, and that they are a strong and robust predictor of the demand for oral contraceptives. She argues that both behaviors (i. e., illegitimacy and use of contraceptives) are driven by a particular cultural norm on sexual behavior. In line with this hypothesis, she finds that in Sweden teenage childbearing declined after the introduction of oral contraceptives. Second, we contribute specifically to the burgeoning literature that aims to go beyond showing the mere existence of persistence, but instead to identify the origins of specific cultural norms. We are not aware of any previous study on the historical origins of a cultural norm regarding illegitimacy. The most closely related paper from this strand of literature is Alesina *et al.* (2013), who test the hypothesis that traditional agricultural practices influenced the historical division of labor and the evolution of gender norms. They show that descendants of societies that traditionally practiced plough agriculture today have less equal gender norms and a lower female labor force participation. The finding of Alesina *et al.* (2013) and our main empirical finding on the origins of the cultural norm regarding illegitimacy, both point to a more general phenomenon that cultural norms can be shaped by economic conditions

and may persist even if economic conditions become irrelevant.[4] Thus, our finding contributes to a deeper understanding of the origins of cultural norms and values. Third, we speak to the literature that identifies cultural norms as determinants of family outcomes. A number of papers proxy culture among US immigrants by their country of ancestry to study the role of culture in family-related outcomes such as fertility (Fernández and Fogli, 2006, 2009), living arrangements (Giuliano, 2007), and divorce (Furtado *et al.*, 2013). While these papers clearly show that individuals react to cultural norms in fertility decisions and family formation, they do not explore the origins of these cultural norms. Fourth, more specifically, we also contribute to the literature on the determinants of illegitimate births. Existing papers discuss several potential explanations for the variation in the share of non-marital child births across time and space. The literature on pre-industrial societies puts forward the elimination of formal marriage restrictions (Knodel, 1967), variations in real wages in agriculture (Lee, 1977, 1978), a changing sexual mentality among the poor (Shorter, 1978), and rural inheritance patterns (Kytir and Münz, 1986). The literature on industrial societies provides evidence for the effect of the increased availability of contraception and abortion (Akerlof *et al.*, 1996; Fernández-Villaverde *et al.*, 2014; Nuevo-Chiquero, 2015), the liberalization of divorce law (Alesina and Giuliano, 2007), the reform of joint custody laws (Halla, 2013), existing welfare state arrangements (Lackner *et al.*, 2016), distorted adult sex ratios (Bethmann and Kvasnicka, 2013), and local income inequality (Kearney and Levine, 2014). We provide empirical evidence — for the widely held belief — that cultural norms are an important factor and explore the deep roots of this norm. Fifth, our work relates to existing studies that link the emergence of the so-called *European Marriage Pattern* (EMP) to changes in the agricultural production structure.[5] Most importantly, Voigtländer and Voth (2013) argue that the Black Death contributed crucially to the EMP. Their key-argument is that the drastic loss in population increased the land-labor ratio and favored land-intensive animal husbandry. This provided enhanced employment opportunities for females as servants. In their model, all female servants had to remain celibate as a condition of employment in animal husbandry. In case of pregnancy, they had to return to working in crop production on the family farm. Thus, females faced the trade-off between higher income against having children. Their empirical analysis of English data from the 14th century confirms that after the Black Death more women chose to work in animal husbandry and to postpone (or forgo)

[4]Other studies in this strand of literature exploit large-scale human interventions. There is evidence of the effect of slavery on trust towards others (Nunn and Wantchekon, 2011), on the Jewish presence in Russia before WW2 on an anti-market culture (Grosfeld *et al.*, 2013), on the Habsburg Empire on trust in institutions (Becker *et al.*, 2016), on historic gender imbalance on attitudes towards women (Grosjean and Khattar, 2016), and of the effect of self-government in Italian cities in the Middle Ages on civic capital today (Guiso *et al.*, 2016).

[5]John Hajnal pointed out that women in Western Europe (in particular, in the area west of the so-called *Hajnal line*, which is drawn from St. Petersburg to Trieste) have exhibited a distinct marriage pattern since the late Middle Ages (Hajnal, 1965, 1982). In this area, age at first marriage was high, high percentages of the population remained unmarried, and the nuclear family household predominated itepcarmichael:2016. The literature discusses several other co-factors, such as limited parental authority, neolocality, and the importance of urban labor markets (De Moor and van Zanden, 2010) as potential causes of the EMP. Further, several local and regional case studies reveal substantial variation in marriage and fertility patterns *within* this area (e. g. Teibenbacher, 2009).

marriage and fertility. While our empirical setting is from a much later period, it corroborates that a focus on animal husbandry leads to later (or no) marriage. In contrast, we do not find a dampening effect of animal husbandry on fertility. In our setting, celibacy was not a condition for being employed as a servant in animal husbandry. Thus, we highlight the emergence of a social norm in later periods, which decoupled marriage and fertility.

The remainder of the paper is organized as follows. We begin, in Section 2, by linking historical and contemporaneous data on illegitimacy to document the persistence in this behavior over time. In Section 3, we describe the pre-industrial agricultural society in the Austro-Hungarian Empire and characterize farmhand and day-laborer societies. Section 4 presents our analytical results. We link the historical agricultural production structure with illegitimacy today. We present stepwise results from different estimation strategies to establish a causal link. In the first step, we control for selection based on observables. In the second step, we exploit exogenous variation in the local agricultural suitability due to variation in the local slope of terrain and local historical climate. In Section 5, we provide our two complementary analyses, of stated preferences and shotgun weddings, to support our causal interpretation. In this Section, we also examine several other historical demographic outcomes. In Section 6, we present our 'epidemiological approach' to provide evidence on the transmission channel of the cultural norm regarding illegitimacy. Section 7 concludes the paper.

2 Persistence in illegitimacy

Illegitimacy is the outcome of the main interest in our analysis.[6] Clearly, there is an underlying process of interdependent events, which give rise to this outcome. First, the proportion of females who are potentially at risk of giving birth outside of marriage is decisive. A society with many unmarried females of child-bearing age is, in principle, more prone to having a high illegitimacy ratio. Second, the sexual behavior of this population is important. The illegitimacy ratio is also affected by the incidence of unprotected sexual intercourse. Third, the responses of those females who conceive out of wedlock matter. When large proportions decide to marry before childbirth (or to abort), the illegitimacy ratios can still be low. At each stage, individual decisions (such as age at marriage, premarital sex, etc.) are made under the influence of societal factors. We consider illegitimacy to be the best variable to capture and summarize this chain of events.[7] To measure illegitimacy empirically on an aggregate level, we define the illegitimacy ratio as the share of live births to unmarried mothers of all live births.

As Figure 2 shows, the illegitimacy ratio has varied substantially over the last 200 years in

[6] Although illegitimacy is not the same as out-of-wedlock birth in all societies, we use these terms interchangeably, which is in line with the interpretation of illegitimacy in 19th century Austria (Mitterauer, 1983, p.13).

[7] To complement our analysis, we also examine other demographic outcomes (such as age at marriage and *level* of marital and non-marital fertility) in the historical data in Section 5.3, as well as the prevalence of so-called shotgun marriages in the contemporaneous data in Section 5.2.

Austria. While the ratio increased for most of the 19th century, there was a sharp drop in the 1870s, when formal marriage restrictions were mostly abolished.[8] After some ups and downs around the two World Wars, the lowest ratio was reached in the late 1950s. Ever since, the ratio has been on the rise and reached an all-time high in 2014 at over 40 percent.[9]

While the development of the illegitimacy ratio over time is, in itself, an interesting phenomenon, our focus is on the persistence of regional patterns. We define the variable $illegit\,ratio_{dp}^{t}$, which captures the illegitimacy ratio in the political district d (located in province p) in the year t. Our estimation sample comprises all districts of the Austrian part of the Austro-Hungarian Empire, which are within the boundaries of today's Austria. The only exceptions are nine so-called statutory cities, which are too urban for our context. This leaves us with 66 districts, which comprise 96 percent of the area of Austria (ignoring today's province of Burgenland, which was part of the Hungarian part of the Empire 1900). Section A.1.1 in the Web appendix provides a detailed description of the sample, while Table A.1 summarizes all data sources.

The upper map of Figure 3 displays the variation in the historical illegitimacy ratio across districts for the year 1900. The underlying data are from official population statistics published by the imperial and royal statistical commission. The lower map in Figure 3 shows the equivalent regional variation in contemporaneous data (i. e., yearly averages from Austrian mothers over the period 1972 to 2007), which are constructed from micro-level data available in the *Austrian Birth Register*. A visual comparison of these two maps already indicates that the spatial distribution of the illegitimacy ratio is relatively stable over time.

To obtain a more formal comparison, we estimate the following equation with our sample of 66 districts by OLS.

$$illegit\,ratio_{dp}^{1972-2007} \;=\; \alpha_1 + \beta_1 \cdot illegit\,ratio_{dp}^{1900} + \mathbf{X}_{dp}^{1900} \cdot \gamma_1 + \phi_{1p} + \varepsilon_{1dp}^{1972-2007} \qquad (1)$$

Table 1 provides descriptive statistics for the two illegitimacy ratios and the covariates $\mathbf{X}_{dp}^{1900}$. Table 2 summarizes the estimation output from seven different specifications, which differ in the set of included covariates. Across specifications, we find a large persistence in the regional prevalence of illegitimacy over the last 100 years. Column (1) shows the unconditional relationship between the historic share of illegitimate births and todays ratio. A one percentage point increase in the historic illegitimacy ratio corresponds to a 0.56 percentage point increase in today's illegitimacy ratio. The inclusion of province fixed effects in column (2) reduces the estimate to 0.42. In the specifications summarized in columns (3) to (6), we control in turn for the urbanization rate, age structure, sectoral composition, share of Catholics, share

[8] Legal marriage restrictions were removed in all provinces in 1868 with the exception of Salzburg (in 1883), Tyrol, and Vorarlberg (in 1921) (Ehmer, 1991, p.61). Since we include province fixed effects in all our estimations, our results will not be influenced by the differential timing in the removal of legal marriage restrictions.

[9] The development of the illegitimacy ratio in Austria corresponds well with the average European trend. Most European countries experienced a comparable drop between the mid-19th and the mid-20th centuries (Shorter *et al.*, 1971) and a rise thereafter (Heuveline *et al.*, 2003) as part of the so-called *second demographic transition* (Van de Kaa, 1987).

of illiterate persons, and teacher's income. The latter variable proxies for non-agricultural wages. In column (7), we include all covariates simultaneously. The inclusion of these historic control variables does not greatly affect the estimate. This means that historic factors do not significantly influence today's regional variation in the share of illegitimate births once the historic illegitimacy ratio is included in the model.[10]

In the next step, we exploit the individual-level information provided in the *Austrian Birth Register* for the universe of births between 1972 and 2007. This allows us to estimate the following linear probability model,

$$\begin{aligned}\Pr(ILL^t_{idp}=1|illegit\,ratio,\mathbf{X},\mathbf{Z},\phi,\psi) &= \alpha'_1+\beta'_1\cdot illegit\,ratio^{1900}_{dp}+\mathbf{X}^{1900}_{dp}\cdot\gamma'_1+\mathbf{Z}^t_{idp}\cdot\delta'_1 \\ &\quad +\phi'_{1p}+\psi'_{1t}+\varepsilon'^t_{1idp}, \qquad (2)\end{aligned}$$

where the dependent variable ILL^t_{ip} is equal to one if a mother i (residing in district d, giving birth in year t) was not married at the time of birth. The explanatory variable of primary interest is (as in equation 1) the illegitimacy ratio in district d in the year 1900. One advantage of measuring illegitimacy on an individual level is that we can control (besides our standard set of district-level covariates, $\mathbf{X}^{1900}_{dp}$ and province fixed effects ϕ'_{1p}) also for individual-level covariates $\mathbf{Z}^t_{idp}$ and year of conception effects ψ'_{1t}.

Table 3 summarizes five different specifications, which differ with respect to the sample years, and the set of included control variables. The first two specifications use all births from 1972 to 2007, while the next three specifications focus on births from 1984 to 2007. For the latter sample period, a large set of covariates is available. In column (1), we only control for our standard set of district-level covariates, province fixed effects, and conception year fixed effects. In column (2), we include additional controls capturing mother's age (binary indicators capturing five different age-groups) and religious denomination (binary indicators capturing Catholics, Protestants, Muslims, other denominations, and unknown/atheist). In column (3), we replicate the latter specification for the shorter sample period. In columns (4) and (5), we control in addition for parity (binary indicators capturing first, second, or any higher parity) and mother's educational attainment (binary indicators capturing compulsory schooling, apprenticeship, intermediate technical or vocational school, university degree, or unknown). Across specifications, we consistently find that a high illegitimacy ratio in 1900 significantly increases the likelihood of an illegitimate birth for a woman residing in this region today. A one percentage point increase in the historic illegitimacy ratio corresponds to an increased likelihood of an illegitimate birth today by approximately 0.38 percentage points. The estimated quantitative effects hardly change due to the inclusion of covariates. This is remarkable given the high predictive power of the individual-level covariates (as shown by the adjusted R-squared across columns in Table 3 and the more detailed estimation output in the

[10]Ragan (2012) finds in her Swedish county data a comparable persistence in illegitimacy between 1860 and 1910, as well as between 1910 and 1960.

Web appendix in Table C.1). The estimate is quantitatively very comparable to those obtained by the aggregated data in Table 2.

While the literature in contemporary Austrian history has dealt extensively with illegitimacy in pre-industrial Austria (Haslinger, 1982; Mitterauer, 1983, 1986, 1992), we are the first to empirically examine the connection to today's regional pattern of illegitimacy.[11]

3 Agricultural production structure and illegitimacy

For a long time, the Austrian economy was dominated by agriculture. In 1900, more than 50 percent of the population was still employed in the agricultural sector.[12] Given this dominance of agriculture across most of the population, a strong connection between the predominant forms of agricultural production structure and all aspects of life can be expected. A strand of literature in contemporary history focuses on the complex system of interrelationships between the agricultural production structure and the organization of families in pre-industrial societies (e. g. Mitterauer, 1992). A particularly important distinction is between crop farming and animal husbandry. These two types of activity have very different production functions, with profound consequences for labor markets and family arrangements.

The agricultural sector in pre-industrial Austria was organized on a spectrum between crop farming and animal husbandry. Thus, in most areas, there are features of both forms of agricultural specialization: farmers not only grew crops, but also kept animals to supplement their diary, or vice-versa. In our empirical analysis, we will therefore speak of the relative dominance of one form of agriculture. However, for the benefit of the following discussion, it is helpful to describe two extreme forms of agricultural specialization.

3.1 Crop farming and day laborer societies

The planting, growing, and harvesting of plants required large amounts of labor during peak seasons, but relatively little during downtime. The additional labor needed during peak seasons, was hired on short-term contracts. These day laborers were mostly paid in cash and did not become part of the extended family of the farmer. Due to the large demand for day laborers during the peak season, wages were relatively high (Mitterauer, 1986, p.213f). Farmers in crop farming areas often provided small dwellings for cottager families, who provided a certain amount of labor in exchange. This form of dependency allowed the farmer access to additional workers when required, but avoided having a permanent contract with the worker (Mitterauer, 1986, p.216). Since day laborers and cottagers could not find employment in agriculture year round, they performed different kinds of crafts and trades during the low seasons (Ortmayr,

[11] Kytir and Münz (1986) loosely discuss the persistence of illegitimate births in Austria and show suggestive maps.

[12] Over time, this share has declined sharply (see Figure B.1 in the Web appendix). In 2001, the share of the population in agriculture was below 5 percent.

1984, p.107f). The additional cash income and the requirement to find a different kind of work during the low seasons, prevented the non-landholding population from forming a relationship of dependency with landholding farmers. This enabled agricultural workers in crop farming areas to establish their own households, get married, and have marital offspring.

3.2 Animal husbandry and farmhand societies

Animal husbandry is at the opposite extreme of the spectrum of the agricultural production structure. It was labor intensive throughout the year, since animals had to be tended to every day. This form of agriculture led to a completely different relationship between workers and farmers than did crop farming. Farmers employed servants to perform the necessary tasks of feeding, milking, and minding the cattle in the meadows. Due to the close relationship between workers and animals, these farmhands (or servants) had to learn the peculiarities of each animal. The relation-specific knowledge and more or less even distribution of the workload throughout the year made long-term labor contracts the prevalent form (Mitterauer, 1986, p.200). Servants were usually hired for a year and contracts were regularly renewed. In this way, servants became part of the larger family of the farmer. A large part of the compensation package was paid in kind by providing food and residence. Data from a historical wage survey show that a simple servant received almost two-thirds of his compensation in kind (see Table C.2 in the Web appendix). For higher rank servants, the share was slightly lower, while for maids the share was slightly higher.

3.3 Linking agricultural specialization to types of labor contract

In this section, we estimate the relationship between the relative dominance of animal husbandry and the presence of a farmhand society in the year 1900/02. The data come from two sources. First, the agricultural census of 1902 (*Landwirtschaftliche Betriebszählung 1902*) provides very detailed information on agricultural production at the district level. Among other sources, we have collected information on the composition of the workforce, land usage, and details on the livestock. Second, the population census of 1900 provides more general information on the district level.

To empirically capture the relative dominance of animal husbandry, we employ the variable $cattle_{dp}^{1902}$, which is defined as the ratio of cattle to agricultural workers in district d (located in province p) in the year 1902. This variable is very useful in the Austrian context, since the vast majority of livestock comprised cattle.[13] On average, there were 1.84 cattle per agricultural worker. To quantify the relative dominance of a farmhand society, we use the share of servants in agriculture of the total population. The resulting variable $servants_{dp}^{1902}$ varies between 0.01

[13]In the area covered by our estimation sample, the total livestock population in the year 1900 comprised approximately 2.2 million cattle, 1.3 million pigs, 0.4 million sheep, and 0.2 million horses.

and 0.20 with a mean of 0.09.[14] We relate these two variables of primary interest in the following estimation model,

$$servants_{dp}^{1902} = \alpha_2 + \beta_2 \cdot cattle_{dp}^{1902} + \mathbf{X}_{dp}^{1900} \cdot \gamma_2 + \phi_{2p} + \varepsilon_{2dp}^{1902}, \quad (3)$$

where we control for covariates $\mathbf{X}_{dp}^{1900}$ and province fixed effects ϕ_{2p}. Estimation results are summarized in Table 4. Across columns, we expand the set of covariates. Column (1) shows a strong positive unconditional relationship between the ratio of cattle to agricultural workers and the share of servants in agriculture of the total population. This correlation holds when we control for unobserved heterogeneity at the province level. The inclusion of province fixed effects in column (2) decreases the estimate slightly in size, but it remains highly statistically significant. In the specifications summarized in columns (3) to (6), we control in turn for the urbanization rate, age structure, sectoral composition, and share of Catholics, share of illiterate persons, and teachers' income. In column (7), we include all covariates simultaneously. Across all specifications, the estimated relationship between the relative dominance of animal husbandry and the presence of a farmhand society remains significant with a beta coefficient of approximately 0.6. This set of estimates strengthens our prior on the close connection between the relative dominance of animal husbandry and the occurrence of a farmhand society.

3.4 Linking animal husbandry to illegitimacy in a pre-industrial agricultural society

We now turn to studying the link between a farmhand society and the prevalence of illegitimacy. Servants in agriculture were closely integrated into the family of the farmer and were paid mostly in kind. In this way, the farmer had substantial power over his servants. In particular, the servants' individual liberty to marry was very restricted (even in the absence of formal marriage restrictions). As in the rest of Western Europe, in Austria, newlyweds were expected to set up a new household. This cultural norm of so-called *neo-locality*, de facto prevented all couples from marriage who were not in an economic situation to establish their own household. As a consequence, many adults spent a substantial number of years as so-called *life cycle servants*, during which time they earned the means to establish their own households (Laslett, 1977a,b). While this phenomenon can also be observed in other parts of Europe, historians highlight a high prevalence of so-called *life time servants* in the alpine areas of Austria. Thus, in many cases, servants not only delayed marriage, but remained single all their lives. In contrast, day laborers (and cottagers) in agriculture were in a completely different situation. They earned cash income through their work in agriculture and also in crafts and trades during the low

[14] Below, we demonstrate the robustness of our findings to using other quantifications of the relative dominance of a farmhand society based on servants. An equivalent measure for day laborers cannot be meaningfully constructed. The number of day laborers varies substantially across seasons. On the cutoff date of the agricultural census (June 3rd, 1902), relatively few day laborers were present.

seasons. That group was also not in a relationship of dependence with the landholding farmers that could dictate a certain family arrangement.

The two groups of agricultural workers, servants and day laborers, had in common that they produced offspring. The marital situation of each group, however, typically generated illegitimate children in the case of servants and legitimate offspring for day laborers. Table 5 provides direct descriptive evidence in support of this claim. It tabulates the legitimacy status for all children born to fathers or unmarried mothers working as servants or day laborers in agriculture in 1900. While almost 80 percent of births were illegitimate for servants, only 15.7 percent were so for day laborers.[15] This corresponds with a clear correlation between the type of employment of the father or unmarried mother and the legal status of his/her child. The very high illegitimacy ratio among servants seems surprising given that the Roman Catholic church clearly objected to pregnancy in unmarried women. Among other measures, they charged higher fees for christenings or special repentance (Klammer, 1992, p.91f.). In some cases, unmarried mothers had to give their children away to another farm, pledging a number of years of free labor by the child in the future. However, for farmers in labor-intensive animal husbandry, illegitimate children of servants formed a welcome pool of future disenfranchised labor. Illegitimate children of servants would almost certainly become servants themselves.

Some important aspects of illegitimate children's live can be assessed from the official statistics. First, it is documented that illegitimate children had a substantially higher likelihood of early death. Referring to children from the birth cohorts from 1900 through 1904, we can see that among legitimate children, 14.2 percent died during their first year after birth. For illegitimate children, this share amounted to 19.2 percent (see Figure B.2 in the Web appendix). Second, we see that the vast majority of children born out of wedlock from these birth cohorts remained illegitimate. Five years after birth, only approximately 20 percent had experienced a post-birth legitimation through the marriage of their mother (see Figure B.3 in the Web appendix).

To more formally explore the relationship between the predominant labor relationship in agriculture and the prevalence of illegitimacy, we combined data from the agricultural census of 1902, the population census of 1900, and the population statistics of 1900 (*Bewegung der Bevölkerung in 1900*). The main estimating equation to explore the historic association between a farmhand society and illegitimacy is as follows:

$$illegit\,ratio_{dp}^{1900} \;=\; \alpha_3 + \beta_3 \cdot servants_{dp}^{1902} + \mathbf{X}_{dp}^{1900} \cdot \gamma_3 + \phi_{3p} + \varepsilon_{3dp}^{1900}. \tag{4}$$

Table 6 summarizes the estimation results from different specifications with varying control variables. Column (1) gives the unconditional relationship. The estimated effect becomes smaller in the within-province estimates in column (2), but remains significantly different from

[15] Our analysis of census data shows that males and females balance across occupation groups and marital status in agriculture. It is therefore unlikely that this pattern emerged by sorting unmarried females into the group of servants.

zero at the 1-percent level. The relationship between the share of servants and illegitimacy remains relatively stable when various district controls are included. Column (7) includes the full set of controls. The point estimate of 1.44 indicates that a one percentage point increase of servants in the population is associated with an increase in the share of illegitimate births by 1.44 percentage points, which is equivalent to a beta-coefficient of 0.56.

To check the robustness of this finding, we employ alternative measurements of the dominance of a farmhand society. Instead of the share of servants in the total population, we consider the *share of servants of agricultural workers*, the *share of non-family agricultural workers*, and the *share of permanent agricultural workers*. We regress each proxy for the dominance of a farmhand society, along with province fixed-effects, on the illegitimacy ratio in the year 1900. In each case, we find a strong positive correlation, with beta coefficients between 0.38 and 0.64 (see Table C.3 in the Web appendix).

4 Illegitimacy beyond animal husbandry: The origin of a cultural norm

4.1 Linking historical animal husbandry to illegitimacy today

Our main hypothesis is that the historic agricultural structure has formed a cultural norm in relation to illegitimacy that persists until today. To directly test this hypothesis, we now regress the contemporary illegitimacy ratio on the historical ratio of cattle to agricultural workers:

$$illegit\,ratio_{mp}^{1972-2007} \;=\; \alpha_4 + \beta_4 \cdot cattle_{mp}^{1900} + X_{mp}^{1900} \cdot \gamma_4 + \phi_{4p} + \varepsilon_{4mp}^{1972-2007}. \qquad (5)$$

In this model, we do not specify the details of the mechanism but focus on cause and consequence. It should be emphasized that none of the mothers covered by our illegitimacy today experienced a pre-industrial agricultural society themselves.

Fortunately, we can run this regression at the municipality level (m).[16] Since municipalities are much smaller geographic units than districts, our number of observations increases substantially. The municipality sample comprises 1,318 municipalities that we can cleanly track since 1900. These municipalities are shown in red in the upper panel of Figure 4. Municipalities in which animal husbandry is the predominant form of agriculture are shown in dark red, and make up the alpine regions in the center and the border region to Germany in the northwest. The gray areas depict the municipalities that we cannot track over time (until today), while white areas are not part of our estimation sample (see Section A.1.1 in the Web appendix). The lower panel shows the contemporaneous distribution of the illegitimacy ratio. The dark red

[16] While all contemporaneous variables are available on this level, historical variables are often not. In our estimations above, we had to resort to the district level since the historical illegitimacy ratio $illegit\,ratio_{dp}^{1900}$ is not available on a more disaggregated level. In contrast, the historical ratio of cattle to agricultural workers $cattle_{mp}^{1900}$ is available at the municipality level.

areas in the center of Austria and the northwest indicate a high prevalence of illegitimate births. The comparison of the two panels shows well the correlation between the spatial distribution of historic animal husbandry and illegitimate births today.

The only disadvantage of using municipality-level data is the lack of precise information on the number of agricultural workers in 1902[17] and the smaller set of available historical covariates X_{mp}^{1900}. Besides province fixed effects, we can control for the share of people in agriculture, the population level, the existence of large landholdings, the existence of large factories, and the municipalities market status. Table 7 provides descriptive statistics for all variables on the municipality level.

4.2 Addressing causality

4.2.1 Selection on observables

Table 8 presents the OLS estimates of equation (5). Columns (1) to (3) are specifications based on municipality-level data. The first column shows a positive unconditional relationship between the relative dominance of cattle farming and illegitimacy today. The inclusion of province fixed effects in column (2) reduces the positive association, but also increases the precision of the estimate. The inclusion of the full set of covariates in column (3) hardly changes the estimated effect. According to this estimate, one more cattle per agricultural worker in 1900 is associated with an increase in today's illegitimacy ratio by 3.1 percentage points. This is equivalent to a beta-coefficient of 0.23. Thus, a one standard deviation increase in the ratio of cattle to agricultural workers increases the illegitimacy ratio by 0.23 standard deviations. Columns (4) to (6) summarize for comparison equivalent estimates based on district-level data. The unconditional relationship between the ratio of cattle to people and illegitimacy today is slightly larger in this sample. The point estimate decreases again slightly with the inclusion of province fixed effects, but again remains basically unchanged after including the full set of covariates.

Clearly, the strong and robust relationship between the historic dominance of cattle farming and today's illegitimacy ratio does not lend itself to a causal interpretation. Nonetheless, a number of potential threats to identification can already be dispelled based on observable patterns and characteristics. First, we can basically rule out that the illegitimacy ratio today is affected by persistent characteristics of the agricultural sector itself. The sector has changed substantially in size and nature over the last century. While over 50 percent of the population were affiliated with agriculture in 1900 in the sample region, this number had shrunk to less than 5 percent by 2001 (see Figure B.1 in the Web Appendix). The small share of remaining workers

[17] At the municipality level, we need to approximate the number of people in agriculture in 1900 with the share of people in agriculture measured in 1934 times the total population in 1900. The census of 1934 was the first census in Austria to publish detailed information on the employment sector at the municipality level. The correlation of the share of the population in agriculture in 1900 and 1934 at the district level is 0.929. This suggests that there was little regional variation in the reduction of the agricultural sector.

in agriculture face completely different working conditions and labor contracts. Technological innovations have reduced the physical nature of the job and modern labor relationships rule out dependency as experienced by servants in the past. Second, one might be concerned that the historical dominance of animal husbandry is correlated with persistent regional variation in human capital accumulation. We can show that neither the inclusion of historic nor contemporaneous human capital controls change our estimates. Column (6) in Table 8 introduces historical human capital controls. This changes our estimate only marginally as compared to Column (5). The same holds true for the inclusion of comprehensive contemporaneous human capital controls in municipality-level specifications: compare columns (1) and (2) of Table C.4 in the Web appendix. Third, further specifications in this table in columns (3) to (7) highlight that our results are also insensitive to the inclusion of other potentially confounding municipality characteristics, capturing the importance of tourism in today's economy. Fourth, persistent institutional or legal differences between regions are also an unlikely reason for the observed positive correlation. The lowest administrative level at which legal regulations vary is the provincial level. Since we always control for province fixed effects, persistent institutional differences can not confound our estimate.

While it is reassuring that the inclusion of these important covariates hardly changes our estimated effect, a number of potential problems in the OLS estimates remain. First, persistent omitted factors that are not captured by our covariates could have influenced the dominant form of agriculture in the past, and also affect today's illegitimacy ratio. Local prosperity through the geographic location of the region along a trade route could be such a factor. Second, the causality could run the other way. A region with a persistently high share of illegitimate children offers a large pool of cheap labor. Labor-intensive cattle farming would have had a comparative advantage over crop farming in the past. The correlation between the historic agricultural structure and today's prevalence of illegitimacy would then be spurious. Third, measurement error in the explanatory variable could attenuate the estimated effect. This is very likely as we capture a complex system of relationships that make up the historic agricultural structure in just one number, the ratio of cattle to agricultural workers. It is unavoidable that the compression of the agricultural structure into this statistic obliterates important information.

These three potential issues do not allow a clear prediction of the bias of the OLS estimates. Reverse causality would over-estimate the causal effect, while measurement error would lead to attenuation bias of the OLS estimates. An omitted variable could bias the estimates in either direction. In the next subsection, we deal with these issues by employing an instrumental variable strategy that solves these issues.

4.2.2 Selection on unobservables

We now exploit variation in the comparative advantages of cattle raising across regions as an exogenous determinant of the historical dominance of cattle (over crop) farming. The

notion that persistent environmental factors have a strong effect on agricultural production can already be found in the early anthropological literature (e. g. Löfgren, 1976). In line with this supposition, we suggest using the slope of the terrain and climatic variables as instrumental variables (IV) for the historical dominance of cattle farming.[18]

Slope of terrain The slope of the terrain is an important landscape characteristic for crop farming. It affects the productivity of the soil in multiple ways. The higher the slope the more water runoff and the higher the hazard of soil erosion. Steep terrain soils also tend to be low in natural fertility due to the loss of topsoil from past erosion. Thus, in steep-slope regions it is comparably more efficient to focus on cattle farming. The slope of terrain is highly time-invariant. Therefore, we can use modern GIS data to capture the historical situation. Our data allow us to calculate the mean slope of a certain region based on 10m×10m grid cells. Figure 5 correlates the resulting mean slope of the terrain with the historical predominance of cattle farming. We distinguish between data at the district and municipality levels, as well as between an unconditional association and a within-province relationship. Across all four panels, we find that the dominance of cattle farming increases significantly with the slope of terrain. This relationship also holds in a regression framework with different covariates. Panel B of Table 9 summarizes the estimation results based on municipality-level (columns 1 to 3) and district-level data (columns 4 to 6). The estimated relationship is quite robust across specifications. Based on municipality- and district-level data, we find beta coefficients of approximately 0.3 and 0.3, respectively. The F-statistic on the excluded instrument is sufficiently high across all specifications using municipality-level data. In the case of district-level data, which comprise only 66 observations, we have a problem of a weak IV. In the interpretation of the second stage estimates, we will focus on the former set of estimates.

For the slope of terrain to be a valid IV, we must assume (i) that the slope affects illegitimacy today only through the channel of historical dominance of cattle farming, and (ii) that it is not correlated with any unobserved determinants of illegitimacy today. The validity of these assumptions can be rationalized by the fact that life in a modern economy is very much detached from nature, such that the topography should have no systematic impact. Even for women employed in agriculture, a direct effect of the slope on fertility seems unreasonable today. Technological progress and governmental interventions have fundamentally changed the physical production process and labor contracts in the agricultural sector. Given the minor importance of agriculture today, we can easily exclude the few remaining workers in the agricultural sector from our analysis with little loss of generality (see below). Beyond agriculture, we do not see any other major industry in which the slope of terrain may have a significant impact. The only exception we can think of is tourism. Regions with a steep slope may have more tourism due to skiing and hiking. A strong dominance of tourism may have an independent effect

[18]Another potential determinant of the predominant form of agriculture is soil type and quality. However, soil quality is endogenous to the form of past land usage (Dell, 2010), which invalidates its use as an IV.

on the fertility behavior of the local population. To assess the respective sensitivity of our IV estimates, we provide additional specifications, in which we include additional controls to partial-out this (and other) potential confounding factors.

Panel A of Table 9 shows estimations of equation (5), where the ratio of cattle to agricultural workers is instrumented with the mean terrain slope. Thus, we focus on exogenous variation in the historical dominance of animal husbandry. The resulting *local average treatment effects* (LATEs) can be interpreted as the effect of a strong dominance of animal husbandry (due to steep slope of terrain) on today's illegitimacy ratio. Columns (1) to (3) of Table 9 use the municipality-level dataset and sequentially include province fixed effects and control variables. Columns (4) to (6) provide equivalent specifications based on district data. All specifications show that a higher historical dominance of animal husbandry leads to a higher illegitimacy ratio today. The quantitative effects in the richest specification (3) and (6) are quite comparable. Given the substantially higher F-statistic in the first stage of the municipality data, we put more emphasis on this coefficient. An increase in the ratio of cattle to agricultural workers by one unit increases the share of illegitimate births by 10 percentage points today. This corresponds to a beta-coefficient of 0.76, which indicates the dominant role of the historic agricultural structure in explaining the contemporary variation in illegitimacy ratios. This estimate is approximately three times larger than the corresponding OLS estimate. The difference between these two estimates can be explained either by measurement error or confounding factors in the OLS estimate, which are negatively correlated with the illegitimacy ratio.

Panel C of Table 9 summarizes the estimates of our reduced forms. These identify the net effect of the mean terrain slope on illegitimacy today and show that biophysical factors structurally affect illegitimacy in a modern society. While these estimates are silent on the causal mechanisms, they impose relatively few identification assumptions and allow a strong causative interpretation (Dell *et al.*, 2014).

Climate As an alternative IV strategy on the municipality level, we use variation in local climate. Crop farming requires a certain level (and combination) of temperature, precipitation, and sunshine. The climate in some areas might not have been very suitable for sustained crop farming, leading to a higher dominance of animal husbandry. We have access to historical climate data covering the period from 1896 to 1925 on temperature, precipitation, air pressure, and sunshine hours. The disadvantage of these historical data is that they cover at most 48 weather stations. The Austrian meteorological institute (ZAMG) provides more recent climate data for all grid cells of Austria, which interpolates climate data from all weather stations in Austria. Fortunately, we find a very high correlation in all climate variables over time, such that we can proxy historical climate variables very well with more recent data.[19] These more recent

[19]One might be concerned that climate change over the last 100 years has changed the local climate pattern. We show in Table C.6 in the Appendix, using data from long-standing weather stations, that the correlation in temperature, precipitation, air pressure, and sunshine hours is very close to one between the mean of the periods 1896–1925 and 1961–1990.

data from the period 1961 to 1990 comprise detailed information on temperature, precipitation, cloud cover, and sunshine hours for winter and summer.

We calculate mean values for a range of climate variables in each municipality, and use (a combination of) these climatic variables as IVs for the historical dominance of animal husbandry. Panel B of Table 10 summarizes the estimation results for a number of specifications. The climate variables used are the mean precipitation in summer, and sunshine hours, cloud cover, humidity, and temperature in July. The first stage is sufficiently strong for each one of these variables, as well as when we include them jointly in column (6). Panel A summarizes the second stage estimates. The LATEs using climate variables are very robust across the different first stage specifications, and also very similar to those based on the terrain slope. The estimates even remain unchanged, when we use all climate variables and terrain slope instruments together in column (7). This alternative IV strategy provides the same conclusions.

Remaining threats to identification Our IV estimates are only valid if terrain slope (or local climate) affects illegitimacy today only through the channel of historical dominance of animal husbandry, and if it is not correlated with any unobserved determinants of illegitimacy today. One way to assess the plausibility of these assumptions, and to test the robustness of our IV estimates, is to include control variables for alternative pathways of the IVs. The additional control variables we consider are current income level, current sector shares, the distribution of educational attainment, and two proxies for the importance of local tourism.[20] One may argue, for instance, that regions with a strong historical dominance in animal husbandry witnessed a different economic development, which in turn affects fertility behavior today. It is very reassuring that the inclusion of these (potentially endogenous) control variables changes our IV estimates only marginally (see Table C.5 in the Web appendix). If we include all these contemporary control variables simultaneously, the IV estimates become slightly larger.[21]

Individual-level data The *Austrian Birth Register* also allows us to observe the legitimacy status on an individual level for the universe of births between 1972 and 2007. We exploit this

[20]The proxies are the share of people employed in tourism and the log of beds in tourism per capita. We abstain from including any of these covariates in our baseline specification, since they are potentially bad controls.

[21]It could also be instructive to study the historical development of animal husbandry and illegitimacy over longer periods of time. Ideally, one could even observe periods before the introduction of (widespread) animal husbandry and examine its impact on illegitimacy. This timing would allow reversed causality to be ruled out. We obtained data that allow us to measure both variables consistently from 1830 through 1900 on the province level (see Figure B.4 in the Web appendix). It emerges that animal husbandry was already very common in 1830 and there had been little variation between 1830 and 1900 in half of the provinces. Nevertheless, it is instructive to see that in those provinces with little (to no) variation in the ratio of cattle to agricultural workers, the illegitimacy ratio had also been constant. Even more importantly, in those provinces (Carinthia, Salzburg, Styria) in which the ratio of cattle to agricultural workers varied over time, we observe with some lag the same pattern in the illegitimacy ratio. We interpret these figures as suggestive evidence that animal husbandry affects illegitimacy (and *not* vice versa).

disaggregated information to consider the following linear probability model,

$$\begin{aligned}\Pr(ILL^t_{imp}=1|cattle,\mathbf{X},\mathbf{Z},\phi,\psi) &= \alpha'_4+\beta'_4\cdot cattle^{1900}_{mp}+\mathbf{X}^{1900}_{mp}\gamma'_4+\mathbf{Z}^t_{imp}\delta'_4 \\ &\quad +\phi'_{4p}+\psi'_{4t}+\varepsilon'^t_{4imp}, \end{aligned} \tag{6}$$

where the dependent variable is equal to one if a mother i (residing in municipality m, giving birth in year t) was not married at the time of birth. The explanatory variable of primary interest is (as in equation 5) the ratio of cattle to agricultural workers in municipality m in the year 1900. One advantage of measuring illegitimacy on an individual level is that we can also control (besides our standard set of municipality-level covariates, $\mathbf{X}^{1900}_{mp}$ and province fixed-effects ϕ'_{4p}) for individual-level covariates $\mathbf{Z}^t_{imp}$ and year of conception effects ψ'_{4t}. To account for the potential endogeneity of $cattle^{1900}_{mp}$, we use the terrain slope IV.

Table 11 summarizes five different specifications, which differ with respect to the sample years, and the set of included control variables. The first two specifications use all births from 1972 to 2007, while the next three specifications focus on births from 1984 to 2007. For the latter sample period, a larger set of covariates is available. In column (1), we only control for our standard set of district-level covariates, province fixed effects, and conception year fixed effects. In column (2), we also include controls capturing mother's age and religious denomination. In column (3), we replicate the latter specification for the shorter sample period. In columns (4) and (5), we also control for mother's parity and educational attainment. In each specification, we have a sufficiently strong first stage with an F-statistic of about 50. Across specifications, we consistently find that a strong regional dominance of animal husbandry in municipality m (due to steep slope of terrain) significantly increase the likelihood of an illegitimate birth for a woman residing in municipality m today. The estimated quantitative effects hardly change due to the inclusion of covariates. An increase in the ratio of cattle to agricultural workers by one increases the probability of an illegitimate birth by approximately eight percentage points (or 30 percent).[22] The analysis on the individual level also points to a downward bias of OLS estimates (which are for comparison summarized in Table C.9 in the Web appendix).

4.3 Interpretation of empirical findings

The evidence presented so far strongly suggests that the relative dominance of cattle farming causally affected illegitimacy in the past, and has a lasting effect on it today. Our IV estimates highlight a causal chain, where local agricultural suitability determined the historical dominance of animal husbandry. The specific agricultural production structure of this led in turn to predominantly long-term labor contracts for farmhands with a high share of wages paid in kind. These labor arrangements caused illegitimate births to be an acceptable (if not desired)

[22]Our results are completely unchanged, when we exclude the 2.6 to 4.6 percent of all women who are employed in agriculture before birth. For the sub-group of first-time mothers (approximately 44 percent), we find somewhat larger effects. For a detailed estimation output, see Tables C.7 and C.8 in the Web appendix.

phenomenon for all parties involved in these pre-industrial farmhand societies. All steps in this causal chain involve a clear economic rationale. Thus, we interpret the high illegitimacy ratios in these pre-industrial farmhand societies as the result of clear economic incentives.

The final link we have identified, which shows the persistent effects of this past economic outcome on illegitimacy today, stands out. There is no economic rationale (in the narrower sense), which can explain this persistence in behavior for individuals in today's economy. Figure 6 contrasts the development of the agricultural sector over time, with the estimated effect of the historical dominance of cattle farming on illegitimacy in the respective year. The share of the population in agriculture has declined dramatically and was below 5 percent in 2001. In contrast, the effect of the historical dominance of cattle farming on illegitimacy had declined by a much smaller extent, and has been quite constant since the 1960s. Thus, although the economic rationale linking the dominance of cattle farming and illegitimacy has completely vanished, individuals have not changed their behavior. These findings let us suggest interpreting the persistence in revealed preferences regarding illegitimacy as a cultural norm. Our findings highlight the more general phenomenon that cultural norms can be shaped by economic conditions, and may persist, even if economic conditions become irrelevant.

5 Supportive evidence and other demographic outcomes

In this section, we provide two complementary analyses to support our causal interpretation. First, we present evidence based on stated preferences. Second, we provide an analysis of so-called shotgun weddings. Finally, we briefly study several other historical demographic outcomes at the district level to provide more context for our main result.

5.1 Evidence from stated preferences

So far, we have examined revealed preferences by looking at actual behavior. In this section, we make use of individual-level survey data to study the stated preferences. This analysis is instructive for two reasons. First, there might be a gap between these two dimensions (beyond survey response bias) due to unintended illegitimate births. Second, stated and revealed preferences are most likely correlated with a different set of confounding factors. Thus, if we find the same pattern in stated preferences, this would clearly corroborate our conclusion derived from our main analysis.

We use data from the *Generations & Gender Programme* (GGP) survey, which includes a question on whether *[. . .]' woman can have child as single parent even without stable relationship'*. Respondents are asked to evaluate this statement on a 5-point scale ranging from *'strongly disagree (1)'* to *'strongly agree'*. While this survey question is not ideal (since it does not explicitly refer to marriage), the GGP survey has the clear advantage over other surveys that it includes quite detailed information on the respondents place of residence. This allows us

to link the historical illegitimacy ratio (and animal husbandry) of the respective respondents' districts of residence to their stated preference. Our estimation sample comprises almost 1,130 respondents from 63 different districts. In our OLS estimations of stated preferences, we control for the same set of district-level covariates as used above, and a basic set of individual-level controls. Standard errors are clustered at the district-level.[23]

The estimation results summarized in Table 12 show a significant positive association between both historical measures and the approval for women having a child as a single parent. In columns (1) and (2), we use an ordinal variable based on the original scale as a dependent variable. An increase in the historical illegitimacy ratio and in the historical cattle ratio by one standard deviation, increases the approval of women having a child as a single parent today by 0.12 and 0.13 standard deviations, respectively. The specifications summarized in columns (3) and (4) using a binary indicator (equal to one if a respondent agrees or strongly agrees) as a regressand provide equivalent conclusions.

5.2 Evidence from shotgun weddings

If illegitimate births are socially unwanted events, individuals will exert more effort to avoid them. Most of the potential actions to avoid an illegitimate birth (such as chastity, contraception, or abortion) are difficult to observe and thus difficult to study. However, there is the exception of so-called *shotgun weddings*. This describes the common practice of averting an illegitimate birth, in the case of an unmarried woman becoming pregnant, by arranging a wedding on short notice.[24] Given that shotgun weddings and low illegitimacy ratios should depend on the same social norm, we can check empirically whether we find equivalent patterns between a strong regional historical dominance of animal husbandry and these two measurements, respectively.

To capture the phenomenon of shotgun weddings empirically, we define a case where a woman was unmarried at the time of conception, but married before birth in a shotgun wedding. While we do not observe who was the driving force behind this wedding, we associate this particular timing with the intent to avoid the embarrassment of an illegitimate birth. Starting from 1984, we are able to observe the conception date in the *Austrian Birth Register*. It turns out that shotgun weddings are a common phenomenon. In 1984, in approximately 40 percent of cases of pre-marital conception, we observed shotgun weddings. Over time, this share decreased steadily to approximately 20 percent in 2007 (see Figure B.5 in the Web appendix).

Using the sample of all births to first-time Austrian mothers, which were conceived before marriage, we estimate an IV model equivalent to equation (6), where the dependent variable $shotgun^{t}_{imp}$ is equal to one if a wedding took place before birth, and zero otherwise. Thus,

[23] We do not have information on the respondents' municipality. We do not present IV-estimates, since the first stage is not sufficiently strong on the district level.

[24] In the American colloquialism, the term *shotgun wedding* is used to describe a hypothetical scenario in which the father of the pregnant girl must resort to using coercion (e. g., a threat with a shotgun) to ensure that the man who supposedly impregnated his daughter follows through with the wedding.

we estimate conditional on a pre-marital conception, the likelihood of a wedding before child birth. Table 13 summarizes three different specifications, which differ with respect to the set of included control variables. Across specifications, we find that a strong regional historical dominance of animal husbandry (because of steep slope of terrain) significantly increases the likelihood of a shotgun wedding today. An increase in the ratio of cattle to agricultural workers by one, increases the probability of a shotgun wedding by approximately nine percentage points (or 38 percent). The corresponding OLS estimates are, consistent with our estimates presented above, comparably smaller (see Table C.10 in the Web appendix).

5.3 The effect of historical animal husbandry on other historical demographic outcomes

On the district level, information is available on several historic demographic outcomes. We have collected data on age at marriage, the stock of married people, and the *level* of marital and non-marital fertility. The analyses of these additional outcomes allow us to put our estimated effects of the relative dominance of cattle farming on past illegitimacy into perspective and to extend our conclusions. In the following, we briefly discuss our main qualitative findings.[25]

Across estimation methods, we do not find evidence that the dominance of cattle farming had significantly increased the age at marriage. This finding suggests that servants in animal husbandry not only postponed marriage, but, in most cases, remained unmarried for their whole lives. This is in line with our evidence that the legitimization of children born out of wedlock, was a rather rare event (see Figure B.3 in the Web appendix). It also supports the concept of the life long servant discussed in qualitative studies on contemporary Austrian history (Ehmer, 1991). Consistent with this supposition, we observe a significantly lower share of married women in regions with a higher dominance of cattle farming. We purposely refer here to the group of women of 46 years of age and above, since a later marriage seems quite unlikely for this group, and thus, the measurement can essentially be interpreted as a measure of the share of never married. With respect to fertility *levels*, we find a significant positive effect of the relative dominance of cattle farming on the non-married fertility rate. This result supports the idea that in areas with more animal husbandry, illegitimacy was quite accepted, and thus led to a higher demand for these children. In contrast, we do not observe a significant difference in the married fertility rates across regions with a high or low dominance of cattle farming. Thus, the impact of the agricultural production structure on *overall* fertility is rather small.

[25]Detailed estimation output from additional OLS and IV estimations is available in Table C.11 in the Web appendix.

6 Analysis of the transmission channel

In a final step, we analyze the determinants of illegitimacy in the sample of immigrant women in Austria. This analysis exploits two interesting sources of variation. First, immigrants from the *same* country of origin are placed in Austrian regions with very different historical agricultural production structures. A comparison among these immigrants might inform us as to how the exposure to different local cultural norms that originated from different historical agricultural production structures affects their behavior. Second, immigrants from *different* countries of origin are placed in the same Austrian region. This comparison might inform us as to how a different cultural background (in particular, the norm regarding illegitimacy) affects behavior in a region with a constant historical agricultural production structure. The latter comparison is often called an epidemiological approach.[26] By exploiting both dimensions of variation within one approach, we aim to quantify the relative importance of the inherited cultural norm regarding illegitimacy and the prevailing cultural norm of the receiving municipality (which is shaped by the historical agricultural production structure).

To implement this approach, we would ideally have data on the historical agricultural production structure of immigrants' place of origin. Owing to data restrictions, two deviate from this first best solution and use the historical illegitimacy ratio measured on a national level. We translate this attempt into the following linear probability model:

$$\begin{aligned}\Pr(ILL^t_{icdp} = 1|illegit\,ratio, \mathbf{X}, \mathbf{Z}, \phi, \psi) \;=\; & \alpha_5 + \beta_5^{local} \cdot illegit\,ratio^{1900}_{dp} + \beta_5^{origin} \cdot illegit\,ratio^{1900}_{c} \\ & + \mathbf{X}^{1900}_{dp}\gamma_5 + \mathbf{Z}^t_{icdp}\delta_5 + \phi_{5p} + \psi_{5t} + \varepsilon^t_{5icdp}. \qquad (7)\end{aligned}$$

where the dependent variable ILL^t_{icdp} is equal to one if the child of the immigrant mother i, who originates from country c, residing in the Austrian district d of province p, born in period t was illegitimate. The two explanatory variables of primary interest are the historical illegitimacy ratio in district d, $illegit\,ratio^{1900}_{dp}$, and the historical illegitimacy ratio in the sending country c, $illegit\,ratio^{1900}_{c}$. The latter variable serves as a proxy for the cultural norm regarding illegitimacy in country c. We include immigrants from all sending countries, for which there were at least 50 births in our sample. For this list of 62 countries, we aim to measure the historical illegitimacy ratio in the year 1900. If no data for 1900 are available, we use data from the earliest year possible. For 16 countries, no historical data were available at all. Details are provided in Table C.12 in the Web appendix.

If the cultural norm regarding illegitimacy is enforced through the population of residence

[26] Fernández (2011) defines the epidemiological approach as the attempt to identify the effect of culture through the variation in outcomes of individuals who share the same institutional environment, but whose cultural norms are potentially different. Most empirical analyses have focused on immigrants from various sending countries within one receiving country. In our context, the culture comprises the norm regarding illegitimacy (from the sending country) and the institutional environment comprises the local historical agricultural production structure (in the specific region of the receiving country, Austria). Compared to the traditional epidemiological approach, we exploit not only variation in the cultural norm across groups of immigrants, but also variation in the institutional environment *within* the receiving country.

through some form of punishment, then the historic prevalence of illegitimacy in the receiving municipality would influence the occurrence of illegitimacy among immigrant women. On the other hand, if the cultural norm is passed down through the family to immigrant mothers, then the historic illegitimacy ratio of the country of origin would matter. In special cases when $\beta_5^{local} > 0$ and $\beta_5^{origin} = 0$, only the cultural norm of the local population matters, while when $\beta_5^{local} = 0$ and $\beta_5^{origin} > 0$, then only the cultural norm passed on through the family is important.

The estimation results from linear probability models are summarized in Table 14. The specifications in columns (1) to (5) differ with respect to the sample years, and the set of included control variables. Across specifications, we consistently find that the likelihood of immigrants having an illegitimate birth is only very weakly related to the historical illegitimacy ratio of their current place of residence in Austria. The estimate ranges, depending on the specification, between 0.13 and 0.16.[27] In contrast, the historical illegitimacy ratio in their (ancestors') country of origin is a very powerful predictor for their behavior. Across columns (1) to (4), the effect of the historical illegitimacy ratio in the sending country is approximately seven times larger than the effect of the historical illegitimacy ratio in the residing district. In column (5), this ratio drops to four. This was caused by the inclusion of control variables for mothers' religious denominations. We interpret this result as evidence of the importance of the family as a transmission channel for the cultural norm regarding illegitimacy. Put differently, the norm seems to be passed down through generations and the enforcement of a prevailing cultural norm at the current place of residence is only of second order importance.[28]

7 Conclusions

This paper explores the historical origins of the cultural norm regarding illegitimacy. We test the hypothesis that traditional agricultural production structures influence the historical illegitimacy ratio, and have a lasting effect until today. Based on data from the Austro-Hungarian Empire and modern Austria, we show that regions that focused on animal husbandry (as compared to crop farming) had significantly higher illegitimacy ratios in the past, and female descendants of these societies are today still more likely to approve illegitimacy (in survey data) and give birth outside marriage.mach. Since the differences in the agricultural production structure are completely obsolete in today's economy, we suggest interpreting the persistence in revealed and stated preferences as a cultural norm. Complementary evidence from an 'epidemiological approach' suggests that this norm is passed down through generations, and the family is the most important transmission channel. Our findings highlight the more general

[27] For comparison, the corresponding estimate for Austrian women is about about 2.5 times larger (see Table 3).

[28] Given that these estimations have an unequal number of observations across sending countries — most immigrants come from (former) Yugoslavia, Turkey, and Germany (see Table C.12 in the Web appendix) — we verify that this relationship is also significant at the country level. Figure B.6 in the Web appendix shows a significant correlation of 0.37 (p-value=0.025).

phenomenon that cultural norms can be shaped by economic conditions, and may persist, even if economic conditions become irrelevant. We suggest studying the origins of other cultural norms that are important for economic conditions today.

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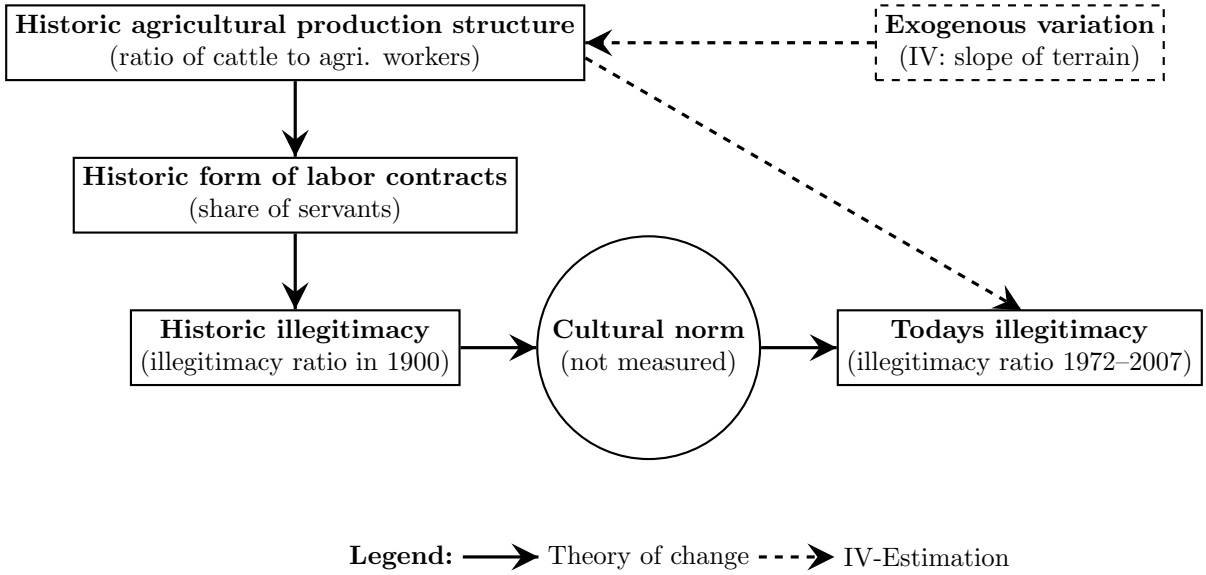
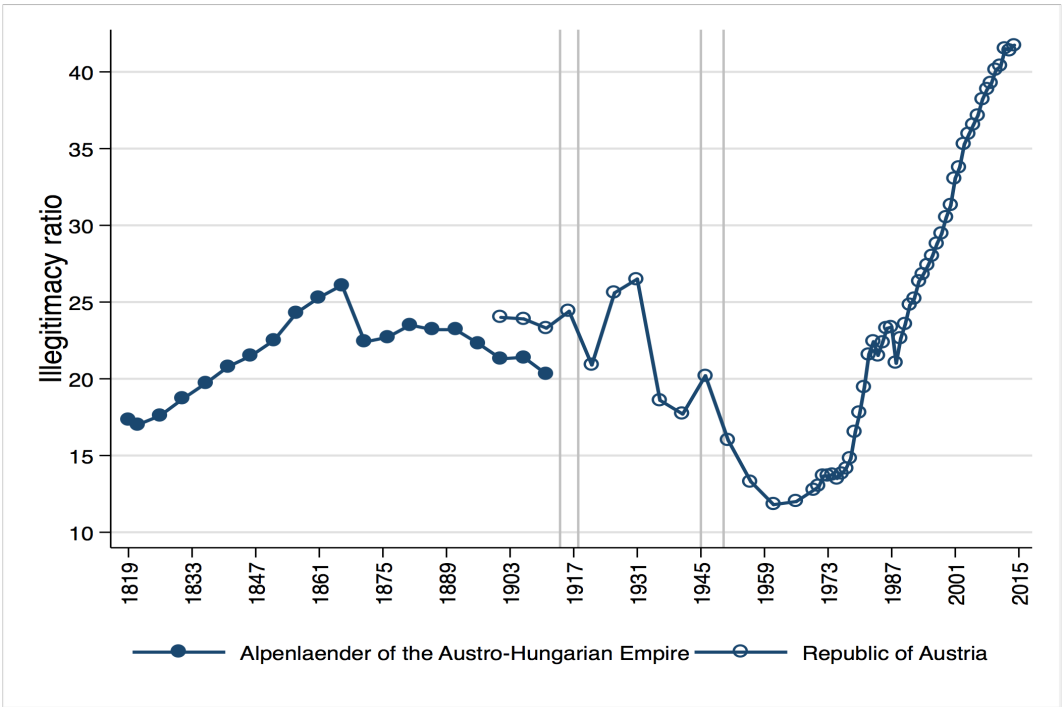
8 Tables and figures (to be placed in article)

Figure 1: Theory of change and empirical variables



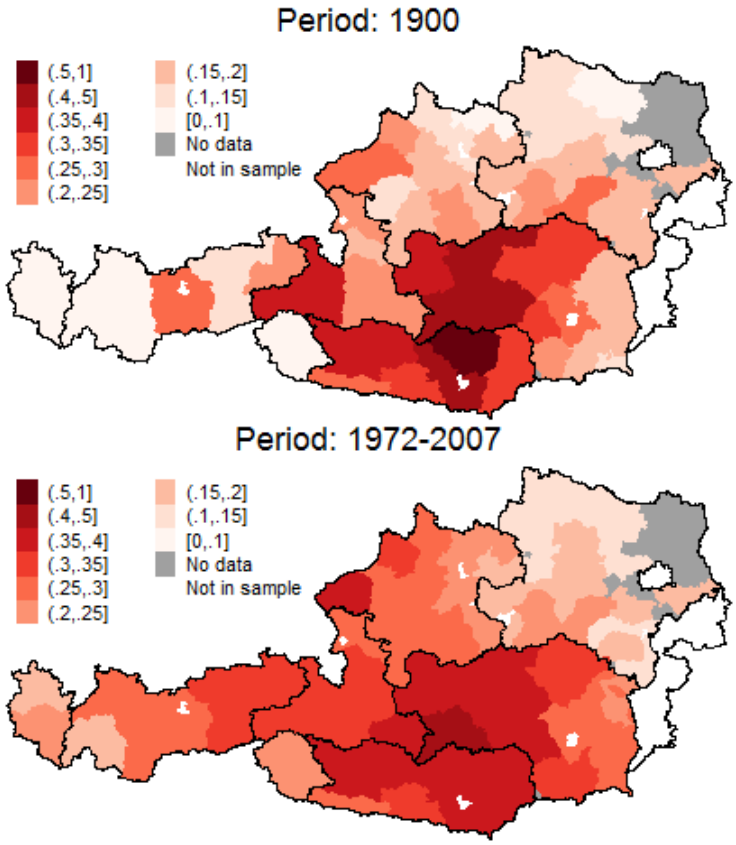
Notes: The term in parenthesis gives the empirical variables that we use as proxies for the different blocks in our argument.

Figure 2: Development of the illegitimacy ratio in Austria, 1819–2014



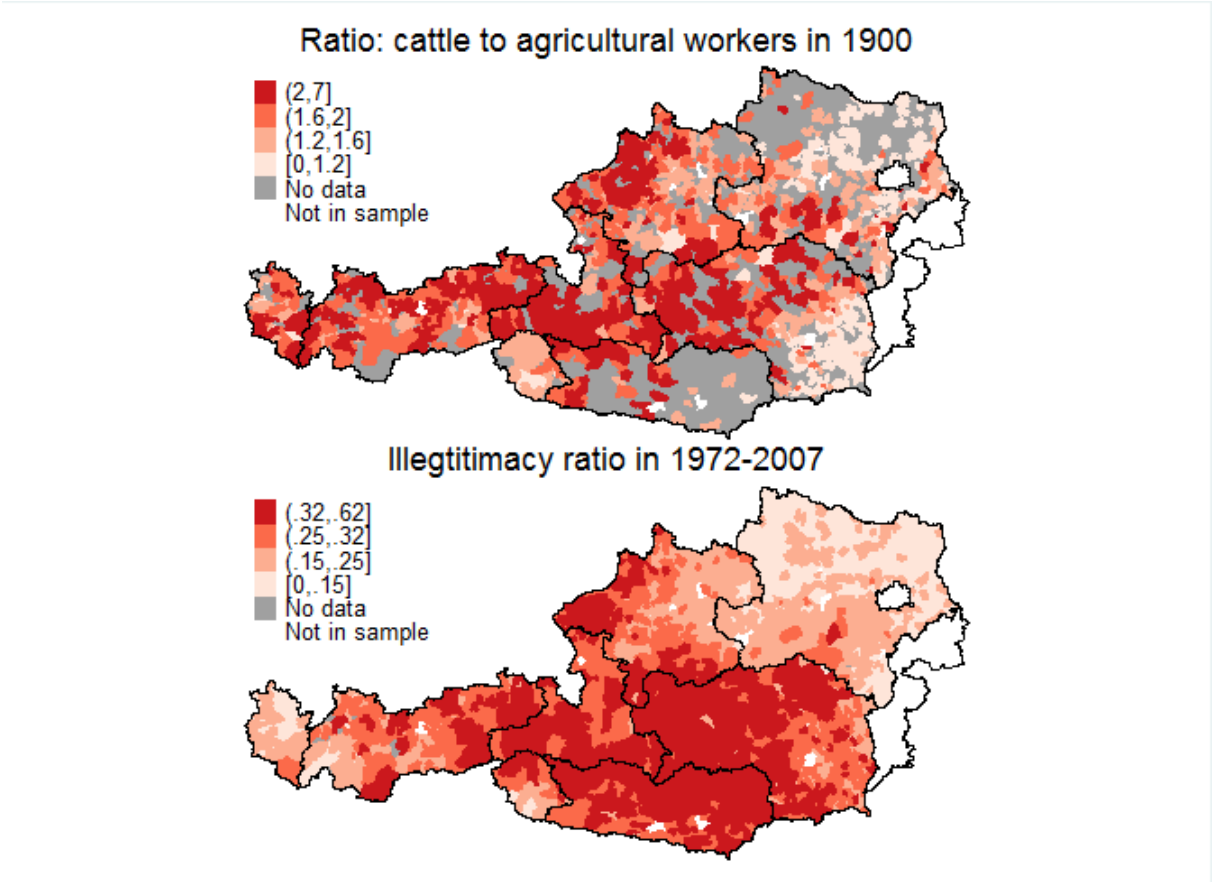
Notes: The illegitimacy ratio is defined as the share of live births to unmarried mothers of all live births. The so-called Alpenländer of the Austro-Hungarian Empire are roughly equivalent to the current territory of the Republic of Austria minus todays province of Burgenland. The province of Burgenland was not part of Austria in 1900. Data for the years 1819 to 1966 are from Haslinger (1982). Data for the years 1970 to 2014 are retrieved from the statistical database of *Statistics Austria* (STATcube, accessed in August 2015). The vertical lines indicate the periods of WWI and WWII.

Figure 3: Illegitimacy ratio in Austrian districts



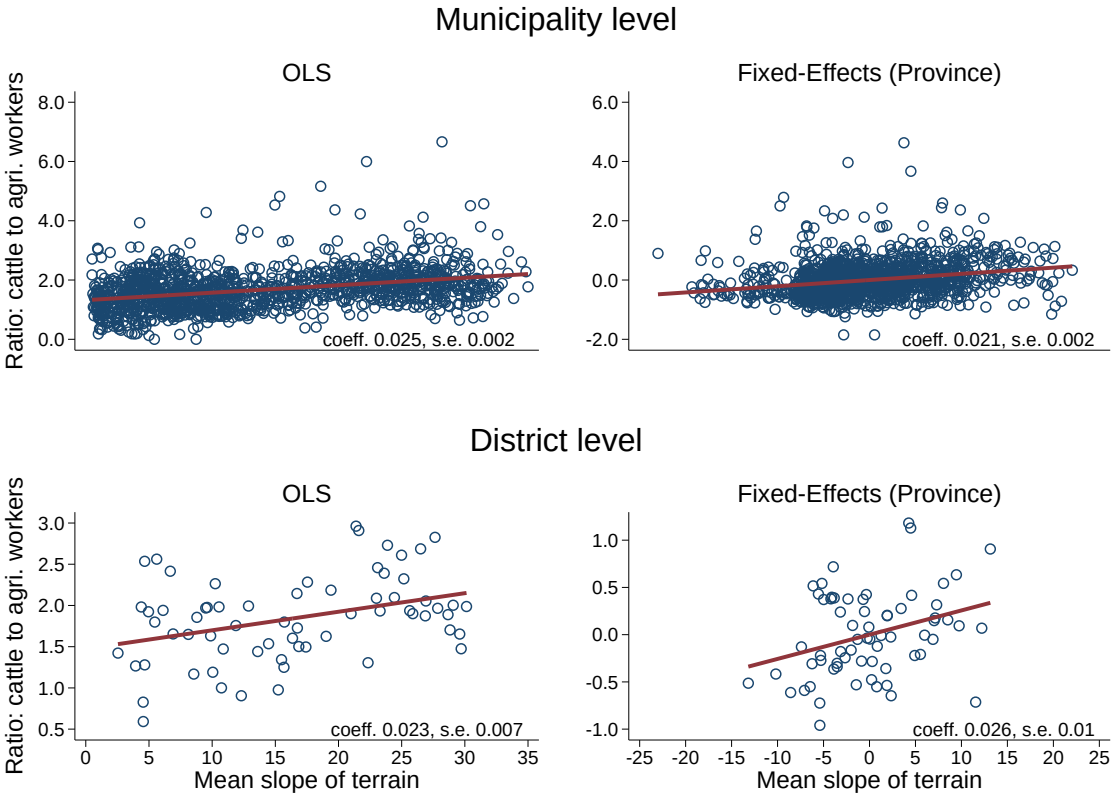
Notes: The illegitimacy ratio is defined as the share of live births to unmarried mothers of all live births. Data are from the population statistics (*Bewegung der Bevölkerung*) in 1900 and the *Austrian Birth Register* (1972–2007). Districts correspond to borders in 1900. We exclude city-districts and the province of Burgenland (which was not part of Austria in 1900) from our estimation sample (shown in white). Missing data points are municipalities in historic districts that we could not reconstruct with todays municipalities (shown in gray). Section A.1.1 in the Web appendix provides details on the sample construction. The outlined borders in black refer to provincial borders today.

Figure 4: Agricultural structure in 1900 and illegitimacy ratio today in Austrian municipalities



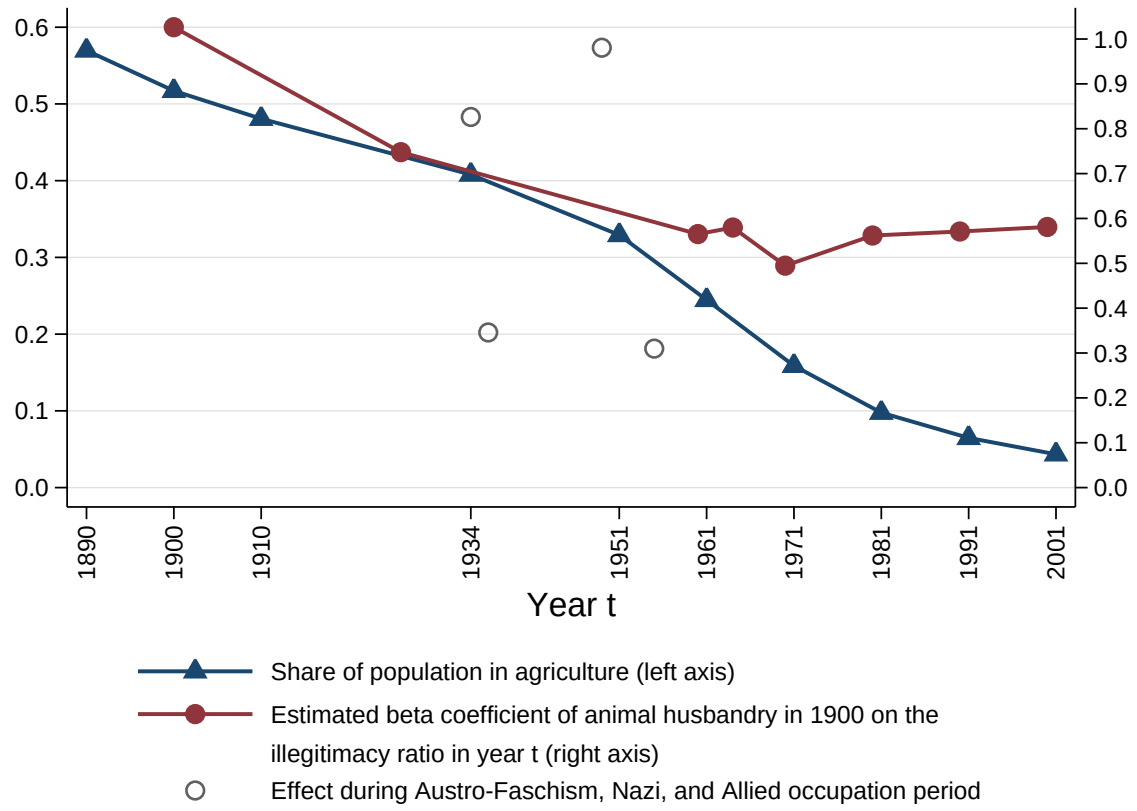
Notes: The ratio of cattle to agricultural workers is our measure of the agricultural production structure and corresponds to the district of residence in the year 1900. The illegitimacy ratio is defined as the share of live births to unmarried mothers of all live births. Data are from the population census in 1900 and the *Austrian Birth Register* (1972–2007). Districts correspond to borders in 1900. We exclude city-districts and the province of Burgenland (which was not part of Austria in 1900) from our estimation sample (shown in white). Missing data points are municipalities that we could not track over time (shown in gray). Section A.1.1 in the Web appendix provides details on the sample construction. The outlined borders in black refer to provincial borders today.

Figure 5: Relationship between slope of terrain and the historical dominance of animal husbandry farming



Notes: Each panel shows the relationship between the mean slope of terrain an the ratio of cattle to agricultural workers in 1900 (first stage relationship). The upper panels use municipality-level data, the lower panels data at the district level. On the left is the unconditional relationship and on the right the within-province correlation. Regression coefficients and standard errors are reported. See Panel B of Table 9 for further details. Note that the scale of the vertical axis is not comparable between panels.

Figure 6: Development of the agricultural sector and the cultural norm regarding illegitimacy, 1890–2001



Notes: The estimated beta-coefficient of animal husbandry in 1900 on the illegitimacy ratio in year t results from a district-level IV-regression of the illegitimacy ratio in the respective year on the ratio of cattle to agricultural workers, district-level covariates, and province fixed effects, where we instrument the ratio of cattle to agricultural workers with the mean slope of a district as in column (6) of Table 9.

Table 1: Descriptive statistics: District-level

			Mean by quartile of ratio: cattle to agri. workers			
	Mean	Std. Dev.	1st	2nd	3rd	4th
Illegitimacy						
Illegitimacy ratio in 1900	0.21	0.11	0.15	0.21	0.18	0.30
Illegitimacy ratio today (1972–2007)	0.26	0.08	0.21	0.26	0.23	0.33
Main variables						
Ratio: cattle to agri. workers	1.84	0.51	1.18	1.69	1.97	2.49
Share of servants	0.09	0.04	0.07	0.09	0.08	0.13
Instrumental variable						
Mean slope of terrain	16.37	8.43	11.55	16.56	18.17	19.01
Covariates, $\mathbf{X_{dp}^{1900}}$						
Urbanization rate	0.43	0.21	0.55	0.41	0.42	0.35
Share of age <14	0.31	0.02	0.31	0.31	0.32	0.32
Share of age 15–60	0.59	0.02	0.59	0.59	0.58	0.59
Share employed in agriculture	0.59	0.13	0.56	0.61	0.59	0.61
Share employed in manufacturing	0.21	0.11	0.23	0.21	0.22	0.19
Share employed in services	0.05	0.03	0.06	0.05	0.05	0.05
Share of catholics	0.98	0.03	0.98	0.98	0.98	0.99
Share of illiterate	0.09	0.07	0.07	0.10	0.07	0.11
Log. teacher income	7.41	0.25	7.48	7.38	7.36	7.44
Fertility and nuptiality						
Mean age at marriage (females)	29.17	1.04	29.11	29.16	28.82	29.58
Share of married females (age 46+)	0.39	0.05	0.41	0.39	0.40	0.37
Marital fertility rate	273.11	35.15	262.94	271.79	289.72	268.36
Non-marital fertility rate	46.61	23.72	33.54	44.57	41.59	65.68
Alternative agricultural variables						
Share of servants of agri. workers	0.24	0.10	0.17	0.25	0.20	0.34
Share of non-family agri. workers	0.28	0.10	0.22	0.28	0.23	0.37
Share of permanent agri. workers	0.61	0.09	0.55	0.61	0.61	0.67

Notes: All variables without an indication of the year are either measured in 1900/1902 or time-invariant. The level of observation is a district ($N = 66$). The (non-)marital fertility rate is defined as the number of (il)legitimate births per 1,000 (un)married women at age 14–45. The mean slope is calculated from a digital terrain model of Austria with a 10×10 meter grid size. The urbanization rate is defined as the share of the population that lives in towns with more than 500 inhabitants. Teacher income measures the mean total income of a male teacher as reported in the *Volksschulstatistik 1900*.

Table 2: Illegitimacy in 1900 and illegitimacy today: OLS estimates

	Dependent variable: illegitimacy ratio today (1972-2007)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Illegitimacy ratio in 1900[a]	0.559***	0.420***	0.426***	0.431***	0.432***	0.375***	0.395***
	(0.064)	(0.055)	(0.057)	(0.064)	(0.063)	(0.065)	(0.072)
Urbanization rate			−0.014				−0.007
			(0.024)				(0.033)
Age structure (Base group: Share >60)							
Share <14				−0.478			−0.713
				(0.432)			(0.636)
Share 15 to 60				−0.192			−0.216
				(0.405)			(0.741)
Sectoral composition (Base group: Residual share)							
Agriculture					0.028		0.016
					(0.146)		(0.158)
Manufacturing					0.099		0.101
					(0.144)		(0.152)
Services					−0.402		−0.551
					(0.319)		(0.357)
Share of catholics						−0.165	−0.248
						(0.168)	(0.184)
Share of illiterate						0.182	0.177
						(0.127)	(0.129)
Log. teacher income						0.023	0.048
						(0.048)	(0.055)
Province FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	66	66	66	66	66	66	66
Adj. R-squared	0.538	0.858	0.856	0.857	0.860	0.856	0.861
Mean of dependent variable	0.262	0.262	0.262	0.262	0.262	0.262	0.262

Notes: Method of estimation is OLS. Standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Data sources are listed in Table A.1 in the Web appendix. [a] Illegitimacy ratio in the mother's district of residence d in the year 1900.

Table 3: Illegitimacy in 1900 and illegitimacy today: Individual-level OLS estimates

	Dependent variable: Binary variable indicating an illegitimate birth in the universe of all births to women in Austria between				
	1972 and 2007		1984 and 2007		
	(1)	(2)	(3)	(4)	(5)
Illegitimacy ratio in 1900[a]	0.394***	0.380***	0.363***	0.372***	0.372***
	(0.082)	(0.078)	(0.087)	(0.086)	(0.083)
Province fixed effects	Yes	Yes	Yes	Yes	Yes
Conception year fixed effects	Yes	Yes	Yes	Yes	Yes
District-level covariates[b]	Yes	Yes	Yes	Yes	Yes
Mother's age	No	Yes	Yes	Yes	Yes
Mother's religious denomination	No	Yes	Yes	Yes	Yes
Parity[c]	No	No	No	Yes	Yes
Mother's educational attainment[c]	No	No	No	No	Yes
Number of observations	1,870,497	1,870,497	1,146,613	1,146,613	1,146,613
Adj. R-squared	0.069	0.183	0.163	0.222	0.229
Mean of dependent variable	0.266	0.266	0.320	0.320	0.320

Notes: Method of estimation is a linear probability model. Standard errors reported in parentheses are clustered on the district-level. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Individual-level data is from the *Austrian Birth Register*. [a] Illegitimacy ratio in the mother's district of residence d in the year 1900. [b] The variables are listed in Table 1. [c] Information on parity and mothers educational attainment was not collected in the *Austrian Birth Register* before 1984. More detailed estimation output is summarized in the Web appendix in Table C.1.

Table 4: Animal husbandry and farmhand societies in 1900: OLS estimates

	Dependent variable: Share of servants of total population in 1900						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ratio: cattle to agri. workers[a]	0.047***	0.038***	0.034***	0.049***	0.040***	0.039***	0.039***
	(0.009)	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)
Urbanization rate			−0.042**				0.008
			(0.021)				(0.024)
Age structure (Base group: Share >60)							
Share <14				−1.519***			−0.312
				(0.337)			(0.502)
Share 15 to 60				−0.865***			0.473
				(0.283)			(0.563)
Sectoral composition (Base group: Residual share)							
Agriculture					0.080		0.065
					(0.108)		(0.107)
Manufacturing					−0.091		−0.127
					(0.108)		(0.102)
Services					0.229		0.028
					(0.257)		(0.251)
Share of catholics						0.399***	0.181
						(0.139)	(0.133)
Share of illiterate						−0.077	0.037
						(0.104)	(0.092)
Log. teacher income						−0.021	0.017
						(0.038)	(0.039)
Province FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	66	66	66	66	66	66	66
Adj. R-squared	0.303	0.569	0.591	0.673	0.673	0.618	0.738
Mean of dependent variable	0.094	0.094	0.094	0.094	0.094	0.094	0.094

Notes: Method of estimation is OLS. Standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Data sources are listed in Table A.1 in the Web appendix. [a] This variable captures the ratio of cattle to agricultural workers in the women's municipality of residence in the year 1900.

Table 5: (Il)legitimacy status of child by occupation of parents

	Birth status of child (in %)	
	Legitimate	Illegitimate
Occupation of father or unmarried mother		
Servant in agriculture	20.1	79.9
Day laborer in agriculture	84.3	15.7

Notes: The occupation refers to the father for legitimate children and the mother for illegitimate children. Austrian part of the Habsburg Monarchy, Data source: *Bewegung der Bevölkerung 1900.*

Table 6: Farmhand societies and illegitimacy in 1900: OLS estimates

	Dependent variable: illegitimacy ratio in 1900						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Share of servants[a]	1.554***	0.970***	1.272***	1.158***	1.524***	1.008***	1.440***
	(0.257)	(0.266)	(0.262)	(0.221)	(0.213)	(0.244)	(0.267)
Urbanization rate			0.162***				0.027
			(0.049)				(0.052)
Age structure (Base group: Share >60)							
Share <14				3.015***			0.708
				(0.725)			(1.006)
Share 15 to 60				3.532***			0.643
				(0.616)			(1.206)
Sectoral composition (Base group: Residual share)							
Agriculture					−0.838***		−0.721***
					(0.207)		(0.241)
Manufacturing					−0.418*		−0.438*
					(0.215)		(0.232)
Services					−0.764		−0.733
					(0.483)		(0.555)
Share of catholics						−0.787**	−0.418
						(0.309)	(0.287)
Share of illiterate						0.668***	0.334*
						(0.215)	(0.199)
Log. teacher income						0.256***	0.003
						(0.082)	(0.088)
Province FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	66	66	66	66	66	66	66
Adj. R-squared	0.354	0.627	0.681	0.756	0.809	0.726	0.801
Mean of dependent variable	0.209	0.209	0.209	0.209	0.209	0.209	0.209

Notes: Method of estimation is OLS. Standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Data sources are listed in Table A.1 in the Web appendix. [a] The share of servants in the population is our preferred measure of the prevailing form of labor contracts in the mother's district of residence d in the year 1900.

Table 7: Descriptive statistics: Municipality-level

			Mean by quartile of ratio cattle to agri. workers			
	Mean	Std. Dev.	1st	2nd	3rd	4th
Illegitimacy						
Illegitimacy ratio today (1972–2007)	0.25	0.09	0.20	0.23	0.27	0.30
Main variables						
Ratio: cattle to agri. workers in 1900	1.67	0.67	0.90	1.45	1.83	2.51
Instrumental variables						
Mean slope of terrain	14.24	9.56	8.97	13.25	16.70	18.06
Mean precipitation in summer	6.94	2.13	5.56	6.81	7.64	7.73
Mean sunshine in July	50.53	3.33	53.57	50.53	49.20	48.83
Mean cloud cover in July	59.01	3.69	55.12	59.13	60.81	60.99
Mean humidity in July	72.10	2.25	70.12	72.04	73.13	73.10
Mean temperature in July	15.89	2.70	17.87	16.10	14.99	14.61
Covariates, $\mathbf{X}_{mp}^{1900}$						
Log. population in 1900	6.91	0.63	7.07	6.96	6.83	6.78
Dummy: factory in 1900	0.19	0.39	0.23	0.17	0.16	0.20
Dummy: large land hondling in 1900	0.59	0.49	0.63	0.62	0.54	0.56
Share in agriculture in 1934	0.56	0.20	0.62	0.56	0.57	0.49
Dummy: market status in 2013	0.32	0.47	0.40	0.34	0.27	0.27

Notes: The level of observation is a municipality (N=1,318). The mean slope is calculated from a digital terrain model of Austria with a 10×10 meter grid size. Climate data are averages for 1961–1990 and was published as GIS raster data by the Austrian meteorological institute (*ZAMG*). The share of the population in agriculture was first published at the municipality level in 1934, which we use as a proxy for the share of the population in agriculture in 1900.

Table 8: Historical animal husbandry and illegitimacy today: OLS estimates

	Dependent variable: illegitimacy ratio today (1972-2007)					
	Municipality-level estimates			District-level estimates		
	(1)	(2)	(3)	(4)	(5)	(6)
Ratio: cattle to agri. workers[a]	0.051***	0.033***	0.031***	0.084***	0.050***	0.052***
	(0.003)	(0.003)	(0.003)	(0.018)	(0.010)	(0.013)
Province FE	No	Yes	Yes	No	Yes	Yes
Municipality-level covariates[b]	No	No	Yes			
District-level covariates[c]				No	No	Yes
Number of observations	1,318	1,318	1,318	66	66	66
Adj. R-squared	0.141	0.572	0.579	0.250	0.797	0.830
Mean of dependent variable	0.250	0.250	0.250	0.262	0.262	0.262

Notes: Method of estimation is OLS. Standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. The unit of observation is either a municipality according to borders in 2013 (columns (1) to (3)) or a district according to borders in 1900 (columns (4) to (6)). Data sources are listed in Table A.1 in the Web appendix. [a] This variable captures the ratio of cattle to agricultural workers in the women's municipality/district of residence in the year 1900. [b] The variables are listed in Table 7. [c] The variables are listed in Table 1.

Table 9: Historical animal husbandry and illegitimacy today: IV estimates

	Dependent variable: illegitimacy ratio today (1972-2007)					
	Municipality-level estimates			District-level estimates		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Second stage estimates						
Ratio: cattle to agri. workers[a]	0.132***	0.106***	0.104***	0.217***	0.114***	0.083**
	(0.012)	(0.014)	(0.013)	(0.065)	(0.039)	(0.039)
Province FE	No	Yes	Yes	No	Yes	Yes
Municipality-level covariates[b]	No	No	Yes			
District-level covariates[c]				No	No	Yes
Number of observations	1,318	1,318	1,318	66	66	66
Mean of dependent variable	0.250	0.250	0.250	0.262	0.262	0.262
Panel B: First stage estimates	Dependent variable: Ratio of cattle to agricultural workers					
Mean slope of terrain	0.025***	0.021***	0.021***	0.023***	0.026**	0.026**
	(0.002)	(0.002)	(0.002)	(0.007)	(0.010)	(0.012)
F-statistic	187.143	83.049	103.114	10.055	6.756	4.990
Adj. R-squared	0.124	0.247	0.395	0.122	0.231	0.506
Panel C: Reduced form estimates	Dependent variable: illegitimacy ratio today (1972-2007)					
Mean slope of terrain	0.003***	0.002***	0.002***	0.005***	0.003***	0.002*
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Adj. R-squared	0.115	0.554	0.572	0.228	0.761	0.787

Notes: Method of estimation is 2SLS. Standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. The unit of observation is either a municipality according to borders in 2013 (columns (1) to (3)) or a district according to borders in 1900 (columns (4) to (6)). Data sources are listed in Table A.1 in the Web appendix. [a] This variable captures the ratio of cattle to agricultural workers in the women's municipality/district of residence in the year 1900. It is instrumented with the mean slope of the terrain in this municipality/district. [b] The variables are listed in Table 7. [c] The variables are listed in Table 1.

Table 10: Historical animal husbandry and illegitimacy today: Alternative IV estimates

	Dependent variable: illegitimacy ratio today (1972-2007)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Second stage estimates							
Ratio: cattle to agri. workers[a]	0.121***	0.109***	0.087***	0.115***	0.091***	0.092***	0.090***
	(0.015)	(0.010)	(0.008)	(0.012)	(0.010)	(0.008)	(0.008)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality-level covariates[b]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1,318	1,318	1,318	1,318	1,318	1,318	1,318
Mean of dependent variable	0.250	0.250	0.250	0.250	0.250	0.250	0.250
Panel B: First stage estimates	Dependent variable: Ratio cattle to agricultural workers						
Mean precipitation in summer	0.098***					0.035***	0.050***
	(0.010)					(0.013)	(0.014)
Mean sunshine in July		−0.072***				−0.015*	−0.016*
		(0.005)				(0.008)	(0.008)
Mean cloud cover in July			0.086***			0.075***	0.080***
			(0.005)			(0.011)	(0.011)
Mean humidity in July				0.109***		−0.017	−0.019
				(0.009)		(0.015)	(0.015)
Mean temperature in July					−0.096***	0.004	−0.023*
					(0.007)	(0.012)	(0.014)
Mean slope of terrain							−0.013***
							(0.003)
F-statistic	95.885	222.452	297.483	153.589	176.175	62.679	55.315
Adj. R-squared	0.392	0.442	0.468	0.416	0.425	0.472	0.478

Notes: Method of estimation is 2SLS. Standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Data sources are listed in Table A.1 in the Web appendix. [a] This variable captures the ratio of cattle to agricultural workers in the women's municipality of residence in the year 1900. It is instrumented with the mean slope of the terrain in this municipality. [b] The variables are listed in Table 7.

Table 11: Historical animal husbandry and illegitimacy today: Individual-level IV estimates

	Dependent variable: Binary variable indicating an illegitimate birth in the universe of all births to women in Austria between				
	1972 and 2007		1984 and 2007		
	(1)	(2)	(3)	(4)	(5)
Ratio: cattle to agri. workers[a]	0.096***	0.077***	0.074***	0.099***	0.092***
	(0.016)	(0.013)	(0.015)	(0.017)	(0.016)
Province fixed effects	Yes	Yes	Yes	Yes	Yes
Conception year fixed effects	Yes	Yes	Yes	Yes	Yes
Municipality-level covariates[b]	Yes	Yes	Yes	Yes	Yes
Mother's age	No	Yes	Yes	Yes	Yes
Mother's religious denomination	No	Yes	Yes	Yes	Yes
Parity[c]	No	No	No	Yes	Yes
Mother's educational attainment[c]	No	No	No	No	Yes
Number of observations	968,299	968,299	591,945	591,945	591,945
Mean of dependent variable	0.255	0.255	0.304	0.304	0.304
F-statistic	51.068	50.798	49.294	48.938	48.675

Notes: Method of estimation is 2SLS. Standard errors reported in parentheses are clustered on the municipality-level. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Individual-level data is from the *Austrian Birth Register*. [a] This variable captures the ratio of cattle to agricultural workers in the women's municipality of residence in the year 1900. It is instrumented with the mean slope of the terrain in this municipality. [b] The variables are listed in Table 7. [c] Information on parity and mothers educational attainment was not collected in the *Austrian Birth Register* before 1984.

Table 12: Historical animal husbandry and illegitimacy today: Stated preferences

	Woman can have child as single parent even without stable relationship: strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4), or strongly agree (5).			
	Dependent variable: ordinal 5-point scale		Dependent variable: Binary Equal to one if (strongly) agree	
	(1)	(2)	(3)	(4)
Illegitimacy ratio in 1900[a]	1.053*		0.895***	
	(0.547)		(0.291)	
Ratio: cattle to agri. workers in 1900[b]		0.235**		0.094*
		(0.090)		(0.052)
Male	−0.154***	−0.149***	−0.110***	−0.113***
	(0.056)	(0.055)	(0.040)	(0.040)
Respondent's marital status (base group: single)				
Married	−0.133**	−0.133**	−0.083**	−0.087**
	(0.057)	(0.057)	(0.036)	(0.036)
Divorced	0.204*	0.205*	0.087	0.085
	(0.120)	(0.120)	(0.079)	(0.080)
Widowed	0.239	0.217	0.312**	0.309**
	(0.417)	(0.423)	(0.135)	(0.135)
Number of children	−0.071**	−0.072**	−0.026	−0.025
	(0.029)	(0.029)	(0.016)	(0.016)
Respondent's decade of birth (base group: 1960s)				
1970s	−0.041	−0.043	−0.035	−0.037
	(0.067)	(0.067)	(0.035)	(0.035)
1980s	−0.023	−0.027	−0.033	−0.035
	(0.081)	(0.081)	(0.041)	(0.042)
Province fixed effects	Yes	Yes	Yes	Yes
District-level covariates[c]	Yes	Yes	Yes	Yes
Number of observations	1,126	1,126	1,126	1,126
Adj. R-squared	0.046	0.048	0.056	0.050
Mean of dependent variable	3.085	3.085	0.391	0.391

Notes: Method of estimation is OLS. Standard errors in parentheses are clustered on a district level. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Individual-level survey data are from the *Generations & Gender Programme* survey (First Wave from Austria). [a] This variable captures the illegitimacy ratio in the respondent's district of residence in the year 1900. [b] This variable captures the ratio of cattle to agricultural workers in the respondent's district of residence in the year 1900. [c] The variables are listed in Table 1.

Table 13: Historical animal husbandry and shotgun weddings today: Individual-level IV estimates

	Dependent variable: Binary variable indicating a shotgun wedding in the universe of all pre-marital conceptions to first-time mothers in Austria between 1984 and 2007[a]		
	(1)	(2)	(3)
Ratio: cattle to agri. workers[a]	−0.094***	−0.092***	−0.092***
	(0.018)	(0.018)	(0.018)
Province fixed effects	Yes	Yes	Yes
Municipality-level covariates[b]	Yes	Yes	Yes
Conception year fixed effects	Yes	Yes	Yes
Mother's age	Yes	Yes	Yes
Mother's educational attainment	No	Yes	Yes
Mother's religious denomination	No	No	Yes
Number of observations	169,744	169,744	169,744
Mean of dependent variable	0.236	0.236	0.236
F-statistic	48.921	48.834	48.535

Notes: Method of estimation is 2SLS. Standard errors are clustered on the municipality-level. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Individual-level data is from the *Austrian Birth Register*. [a] This variable captures the ratio of cattle to agricultural workers in the women's municipality of residence in the year 1900. It is instrumented with the mean slope of the terrain in this municipality. [b] The variables are listed in Table 1.

Table 14: Illegitimacy in Austria among immigrants: An epidemiological approach

	Dependent variable: Binary variable indicating an illegitimate birth in the sample of all births to immigrant first-time mothers in in Austria between 1984 and 2007[a]			
	(1)	(2)	(3)	(4)
Illegitimacy ratio in 1900[b]	0.163**	0.159**	0.158**	0.130**
	(0.071)	(0.072)	(0.068)	(0.064)
Illegitimacy ratio in sending country in 1900c[c]	1.036***	1.098***	1.037***	0.410***
	(0.102)	(0.106)	(0.099)	(0.080)
Province fixed effects	Yes	Yes	Yes	Yes
Conception year fixed effects	Yes	Yes	Yes	Yes
District-level covariates[d]	Yes	Yes	Yes	Yes
Mother's age	No	Yes	Yes	Yes
Mother's educational attainment	No	No	Yes	Yes
Mother's religious denomination	No	No	No	Yes
Number of observations	49,937	49,937	49,937	49,937
Adj. R-squared	0.027	0.033	0.037	0.058
Mean of dependent variable	0.185	0.185	0.185	0.185

Notes: Method of estimation is a linear probability model. Standard errors in parentheses are clustered on a district level. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Individual-level data is from the *Austrian Birth Register*. [a] The estimation sample comprises all first-time non-Austrian mothers, who gave birth in Austria between 1984 and 2007, for whose country of origin c there are at least 50 cases in our estimation sample, and historical illegitimacy ratio is available in the literature. [b] Illegitimacy ratio in the immigrant mother's Austrian district of residence d in the year 1900. [c] Illegitimacy ratio in the immigrant mother's country of origin c, measured around 1900. Details are provided in Table C.12 in the Web appendix. [d] The variables are listed in Table 1.

Web appendix

This Web appendix (not for publication) provides additional material discussed in the unpublished manuscript 'Economic Origins of Cultural Norms: The Case of Animal Husbandry and Bastardy' by Christoph Eder and Martin Halla.

Part

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A.1 Data appendix

A.1.1 Sample selection

Austria-Hungary Empire consisted of two monarchies (the Austrian Empire and the Kingdom of Hungary) and some autonomous regions. The Austrian part of the Empire was commonly (yet unofficially) denoted Cisleithania, while the Hungarian part was usually referred to as Transleithania. Cisleithania consisted of 16 crown lands (Austrian Littoral, Bohemia, Bukovina, Carinthia, Carniola, Dalmatia, Galicia, Lower Austria, Moravia, Salzburg, Silesia, Styria, Tyrol, Upper Austria, Vorarlberg). Further levels of administrative divisions were 380 political districts, 915 court districts, and 28,801 municipalities. Out of these political districts, 33 were so-called statutory cities. These are larger cities that have been vested with district administration functions in addition to their municipal responsibilities. All numbers refer to the year 1900.

Today's Austria (formally the Republic of Austria) is substantially smaller as compared to Cisleithania. It comprises only (parts) of 7 of the former crown lands (namely, Carinthia, Lower Austria, Salzburg, Styria, Tyrol, Upper Austria, Vorarlberg) plus todays province of Burgenland, which was part of the Kingdom of Hungary. In 1900, these 7 crown lands comprised 105 political districts, of which 15 were statutory cities. In our estimation analysis, we focus

- on the subset of 80 political districts, which are within the borders of todays Austria.
- Given our focus on (more) rural areas, we exclude 9 remaining statutory cities (Vienna, Wiener-Neustadt, Waidhofen an der Ybbs, Linz, Steyr, Salzburg, Graz, Klagenfurt, and Innsbruck).
- Finally, we have to exclude 5 political districts, which had changed their borders between 1900 and 1902 (the year when we measure detailed information on the agricultural sector).

This leaves us with 66 political districts, which comprises 94 percent of the area of Austria. A problem we face when connecting the historic data of districts with todays birth registry are the border changes over the last century. We solve this by reconstructing historic districts with todays municipalities. This enables us to compare very similar geographic areas over time. Population data for all population censuses are available for current municipalities borders from *Statistik Austria*. With these data we can compare population figures of reconstructed historic districts with actual population figures of districts in 1900. The numbers shows that on average 95% of the historic population can be reconstructed. The contemporary illegitimacy ratio for historic districts should therefore contain little measurement error.

The municipality-level dataset consists of 1,318 municipalities (according to todays borders) that we can cleanly reconstruct with municipality data from 1900. We drop municipalities from our sample because (a) the province of Burgenland was not part of Austria in 1900 (171 municipalities), (b) we do not use municipalities with city status in 2013 (201 municipalities, including 13 in Burgenland), and (c) a municipality today can not be represented as a union of municipalities in 1900 (677 municipalities). The municipality sample consists of 66.5 percent of the population in 2011 of all rural municipalities outside the province of Burgenland (potential sample).

A.1.2 Data sources

Table A.1: Data sources

Data source	Variables	Level	Year
K.K. Statistische Zentralkommission. (1902). *Bewegung der Bevölkerung der im Reichsrathe vertretenen Königreiche und Länder im Jahre 1900.* Wien: K.K. Hof- und Staatsdruckerei.	Illegitimate live births, total live births, infant mortality by age, age at marriage by gender	District	1900
K.K. Statistische Zentralkommission. (1907). *Gemeindelexikon der im Reichsrathe vertretenen Königreiche und Länder.* Wien: K.K. Hof- und Staatsdruckerei.	Population, cattle, agricultural area uses as field, factories, large land holdings	Municipality, district	1900
K.K. Statistische Zentralkommission. (1909). *Ergebnisse der Landwirtschaftlichen Betriebszählung vom 3. Juni 1902 in den im Reichsrathe vertretenen Königreichen und Ländern.* Wien: K.K. Hof- und Staatsdruckerei.	Number of people in agriculture, servants, number of farms with ≤ 5 hectare land, number of farms with > 20 hectare land, total number of farms	District	1902
K.K. Statistische Zentralkommission. (1902). *Ergebnisse der Volkszählung vom 31. Dezember 1900 in den im Reichsrathe vertretenen Königreichen und Ländern.* LXIII. Band, 1. Heft. Wien: K.K. Hof- und Staatsdruckerei.	Population, total area, number of catholics	District	1900
K.K. Statistische Zentralkommission. (1903). *Ergebnisse der Volkszählung vom 31. Dezember 1900 in den im Reichsrathe vertretenen Königreichen und Ländern.* LXIII. Band, 2. Heft. Wien: K.K. Hof- und Staatsdruckerei.	Share of illiterate, share of population in locations with more than 500 inhabitants	District	1900
K.K. Statistische Zentralkommission. (1903). *Ergebnisse der Volkszählung vom 31. Dezember 1900 in den im Reichsrathe vertretenen Königreichen und Ländern.* LXIII. Band, 3. Heft. Wien: K.K. Hof- und Staatsdruckerei.	People of age < 14, people of age 15–60, number of married females of age 14–45, number of unmarried females of age 14–45	District	1900
K.K. Statistische Zentralkommission. (1903). *Berufsstatistik nach den Ergebnissen der Volkszählung vom 31. Dezember 1900 in den im Reichsrathe vertretenen Königreichen und Ländern.* LXVI. Band, 2.–7. Heft. Wien: K.K. Hof- und Staatsdruckerei.	Number of employed by sector	District	1900
K.K. Statistische Zentralkommission. (1903). *Statistik der Allgemeinen Volksschulen und Bürgerschulen in den im Reichsrathe vertretenen Königreichen und Ländern auf Grund der Statistischen Aufnahme vom 15. Mai 1900.* LXII. Band, 2. Heft. Wien: K.K. Hof- und Staatsdruckerei.	Teacher income	District	1900

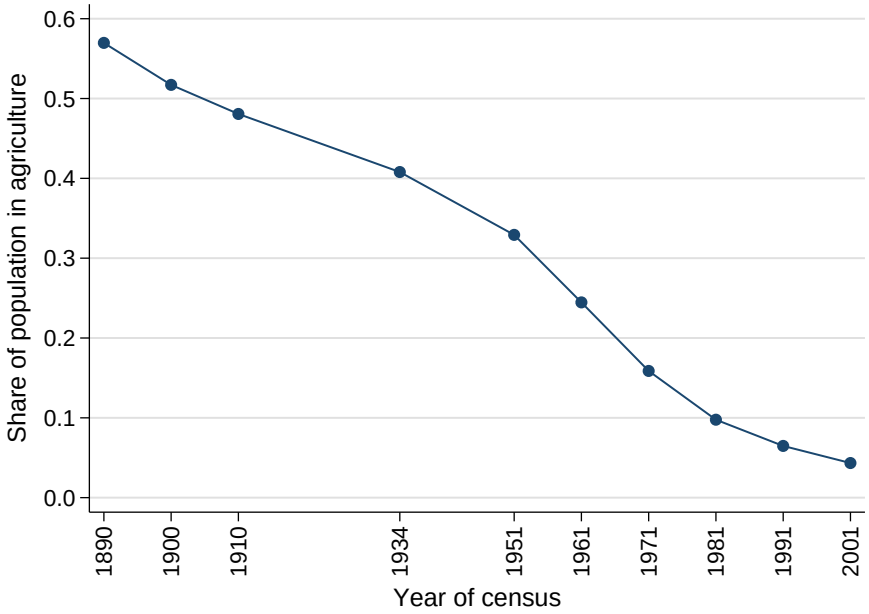
Continued on next page

Table A.1 – continued from previous page

Data source	Variables	Level	Year
Statistik des Bundesstaates Österreich. (1935). *Die Ergebnisse der österreichischen Volkszählung vom 22. März 1934.* Heft 4–11. Wien: Österreichische Staatsdruckerei.	Population, population in agriculture	Municipality, district	1934
Austrian Birth Register	All live births along with socio-economic information on mother	Individual, municipality	1972–2007
Land Kärnten. (2015). *Digitales 10m-Geländemodell Österreich.* Available at: data.gv.at (downloaded in May 2015).	mean slope of terrain	GIS	
ZAMG. (2000). *Sonnenscheindauer, relative - Mittel Jänner, Juli - Klimareferenzkarte 1961–1990 Österreich.* Available at: data.gv.at (downloaded in October 2016).	Mean sunshine in July	GIS	1961–1990
ZAMG. (2000). *Bewölkungsmenge - Mittel Jänner und Juli - Klimareferenzkarte 1961–1990 Österreich.* Available at: data.gv.at (downloaded in October 2016).	Mean cloud cover in July	GIS	1961–1990
ZAMG. (2000). *Luftfeuchte, relative - Mittel Jänner und Juli - Klimareferenzkarte 1961–1990 Österreich.* Available at: data.gv.at (downloaded in October 2016).	Mean humidity in July	GIS	1961–1990
ZAMG. (2000). *Lufttemperatur - Mittel Jahr (Jänner-Dezember), Jnner und Juli - Klimareferenzkarte 1961–1990 Österreich.* Available at: data.gv.at (downloaded in October 2016).	Mean temperature in July	GIS	1961–1990
Generations & Gender Programme (see `http://www.ggp-austria.at`)	Survey data	Individual, district	2008/09

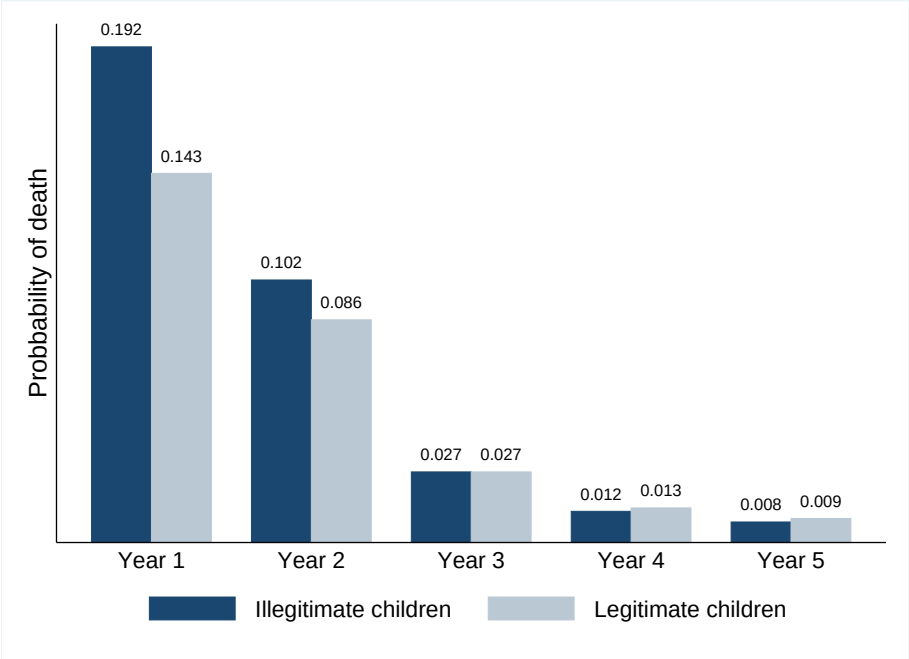
B.2 Additional figures

Figure B.1: Development of the share of the population in agriculture



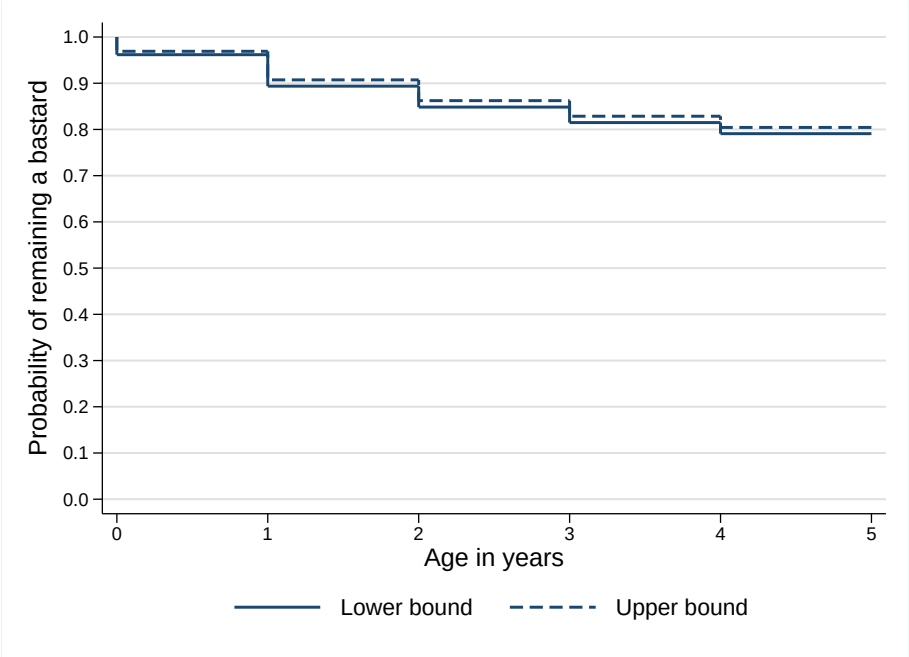
Notes: The graph summarizes the share of the population affiliated with the agricultural sector by year in the area covered by our estimation sample (see Section A.1.1 in the Web appendix).

Figure B.2: Probability of early death by legitimacy status



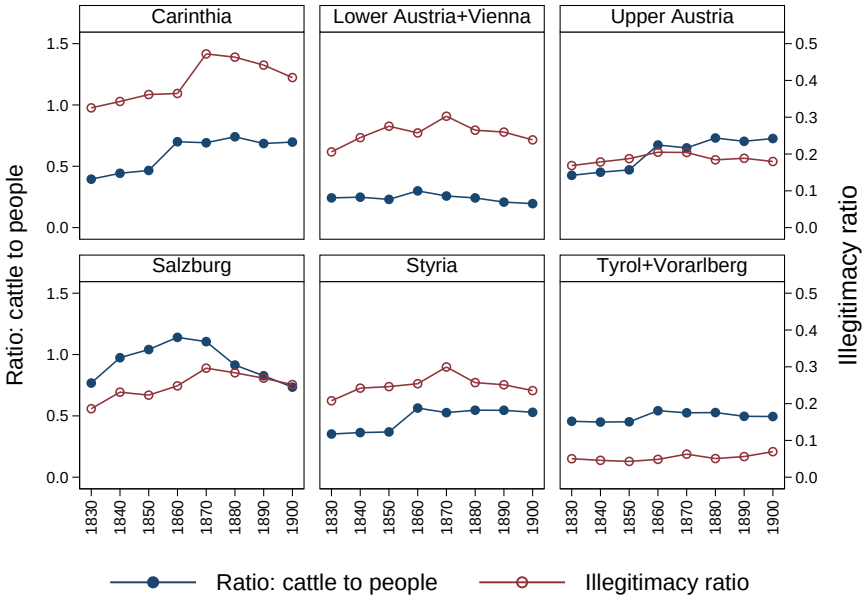
Notes: Data is aggregated for Austria over the birth cohorts 1900–1904. The data come from the publications *Bewegung der Bevölkerung* of the years 1900–1909. Because children can get legitimized (but not the other way round), the probability of death for bastards is downward biased, while the probability of death for legitimate children is upward biased.

Figure B.3: Probability of remaining illegitimate after birth



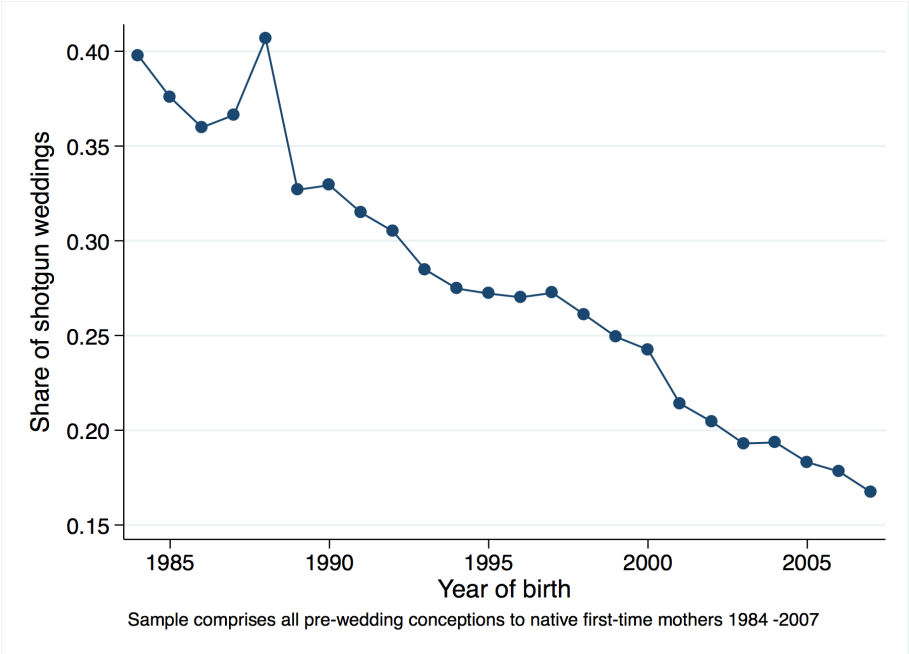
Notes: Data is aggregated for Austria over the birth cohorts 1900–1904. The data come from the publications *Bewegung der Bevölkerung* of the years 1900–1909. The probability of legitimization is the number of legitimizations divided by the stock of illegitimate children. The lower bound assumes that all deaths of illegitimate children occurred on Jan. 1, while the upper bound assumes Dec. 31.

Figure B.4: Development of animal husbandry and illegitimacy before 1900 by province



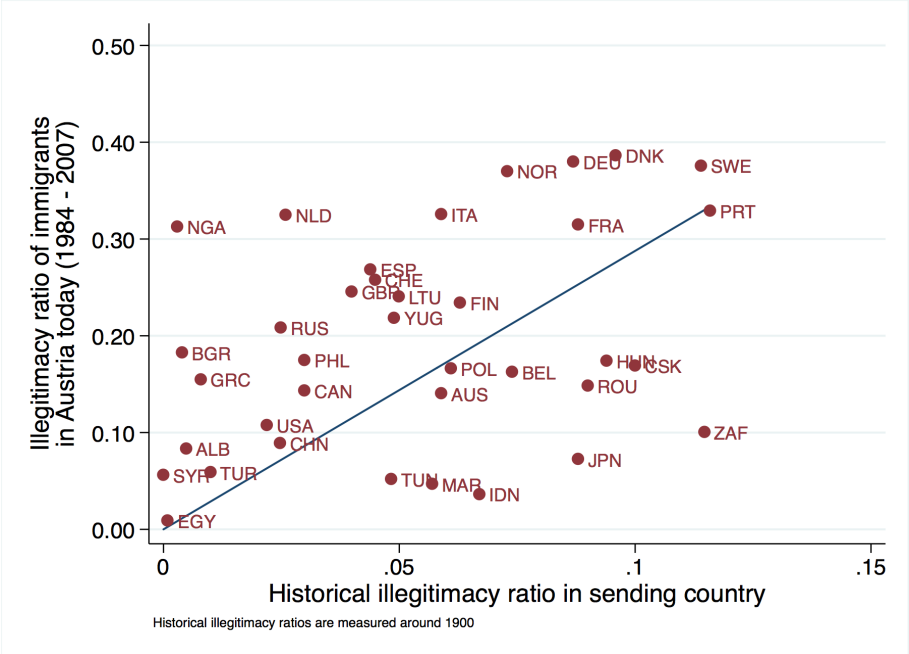
Notes: Data for the variable ratio of cattle to people come from the annually statistical reviews (*Statistisches Jahrbuch*) between 1831–1860 and the population censuses (*Volkszählung*) of 1869, 1880, 1890, and 1900. Data on illegitimate birth come from the annually statistical reviews (*Statistisches Jahrbuch*) between 1831–1860 and population statistics (*Bewegung der Bevölkerung*) in 1880, 1890, and 1900.

Figure B.5: Development of shotgun weddings in Austria, 1984-2007



Notes: Own calculations based on the *Austrian Birth Register*. Figures are based on *all* pre-marital conceptions to Austrian first-time mothers. A shotgun wedding is defined as a case, where a women was unmarried at the time of conception, but married before birth.

Figure B.6: Epidemiological correlation



Notes: Data sources for the historical illegitimacy ratio in the sending country are listed in Table C.12 in the Web appendix. The average illegitimacy ratio of immigrants in Austria today are own calculations based on the *Austrian Birth Register*, see notes to Table 14 in the paper. Countries from South America are excluded, since Hartley (1975) discusses the questionable reliability of (historical) illegitimacy ratios from these countries. In a regression which controls for continent fixed-effects the estimated coefficients amounts to 0.74 (p-value=0.09, $N = 37$). An equivalent estimation, which includes South American countries gives an estimated coefficient of 0.65 (p-value=0.004, $N = 44$).

C.3 Additional tables

Table C.1: Illegitimacy in 1900 and illegitimacy today: Individual-level OLS estimates, more detailed estimation output

	Dependent variable: Binary variable indicating an illegitimate birth in the universe of all births to women in Austria between				
	1972 and 2007		1984 and 2007		
	(1)	(2)	(3)	(4)	(5)
Illegitimacy ratio in 1900[a]	0.394***	0.380***	0.363***	0.372***	0.372***
	(0.082)	(0.078)	(0.087)	(0.086)	(0.083)
Mother's age (base group: 20 years or below)					
between 21 and 25 years		−0.302***	−0.327***	−0.254***	−0.235***
		(0.008)	(0.005)	(0.005)	(0.005)
between 26 and 30 years		−0.442***	−0.496***	−0.367***	−0.334***
		(0.014)	(0.010)	(0.007)	(0.007)
between 31 and 35 years		−0.481***	−0.549***	−0.376***	−0.337***
		(0.016)	(0.013)	(0.008)	(0.008)
36 years and above		−0.466***	−0.545***	−0.345***	−0.307***
		(0.017)	(0.013)	(0.008)	(0.008)
Mother's religious denomination (base group: Catholic)					
Protestant		−0.007	0.002	0.001	0.006
		(0.005)	(0.005)	(0.006)	(0.005)
Muslim		−0.361***	−0.372***	−0.327***	−0.366***
		(0.014)	(0.014)	(0.013)	(0.013)
Other denomination		−0.144***	−0.170***	−0.152***	−0.164***
		(0.010)	(0.012)	(0.012)	(0.011)
Unknown/Atheist		0.033***	0.040***	0.018**	0.022***
		(0.007)	(0.008)	(0.008)	(0.008)
Parity (base group: first)[b]					
Second				−0.233***	−0.243***
				(0.008)	(0.008)
Third or higher				−0.277***	−0.301***
				(0.012)	(0.012)
Mother's educational attainment (base group: compulsory)[b]					
Apprenticeship					−0.047***
					(0.003)
Interm. tech. and voc. school					−0.094***
					(0.004)
Academic secondary school					−0.119***
					(0.005)
University degree					−0.148***
					(0.006)
Unknown					−0.048***
					(0.009)
Province fixed effects	Yes	Yes	Yes	Yes	Yes
Conception year fixed effects	Yes	Yes	Yes	Yes	Yes
Municipality-level covariates[c]	Yes	Yes	Yes	Yes	Yes
Number of observations	1,870,497	1,870,497	1,146,613	1,146,613	1,146,613
Adj. R-squared	0.069	0.183	0.163	0.222	0.229
Mean of dependent variable	0.266	0.266	0.320	0.320	0.320

Notes: Method of estimation is a linear probability model. Standard errors reported in parentheses are clustered on the district-level. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Individual-level data is from the *Austrian Birth Register*. [a] Illegitimacy ratio in the mother's district of residence d in the year 1900. [b] Information on parity and mothers educational attainment was not collected in the *Austrian Birth Register* before 1984. [c] The variables are listed in Table 1.

Table C.2: Share of in-kind payments for different servant groups in 1893

	N	Mean	Std. Dev.	Min.	Max.
Share of in-kind payments					
Simple servant	104	0.641	0.097	0.207	0.833
Higher servant	94	0.583	0.096	0.143	0.806
Simple maid	101	0.685	0.094	0.405	0.895
Higher maid	76	0.682	0.097	0.500	0.910

Notes: N indicates the number of court districts (subdivision of districts) this estimate is based on. Source: *Die landwirtschaftlichen Löhne in den im Reichsrathe vertretenen Königreichen und Ländern nach dem Stande des Jahres 1893.* Bureau der K. K. statistischen Central-Commission.

Table C.3: Different proxies for farmhand societies and illegitimacy in 1900

	Dependent variable: illegitimacy ratio in 1900			
	(1)	(2)	(3)	(4)
Share of servants	0.970***			
	(0.266)			
	[0.376]			
Share of servants of agri. workers		0.669***		
		(0.084)		
		[0.621]		
Share of non-family agri. workers			0.693***	
			(0.076)	
			[0.641]	
Share of permanent agri. workers				0.589***
				(0.144)
				[0.469]
Province FE	Yes	Yes	Yes	Yes
Number of observations	66	66	66	66
Adj. R-squared	0.627	0.782	0.811	0.644
Mean of dependent variable	0.209	0.209	0.209	0.209
Standard dev. of dependent variable	0.111	0.111	0.111	0.111
Mean of independent variable	0.094	0.241	0.278	0.611
Standard dev. of independent variable	0.043	0.103	0.103	0.088

Notes: Method of estimation is OLS. Standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Beta coefficients are reported in brackets. Data sources are listed in Table A.1 in the Web appendix.

Table C.4: Historical animal husbandry and illegitimacy today: OLS estimates using municipality-level data, robustness checks

	Dependent variable: illegitimacy today (illegitimacy share 1972-2007)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ratio: cattle to agri. workers[a]	0.031***	0.029***	0.028***	0.028***	0.031***	0.029***	0.025***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Share education: apprenticeship 2011		0.001					0.001
		(0.001)					(0.001)
Share education: high school 2011		−0.003***					−0.003***
		(0.001)					(0.001)
Share education: tertiary 2011		0.000					0.002**
		(0.001)					(0.001)
Log. mean income in 2010			−0.068***				0.012
			(0.015)				(0.024)
Share employed in agriculture 2011				0.035			0.068
				(0.047)			(0.052)
Share employed in sec. sector 2011				0.187***			0.175***
				(0.026)			(0.033)
Share employed in tourism 2011					0.051		−0.073
					(0.041)		(0.071)
Log. beds in tourism p. c. in 2013						0.023***	0.042***
						(0.006)	(0.010)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality-level covariates[b]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1,318	1,318	1,318	1,318	1,318	1,318	1,318
Adj. R-squared	0.579	0.598	0.585	0.595	0.579	0.582	0.611
Mean of dependent variable	0.250	0.250	0.250	0.250	0.250	0.250	0.250

Notes: Method of estimation is OLS. Standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. The unit of observation is a municipality according to borders in 2013. Data sources are listed in Table A.1 in the Web appendix. [a] This variable captures the ratio of cattle to agricultural workers in the women's municipality of residence in the year 1900. [b] The variables are listed in Table 7.

Table C.5: Historical animal husbandry and illegitimacy today: IV estimates using municipality-level data, robustness checks

	Dependent variable: illegitimacy today (illegitimacy share 1972-2007)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Second stage estimates							
Ratio: cattle to agri. workers[a]	0.104***	0.103***	0.112***	0.142***	0.117***	0.109***	0.197***
	(0.013)	(0.015)	(0.018)	(0.026)	(0.017)	(0.017)	(0.067)
Share education: apprenticeship 2011		0.000					−0.003
		(0.001)					(0.002)
Share education: high school 2011		−0.004***					−0.006***
		(0.001)					(0.002)
Share education: tertiary 2011		0.003***					0.001
		(0.001)					(0.002)
Log. mean income in 2010			0.034				0.036
			(0.028)				(0.044)
Share employed in agriculture 2011				−0.510***			−0.749**
				(0.139)			(0.330)
Share employed in sec. sector 2011				0.131***			0.002
				(0.038)			(0.089)
Share employed in tourism 2011					−0.159**		−0.415**
					(0.065)		(0.183)
Log. beds in tourism p. c. in 2013						−0.008	0.023
						(0.010)	(0.020)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality-level covariates[b]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1,318	1,318	1,318	1,318	1,318	1,318	1,318
Mean of dependent variable	0.250	0.250	0.250	0.250	0.250	0.250	0.250
Panel B: First stage estimates	Dependent variable: Ratio cattle to agricultural workers						
Mean slope of terrain	0.021***	0.019***	0.017***	0.013***	0.018***	0.018***	0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
F-statistic	103.114	81.879	62.095	39.091	73.798	67.348	9.523
Adj. R-squared	0.395	0.409	0.417	0.440	0.403	0.400	0.460

Notes: Method of estimation is 2SLS. Standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. The unit of observation is a municipality according to borders in 2013. Data sources are listed in Table A.1 in the Web appendix. [a] This variable captures the ratio of cattle to agricultural workers in the women's municipality of residence in the year 1900. It is instrumented with the mean slope of the terrain in this municipality. [b] The variables are listed in Table 7.

Table C.6: Correlation between historic and contemporary climate data

	Number of weather stations	Corrrelation coefficient
Mean temperature	48	0.999
Mean temperature in January	48	0.995
Mean temperature in July	48	0.999
Mean precipitation in winter	38	0.938
Mean precipitation in summer	38	0.978
Mean air pressure	10	1.000
Mean sunshine in January	10	0.833
Mean sunshien in July	10	0.973

Notes: Data are from the HISTALP project (http://www.zamg.ac.at/histalp/). The historic period uses data from 1896–1925; the contemporary period from 1961–1990.

Table C.7: Historical animal husbandry and illegitimacy today: Individual-level IV estimates, excluding women employed in agricultural sector

	Dependent variable: Binary variable indicating an illegitimate birth in the universe of all births to women not employed in the agricultural sector in Austria between				
	1972 and 2007		1984 and 2007		
	(1)	(2)	(3)	(4)	(5)
Ratio: cattle to agri. workers[a]	0.100***	0.080***	0.078***	0.101***	0.093***
	(0.016)	(0.014)	(0.015)	(0.017)	(0.016)
Province fixed effects	Yes	Yes	Yes	Yes	Yes
Conception year fixed effects	Yes	Yes	Yes	Yes	Yes
Municipality-level covariates[b]	Yes	Yes	Yes	Yes	Yes
Mother's age	No	Yes	Yes	Yes	Yes
Mother's religious denomination	No	Yes	Yes	Yes	Yes
Parity[c]	No	No	No	Yes	Yes
Mother's educational attainment[c]	No	No	No	No	Yes
Number of observations	938,867	938,867	562,513	562,513	562,513
Mean of dependent variable	0.260	0.260	0.315	0.315	0.315
F-statistic	49.818	49.554	47.184	46.936	46.691

Notes: Method of estimation is 2SLS. Standard errors reported in parentheses are clustered on the municipality-level. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Individual-level data is from the *Austrian Birth Register*. The *Austrian Birth Register* flags all women employed in agriculture. We have excluded these cases from the analysis. [a] This variable captures the ratio of cattle to agricultural workers in the women's municipality of residence in the year 1900. It is instrumented with the mean slope of the terrain in this municipality. [b] The variables are listed in Table 7. [c] Information on parity and mothers educational attainment was not collected in the *Austrian Birth Register* before 1984.

Table C.8: Historical animal husbandry and illegitimacy today: Individual-level IV estimates, focusing on first-time mothers

	Dependent variable: Binary variable indicating an illegitimate birth in the universe of all births to first-time mothers in Austria between				
	1972 and 2007		1984 and 2007		
	(1)	(2)	(3)	(4)	(5)
Ratio: cattle to agri. workers[a]	0.197***	0.146***	0.146***	0.146***	0.142***
	(0.030)	(0.024)	(0.024)	(0.024)	(0.024)
Province fixed effects	Yes	Yes	Yes	Yes	Yes
Conception year fixed effects	Yes	Yes	Yes	Yes	Yes
Municipality-level covariates[b]	Yes	Yes	Yes	Yes	Yes
Mother's age	No	Yes	Yes	Yes	Yes
Mother's educational attainment	No	No	No	No	Yes
Mother's religious denomination	No	Yes	Yes	Yes	Yes
Number of observations	255,035	255,035	255,035	255,035	255,035
Mean of dependent variable	0.498	0.498	0.498	0.498	0.498
F-statistic	48.807	48.010	48.010	48.010	47.920

Notes: Method of estimation is 2SLS. Standard errors reported in parentheses are clustered on the municipality-level. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Individual-level data is from the *Austrian Birth Register*. The *Austrian Birth Register* includes (since 1984) information on parity. The analysis is based on the sample of first-time mothers. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Standard errors reported in parentheses are clustered on the municipality-level. [a] This variable captures the ratio of cattle to agricultural workers in the women's municipality of residence in the year 1900. It is instrumented with the mean slope of the terrain in this municipality. [b] The variables are listed in Table 7.

Table C.9: Historical animal husbandry and illegitimacy today: Individual-level OLS estimates

	Dependent variable: Binary variable indicating an illegitimate birth in the universe of all births to women in Austria between				
	1972 and 2007		1984 and 2007		
	(1)	(2)	(3)	(4)	(5)
Ratio: cattle to agri. workers[a]	0.030***	0.025***	0.022***	0.028***	0.026***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Province fixed effects	Yes	Yes	Yes	Yes	Yes
Conception year fixed effects	Yes	Yes	Yes	Yes	Yes
Municipality-level covariates[b]	Yes	Yes	Yes	Yes	Yes
Mother's age	No	Yes	Yes	Yes	Yes
Mother's religious denomination	No	Yes	Yes	Yes	Yes
Parity[c]	No	No	No	Yes	Yes
Mother's educational attainment[c]	No	No	No	No	Yes
Number of observations	968,299	968,299	591,945	591,945	591,945
Adj. R-squared	0.062	0.188	0.169	0.235	0.241
Mean of dependent variable	0.255	0.255	0.304	0.304	0.304

Notes: Method of estimation is a linear probability model. Standard errors reported in parentheses are clustered on the municipality-level. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Individual-level data is from the *Austrian Birth Register*. [a] This variable captures the ratio of cattle to agricultural workers in the women's municipality of residence in the year 1900. [b] The variables are listed in Table 7. [c] Information on parity and mothers educational attainment was not collected in the *Austrian Birth Register* before 1984.

Table C.10: Historical animal husbandry and shotgun weddings today: Individual-level OLS estimates

	Dependent variable: Binary variable indicating a shotgun wedding in the universe of all pre-marital conceptions to first-time mothers in Austria between 1984 and 2007[a]		
	(1)	(2)	(3)
Ratio: cattle to agri. workers[a]	−0.032***	−0.031***	−0.031***
	(0.005)	(0.005)	(0.005)
Province fixed effects	Yes	Yes	Yes
Municipality-level covariates[b]	Yes	Yes	Yes
Conception year fixed effects	Yes	Yes	Yes
Mother's age	Yes	Yes	Yes
Mother's educational attainment	No	Yes	Yes
Mother's religious denomination	No	No	Yes
Number of observations	169,744	169,744	169,744
Adj. R-squared	0.096	0.101	0.102
Mean of dependent variable	0.236	0.236	0.236

Notes: Method of estimation is a linear probability model. Standard errors reported in parentheses are clustered on the municipality-level. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. Individual-level data is from the *Austrian Birth Register*. [a] This variable captures the ratio of cattle to agricultural workers in the women's municipality of residence in the year 1900. [b] The variables are listed in Table 1.

Table C.11: Historical animal husbandry and other historical demographic outcomes

	Dependent variables:			
	Age at marriage (females)	Share of married females (age 46 or older)	Marital fertility (per 1,000 females)	Non-marital fertility (per 1,000 females)
	(1)	(2)	(3)	(4)
Panel A: Second stage estimates				
Ratio: cattle to agri. workers[a]	−0.398	−0.053*	−9.054	48.444***
	(0.789)	(0.029)	(21.763)	(15.046)
Province FE	Yes	Yes	Yes	Yes
District-level covariates[b]	Yes	Yes	Yes	Yes
Number of observations	66	66	66	66
Mean of dependent variable	29.172	0.391	273.107	46.611
Panel B: First stage estimates	Dep. var.: Ratio of cattle to agri. workers			
Mean slope of terrain	0.026**	0.026**	0.026**	0.026**
	(0.012)	(0.012)	(0.012)	(0.012)
F-statistic	4.990	4.990	4.990	4.990
Adj. R-squared	0.506	0.506	0.506	0.506
Panel C: OLS estimates				
Ratio: cattle to agri. workers[a]	−0.099	−0.018*	−6.080	24.133***
	(0.275)	(0.009)	(7.667)	(4.015)
Adj. R-squared	0.508	0.789	0.663	0.797

Notes: Method of estimation is 2SLS in Panel A and OLS in Panel C. Standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10 percent level, 5 percent level, and 1 percent level, respectively. The unit of observation is a district according to borders in 1900. Data sources are listed in Table A.1 in the Web appendix. [a] This variable captures the ratio of cattle to agricultural workers in the women's district of residence in the year 1900. It is instrumented with the mean slope of the terrain in this district in Panel A. [b] The variables are listed in Table 1.

Table C.12: Historical illegitimacy ratios from all countries of origin

Country of origin *c*	**Number of births in Austria**	**Historical illegitimacy ratio**[a]	**Year of measurement**	**Source**[b]
Yugoslavia[c]	26,636	4.9	1921-25	Wimperis
Turkey	15,590	1.0[d]		Ustek-Spilda
Germany[e]	7,860	8.7	1900	Wimperis
Romania	3,680	9.0	1907-10	Wimperis
Czechoslovakia[f]	2,431	10.0	1921	Hecke
Hungary	1,660	9.4	1900	Wimperis
Poland	1,611	6.1	1900	Wimperis
Italy	907	5.9	1900	Wimperis
Russian Federation[g]	864	2.5	1900	Wimperis
Switzerland	726	4.5	1900	Wimperis
Egypt	677	0.1	1949-57	UN 1959
Philippines	670	3.0	1952	Hartley
Netherlands	635	2.6	1900	Wimperis
UK	489	4.0	1900	Wimperis
China (PRC)	430	.	.	
France	423	8.8	1900	Wimperis
USA	420	2.2	1916-20	Wimperis
Ukraine	416	.	.	
Thailand	415	.	.	
Brazil	405	13.2	1949-52	UN 1959
India	400	.	.	
Bulgaria	390	0.4	1901-05	Wimperis
Iran	310	.	.	
Vietnam	248	.	.	
Nigeria	243	0.3	1953	Hartley
Sweden	229	11.4	1900	Wimperis
Albania	228	0.5	1951-57	UN 1959
Dominican Republic	206	58.6	1951	Wimperis
Unknown	184	.	.	
Ghana	164	.	.	
Spain	164	4.4	1900	Wimperis
Tunisia	156	4.8	1949-56	UN 1959
Belarus	142	.	.	
Irak	134	.	.	
Marokko	129	5.7	1949	Hartley
Japan	125	8.8	1900	Hartley
China (Taiwan)	124	2.5	1949-58	UN 1959
Belgium	117	7.4	1900	Wimperis
Armenia	108	.	.	
Syria	108	0.0	1954	Hartley
Finnland	107	6.3	1900	Wimperis
Canada	105	3.0	1929-30	Wimperis
Pakistan	105	.	.	
Denmark	101	9.6	1900	Wimperis
Australia	100	5.9	1901-05	Wimperis
Mexico	100	29.3	1952	Hartley
Peru	98	25.8	1942	Wimperis
Statelesss	91	.	.	
Georgia	85	.	.	
Greece	84	0.8	1921	Hecke
Indonesia	83	6.7	1949	Hartley

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Table C.12 – continued from previous page

Country of origin c	**Number of Births in Austria**	**Historical illegitimacy ratio**[a]	**Year of measurement**	**Source**[b]
Columbia	82	28.0	1933	Wimperis
Norway	73	7.3	1900	Wimperis
Portugal	70	11.6	1901-05	Wimperis
South Africa	70	11.5	1949-57	UN 1959
Cambodia	64	.	.	
Mongolia	63	.	.	
Moldova	62	.	.	
Afghanistan	57	.	.	
Libanon	56	.	.	
Cuba	55	30.8	1929	Wimperis
Argentina	54	24.8	1949-58	UN 1959
Lithuania	50	5.0	1921-25	Wimperis
Bangladesch	50	.	.	

Notes: [a] The historical illegitimacy ratio (HLR) is calculated as arithmetic mean over the years indicated in the fourth column. [b] Wimperis stands for: Wimperis, Virginia (1960) *The Unmarried Mother and Her Child*, Allen & Unwin Ltd., London. Hartley stands for Hartley, S.F. (1957) *Illegitimacy*, University of California Press, Berkeley and Los Angeles, CA. UN 1959 stands for: United Nations (1960), *Demographic Yearbook 1959*, 11th Edition, Department of Economic and Social Affairs, Statistical Office of the United Nations, New York. Ustek-Spilda stands for Ustek-Spilda, Funda and Oguz Alyanak (2016), 'The Case of Children Born out of Wedlock in Turkey: An Empty Category?', *About Gender* 5(10), 261–281. Hecke stands for Hecke, W. (1930), 'Die Unehelichkeit in Oesterreich', *Jahrbücher für Nationalökonomie und Statistik / Journal of Economics and Statistics*, DRITTE FOLGE, Vol. 77 (132), No. 4 (1930), pp. 572-592. [c] This HLR is also used for mothers with a citizenship from the Socialist Federal Republic of Yugoslavia (SFR); Bosnia and Herzegovina, Croatia, Macedonia, Montenegro, Serbia and Slovenia. [d] This HLR is rather a guesstimate, see Ustek-Spilda. [e] This HLR is also used for mothers with a citizenship from former East and West Germany. [f] This HLR is also used for mothers with a citizenship from Czech Republic and Slovakia. [g] This HLR is also used for mothers with a citizenship from the Russian Soviet Federative Socialist Republic and the Russian Federation.