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The Height of Swiss Mercenaries, c. 1725-c. 1865

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The Height of Swiss Mercenaries, c. 1725 – c. 1865*

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Abstract

This paper examines the evolution of the biological standard of living using anthropometric data from approximately 22,000 Swiss mercenaries born between c. 1725 and c. 1865. Analyzing mercenary data presents two key challenges: left-truncation due to height requirements and potential selection bias across regiments. We address these issues by estimating regiment-specific minimum height thresholds to account for variations in recruitment standards and resource constraints, and by controlling for regiment affiliation to mitigate selection bias. Our findings indicate a decline in average height beginning in the 1770s and continuing into the first half of the 19th century, with no evidence of recovery. While the unique nature of the mercenary sample limits broad generalizations, our results align with the economic hardships of the late 18th century, the challenges of early industrialization, and existing anthropometric evidence from Switzerland and other European countries.

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1 Introduction

Switzerland is known as one of Europe’s early industrializer. The fundamental transformations in its economic and political structure during the 18th and 19th centuries brought prosperity in the long run, but the contemporary effects are largely unknown. To better understand how the standard of living in Switzerland developed during this period, we analyze changes in average human stature between c. 1725 and c. 1865, thus focussing on the so-called “biological standard of living”, a term coined by John Komlos in 1987 (Baten and Blum, 2012, p. S67, fn 3). Since a change in average adult height is a suitable indicator for changes in the standard of living during childhood and adolescence (e.g. Bogin, 1999; Fogel, 2004; Tanner, 2010; Floud *et al.*, 2011), this concept allows us to quantify the impact of the changing socio-economic and epidemiological environment on the human body, expanding the measurement of welfare beyond the usual economic proxies.¹

We estimate the trend in height based on data for Swiss mercenaries, a very specific group of society. Our findings indicate that for this population, the decline in stature began before 1770, aligning with the trend observed in Austria-Hungary by Komlos (2009, Figure 2, p. 344). Compared to the 18th century, average heights remained lower throughout the first half of the 19th century, with no clear sign of recovery. We face two challenges posed by the type of data we analyze. First, our data are truncated to the left due to minimum height requirements, which varied across branches of service. In addition, recruiters often did not strictly enforce the height selection criteria. Hence, the truncation point needs to be estimated (Komlos, 2004), which, in our case, is done on a regiment-specific basis. Since there is not much overlap in terms of time coverage between the regiments, this also accounts for potential time variation in the minimum height requirement. The second challenge is that the decision to join a mercenary regiment potentially introduced a sample selection bias, independently of whether this decision was made by the individual or whether an authority forced the individual to join. When estimating the birthyear trend, we therefore control for the regiment, not only to capture differences in terms of branches of service or employers, but also to account for the specific situation around the measurement year. Failing to control for regiment would significantly overstate the decline in average height from the 18th to the 19th century.

Our paper relates to a large literature on the historical evolution of heights. A first strand of this literature studies the observed paradox between periods of economic growth during the industrialization and the relative decline in biological wellbeing. Because higher incomes enable improved nutrition and living conditions, one would expect a stable positive correlation between measures such as GDP per capita and height. However, there is ample evidence that this is not always the case: during the early stages of industrialization, average human height declined. Beginning with the work of Komlos (1985) on Austria-Hungary, the literature discusses this phenomenon in the European context as “Early Industrial Growth Puzzle” (Steckel, 2024, p. 1796).

Besides Austria-Hungary, a long list of Western European countries has been studied, including Belgium (Alter *et al.*, 2004), France (Komlos *et al.*, 2003), German regions (Baten, 2000; Ewert, 2006; Cinnirella, 2008a), Italy (A’Hearn, 2003), the Netherlands (Drukker and Tassenaar, 1997; Tassenaar, 2019), Portugal (Stolz *et al.*, 2013), Spain (Ramon-Muñoz

¹For overviews of the development of anthropometrics, and its strengths and pitfalls in measuring the evolution of living standards and wellbeing, see Steckel (1995, 2008a,b, 2024); Komlos (2008); Harris (2021).

and Ramon-Muñoz, 2016; Martinez-Carrión, 2016), Sweden (Sandberg and Steckel, 1987), and the United Kingdom (Komlos, 1993; Cinnirella, 2008b; Blum and McLaughlin, 2019). Building on these results, Baten and Blum (2012, 2014) compiled a global dataset of male height trends for cohorts born between 1810 and 1980. For Western Europe, they identify a decline from 1810 to 1840 (Baten and Blum, 2014, Figure 3, p. 154). Our analysis adds to this literature by providing a long-term height series for a sample of 22,000 Swiss mercenaries spanning c. 1725–c. 1865.

We are not the first to look at human stature in Switzerland. However, there is only limited evidence on the changes in the biological standard of living before the foundation of the federal state in 1848 and the implementation of mandatory military service. An early example is Edouard Mallet’s work from 1835 on Genevan conscripts born between 1805 and 1814 (Staub *et al.*, 2011). Due to the short time period, no trend can be established with Mallet’s data. The study by Kues (2007, Part II, pp. 45-73) on Swiss mercenaries in the British service covers birth cohorts 1816-1820 to 1831-1835. Kues (2007) finds a decrease in heights from the 1810s to the 1830s. More recently, Koepke *et al.* (2018) analyze the heights of convicts and passport holders. They show a decline in heights for male low socio-economic status (SES) passport holders born between 1770 and 1870. For high SES passport holders, the trend is less pronounced, while the height of male convicts born between 1800 and 1870 shows no clear trend. Our contribution lies in examining a distinct social group – Swiss mercenaries – whose characteristics shape both the methodological approach and the interpretation of results.

Because of the nature of our data, a second strand of the literature is relevant for us, discussing the caveats of using historical military data to study the changes in height over time. For instance, Bodenhorn *et al.* (2017) find that the decline in the height of voluntary military personnel during the early phase of the industrialization is attributed to a persistent sample selection bias induced by unobserved time-specific factors, e.g. due to the increasing number of alternative employment opportunities. The early industrial growth puzzle survives the critique (see the discussion in Komlos and A’Hearn, 2016; Zimran, 2019; Bodenhorn *et al.*, 2019). In our case, we have also to take into account the possibility that joining a regiment was not necessarily a voluntary decision – during the Napoleonic Wars, Switzerland was forced to contribute soldiers serving in the French army. In this case, selection bias could have been introduced by the decision of the authorities, not the individual.

On the demand side, the requirements to join a regiment might have changed over our observation period. Fourie *et al.* (2020) highlight how changes in military technology at the turn of the twentieth century increase the relative value of shorter individuals, which could lead to an overall decline in the mean height of soldiers. The standard weapon for the period under analysis was the muzzle-loading rifle with flintlock mechanism. Together with training improvements, such as those implemented in the Prussian army before 1740 (Weigley, 1991, p. 170), every innovation speeding up the loading procedure could in principle help to reduce the minimum height requirement. Examples for such innovations were the introduction of the paper cartridge (since about 1700; Ortenburg 1986, p. 66) or the steel ramrod (Prussia: 1718, Austria: 1742-44, France: 1745; Ortenburg 1986, p. 65). It was not before 1834 that European armies started to replace the flintlock with the percussion lock (Ortenburg, 1988, p. 48). These developments might have caused a reduction in the minimum height requirement, respectively a reduction in the strictness with which

this requirement had to be enforced. Especially relevant for us, the weakening of the requirement could have also been a solution to the resource problems during the Napoleonic Wars (Section 2).

2 Historical Background

2.1 Switzerland before 1848

Between 1750 and 1850, Switzerland experienced significant political transformations, leading to the adoption of a federal constitution and the establishment of the modern Swiss state in 1848.² Prior to the French invasion in 1798, Switzerland was a loose association of sovereign entities known as the Swiss Confederacy (*Alte Eidgenossenschaft*), with a weak central body, the Swiss Diet (*Tagsatzung*), which was effectively controlled by a local patriciate. In 1798, the Confederacy was replaced by the short-lived Helvetic Republic, a centralized state dominated by France. The constitution was an attempt to implement a modern state based on the principles of popular sovereignty, separation of powers, and legal equality. Internal trade barriers, tithes and the guild system were abolished. Widespread revolts against this new order were driven by a lack of general acceptance and the adverse effects of the French occupation. Napoleon's Act of Mediation in 1803 marked a partial return to the old Confederacy, retaining some successful elements of the Republic, although Switzerland remained a French protectorate. The Mediation regime ended in 1813, replaced by a new Charter in 1815, assigning the Diet new responsibilities, including foreign trade, military, and foreign relations. However, the Restoration period (1815-1830) was also a step backward, reintroducing internal trade barriers and the guild system. Growing opposition to this regime led to cantonal constitutional revisions and liberal reforms. The Regeneration period (1830-1848) was marked by a struggle between liberals and conservatives, often with a religious dimension, culminating in a civil war in 1847. The liberals' victory over the conservative cantons (*Sonderbund*) paved the way for the establishment of a federal state in 1848, with a constitution that balanced centralization with cantonal sovereignty. Switzerland was thus the only European country where the events of 1848 led to a successful outcome.

Switzerland is one of the earliest industrialized regions in Europe (Bairoch, 1982).³ The political changes mentioned above both shaped and resulted from the rapid economic development. Organized as a putting-out system, the main driving factor of proto-industrialization was the textile industry, benefiting from the expanding trade with France after the 1740s and peaking around 1750-1770. After 1770, the economic situation deteriorated starting with a subsistence crisis 1770/71, followed a drastic drop in the textile exports to France from 1785 onwards, and the arrival of cheap English textile products in 1790s.

The Swiss industrialization and mechanization process started slowly from 1800 until about 1850. During this first phase, the protection guaranteed by the Continental System of Napoleon helped the industry. After the war, an economic downturn followed 1816-1818,

²For the political development, see Church and Head (2013, Chapters 4, 5).

³For the economic situation, see also Bergier (1983, pp. 167-187), Pfister (1992, pp. 77-100), Church and Head (2013, Chapters 4, 5).

caused by a subsistence crisis (Kurmann, 2011) and the return of British competition. This resulted in widespread unemployment of textile workers, which persisted until the 1830s (Pfister, 1992, p. 99). The number of employed workers in the cotton industry declined by 60 per cent between 1780 and 1827 (Bergier, 1983, p. 209). In 1832, protest against the consequences of mechanization became violent, leading to the Uster Fire, the only reported incident of Luddism in Switzerland (Bürgi and Schmid 2013, Church and Head 2013, p. 148). When the pace of the industrialization accelerated after 1850, the economic situation improved again.

2.2 The Mercenary Trade

The economic development had an impact on the importance of the mercenary service, which has been a major economic factor in Switzerland during the Late Middle Ages and the Early Modern Period (Peyer, 1978). Swiss mercenaries were in high demand from the early 16th century, with France as the main employer. Their reputation built on the success of Swiss infantry in the military conflicts of that era (Church and Head, 2013, pp. 63-68). For a long time, the cantons played the role of the intermediary between the foreign employer and the military entrepreneur. In the period of interest, the Swiss mercenary service was a public undertaking. The motivation for the state to get involved was the considerable public income contribution and the vent-for-surplus function of the service.

In terms of numbers, Henry and Krauer (2023, Section 3) report estimates of 900,000 to two million soldiers fighting abroad in Swiss regiments between 1500 and 1850. Considering that the Swiss population in 1798 was 1,664,832 (Schuler, 2023, p. 56), these estimates seem very high. However, about half the individuals who served in these regiments were foreigners (Henry and Krauer, 2023, Section 3).

The introduction of standing armies in the 17th century brought changes, particularly in discipline and the extension of mandatory service, making enlistment less appealing. Additionally, the expansion of the textile industry created alternative employment opportunities, further reducing the pool of potential recruits and increasing the costs for recruiters to find soldiers who met the necessary criteria. As a result, enforcement of the minimum height requirement became more lenient.⁴

The base of the business was a contract, the *Kapitulation*. The foreign employer entered into an agreement with a single or multiple cantons, or the Federal Diet. The *Kapitulation* regulated the number of troops, their composition, the terms of the employment, and the recruitment requirements. The main military unit of a *Kapitulation* was the regiment, subdivided into battalions and companies, and consisted of about 1500 to 4000 soldiers.

A typical example for the recruitment procedure at the beginning of the 19th century can be found in the state archive of the canton Aargau (StAAG BA 09 0517). Most importantly, the procedure was highly regulated: there was an official recruitment commission in place (*Werb-Commission*) since 1804, which ensured compliance with the regulations, both on the cantonal and the state level (*Werb-Reglement* 1804; *Allgemein-Eidgenössisches Werb-Reglement* 1806; *Werb-Reglement für den Kanton Aargau* 1806). Recruitment without cantonal permission (“*Werb-Patent*”) was prohibited, and information on recruits had to

⁴As an example, see Eyer (2008, pp. 360-364) and Eyer (2010, p. 205) for a discussion of the increasingly difficult situation in the Neapolitan service.

be recorded. Recruits had to be 18-40 years old, and were supposed to join voluntarily and uncoerced (“*freiwillig und ungezwungen*”).

In general, the recruitment process was similar across time and cantons. Recruiters were often soldiers from the regiments they recruited for. They were supported by civil agents, which could be family, friends, or public officials. Traditionally, the recruiters, wearing their unit’s uniform and joined by drummers to announce themselves, passed through towns and then set up at the *Werbeplatz*, where they received the interested men. These men were measured and enlisted if they met the requirements. Measurement was without shoes, and both prest money (enlistment bonus) and payment for the recruiter depended on the height of the recruits. The men were then transported in large groups to the regimental barracks, located in the countries for which they had enlisted. There, the final decision regarding their approval was made by military officials.⁵

The *Kapitulation* defined overall height requirements that the recruiters had to adhere to. A sample of 14 contracts in the period 1757-1825 shows that the general requirements varied across regiments, with a minimum of 162.4cm and a maximum of 167.8cm for “normal” soldiers (see Table 8 in the appendix). As elite troops, the *Gardes Suisses* in 1764 and the *Cent Suisses* in 1816 were supposed to be taller (173.2cm and 184.1cm, respectively). Moreover, even within a regiment, the requirements varied dependent on the branch of service. For example, the *Kapitulation* with France in 1812 states that for *fuseliers*, a minimum height of 167.8cm applied, while *voltigeurs* (skirmish units) had to be at least 154.3cm tall (Burin de Rozières, 1902, p. 252). Sometimes, other exceptions were made for age (recruits aged 16-20 years could be smaller), war time (reduction of height requirement by one inch), and specific duties, such as drummers.

Since in the period 1798-1815, the specific situation of the Napoleonic Wars made recruitment even more difficult, the cantons and the state had to come up with solutions going beyond advertisement. The 1803 *Kapitulation* with France required Switzerland to contribute 16’000 soldiers aged 18-40 years to Napoleon’s army.⁶ Each canton was obliged to provide a proportional share based on its population size. The fact that the actual formation of the four regiments took until 1805 (1st Regiment) respectively 1806-1807 (2nd, 3rd and 4th Regiment) is due to the difficulty to find enough native Swiss volunteers, which Napoleon apparently insisted on (Dempsey, 2002, p. 277). Difficult excess demand situations and budget constraints provided incentives for the recruiters to embark on illegal practices (e.g. Suter, 1971, pp. 44-49, 124-128). The actual extent of these practices remains unclear, but more importantly, it also motivated the authorities to adjust the official recruitment process, legally abandoning the principle of voluntariness.

Again, the above mentioned source from the state archive of Aargau can serve as a typical example for local solution attempts. To meet the quota, the canton tried first to grant bonus payments (December 12, 1808). That did not work, as a letter from the cantonal government to the bailiff of the district of Rheinfelden shows (December 17, 1812). The suggestion was to allow petty criminals the choice between enlistment and sentence.

⁵See Suter (1971, Chapter 4) for a description of the typical process in Central Switzerland. Another example for the procedure is a *Kapitulation* between Switzerland and Spain in 1804, where it was agreed on a minimum height requirement varying with age slightly, and a minimum share of Swiss recruits. Measurement was without shoes, and the service was supposed to be voluntary (Canton de Fribourg, 1804, pp. 238-239).

⁶*Militär-Kapitulation zwischen Frankreich und der Schweiz*; see Roucard (2006) for a discussion.

The predicted consequence was that the quota would be met. As additional benefit, a reduction of the number of petty crimes was expected, because potential offenders would be sent away to fight for France. In the end, the decision of the cantonal government was that in general, recruits should join voluntarily. If there were not enough recruits, forced recruitment of swindlers, gamblers, drunkards and thugs should be attempted. In addition, forced recruitment could also be applied to individuals with undisciplined conduct, unmarried or negligent fathers, and those opposing recruitment or spreading disturbing rumors (January 19, 1813).

Desertion was a serious problem in the 18th and early 19th century. For the Seven Years' War (1756-1763), it is estimated that the European armies lost about 20 per cent per year due to disease and desertion, not counting the soldiers killed in action (Dziennik, 2024, p. 19). This was also the case for the Swiss regiments: in his study of the Aargau mercenaries in the Bernese regiments in the Netherlands, France and Sardinia, Pfister (1980, 1984) reports average annual deserters' shares of 6 to 10 per cent. The maxima range from 16 to 32 per cent (Table 1).⁷

Table 1: Annual Deserters' Shares from Bernese Regiments

	Period	Average (%)	Minimum (%)	Maximum (%)
Netherlands	1701-1796	5.93	1.39	16.15
France	1702-1791	5.60	0.79	20.05
Sardinia	1738-1797	9.99	2.08	32.02

Source: Pfister (1980, Tables 1, 2, pp. 271-274; 1984, Table 1, pp. 344-345)

Besides the hardship of the military service abroad, an important motive for soldiers who decided to desert was forced re-enlistment because of debts to the regiment (Pfister, 1984, pp. 84-85). Moreover, there was also the possibility of attempting to re-enlist in another regiment under a different name and receive the prest money multiple times (de Weck, 2006, Section 1).

3 Data

Due to the authorities' efforts to gain greater control over the trade, a substantial body of archival sources on mercenary service in Switzerland has been preserved, particularly from the 18th century onward. These administrative records, created as part of this oversight, offer detailed information on individual recruits, most notably in the form of regimental lists (Hitz, 2015, p. 31). Our primary sources are lists compiled during recruitment from 1750 to 1884 for 24 regiments (including the *Helvetische Legion*, see the discussion below). The data on the regiments *Eptingue*, *Courten* and the *Niederländische Ostindienkompanie* are from secondary sources.⁸ The preliminary figures provided by Foerster (2010, p. 248,

⁷In their analysis of a mercenary company from the canton of Valais, Fayard Duchêne and de Riedmatten (1997, pp. 123-138) provide a detailed discussion of the dynamics of desertion. In 1793, the desertion rate in this specific company was as high as 35.57% (Fayard Duchêne and de Riedmatten, 1997, p. 124).

⁸Bregnard (1996), Fayard Duchêne and de Riedmatten (1997), Gally-de Riedmatten (2014), Krauer (2024). A detailed list of sources can be found in Table 9 in Appendix D.

250) in Table 7 (Appendix C) show that we cover a substantial part of the total number of regiments.

The lists include data on the regiment, recruit’s name, municipality or canton of origin, age or date of birth, enlistment date, and height at enlistment. In some lists, occupation is included, but information on rank and type of soldier (grenadier, fusilier, etc.) is not frequently enough reported to be useful for our analysis. The sources cover lists from six employers: France, the Netherlands (the Dutch Republic and the Kingdom of Holland), the United Kingdom, the Kingdom of the Two Sicilies (Sicily and Naples), the Kingdom of Sardinia, and the Helvetic Republic. The height of the mercenaries was measured in feet (French, Rhinelandic, British), Piedmontese *onces*, and occasionally in centimeters. To ensure comparability for the statistical analysis, we convert the data to centimeters.⁹

We include the individuals serving in the standing army of the Helvetic Republic, not the militia troops. These soldiers were not mercenaries in the traditional sense – volunteers hired to fight for a foreign employer (Rogger and Hitz, 2014, pp. 30-33). However, this definition has been challenged. Sikora (2003) argues that domestic recruitment was also significant for the standing armies of the 17th and 18th centuries and suggests that the defining characteristic should be voluntariness. By including soldiers recruited for the standing army of the Helvetic Republic, we align with Sikora’s broader definition of mercenary service in the sense of voluntariness as formal requirement. At the same time, we note that in praxis, the degree of voluntariness varied over time, especially at the end of the Napoleonic Wars, as we discussed in Section 2.

We exclude mercenaries born abroad, focusing instead on those who were “Swiss”. Although the modern Swiss Confederation was not established until 1848, this is not an ahistorical approach. Most employers placed great importance on quotas specifying how many recruits should be “Swiss”, a term that roughly referred to a territory matching today’s borders, established in 1815 (Section 2). For the sake of simplicity, we have assigned municipalities of origin to their corresponding modern cantons. The main difference is that we merged the cantons Jura and Berne.

We start with about 37,000 individuals and remove incomplete records. It is also possible that the same individual was recorded multiple times in the raw data. In Section 2, we discussed the likelihood of deserters re-enlisting under false identities to obtain the enlistment bonus more than once. However, legal re-enlistment also presents a possibility. While deserters likely re-enlisted under false identities and can only be detected if they were found out and remarked on in the source, we address the issue of legal re-enlistment by implementing a simple routine. We classify a pair of observations as a “double entry” if it meets three criteria: (1) 80 percent of the characters in the surname and birthplace/canton match, (2) the individuals share the same birth year, and (3) the difference in height (cm) is 2 cm or less. For each such pair, one observation is excluded from the analysis (522 individuals). In total, the cleaning process (removing incomplete records, removing duplicates) reduces the final sample size to 21,782.

Table 2 shows the descriptive statistics for these individuals by regiment, together with employer and measurement/birth periods. We do not have a regiment covering the entire period, both in terms of birthyears and entry years (Figure 1). Note that in Table 2, we

⁹Units: 1 foot = 12 inches = 144 lines. Conversion factors (cm): 0.2255829 (French lines), 0.2179538 (Rhinelandic lines), 0.212 (British lines), Twelve Piedmontese *onces* = 1 Turin foot, which is equal to 0.51377m (Gally-de Riedmatten, 2014, p. 304).

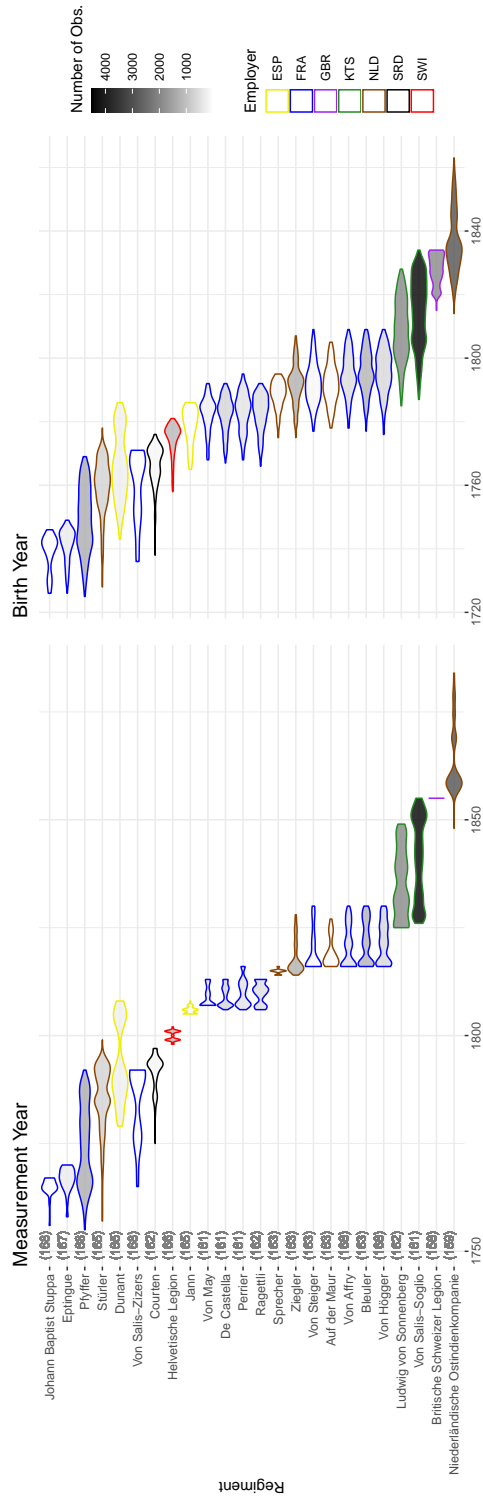
present unconditional moments: because of the truncation problem, the raw means are too high, and the standard deviations too low. The regional distribution and the distribution across occupational categories are displayed in Tables 3 and 4. Table 3 shows that our data are clearly not representative in terms of regional coverage. The same can be said about occupational categories (Table 4). The fact that the share of skilled workers is so high might reflect the vulnerability of this group with respect to fluctuations in overall economic activity and hence, the dependence on alternative employment opportunities.

Table 2: Summary Statistics (Height) by Regiment

Regiment	Employer	Period		Age		Height					N	%
		Measurement	Birth	AV		AV	MED	SD	MIN	MAX		
Johann Baptist Stuppa	FRA	1756 - 1767	1726 - 1746	26		173.68	173.70	4.25	164.45	182.27	43	0.20
Eptingue	FRA	1758 - 1770	1726 - 1749	25		172.74	172.07	4.27	163.72	187.40	347	1.59
Plyffer	FRA	1755 - 1792	1725 - 1769	25		172.85	172.35	4.87	161.29	191.52	1347	6.18
Von Salis-Zizers	FRA	1765 - 1792	1736 - 1771	25		174.15	174.04	4.68	162.42	184.08	54	0.25
Courten	SRD	1775 - 1797	1738 - 1776	25		166.30	165.90	5.45	153.06	184.10	171	0.79
Stürler	NLD	1757 - 1799	1728 - 1778	26		169.43	168.26	5.16	156.93	185.91	727	3.34
Helvetische Legion	SWI	1798 - 1802	1758 - 1781	25		171.34	170.54	5.14	154.30	197.61	1165	5.35
Dunant	ESP	1779 - 1808	1743 - 1786	27		171.19	170.54	4.59	155.65	186.78	293	1.35
Jann	ESP	1805 - 1808	1765 - 1786	27		171.11	170.54	4.63	162.42	182.72	79	0.36
Ragettli	FRA	1806 - 1813	1766 - 1792	27		168.78	167.83	5.50	154.30	186.78	544	2.50
De Castella	FRA	1806 - 1813	1767 - 1792	27		168.18	167.83	5.85	154.30	198.96	706	3.24
Von May	FRA	1807 - 1813	1768 - 1792	26		167.37	166.71	5.73	154.52	183.17	281	1.29
Perrier	FRA	1806 - 1816	1768 - 1795	27		168.80	168.28	5.93	151.59	188.14	457	2.10
Sprecher	NLD	1814 - 1816	1775 - 1795	26		168.28	167.39	5.01	156.93	183.08	163	0.75
Auf der Maur	NLD	1816 - 1827	1778 - 1805	27		169.63	168.70	5.33	156.93	187.00	111	0.51
Ziegler	NLD	1814 - 1828	1775 - 1807	26		168.44	167.39	5.23	154.31	201.17	1294	5.94
Von Högger	FRA	1816 - 1830	1776 - 1809	26		172.85	171.89	4.10	162.42	189.49	645	2.96
Bleuler	FRA	1816 - 1830	1777 - 1809	26		167.98	167.16	4.35	157.01	189.49	1227	5.63
Von Steiger	FRA	1816 - 1830	1777 - 1809	27		168.75	167.83	4.39	162.42	188.14	148	0.68
Von Affry	FRA	1816 - 1830	1778 - 1809	26		172.30	171.78	4.09	162.42	189.49	592	2.72
Ludwig von Sonnenberg	KTS	1825 - 1849	1785 - 1828	26		170.14	169.64	5.16	157.01	193.55	1955	8.98
Von Salis-Soglio	KTS	1826 - 1855	1787 - 1834	26		169.40	168.51	5.38	152.95	200.32	4515	20.73
Britische Schweizer Legion	GBR	1855 - 1855	1815 - 1834	27		167.50	167.27	5.61	152.64	189.53	1964	9.02
Niederländische Ostindienkompanie	NLD	1848 - 1884	1814 - 1863	27		167.12	167.00	5.65	151.00	195.00	2954	13.56
Total:											21782	

AV: average, MED: median, SD: standard deviation, N: number of mercenaries; SWI: Swiss, ESP: Spain, FRA: France, GBR: United Kingdom, KTS: Kingdom of the Two Sicilies, NLD: Netherlands, SRD: Sardinia.

Figure 1: Coverage by Regiment



Fill color: number of observations; border color: employer (Swiss (SWI), Spain (ESP), French (FRA), Great Britain (GBR), Kingdom of the Two Sicilies (KTS), Dutch (NLD) or Sardinian (SRD)). The number in brackets on the right of the regiment name is the estimated truncation point (see Section 4 for details).

Table 3: Regional Coverage

Canton	Observations		Merc.	% Merc.	Ratio
	Population	% Pop.			
ZG	12,487	0.74	367	1.68	2.27
BS	16,934	1.00	474	2.18	2.18
TG	70,862	4.18	1,880	8.63	2.06
BL	29,108	1.72	699	3.21	1.87
VS	60,444	3.56	1,424	6.54	1.84
SG	129,533	7.64	2,941	13.50	1.77
SH	23,318	1.37	525	2.41	1.76
SZ	34,232	2.02	743	3.41	1.69
LU	91,124	5.37	1,872	8.59	1.60
AR	38,197	2.25	689	3.16	1.40
GR	72,903	4.30	941	4.32	1.00
AI	9,355	0.55	116	0.53	0.96
AG	125,669	7.41	1,521	6.98	0.94
SO	45,840	2.70	545	2.50	0.93
NW	8,496	0.50	95	0.44	0.88
GL	22,809	1.34	251	1.15	0.86
ZH	179,801	10.60	1,746	8.02	0.76
FR	66,298	3.91	603	2.77	0.71
GE	46,436	2.74	378	1.74	0.64
BE	308,057	18.16	2,258	10.37	0.57
VD	144,711	8.53	1,033	4.74	0.56
OW	10,580	0.62	73	0.34	0.55
UR	11,843	0.70	69	0.32	0.46
NE	46,615	2.75	240	1.10	0.40
TI	90,309	5.32	299	1.37	0.26
Total:	1,695,961		21,782		

The population data comes from the 1798 census (hssso.ch, Table B.01a). Columns 3 and 5 show the percentage shares of the population and mercenaries relative to the total. The ratio (% Mercenaries / % Population, last column) indicates over-/underrepresentation by the mercenary sample.

Table 4: Age, Height and Occupational Shares

SEP	Age	Height					N	%
	AV	AV	MED	SD	MIN	MAX		
1	26	170.16	169.84	6.00	159.64	186.78	86	0.39
2	27	169.86	169.19	6.37	157.01	200.32	180	0.83
3	26	168.95	168.54	5.45	152.64	201.17	5404	24.81
4	25	169.89	169.19	5.15	151.59	189.49	1212	5.56
5	27	168.35	167.90	5.66	154.55	189.49	1212	5.56
6	26	169.49	169.19	5.56	151.00	197.61	13688	62.84
Total:							21782	

Note: The occupational categories are based on HISCLASS 5, with 1: elite; 2: lower middle class; 3: skilled workers; 4: self-employed farmers and fishermen; 5: unskilled workers and farm workers; category 6 is for missing values.

4 Method

In estimating the birth period effect accurately, we face two major challenges. The first challenge is due to the variation of the recruitment process across regiments and across time. This is potentially also the case for the motivation to join a regiment, introducing a selection bias. In order to identify this bias, we need to control for regiments and/or the situation in the measurement period. In our baseline model (Section 4.1), we use the fact that the measurement periods covered by the regiments are only partially overlapping to capture a combined measurement period/regiment effect. In the robustness checks discussed in Appendix A, we disentangle the two effects as far as it is possible.

The second challenge is caused by the minimum height requirement: historical heights from military records usually suffer from left-truncation and heaping. To tackle the truncation problem, we apply an extension of the Heintel (1996) method, assuming that truncation is regiment specific (Section 4.2).

4.1 Main Model

Our starting point is the following linear regression for individual heights h_i

$$\begin{aligned}
 h_i = & \mu + \sum_{a=1}^{A-1} \alpha_a \mathcal{A}_{i,a} + \sum_{b=1}^{B-1} \beta_b \mathcal{B}_{i,b} + \sum_{r=2}^R \pi_r \mathcal{R}_{i,r} + \\
 & + \sum_{c=2}^C \psi_c \mathcal{C}_{i,c} + \sum_{o=1}^O \omega_o \mathcal{O}_{i,o} + \kappa \mathcal{T}_i + u_i ,
 \end{aligned} \tag{1}$$

where the u_i are identically and independently Gaussian distributed across mercenaries with expectation zero and variance σ^2 . The variables $\mathcal{A}_{i,a}$, $\mathcal{B}_{i,b}$, $\mathcal{R}_{i,r}$, $\mathcal{C}_{i,c}$ and $\mathcal{O}_{i,o}$ are age, birth period, regiment, canton and occupation specific dummies. Finally, \mathcal{T}_i represents a region and year specific temperature anomaly (Swiss Plateau: Wetter and Pfister 2013, Swiss Alps: Trachsel *et al.* 2010). Table 5 displays a detailed list of all the included variables.

Table 5: List of Variables

Variable	Description
Age	Separate dummies for ages 21 and 22. The age group 23-40 represents the reference group.
Birth period	Dummies in steps of 5 years from 1725-1864. The reference cohort is 1860-1864.
Regiment	Regiment specific dummy variables, the reference regiment is <i>Pfyffer</i> .
Canton	Canton specific dummy variables. Luzern is the reference canton. Note: BE and JU are merged.
Occupation	Dummies for the 6 occupation groups. 1-5 are according to HISCLASS 5, 6 is unspecified. The reference group is 3.
Temperature anomaly	Region and year specific temperature anomalies.

In more compact form, equation (1) can be written as

$$h_i = \mathbf{x}_i^\top \boldsymbol{\theta} + u_i, \quad (1')$$

where

$$\boldsymbol{\theta} := \left(\mu, (\alpha_a)_{a=1}^{A-1}, (\beta_b)_{b=1}^{B-1}, (\pi_r)_{r=2}^R, (\psi_c)_{c=2}^C, (\omega_o)_{o=2}^O, \kappa \right)^\top$$

is the vector of the p regression coefficients, and

$$\mathbf{x}_i^\top := \left(1, (\mathcal{A}_{i,a})_{a=1}^{A-1}, (\mathcal{B}_{i,b})_{b=1}^{B-1}, (\mathcal{R}_{i,r})_{r=2}^R, (\mathcal{C}_{i,c})_{c=2}^C, (\mathcal{O}_{i,o})_{o=2}^O, \mathcal{T}_i \right)$$

the vector of covariates.

4.2 Parameter Estimation

To tackle the truncation problem, we apply an extension of the [Heintel \(1996\)](#) method, assuming that truncation is regiment specific (see the discussion in [Komlos, 2004](#)). Each individual i is recruited into a regiment $l, l = 1, \dots, L$, with regiment specific minimum height requirement $a^{(l)}$. For reasons discussed above, this truncation point is not necessarily equal to the minimum height of recruits in a specific regiment l . But if it was known, we could simply drop the recruits smaller than required. In this case, the set of selected recruits is

$$S := \{i = 1, \dots, N : h_i \geq a_i\},$$

where a_i , the minimum height requirement relevant for individual i , is determined by the recruit's regiment:

$$a_i := a^{(l)} \quad \forall i \in \text{Reg}_l, \quad l = 1, \dots, L.$$

The set Reg_l holds the indices of recruits in the l^{th} regiment. Since the regiment specific truncation point $a^{(l)}$ is unknown (Section 1), we estimate the parameters a_i and $\boldsymbol{\theta}$ in a two-step procedure.

Step 1 The truncation parameters are estimated applying a modified version of the method proposed by Heintel (1996). For each regiment l and a grid of equally spaced candidate points

$$h \in \mathcal{U}_l := \{h_{l,\min}, h_{l,\min} + s, h_{l,\min} + 2s, \dots, h_{l,\max} - s\}, \quad (2)$$

where $h_{l,\min} := \min(\{h_i\}_{i \in \text{Reg}_l})$, $h_{l,\max} := \max(\{h_i\}_{i \in \text{Reg}_l})$ and $s > 0$, we estimate the unconditional regiment specific density f_l from the observed heights as

$$\hat{f}_{N_l}(h) := \frac{1}{\tau_{N_l} N_l} \sum_{i \in \text{Reg}_l} K\left(\frac{h - h_i}{\tau_{N_l}}\right). \quad (3)$$

Because of the heaping problem, we slightly deviate from Heintel (1996) by specifying $K(\cdot)$ as triweight smoothing kernel based on the beta(4,4) density. We choose the oversmoothed bandwidth selector of Wand and Jones (1994, p. 61) for τ_{N_l} . The estimated truncation parameter is the candidate point where the difference in density estimates is maximal:

$$\hat{a}^{(l)} := \arg \max_{h \in \mathcal{U}_l} \hat{f}_{N_l}(h) - \hat{f}_{N_l}(h + s). \quad (4)$$

Step 2 Given the estimated truncation parameters, the regression coefficients of equation (1') are estimated through maximum likelihood (ML). Assuming the distribution function of u_i belongs to the location-scale family, the log-likelihood, given the data and the estimated truncation parameter, is given by

$$\begin{aligned} \ell(\tilde{\boldsymbol{\theta}}, \tilde{\sigma} \mid \{h_i, \mathbf{x}_i, \hat{a}_i\}_{i \in \hat{S}}) := & \sum_{i \in \hat{S}} \left[\log \left(f \left(\frac{h_i - \mathbf{x}_i^\top \tilde{\boldsymbol{\theta}}}{\tilde{\sigma}} \right) \right) - \log(\tilde{\sigma}) - \right. \\ & \left. - \log \left(1 - F_{\mathbf{x}_i^\top \tilde{\boldsymbol{\theta}}, \tilde{\sigma}}(\hat{a}_i) \right) \right], \end{aligned} \quad (5)$$

where f is the probability density function and F the cumulative distribution function. The set \hat{S} is the set of selected recruits determined by the estimated truncation points $\hat{a}_i = \hat{a}^{(l)} \quad \forall i \in \text{Reg}_l, \quad l = 1, \dots, L$. For the ML-estimates we obtain

$$\hat{\boldsymbol{\eta}} = (\hat{\boldsymbol{\theta}}^\top, \hat{\sigma})^\top := \arg \max_{\tilde{\boldsymbol{\theta}}, \tilde{\sigma}} \ell(\tilde{\boldsymbol{\theta}}, \tilde{\sigma} \mid \{h_i, \mathbf{x}_i, \hat{a}_i\}_{i \in \hat{S}}). \quad (6)$$

Expression (6) generally has no closed form solution and is solved numerically.¹⁰

Based on the parameter estimates, we calculate the height trend for a representative individual using

$$\hat{h}_b := \hat{\beta}_b + \hat{\boldsymbol{\theta}}_{-\text{Birth}}^\top \bar{\mathbf{x}}_{-\text{Birth}} , \quad (7)$$

where $\hat{\boldsymbol{\theta}}_{-\text{Birth}}$ are the estimated regression coefficients without the estimated birth period effects and $\bar{\mathbf{x}}_{-\text{Birth}}$ are the variable specific averages without the birth period dummies.

Finally, we calculate the difference of the average estimated birth period effects before 1800 ($\bar{\beta}^{<1800}$) and after 1800 ($\bar{\beta}^{\geq 1800}$):

$$\hat{\Delta} := \bar{\beta}^{<1800} - \bar{\beta}^{\geq 1800} . \quad (8)$$

4.3 Construction of Confidence Intervals

Because estimating the truncation parameter in the first step produces an additional layer of uncertainty, we can not construct classical confidence intervals via the inverse of the Hessian matrix of the log-likelihood. In addition, the heaped nature of the height observations invalidates classical inference. Therefore we use a non-parametric bootstrap to construct symmetric confidence intervals.

Let

$$\hat{\xi} \in \{\hat{\theta}_1, \dots, \hat{\theta}_p, \hat{h}_1, \dots, \hat{h}_B, \hat{\Delta}\} ,$$

i.e. $\hat{\xi}$ represents either the j th estimated regression coefficient $\hat{\theta}_j, j = 1, \dots, p$, the b th estimated trend parameter $\hat{h}_b, b = 1, \dots, B$ or the estimated trend difference $\hat{\Delta}$. Similarly,

$$\hat{\xi}_w^* \in \{\hat{\theta}_{w,1}^*, \dots, \hat{\theta}_{w,p}^*, \hat{h}_{w,1}^*, \dots, \hat{h}_{w,B}^*, \hat{\Delta}_w^*\}$$

is either the j th estimated regression coefficient, the b th estimated trend parameter or the estimated trend difference from the w th bootstrap sample, $w = 1, \dots, W$. With $\omega_w^* := |\hat{\xi}_w^* - \hat{\xi}|$, the resulting $(1 - \alpha)\%$ bootstrap confidence interval for ξ is given by

$$CI_{(1-\alpha)\%}(\xi) := \left[\hat{\xi} \pm c^*(1 - \alpha) \right] , \quad (9)$$

where $c^*(\lambda)$ denotes the λ quantile of the empirical distribution of $\{\omega_w^*\}_{w=1}^W$. We set $W = 10,000$ and $\alpha = 0.05$.

¹⁰We apply the Broyden–Fletcher–Goldfarb–Shanno (BFGS) algorithm. For a more detailed discussion of truncated linear regression models see Hayashi (2011, Chapter 8.2).

5 Results

In some of the smaller cantons, manufactures have been introduced, which, by furnishing a greater quantity of employment, and at the same time a greater quantity of exports for the purchase of corn, have of course considerably increased their population. But the Swiss writers seem generally to agree, that the districts where they have been established, have upon the whole suffered in point of health, morals and happiness.

Malthus (1803, p. 280)

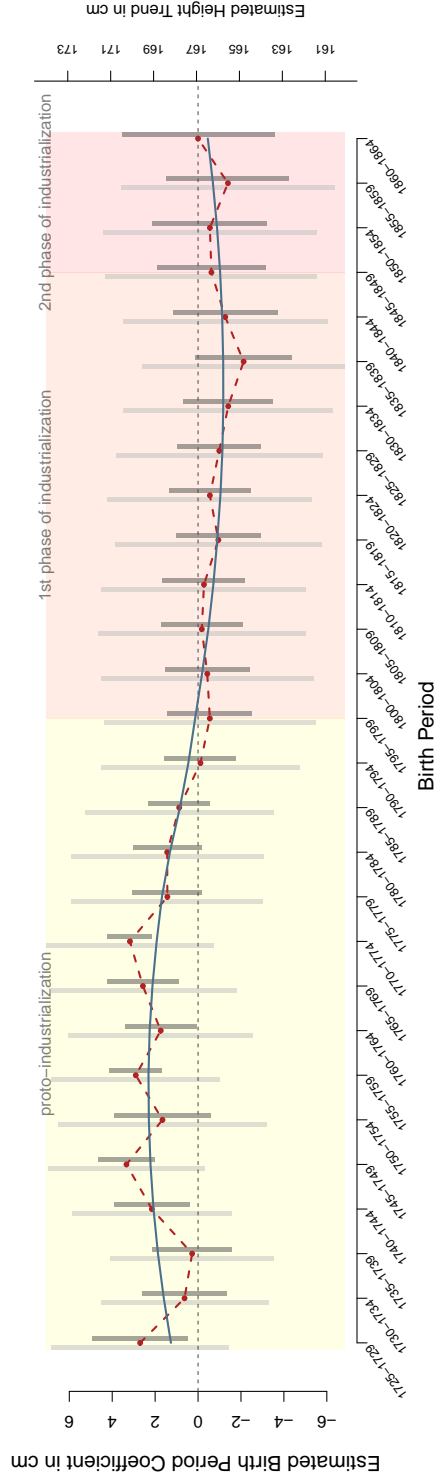
In the second edition of his *Principle of Population* published in 1803, Malthus considerably extended the empirical part in support of his ideas about population dynamics. Among material on other European countries, Book II contains a chapter “Of the Checks to Population in Switzerland” (Malthus, 1803, Book II, Chapter V). The chapter is based on contemporary literature on Swiss demography, but also on his own experiences from travelling the country in 1802 (James, 1979, p. 96-98). In the paragraph quoted above, Malthus stresses the adverse effect of increasing economic activity during the early stages of industrialization on public health.

As far as health is concerned, our main result displayed in Figure 2 support the view of the “Swiss writers” mentioned by Malthus, not just for “some smaller cantons”, but more general for the social group represented by the mercenaries. The height trend calculated based on equation (7) shows a significant decline in heights until 1795-99.¹¹ The point estimates show a continuation of the decline during the difficult first phase of industrialization. However, the effects for the first half of the 19th century are only very imprecisely measured. What we can say is that compared to the situation in the 18th century, heights were lower and stayed at this lower level until the end of our observation period. As the sensitivity analysis in Appendix A shows, the result is robust with respect to changes in the set of control variables and/or estimation techniques.

Turning to the partial birth periods effects in Figure 2, and Table 6, we see that the confidence intervals include zero for all periods. To test whether there is an overall trend, we calculate the difference between the average estimated birth period effects before 1800 and after 1800 (equation 8). This difference is 2.51cm, with 95%-confidence interval [0.63cm, 4.39cm]. We therefore conclude that there is a significant difference between average height in the second half of the 18th century compared to the first half of the 19th century.

¹¹The underlying parameters can be found in Table 6.

Figure 2: Estimated Birth Cohort Effects (Equation 1)



The reference birth period is 1860-1864. The confidence intervals are estimated as described in Section 4.3 (dark gray bars: birth cohort effects; light gray bars: height trend). The blue curve is generated applying a loess smoother to the estimated birth cohort effects. The vertical axis on the right represents the estimated birth cohort effect plus the average effect of all the control variables (equation 7).

Table 6: Estimated Parameters of Model (1)

Variable	Coeff.	Boot CI	Variable cont.	Coeff.	Boot CI
Intercept	167.23	[162.24, 172.21]	Canton OW	0.79	[−1.10, 2.69]
1725-1729	2.70	[−1.43, 6.83]	Canton SG	−0.08	[−0.60, 0.43]
1730-1734	0.63	[−3.26, 4.52]	Canton SH	0.35	[−0.43, 1.12]
1735-1739	0.28	[−3.53, 4.08]	Canton SO	1.48	[0.16, 2.80]
1740-1744	2.15	[−1.55, 5.86]	Canton SZ	0.57	[−0.22, 1.36]
1745-1749	3.34	[−0.32, 6.99]	Canton TG	0.78	[0.19, 1.38]
1750-1754	1.66	[−3.19, 6.51]	Canton TI	1.43	[0.22, 2.63]
1755-1759	2.90	[−1.01, 6.82]	Canton UR	−0.35	[−2.26, 1.56]
1760-1764	1.74	[−2.57, 6.04]	Canton VD	2.29	[1.34, 3.24]
1765-1769	2.57	[−1.81, 6.95]	Canton VS	−0.58	[−1.29, 0.13]
1770-1774	3.17	[−0.72, 7.07]	Canton ZG	1.29	[0.01, 2.57]
1775-1779	1.43	[−3.03, 5.89]	Canton ZH	0.26	[−0.38, 0.89]
1780-1784	1.44	[−3.04, 5.92]	Johann Baptist Stuppa	1.32	[−0.80, 3.44]
1785-1789	0.88	[−3.52, 5.27]	Eptingue	−1.22	[−3.01, 0.58]
1790-1794	−0.11	[−4.75, 4.52]	Von Salis-Zizers	0.83	[−0.74, 2.41]
1795-1799	−0.55	[−5.48, 4.38]	Courten	−5.22	[−8.72, −1.72]
1800-1804	−0.43	[−5.38, 4.52]	Stürler	−3.43	[−5.01, −1.85]
1805-1809	−0.18	[−5.02, 4.66]	Helvetische Legion	−1.54	[−3.42, 0.35]
1810-1814	−0.28	[−5.04, 4.49]	Dunant	−2.52	[−3.65, −1.38]
1815-1819	−0.95	[−5.76, 3.87]	Jann	−1.99	[−4.19, 0.22]
1820-1824	−0.55	[−5.33, 4.23]	Ragetti	−1.87	[−5.37, 1.63]
1825-1829	−0.99	[−5.80, 3.82]	De Castella	−2.20	[−6.03, 1.64]
1830-1834	−1.41	[−6.28, 3.47]	Von May	−2.94	[−6.90, 1.02]
1835-1839	−2.12	[−6.85, 2.60]	Perrier	−1.10	[−5.08, 2.88]
1840-1844	−1.27	[−6.03, 3.49]	Sprecher	−2.43	[−5.78, 0.92]
1845-1849	−0.62	[−5.55, 4.31]	Auf der Maur	−1.60	[−5.27, 2.07]
1850-1854	−0.55	[−5.53, 4.43]	Ziegler	−1.86	[−5.35, 1.64]
1855-1859	−1.39	[−6.36, 3.57]	Von Högger	−0.21	[−2.54, 2.11]
Age 21	−1.45	[−2.03, −0.87]	Bleuler	−3.35	[−7.02, 0.31]
Age 22	−0.78	[−1.13, −0.42]	Von Steiger	−4.18	[−7.06, −1.30]
Canton AG	0.26	[−0.32, 0.83]	Von Affry	−0.16	[−1.99, 1.67]
Canton AI	0.70	[−1.13, 2.53]	Ludwig von Sonnenberg	0.61	[−3.48, 4.70]
Canton AR	−1.43	[−2.30, −0.56]	Von Salis-Soglio	−0.33	[−4.56, 3.91]
Canton BE	0.96	[0.44, 1.49]	Britische Schweizer Legion	−0.45	[−4.74, 3.85]
Canton BL	0.19	[−0.53, 0.91]	Niederländische Ostindienkompanie	−1.31	[−5.49, 2.86]
Canton BS	0.74	[−0.24, 1.72]	SEP 1	1.77	[0.05, 3.49]
Canton FR	1.49	[0.52, 2.47]	SEP 2	1.31	[−0.16, 2.77]
Canton GE	1.71	[0.63, 2.79]	SEP 4	−0.36	[−1.08, 0.35]
Canton GL	0.23	[−0.83, 1.30]	SEP 5	0.32	[−0.24, 0.89]
Canton GR	1.24	[0.46, 2.02]	SEP 6	0.82	[0.30, 1.35]
Canton NE	0.70	[−0.36, 1.75]	Temperature anomaly	0.02	[−0.16, 0.20]
Canton NW	2.12	[0.30, 3.94]	σ	6.56	[5.87, 7.25]

Rows 1725-1729, ..., 1855-1859: birth periods; rows Johann Baptist Stupa, ..., Niederländische Ostindienkompanie: regiments. Reference groups: birth period 1860-1864, age ≥ 23 , canton LU, regiment Pfyffer and SEP 3. The bootstrap confidence intervals are calculated as described in Section 4.3.

Komlos (2009, p. 344-348) summarizes the literature on Europe’s “Early Industrial Growth Puzzle”. During this period, rapid population growth combined with sluggish technological progress in agriculture resulted in a decline in living standards. Unlike the 17th century, however, these challenges did not culminate in a severe subsistence crisis, largely due to the improved economic conditions brought about by early industrialization. However, the development led to a decline in the biological standard of living reflected in a reduction of average human stature. In 18th-century Switzerland, the population grew by approximately 40 per cent, increasing from an estimated 1,200,000 in 1690 to 1,695,961 in 1798 (hssso.ch, Table B.01a). This growth was primarily driven by demographic changes in protoindustrial regions, where higher fertility rates, earlier marriages, and reduced mobility of young males – now able to find work locally – contributed to the population increase (Head-König, 2012, Section 5). At the same time, technological progress in agriculture was slow, despite the effort of learned societies to disseminate knowledge about techniques to improve productivity.¹² Because of the slow technological progress in agriculture, the relative price of nutrients increased.

In addition, Komlos (2009, p. 344-348) mentions the stress caused by the transformation of the economic system as a negative influence on the biological standard of living. In addition, the increasing degree of commercialization might have played a role: The reduction of subsistence farming led to increasing vulnerability with respect to short-run economic fluctuations.¹³ And, of course, the period is characterized by a series of adverse exogenous shocks, such as the Napoleonic wars or the climate related hunger crises in 1770/71 (e.g. Collet, 2019) and 1816/17 (e.g. Frommelt *et al.*, 2017).

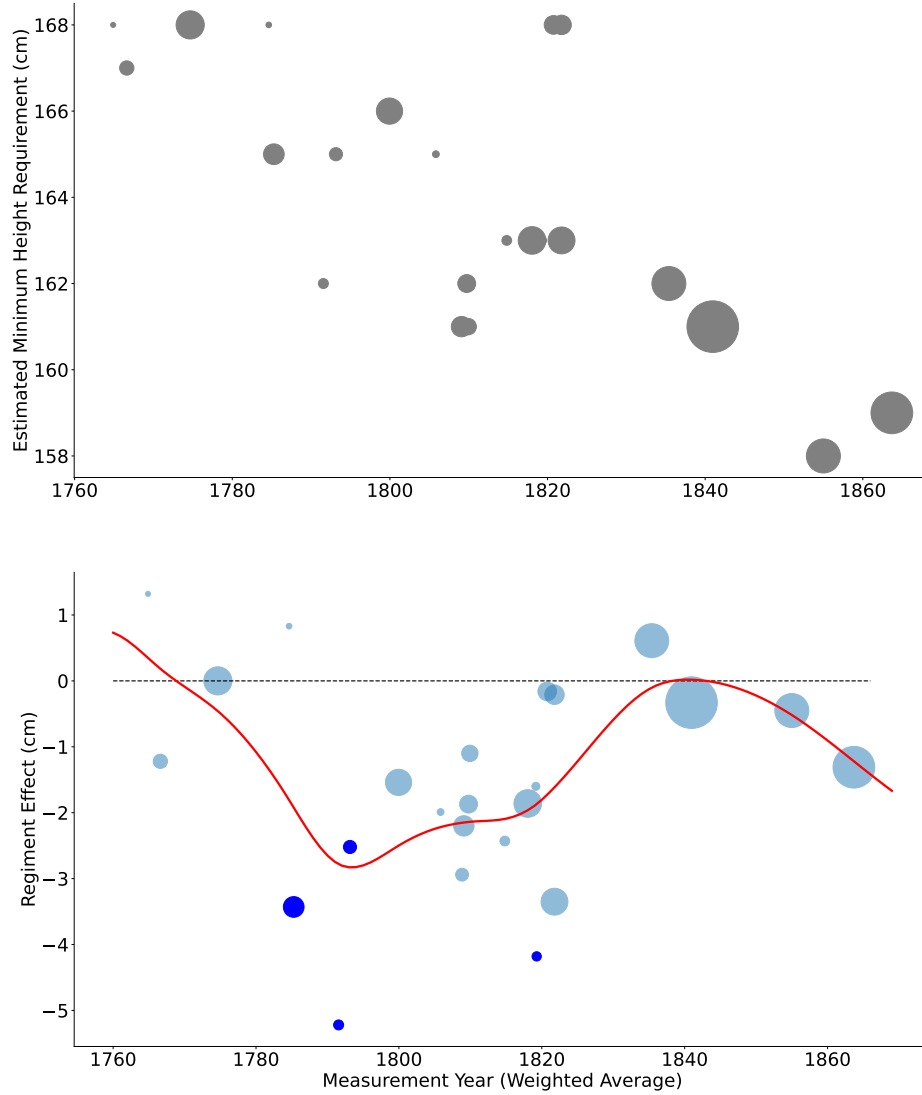
Turning to the measurement year effects, the first graph in Figure 3 shows a plot of the estimated truncation points against the weighted average of the measurement period of the respective regiment. For reasons discussed above in the introduction, there is clearly a reduction in the de-facto minimum height requirement, from about 168cm around 1760 to 158cm around 1860. Interestingly, the minimum height requirement for the Swiss army implemented in 1874 was 155cm, very close to our estimate for 1860 (Staub, 2010, p. 147).

When looking at the effect of the measurement period, it is not just the minimum height requirement which we have to consider. As argued in the introduction, it is crucial to take the general situation at the time of recruitment into account to mitigate the selection bias caused by the fact that joining the mercenary service is by and large voluntary. It is the role of the regiment dummy variable to control to some extent for this phenomenon. Table 2 and Figure 1 show that there is not much overlap between the measurement periods of the regiments. Therefore, the estimated parameters reflect not only differences with respect to branch of service or employer compared to the reference regiment (*Pfyffer*, French service), but also changes with respect to the impact of the general situation during the measurement period of this regiment (1755-1792).

¹²Pfister (1985, Chapter 10) lists three major fields for the modernization attempts: the introduction of the potato, the use of leguminous crops in crop rotation, and permanent indoor farming. For milk production, a simulation of the potential consequences shows a substantial increase of about 140 per cent (Pfister, 1985, Table 2/6, p. 114). But Pfister (1985, p. 115-116) also stresses the fact that natural and institutional obstacles prevented a fast implementation of the potential improvements.

¹³See the literature on business cycles and human stature (Woitek, 2003; Tassenaar and Jacobs, 2004; Brabec, 2005; Sunder and Woitek, 2005). Examples for the literature on the effect of the changing situation in the protoindustrialized regions of Switzerland are Bodmer (1960, p. 213-232), Hauser (1961, p. 184-185), Jäger *et al.* (1986, p. 44-45), Holenstein (2014, p. 324-325), and Gabathuler (2017, p. 31-33).

Figure 3: Minimum Height Requirements and Measurement Year/Regiment Effects



Notes: The estimated minimum height requirements (Figure 1) and the regiment effects (Table 6) are plotted against the weighted average of the measurement period for the regiment. The weight for a specific year is given by the number of observations. Lower plot: the diameter of the circle reflects the number of observations, and a dark blue colored circle represents a parameter significantly different from zero (5% level). The red curve is a smoothing spline based on the underlying data.

The plot of the regiment parameters in the second graph of Figure 3 shows a u-shaped temporal pattern. At the start and the end of the observation period, the differences to the regiment *Pfyffer* are small and very imprecisely estimated. For the period 1780-1825, there

are sizeable negative deviations from the average height of the reference regiment, four of them actually significant:¹⁴ *Courten* (measurement period: 1775-1797, Sardinian service), *Stürler* (measurement period: 1757-1799, Dutch service), *Dunant* (measurement period: 1779-1808, Spanish service), and *Von Steiger* (measurement period: 1816-1830, French service). The effect is sizeable – if we look at the point estimates, the averages are 1.5cm - 5cm smaller than the reference category. This result points towards the increasing difficulties of finding suitable recruits at the time of the Napoleonic Wars discussed in Section 2. Alternatively, the example from the canton Aargau (Section 2) and parts of the literature (e.g. [Peyer 1978](#), p. 713, [Moos 1995](#), p. 129-131) suggest a “vent-for-surplus” interpretation: municipalities used the opportunity of forced recruitment to get rid of unproductive troublemakers and petty criminals, typically with lower socio-economic position. After 1815, the situation started to turn back to normal again. On top of the climatic differences already captured by the cantonal effects, we do not find a significant impact of temperature anomalies on the height of mercenaries. The cantonal effects are difficult to compare with results from the literature, because our sample is not representative with respect to regional coverage (Section 3).¹⁵ This is also true for the occupational structure. However, the pattern is reasonable: mercenaries with SEP 1 (elite) are on average 1.8cm taller than the mercenaries from the reference category SEP 3 (skilled workers). SEP 2 (lower middle class), SEP 4 (self-employed farmers and fishermen), and SEP 5 (unskilled workers and farm workers) are not distinguishable from SEP 3. Mercenaries with unknown occupation turn out to be on average 0.8cm taller than the reference category.

Another possibility to analyze the impact of the measurement year and the regiment on the change in height is to estimate measurement year and regiment specific trends. Appendix B describes the procedure, and Figures 4 and 5 show the results. When looking at the overall picture of both approaches, we see a negative estimated height trend, very much in line with the result in Figure 2. Even more interesting, for all measurement periods and regiments with birth cohorts during the decline of the proto-industry, we estimate a negative height trend. On the other hand, for a given birth cohort, the estimated height level between different regiments and measurement periods can vary substantially.

¹⁴If we look at the point estimates only, there are just three regiments (out of 23) for which the regiment effects are positive: *Johann Baptist Stuppa* (measurement period: 1756-1767, French service), *Von Salis - Zizers* (measurement period: 1765-1792, French service), and *Ludwig von Sonnenberg* (measurement period: 1825-1849, Kingdom of the Two Sicilies).

¹⁵It might be worthwhile to point out that we find a sizeable negative and significant effect of about 1.4cm for mercenaries from the canton Appenzell Auser Rhoden (AR) compared to the reference canton Lucerne (LU). This is also the case at the end of the 19th century: AR recruits measured 1884-1891 (birthyears: 1865-1872) were on average 3.4cm smaller than LU recruits ([Rühli et al., 2008](#), Figure 7).

Figure 4: Regiment Specific Height Trend

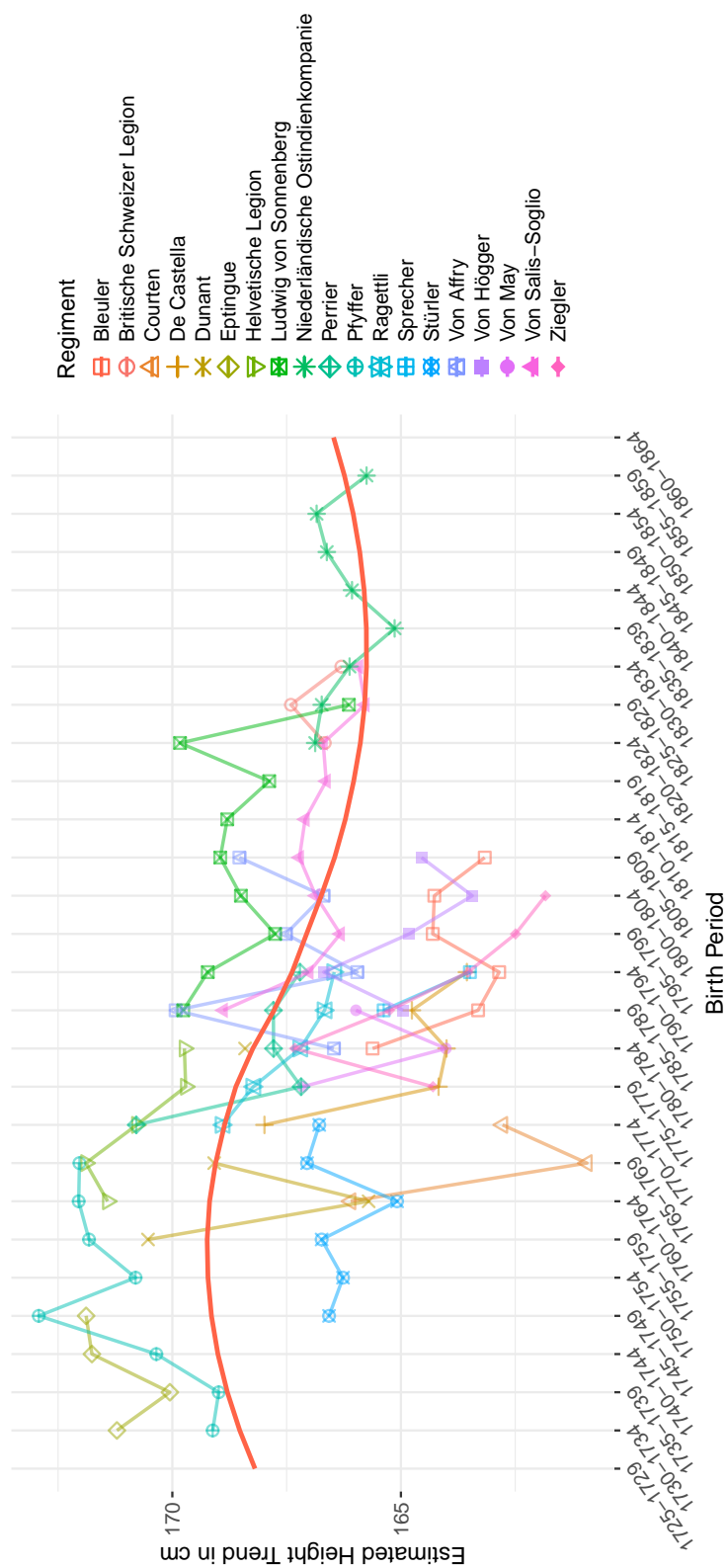
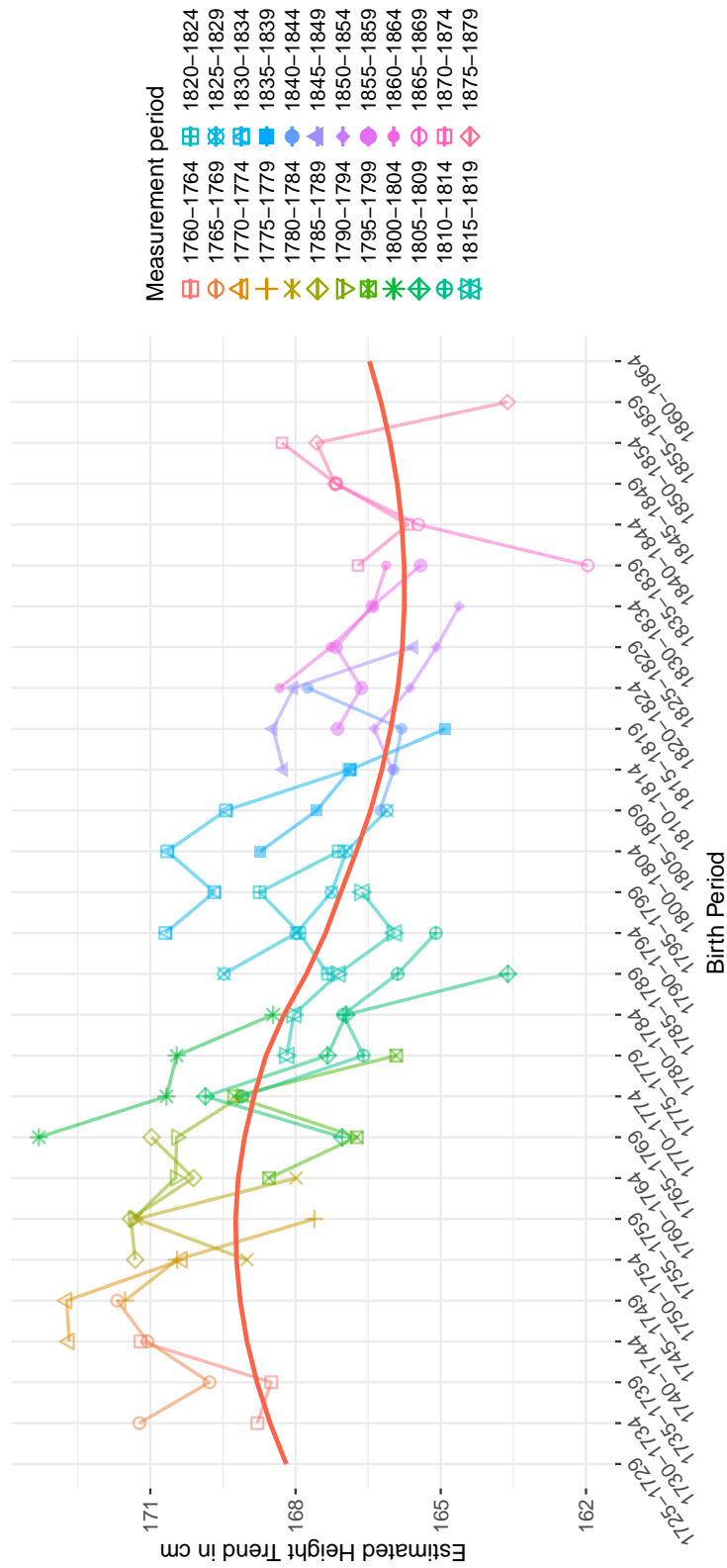


Figure 5: Measurement Year Specific Height Trend



6 Conclusion

How did the biological standard of living respond to the changes brought about by the onset of industrialization? Examining height data of Swiss mercenaries born between 1725 and 1865, we are facing two challenges: First, our mercenary records suffer from left-truncation due to height requirements in the recruitment process. Second, the changing conditions on the supply and demand side of the mercenary labor market potentially produce a measurement period selection bias.

We deal with the first challenge by estimating the minimum height requirement separately for each regiment to account for variations in recruitment standards, resource constraints, and advancements in military technology. Beginning at approximately 168cm in the 1760s, the truncation point declined to 158cm by the 1860s, aligning closely with the official minimum height requirement established by the Swiss army in 1874. To account for sample selection bias, we control for the regiment and find evidence for a reduction in measurement period related height around 1800. A plausible explanation for this pattern is the challenging conditions experienced during the Napoleonic Wars.

Our results indicate a decline in average height during the second half of the 18th century, starting around the 1770s, with no signs of recovery in the first half of the 19th century. This result remains robust across different sets of control variables and estimation techniques. Given the specific nature of the mercenary population, it is not feasible to generalize from this finding to the general Swiss population. Nevertheless, the result is broadly in line with European height trends and the already existing evidence from Switzerland reported in the anthropometric literature. The decline in height during the late 18th century aligns with the economic challenges faced by Switzerland during that time, while the persisting low during the first half of the 19th century corresponds with the prevailing understanding of a difficult first phase of industrialization, as described by contemporaries and economic historians.

References

- A'Hearn, B. (2003), "Anthropometric evidence on living standards in northern Italy, 1730-1860." *Journal of Economic History* **63**, 351-381.
- Alter, G., Neven, M., and Oris, M. (2004), "Stature in Transition: A Micro-Level Study from Nineteenth-Century Belgium." *Social Science History* **28**, 231-247.
- Bairoch, P. (1982), "International industrialization levels from 1750 to 1980." *Journal of European Economic History* **11**, 269.
- Baten, J. (2000), "Economic development and the distribution of nutritional resources in Bavaria, 1797-1839: An anthropometric study." *Journal of Income Distribution* **9**, 89-106.
- Baten, J. and Blum, M. (2012), "Growing Tall but Unequal: New Findings and New Background Evidence on Anthropometric Welfare in 156 Countries, 1810-1989." *Economic History of Developing Regions* **27**, S66-S85.
- Baten, J. and Blum, M. (2014), "Why Are You Tall While Others Are Short? Agricultural Production and Other Proximate Determinants of Global Heights." *European Review of Economic History* **18**, 144-165.
- Bergier, J.-F. (1983), *Wirtschaftsgeschichte der Schweiz: Von den Anfängen bis zur Gegenwart*. Zurich: Benziger.
- Blum, M. and McLaughlin, E. (2019), "Living Standards and Inequality in the Industrial Revolution: Evidence from the Height of University of Edinburgh Students in the 1830." *Economics and Human Biology* **35**, 185-192.
- Bodenhorn, H., Guinane, T., and Mroz, T. (2017), "Sample-Selection Biases and the Industrialization Puzzle." *Journal of Economic History* **77**, 171-207.
- Bodenhorn, H., Guinane, T., and Mroz, T. (2019), "Diagnosing Sample-Selection Bias in Historical Heights: A Reply to Komlos and A'Hearn." *Journal of Economic History* **79**, 1154-1175.
- Bodmer, W. (1960), *Die Entwicklung der schweizerischen Textilwirtschaft im Rahmen der übrigen Industrien und Wirtschaftszweigen*. Zürich: Verlag Berichtshaus Zürich.
- Bogin, B. (1999), *Patterns of Human Growth*. Cambridge: Cambridge University Press.
- Brabec, M. (2005), "Analysis of Periodic Height Fluctuations of Swedish Soldiers in 18th and 19th Centuries." *Economics and Human Biology* **3**, 1-16.
- Bregnard, D. (1996), *Le régiment du prince-évêque de Bâle au service de France lors de la campagne de Corse (1768-1770) : une approche quantitative à partir des contrôles de troupes*. Mémoire de licence, Université de Neuchâtel.
- Bürgi, M. and Schmid, B. (2013), "Usterbrand." <https://hls-dhs-dss.ch/de/articles/016530/2013-02-19/> [Accessed: 19.05.2024].

- Burin de Roziers, M. (1902), *Les capitulations militaires entre la Suisse et la France*. Paris: Arthur Rousseau.
- Canton de Fribourg (Ed.) (1804), *Bulletin officiel des lois, décrets, arrêtés et autres actes publics du Gouvernement du canton de Fribourg*, Vol. 2. Fribourg: B. Louis Piller.
- Church, C. H. and Head, R. C. (2013), *A Concise History of Switzerland*. Cambridge: Cambridge University Press.
- Cinnirella, F. (2008a), “On the road to Industrialization: Nutritional Status in Saxony, 1690–1850.” *Cliometrica* **2**, 229–257.
- Cinnirella, F. (2008b), “Optimists or Pessimists? A Reconsideration of Nutritional Status in Britain, 1740–1865.” *European Review of Economic History* **12**, 325–354.
- Collet, D. (2019), *Die doppelte Katastrophe. Klima und Kultur in der europäischen Hungerkrise 1770–1772*. Göttingen: Vandenhoeck & Rupprecht.
- de Weck, H. (2006), “Fahnenflucht.” <https://hls-dhs-dss.ch/de/articles/008595/2006-10-23/> [Accessed: 16.08.2024].
- Deaton, A. S. and Paxson, C. H. (1994a), “Intertemporal Choice and Inequality.” *Journal of Political Economy* **102**, 437–467.
- Deaton, A. S. and Paxson, C. H. (1994b), “Saving, Growth, and Aging in Taiwan.” In: D. A. Wise (Ed.), *Studies in the Economics of Aging*, 331–357, Chicago: University of Chicago Press.
- Dempsey, G. C. (2002), *Napoleon’s Mercenaries. Foreign Units in the French Army under the Consulate and Empire, 1799–1814*. London: Greenhill Books.
- Drukker, J. W. and Tassenaar, V. (1997), “Paradoxes of Modernization and Material Well-Being in the Netherlands during the Nineteenth Century.” In: R. Steckel and R. Floud (Eds.), *Health and Welfare during Industrialization*, chap. 9, 331–378, Chicago: University of Chicago Press.
- Dziennik, M. (2024), “Manpower.” In: T. Burnard, E. Hart, and M. Houllemare (Eds.), *The Oxford Handbook of the Seven Years’ War*, chap. 2, 19–38, Oxford: Oxford University Press.
- Ewert, U. C. (2006), “The Biological Standard of Living on the Decline: Episodes from Germany During Early Industrialisation.” *European Review of Economic History* **10**, 51–88.
- Eyer, R.-P. (2008), *Die Schweizer Regimente in Neapel im 18. Jahrhundert (1734–1789)*, Vol. 12. Peter Lang.
- Eyer, R.-P. (2010), “Die Auflösung der Schweizer Regimente in Neapel 1789.” In: R. Jaun, P. Streit, and H. de Weck (Eds.), *Schweizer Soldatendienst: neue Arbeiten, neue Aspekte*, 199–214, Birmensdorf: Schweizerische Vereinigung für Militärgeschichte und Militärwissenschaft.

- Fayard Duchêne, J. and de Riedmatten, L. (1997), “La compagnie valaisanne de Joseph Augustin de Riedmatten au service de Sardaigne pendant la Révolution Française (1793–1794) ou La critique d’une source d’histoire militaire.” *Vallesia : bulletin annuel de la Bibliothèque et des Archives cantonales du Valais, des Musées de Valère et de la Majorie* 69–145.
- Floud, R., Fogel, R. W., Harris, B., and Hong, S. C. (2011), *The Changing Body. Health, Nutrition and Human Development in the Western World since 1700*. Cambridge: Cambridge University Press.
- Foerster, H. (2010), “Truppenstellungen für den Fremden Dienst in Frankreich, Holland, Sardinien, Spanien, Neapel vor 1797.” In: R. Jaun, P. Streit, and H. de Weck (Eds.), *Schweizer Solddienst: neue Arbeiten, neue Aspekte*, 247–252, Birmensdorf: Schweizerische Vereinigung für Militärgeschichte und Militärwissenschaft.
- Fogel, R. W. (2004), *The Escape from Hunger and Premature Death, 1700-2100*. Cambridge: Cambridge University Press.
- Fourie, J., Inwood, K., and Mariotti, M. (2020), “Military Technology and Sample Selection Bias.” *Social Science History* **44**, 485–500.
- Frommelt, F., Hitz, F., Kasper, M., and Thöny, C. (Eds.) (2017), *Das Jahr ohne Sommer. Die Hungerkrise 1816/17 im mittleren Alpenraum*. Innsbruck: Universitätsverlag Wagner.
- Gabathuler, H. (2017), “*Des Wuchers höllisches Ungetüm und das weite Feld des Verderbens*. Die Entwicklung der Hungersnot von 1816/17 in der Ostschweiz, im Kanton St. Gallen und in der Region Werdenberg.” In: F. Frommelt, F. Hitz, M. Kasper, and C. Thöny (Eds.), *Das Jahr ohne Sommer. Die Hungerkrise 1816/17 im mittleren Alpenraum*, 27–42, Innsbruck: Universitätsverlag Wagner.
- Gally-de Riedmatten, L. (2014), *Du sang contre de l’or : le service étranger en Valais sous l’Ancien Régime*. Phd thesis, Université de Berne.
- Harris, B. (2021), “Anthropometric History and the Measurement of Wellbeing.” *Vienna Yearbook of Population Research* **19**, 91–124.
- Hauser, A. (1961), *Schweizerische Wirtschafts- und Sozialgeschichte*. Erlenbach-Zürich, Stuttgart: Eugen Rentzsch Verlag.
- Hayashi, F. (2011), *Econometrics*. Princeton University Press.
- Head-König, A.-L. (2012), “Bevölkerung.” Historisches Lexikon der Schweiz (HLS), <https://hls-dhs-dss.ch/de/articles/007946/2012-03-30/>.
- Heintel, M. (1996), “Historical height samples with shortfall: a computational approach.” *History and Computing* **8**, 24–37.
- Henry, P. and Krauer, P. (2023), “Fremde Dienste.” Historisches Lexikon der Schweiz (HLS), <https://hls-dhs-dss.ch/de/articles/008608/2023-10-31/> [Accessed: 09.08.2024].

- Hitz, B. (2015), *Kämpfen um Sold. Eine Alltags- und Sozialgeschichte schweizerischer Söldner in der Frühen Neuzeit*. Cologne, Weimar, Vienna: Böhlau.
- Holenstein, A. (2014), “Beschleunigung und Stillstand. Spätes Ancien Régime und Helvetik (1712-1802/03).” In: G. Kreis (Ed.), *Die Geschichte der Schweiz*, 310–361, Basel: Schwabe Verlag.
- Jäger, R., Lemmenmeier, M., Rohr, A., and Wiher, P. (1986), *Baumwollgarn als Schicksalsfaden. Wirtschaftliche und gesellschaftliche Entwicklungen in einem ländlichen Industriegebiet (Zürcher Oberland) 1750 bis 1920*. Zürich: Chronos.
- James, P. (1979), *Population Malthus. His Life and Times*. London, Boston, Henley: Routledge & Kegan Paul.
- Koepke, N., Floris, J., Pfister, C., Rühli, F. J., and Staub, K. (2018), “Ladies First: Female and Male Adult Height in Switzerland, 1770-1930.” *Economics & Human Biology* **29**, 76–87.
- Komlos, J. (1985), “Stature and Nutrition in the Habsburg Monarchy: the Standard of Living and Economic Development in the Eighteenth Century.” *American Historical Review* **90**, 1149–1161.
- Komlos, J. (1993), “The Secular Trend in the Nutritional Status of the Population of the United Kingdom, 1730-1860.” *Economic History Review* **46**, 115–144.
- Komlos, J. (2004), “How to (and How Not to) Analyze Deficient Height Samples: An Introduction.” *Historical Methods* **37**, 160–173.
- Komlos, J. (2008), “Anthropometric History.” In: S. N. Durlauf and L. E. Blume (Eds.), *The New Palgrave Dictionary of Economics*, second ed., London, Basingstoke: Palgrave Macmillan.
- Komlos, J. (2009), “Anthropometric History: An Overview of a Quarter Century of Research.” *Anthropologischer Anzeiger* **67**, 341–356.
- Komlos, J. and A’Hearn, B. (2016), “The Decline in the Nutritional Status of the U.S. Antebellum Population at the Onset of Modern Economic Growth.”, NBER Working Papers 21845.
- Komlos, J., Hau, M., and Bourguinat, N. (2003), “An Anthropometric History of Early-Modern France.” *European Review of Economic History* **7**, 159–189.
- Krauer, P. (2024), *Swiss Mercenaries in the Dutch East Indies: Colonial Military Labour Markets, 1848-1914*. Leiden University Press.
- Kues, A. B. (2007), *Essays in Anthropometric History*. Saarbrücken: VDM Verlag Dr. Müller.
- Kurmann, F. (2011), “Hungersnöte.” <https://hls-dhs-dss.ch/de/articles/016226/2011-02-16/> [Accessed: 19.05.2024].

- Malthus, T. R. (1803), *An Essay on the Principle of Population, or, a view of its Past and Present Effects on Human Happiness: with an Inquiry into our Prospects respecting the future Removal or Mitigation of the Evils which it occasions*. Second ed., London: J. Johnson.
- Martinez-Carrión, J. M. (2016), “Living Standards, Nutrition and Inequality in the Spanish Industrialisation. An Anthropometric View.” *Revista de Historia Industrial/Industry History Review* **25**, 11–50.
- Moos, C. (1995), “Zur Schweizer Truppenstellung an Napoleon.” In: C. Simon and A. Schluchter (Eds.), *Souveränitätsfragen - La souveraineté en question*, Vol. 1 of *Dossier Helvetik - Dossier Helvétique*, 125–133, Basel, Frankfurt am Main: Helbing & Lichtenhahn.
- Ortenburg, G. (1986), *Waffe und Waffengebrauch im Zeitalter der Kabinettskriege*. Koblenz: Bernard & Graefe Verlag.
- Ortenburg, G. (1988), *Waffe und Waffengebrauch im Zeitalter der Revolutionskriege*. Koblenz: Bernard & Graefe Verlag.
- Peyer, H. C. (1978), “Die wirtschaftliche Bedeutung der Fremden Dienste für die Schweiz vom 15. bis 18. Jahrhundert.” In: J. Schneider (Ed.), *Wirtschaftskräfte und Wirtschaftswege. Festschrift für Hermann Kellenbenz*, Vol. 5, 701–716, Klett-Cotta.
- Pfister, C. (1985), *Klimageschichte der Schweiz 1525-1860. Das Klima der Schweiz und seine Bedeutung in der Geschichte der Landwirtschaft*. Second ed., Bern: Paul Haupt.
- Pfister, U. (1992), *Die Zürcher Fabriques. Protoindustrielles Wachstum vom 16. zum 18. Jahrhundert*. Zürich: Chronos Verlag.
- Pfister, W. (1980), *Die Aargauer im bernischen Regiment und in der Garde in Frankreich 1701-1792 / Die Aargauer im bernischen Regiment in Sardinien 1737-1799*, Vol. 1 of *Aargauer in fremden Kriegsdiensten*. Aarau: Sauerländer.
- Pfister, W. (1984), *Die bernischen Regimenter und Gardekompanien in den Niederlanden 1701-1796*, Vol. 2 of *Aargauer in fremden Kriegsdiensten*. Aarau: Sauerländer.
- Ramon-Muñoz, R. and Ramon-Muñoz, J.-M. (2016), “The Biological Standard of Living in Nineteenth-Century Industrial Catalonia: A Case Study.” *Revista de Historia Industrial* **25**, 77–118.
- Rogger, P. and Hitz, B. (2014), “Söldnerlandschaften-räumliche Logiken und Gewaltmärkte in historisch-vergleichender Perspektive. Eine Einführung.” *Beihefte der Zeitschrift für historische Forschung* **49**, 9–43.
- Roucard, M. (2006), “La capitulation générale de 1803.” *Revue historique des armées* **243**, 108–111.
- Rühli, F., Henneberg, M., and Woitek, U. (2008), “Variability of Height, Weight, and Body Mass Index in a Swiss Armed Forces 2005 Census.” *American Journal of Physical Anthropology* **137**, 457–468.

- Sandberg, L. G. and Steckel, R. H. (1987), “Heights and Economic History: The Swedish Case.” *Annals of Human Biology* **14**, 101–109.
- Schuler, M. (2023), *Recenser la population en Suisse avant 1850. Les effectifs de la population au niveau local*. Neuchâtel: Office fédéral de la statistique (OFS).
- Sikora, M. (2003), “Söldner: historische Annäherung an einen Kriegertypus.” *Geschichte und Gesellschaft* **29**, 210–238.
- Staub, K. (2010), *Der biologische Lebensstandard in der Schweiz seit 1800. Historisch-anthropometrische Untersuchung der Körperhöhe (und des Körpergewichts) in der Schweiz seit 1800, differenziert nach Geschlecht, sozioökonomischem und regionalem Hintergrund*. Ph.D. thesis, Universität Bern.
- Staub, K., Rühli, F. J., Bogin, B., Woitek, U., and Pfister, C. (2011), “Edouard Mallet’s early and almost forgotten study of the average height of Genevan conscripts in 1835.” *Economics & Human Biology* **9**, 438–442.
- Steckel, R. H. (1995), “Stature and the Standard of Living.” *Journal of Economic Literature* **XXXIII**, 1903–1940.
- Steckel, R. H. (2008a), “Biological Measures of the Standard of Living.” *Journal of Economic Perspectives* **22**, 129–152.
- Steckel, R. H. (2008b), “Standards of Living (Historical Trends).” In: S. N. Durlauf and L. E. Blume (Eds.), *The New Palgrave Dictionary of Economics*, second ed., London, Basingstoke: Palgrave Macmillan.
- Steckel, R. H. (2024), “Anthropometrics.” In: C. Diebolt and M. Hauptert (Eds.), *Handbook of Cliometrics*, third ed., Springer.
- Stolz, Y., Baten, J., and Reis, J. (2013), “Portuguese Living Standards, 1720-1980, in European Comparison: Heights, Income, and Human Capital.” *Economic History Review* **66**, 545–578.
- Sunder, M. and Woitek, U. (2005), “Boom, Bust, and the Human Body: Further Evidence on the Relationship Between Height and Business Cycles.” *Economics and Human Biology* **3**, 450–466.
- Suter, H. (1971), *Innerschweizerisches Militär-Unternehmertum im 18. Jahrhundert*. Buchdruckerei Leemann AG.
- Tanner, J. M. (2010), *A History of the Study of Human Growth*. Cambridge: Cambridge University Press.
- Tassenaar, V. (2019), “Development of Regional Variety of the Biological Standard of Living in the Netherlands, 1812–1913.” *Economics & Human Biology* **34**, 151–161.
- Tassenaar, V. and Jacobs, J. (2004), “Height, Income, and Nutrition in the Netherlands: The Second Half of the 19th Century.” *Economics and Human Biology* **2**, 181–195.

- Trachsel, M., Grosjean, M., Larocque-Tobler, I., Schwikowski, M., Blass, A., and Sturm, M. (2010), “Quantitative Summer Temperature Reconstruction Derived From A Combined Biogenic Si And Chironomid Record From Varved Sediments of Lake Silvaplana (south-eastern Swiss Alps) Back To AD 1177.” *Quaternary Science Reviews* **29**, 2719–2730, <https://www.ncei.noaa.gov/access/paleo-search/study/13015>.
- Wand, M. P. and Jones, M. C. (1994), *Kernel smoothing*. CRC press.
- Weigley, R. F. (1991), *The Age of Battles. The Quest for Decisive Warfare from Breitenfeld to Waterloo*. Bloomington, Indianapolis: Indiana University Press.
- Wetter, O. and Pfister, C. (2013), “An Underestimated Record Breaking Event - Why Summer 1540 Was Likely Warmer Than 2003.” *Climate of the Past* **9**, 41–56, <https://www.ncei.noaa.gov/access/paleo-search/study/17616>.
- Woittek, U. (2003), “Height Cycles in the 18th and 19th Centuries.” *Economics and Human Biology* **1**, 243–257.
- Zimran, A. (2019), “Sample-Selection Bias and Height Trends in the Nineteenth-Century United States.” *Journal of Economic History* **79**, 99–138.

Appendix A Sensitivity Analysis

A.1 Regiment and Measurement Period Specific Truncation Point Estimation (MTrunk)

For regiments with more than 100 observations for each measurement period, we estimate the truncation point regiment and measurement period specific. The regiments for which this is possible are *Helvetische Legion*, *Ragetti*, *De Castella*, *Ludwig von Sonnenberg*, *Von Salis-Soglio* and *Britische Schweizer Legion*.¹⁶ For the other regiments we keep the estimated regiment specific truncation parameter. The rest of the analysis remains as described in Section 4.

A.2 Measurement Period Dummies (Naive)

The heights are modeled via the following linear regression

$$h_i = \mathbf{x}_{\text{Naive},i}^\top \boldsymbol{\theta}_{\text{Naive}} + \ddot{u}_i, \quad \forall i \in S, \quad (10)$$

where

$$\boldsymbol{\theta}_{\text{Naive}} := \left(\ddot{\mu}, (\ddot{\alpha}_a)_{a=1}^{A-1}, (\ddot{\beta}_b)_{b=1}^{B-1}, (\gamma_m)_{m=1}^{M-1}, (\ddot{\psi}_c)_{c=2}^C, (\ddot{\omega}_o)_{o=2}^O, \ddot{\kappa}, \nu \right)^\top,$$

and,

$$\mathbf{x}_{\text{Naive},i}^\top := \left(1, (\mathcal{A}_{i,a})_{a=1}^{A-1}, (\mathcal{B}_{i,b})_{b=1}^{B-1}, (\mathcal{M}_{i,m})_{m=1}^{M-1}, (\mathcal{C}_{i,c})_{c=2}^C, (\mathcal{O}_{i,o})_{o=2}^O, \mathcal{T}_i, (\mathcal{E}_{i,e})_{e=2}^E \right).$$

The only difference to the main methodology Section 4 is that instead of controlling for the regiment, we include measurement period dummies and $\mathcal{E}_{i,e}$, dummies representing the i^{th} mercenary's employer, where France is the reference category (see Table 2 and Figure 1 for a brief overview of the employers). The measurement period dummies are constructed in 5 year steps, ranging from 1755–1884, where 1880–1884 is the reference period. Obviously, this results in a high correlation between the age, birth cohort and measurement period dummies.

The resulting estimated height trend is then given by

$$\hat{h}_{\text{Naive},b} := \hat{\beta}_b + \hat{\boldsymbol{\theta}}_{-\text{Birth},\text{Naive}}^\top \bar{\mathbf{x}}_{-\text{Birth},\text{Naive}}. \quad (11)$$

A.3 Deaton-Paxson Normalized Measurement Period Dummies (DP)

Heights are modeled via the following linear regression

$$h_i = \mathbf{x}_{\text{DP},i}^\top \boldsymbol{\theta}_{\text{DP}} + \tilde{u}_i, \quad \forall i \in S, \quad (12)$$

¹⁶The mercenaries of the *Britische Schweizer Legion* are measured in a single year only (1855).

where

$$\boldsymbol{\theta}_{\text{DP}} := \left(\tilde{\mu}, (\tilde{\alpha}_a)_{a=1}^{A-1}, (\tilde{\beta}_b)_{b=1}^{B-1}, (\tilde{\gamma}_m)_{m=3}^M, (\tilde{\psi}_c)_{c=2}^C, (\tilde{\omega}_o)_{o=2}^O, \tilde{\kappa}, \tilde{\nu} \right)^\top,$$

and,

$$\mathbf{x}_{\text{DP},i}^\top := \left(1, (\mathcal{A}_{i,a})_{a=1}^{A-1}, (\mathcal{B}_{i,b})_{b=1}^{B-1}, (\mathcal{M}_{i,m}^\star)_{m=3}^M, (\mathcal{C}_{i,c})_{c=2}^C, (\mathcal{O}_{i,o})_{o=2}^O, \mathcal{T}_i, (\mathcal{E}_{i,e})_{e=2}^E \right).$$

In contrast to naive approach above (Section A.2), the measurement period specific dummy variables $\mathcal{M}_{i,m}$ are normalized according to [Deaton and Paxson \(1994a,b\)](#), resulting in

$$\mathcal{M}_{i,m}^\star = \mathcal{M}_{i,m} - (m-1)\mathcal{M}_{i,2} + (m-2)\mathcal{M}_{i,1}, \quad m = 3, \dots, M, \quad (13)$$

where we assume that the measurement period effects average to zero and are orthogonal to a time trend:

$$\begin{aligned} \tilde{\alpha}_1 &= 0; & \tilde{\beta}_1 &= 0; \\ \sum_{m=1}^M \tilde{\gamma}_m &= 0; & \sum_{m=1}^M m\tilde{\gamma}_m &= 0. \end{aligned}$$

The reason behind this transformation is the perfect linear relationship between age, cohort and measurement period. The Deaton-Paxson normalization is suited to deal with a cyclical measurement effect, not the distortion of the long-run height trend [Bodenhorn et al. \(2017\)](#) have in mind. However, we think that this is also a worthwhile exercise.

The resulting estimated height trend is then given by

$$\hat{h}_{\text{DP},b} := \hat{\beta}_b + \boldsymbol{\theta}_{-\text{Birth},\text{DP}}^\top \bar{\mathbf{x}}_{-\text{Birth},\text{DP}}. \quad (14)$$

To arrive at equation (13), we start with the assumptions above and their implications for $\tilde{\gamma}_1$ and $\tilde{\gamma}_2$:

$$\begin{aligned} \begin{pmatrix} 1 & 1 \\ 1 & 2 \end{pmatrix} \begin{pmatrix} \tilde{\gamma}_1 \\ \tilde{\gamma}_2 \end{pmatrix} &= \begin{pmatrix} -\sum_{m=3}^M \tilde{\gamma}_m \\ -\sum_{m=3}^M m\tilde{\gamma}_m \end{pmatrix}; \\ \begin{pmatrix} \tilde{\gamma}_1 \\ \tilde{\gamma}_2 \end{pmatrix} &= \begin{pmatrix} 2 & -1 \\ -1 & 1 \end{pmatrix} \begin{pmatrix} -\sum_{m=3}^M \tilde{\gamma}_m \\ -\sum_{m=3}^M m\tilde{\gamma}_m \end{pmatrix}; \\ \tilde{\gamma}_1 &= \sum_{m=3}^M m\tilde{\gamma}_m - 2 \sum_{m=3}^M \tilde{\gamma}_m = \sum_{m=3}^M (m-2)\tilde{\gamma}_m; \\ \tilde{\gamma}_2 &= \sum_{m=3}^M \tilde{\gamma}_m - \sum_{m=3}^M m\tilde{\gamma}_m = -\sum_{m=3}^M (m-1)\tilde{\gamma}_m. \end{aligned}$$

Plugging $\tilde{\gamma}_1$ and $\tilde{\gamma}_2$ into Model (12) results in

$$\begin{aligned}
h_i &= \tilde{\mu} + \dots + \sum_{m=1}^M \tilde{\gamma}_m \mathcal{M}_{i,m} + \epsilon_i = \\
&= \tilde{\mu} + \dots + \tilde{\gamma}_1 \mathcal{M}_{i,1} + \tilde{\gamma}_2 \mathcal{M}_{i,2} + \sum_{m=3}^M \tilde{\gamma}_m \mathcal{M}_{i,m} + \epsilon_i = \\
&= \tilde{\mu} + \dots + \sum_{m=3}^M (m-2) \tilde{\gamma}_m \mathcal{M}_{i,1} - \sum_{m=3}^M (m-1) \tilde{\gamma}_m \mathcal{M}_{i,2} + \sum_{m=3}^M \tilde{\gamma}_m \mathcal{M}_{i,m} + \epsilon_i = \\
&= \tilde{\mu} + \dots + \sum_{m=3}^M \left(\underbrace{\mathcal{M}_{i,m} - (m-1) \mathcal{M}_{i,2} + (m-2) \mathcal{M}_{i,1}}_{\mathcal{M}_{i,m}^*} \right) \tilde{\gamma}_m + \epsilon_i .
\end{aligned}$$

A.4 Penalized Maximum Likelihood Estimation (Penalized)

The relationship between heights and independent variables is again assumed linear. However, now we include both regiment and measurement period dummies. The assumed model structure is given by

$$h_i = \mathbf{x}_{\text{Pen},i}^\top \boldsymbol{\theta}_{\text{Pen}} + \dot{u}_i, \quad \forall i \in S, \quad (15)$$

where

$$\boldsymbol{\theta}_{\text{Pen}} := \left(\dot{\mu}, (\dot{\alpha}_a)_{a=1}^{A-1}, (\dot{\beta}_b)_{b=1}^{B-1}, (\dot{\pi}_r)_{r=2}^R, (\dot{\gamma}_m)_{m=1}^{M-1}, (\dot{\psi}_c)_{c=2}^C, (\dot{\omega}_o)_{o=2}^O, \dot{\kappa} \right)^\top,$$

and,

$$\mathbf{x}_{\text{Pen},i}^\top := \left(1, (\mathcal{A}_{i,a})_{a=1}^{A-1}, (\mathcal{B}_{i,b})_{b=1}^{B-1}, (\mathcal{R}_{i,r})_{r=2}^R, (\mathcal{M}_{i,m})_{m=1}^{M-1}, (\mathcal{C}_{i,c})_{c=2}^C, (\mathcal{O}_{i,o})_{o=2}^O, \mathcal{T}_i \right).$$

The above design matrix is highly collinear. Hence, we penalize the regression coefficients in the likelihood (5) as follows

$$\ell_{\text{Pen}}(\tilde{\boldsymbol{\theta}}_{\text{Pen}}, \tilde{\sigma} \mid \{h_i, \mathbf{x}_{\text{Pen},i}, \hat{a}_i\}_{i \in \hat{S}}) := \ell(\tilde{\boldsymbol{\theta}}_{\text{Pen}}, \tilde{\sigma} \mid \{h_i, \mathbf{x}_{\text{Pen},i}, \hat{a}_i\}_{i \in \hat{S}}) + \frac{\lambda}{2} \sum_{j \in \text{Pen}} \tilde{\boldsymbol{\theta}}_{\text{Pen},j}^2, \quad (16)$$

where Pen contains all the regression coefficient indices apart from the birth period effects and λ is a regularization parameter. In other words we penalize all the coefficients apart from the birth cohort effects. Since the first and second derivative of (16) still exist, the maximization of the above penalized likelihood is done in the same way as described at the end of Section 4. The optimal regularization parameter is found via 10-fold cross-validation.

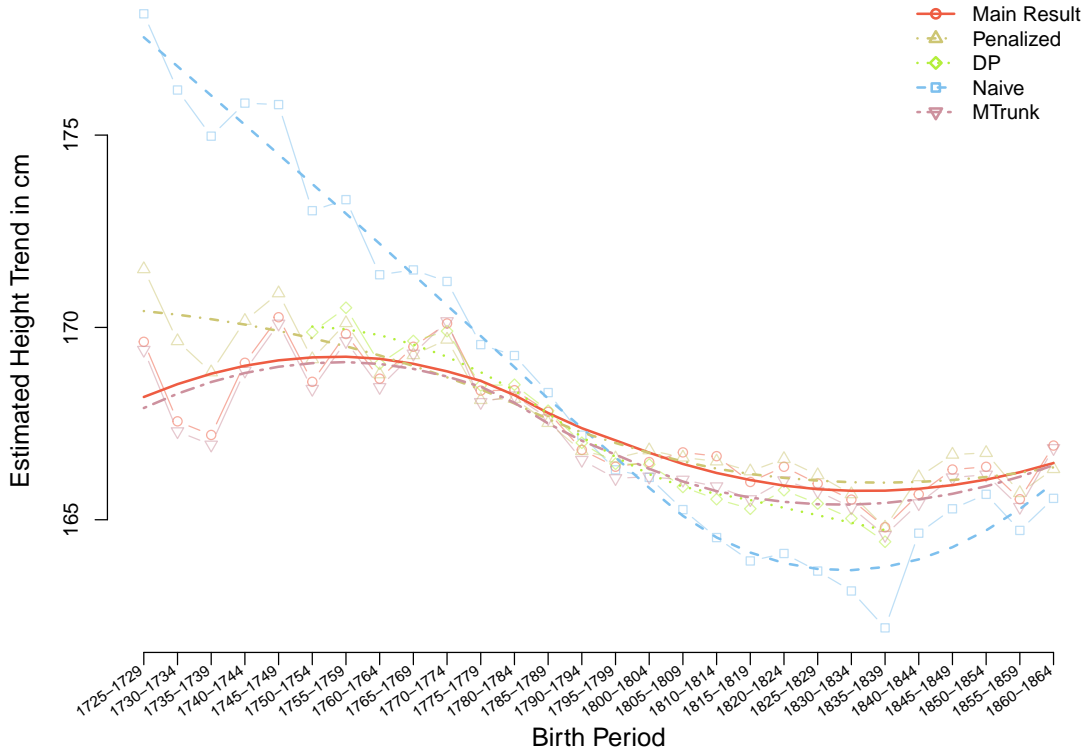
The resulting estimated height trend is then given by

$$\hat{h}_{\text{Pen},b} := \hat{\beta}_b + \hat{\boldsymbol{\theta}}_{-\text{Birth},\text{Pen}}^\top \bar{\mathbf{x}}_{-\text{Birth},\text{Pen}}. \quad (17)$$

A.5 Results of the Sensitivity Analysis

Figure 6 summarizes the estimated average heights of the methods described in Sections A.1-A.4. For comparison reasons, we also include the result of the main text (Section 4). Since the birth cohort effect can not be distinguished from the measurement period effect and age effect, the naive approach of Section A.2 results in a too extreme negative height trend estimate. The DP approach of Section A.3 tackles the issue of the perfect linear relationship between birth year, measurement year and age, nevertheless, the estimated height trend is not trustworthy. The reason is the fact that we only observe one regiment (*Niederländische Ostindienkompanie*) at the very end of our measurement period, restricting the number of birthyears for those particular measurement years. Compared to our main result, the penalized approach of Section A.4 results in a very similar trend.

Figure 6: Sensitivity Analysis



Appendix B Regiment and Measurement Year Specific Analysis

B.1 Regiment Specific Analysis

For regiments $l = 1, \dots, L$, the heights are modeled via the following regiment specific linear regressions

$$h_i = \mathbf{x}_{\text{Reg},i}^\top \boldsymbol{\theta}_{\text{Reg}}^{(l)} + \acute{u}_i, \quad \forall i \in S^{(l)}, \quad (18)$$

where

$$S^{(l)} := \{i \in \text{Reg}_l : h_i \geq a_i\} ,$$

$$\boldsymbol{\theta}_{\text{Reg}}^{(l)} := \left(\dot{\mu}^{(l)}, (\dot{\alpha}_a^{(l)})_{a=1}^{A-1}, (\dot{\beta}_b^{(l)})_{b=1}^{\dot{B}-1}, \dot{\kappa}^{(l)} \right)^\top ,$$

and,

$$\mathbf{x}_{\text{Reg},i}^\top := \left(1, (\mathcal{A}_{i,a})_{a=1}^{A-1}, (\mathcal{B}_{i,b})_{b=1}^{\dot{B}-1}, \mathcal{T}_i \right) .$$

The birth cohorts vary across regiments, indicated by the acute on top of the birth period index, and there is not a single regiment covering all the birth periods. The last birth cohort in a specific regiment forms the reference group, respectively.¹⁷ For each of the 12 regiments, the estimation is carried out as described in the main text in Section 4, without control variables for cantons and socioeconomic position.

The resulting estimated regiment specific height trends are given by

$$\hat{h}_{\text{Reg},b}^{(l)} := \hat{\beta}_b^{(l)} + \hat{\boldsymbol{\theta}}_{-\text{Birth},\text{Reg}}^{(l)\top} \bar{\mathbf{x}}_{-\text{Birth},\text{Reg}}^{(l)} . \quad (19)$$

B.2 Measurement Period Specific Analysis

For measurement periods $m = 2, \dots, M-1$, that is 1760–1879 in 5 years steps, the heights are modeled via the following measurement period specific linear regressions

$$h_i = \mathbf{x}_{\text{Measure},i}^\top \boldsymbol{\theta}_{\text{Measure}}^{(m)} + u_i , \quad \forall i \in S^{(m)} , \quad (20)$$

where where Measure_m holds the indices of the m^{th} measurement period,

$$S^{(m)} = \{i \in \text{Measure}_m : h_i \geq a_i\} ,$$

$$\boldsymbol{\theta}_{\text{Measure}}^{(m)} = \left(\dot{\mu}^{(m)}, (\dot{\alpha}_a^{(m)})_{a=1}^{A-1}, (\dot{\beta}_b^{(m)})_{b=1}^{\dot{B}-1}, \dot{\kappa}^{(m)} \right)^\top ,$$

and,

$$\mathbf{x}_{\text{Measure},i}^\top = \left(1, (\mathcal{A}_{i,a})_{a=1}^{A-1}, (\mathcal{B}_{i,b})_{b=1}^{\dot{B}-1}, \mathcal{T}_i \right) .$$

The birth cohorts vary across measurement periods. We use the same acute on top of the birth period index as in the regiment specific analysis above, and there is not a single measurement period covering all the birth periods. The last birth cohort in a specific measurement period forms the reference group, respectively. As in the regiment specific analysis, we do not control for cantons and socioeconomic position. For each of the 24 measurement periods, the estimation is carried out as described in the main text in Section 4.

¹⁷For five regiments (*Johann Baptist Stuppa, Von Salis-Zizers, Jann, Von Steiger, Auf der Maur*) the total number of observations is below 100, after excluding individuals with a birth period with less than 30 observations. Hence, these five regiments are not included in this analysis.

The resulting estimated measurement period specific height trends are given by

$$\hat{h}_{\text{Measure},b}^{(m)} = \hat{\beta}_b^{(m)} + \hat{\boldsymbol{\theta}}_{-\text{Birth,Measure}}^{(m)\top} \bar{\mathbf{x}}_{-\text{Birth,Measure}}^{(m)} . \quad (21)$$

Appendix C Swiss Mercenary Regiments: Background Information

Table 7: Swiss Regiments (Overview)

	Before 1797		After 1815/15	
	Regiments	Companies	Regiments	Companies
France	12	193	6	120
Netherlands	6	68	4	64-82
Sardinia	4	44	1	12
Spain	4	60	6	60
Naples	4	38	4	48

Preliminary figures provided in [Foerster \(2010, p. 248, 250\)](#). In addition, there were Swiss soldiers in other units (e.g. since 1831 the French Foreign Legion), and smaller elite units such as the Cent-Suisses.

Table 8: Official Minimum Height Requirements: Examples

Regiment	Canton	Employer	Year	Height
Karl von Reding	SZ	ESP	1757	167.8
Dunant	SG	ESP	1758	167.8
von Jaun	UR/other catholic cantons	KTS	1774	165.1
von Reding und Betschart	SZ	ESP	1779	165.1
von Thurn	SG	ESP	1779	165.1
Jann	UW	ESP	1793	165.1
4 Regiments	Swiss Confederation	FRA	1803	167.8
5 Regiments	Swiss Confederation	ESP	1804	165.1
Ziegler	SH, SG, AG, TG	NLD	1814	164.8
Line Regiments	Swiss Confederation	FRA	1816	165.1
Guard Regiments	Swiss Confederation	FRA	1816	167.8
4 Regiments	Swiss Confederation	KTS	1826	165.1

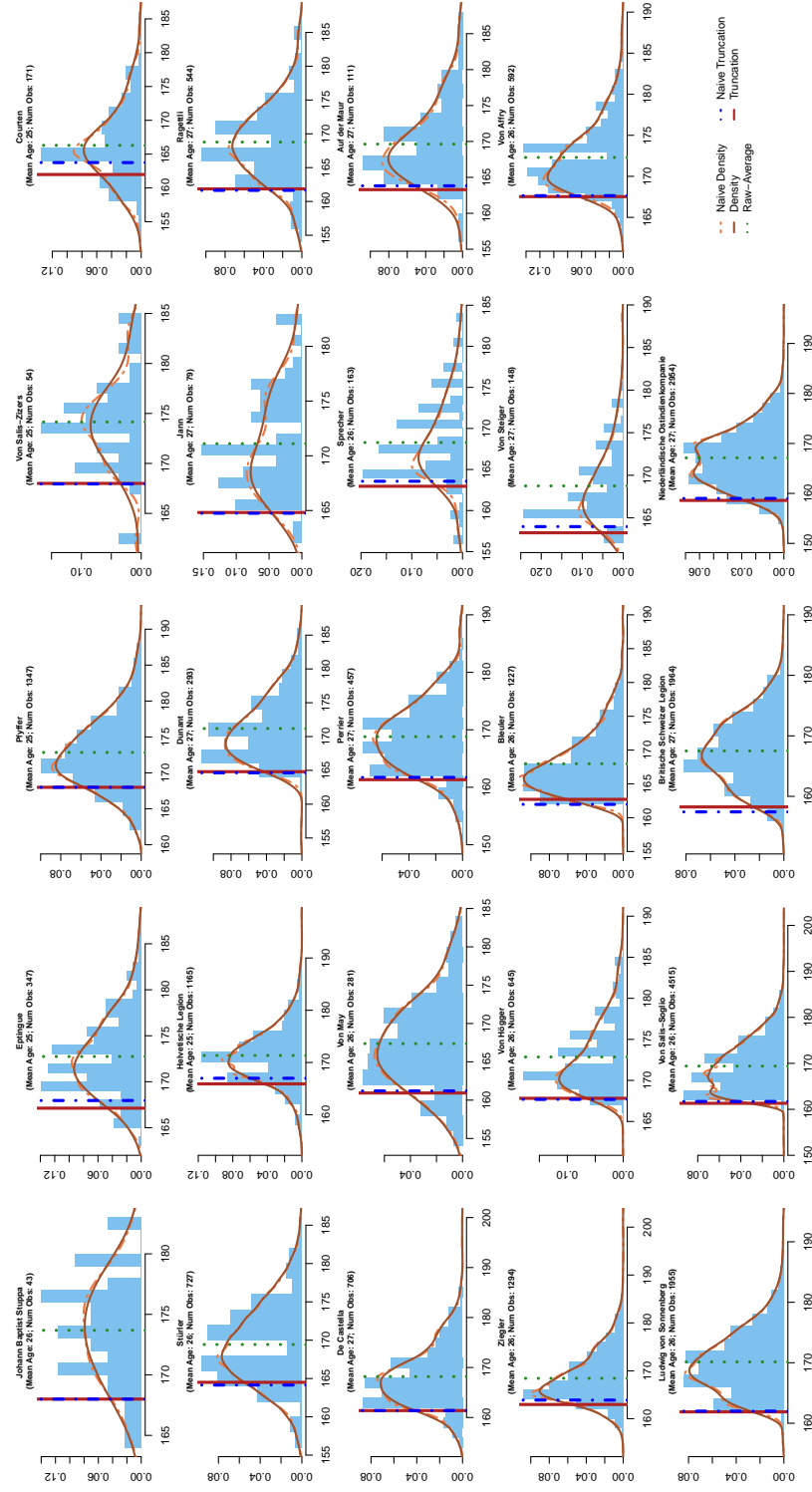
Cantons: SZ: Schwyz; SG: St. Gallen; ZH: Zurich; SH: Schaffhausen; AG: Aargau; TG: Thurgau, UR: Uri, UW: Unterwalden.

Employers: ESP: Spain; FRA: France; NLD: Netherlands; KTS: Kingdom of the Two Sicilies.

Archives: StASZ: State Archive Schwyz; StiASG: Abbey Archives St. Gallen; StAZH: State Archive Zurich; StAF: State Archive Fribourg.

Sources: StASZ HA.III.2065, StiASG Rubrik 9 Faszikel 2, StiASG Rubrik 9 Faszikel 9, StiASG Rubrik 9 Faszikel 7, StAZH OS AF 1 (p. 120-133), StAZH OS AF 2 (p. 409-481), StAZH OS NF 1 (p. 53-84), StAZH OS NF 1 (p. 309-350), StAZH OS NF 1 (p. 309-350), StAF DM VI 56

Figure 7: Estimated Minimum Height Requirements



Appendix D Sources

Table 9: Sources

ID	Archive	Signature	Regiment	Employer	Measurement
					Year
(1)	AAEB	B 241a/22 GF	Eptingue	FRA	1753 - 1770
(2)	AEV	Augustin de Riedmatten I, R 2/13	Courten	SAR	1778 - 1795
(3)	AEV	Mf35 66/1-2	Courten	SAR	1772 - 1797
(4)	AEV	SE 30	Courten	SAR	1775 - 1793
(5)	BAR	B0#1000/1483#2761*	Helvetische Legion	SWI	1798 - 1799
(6)	BAR	B0#1000/1483#2946*	Helvetische Legion	SWI	1798 - 1802
(7)	BAR	B0#1000/1483#2947*	Helvetische Legion	SWI	1801 - 1802
(8)	BAR	B0#1000/1483#2948*	Helvetische Legion	SWI	1800 - 1802
(9)	BAR	B0#1000/1483#2949*	Helvetische Legion	SWI	1801 - 1801
(10)	BAR	B0#1000/1483#2950*	Helvetische Legion	SWI	1800 - 1801
(11)	BAR	J4.12#1000/1268#17*	Britische Schweizer Legion	GBR	1855 - 1855
(12)	BAR	J4.14#1000/1269#1*	Von Salis-Soglio	KTS	1827 - 1831
(13)	BAR	J4.14#1000/1269#2*	Von Salis-Soglio	KTS	1826 - 1842
(14)	BAR	J4.14#1000/1269#3*	Von Salis-Soglio	KTS	1842 - 1850
(15)	BAR	J4.14#1000/1269#4*	Von Salis-Soglio	KTS	1850 - 1855
(16)	NA	2.10.50 121 - 2.10.50 254	Ndl. Ostindienkompanie	NLD	1848 - 1884
(17)	StAAG	DM01/0073	Ziegler	NLD	1815 - 1828
(18)	StAAR	Aa.49-03-03	Stürler	NLD	1747 - 1780
(19)	StAAR	Ca.H11-05	Sprecher	NLD	1814 - 1816
(20)	StAAR	Ca.H11-06	De Castella	FRA	1807 - 1813
(21)	StAAR	Ca.H11-06	Perrier	FRA	1807 - 1811
(22)	StAAR	Ca.H11-06	Ragettli	FRA	1806 - 1813
(23)	StAAR	Ca.H11-06	Von May	FRA	1807 - 1811
(24)	StABS	Fremde Staaten Frankreich F 7.4.	Ragettli	FRA	1806 - 1812
(25)	StABS	Fremde Staaten Frankreich F 7.5.	De Castella	FRA	1807 - 1811
(26)	StABS	Fremde Staaten Frankreich F 7.6.	Perrier	FRA	1806 - 1816
(27)	StABS	Fremde Staaten Frankreich F 7.7.	Bleuler	FRA	1816 - 1830
(28)	StABS	Fremde Staaten Frankreich F 7.7.	De Castella	FRA	1812 - 1813
(29)	StABS	Fremde Staaten Frankreich F 7.7.	Perrier	FRA	1812 - 1813
(30)	StABS	Fremde Staaten Frankreich F 7.7.	Ragettli	FRA	1813 - 1813
(31)	StABS	Fremde Staaten Frankreich F 7.7.	Von Affry	FRA	1816 - 1829
(32)	StABS	Fremde Staaten Frankreich F 7.7.	Von Högger	FRA	1816 - 1830
(33)	StABS	Fremde Staaten Frankreich F 7.7.	Von May	FRA	1813 - 1813
(34)	StALU	AKT 13/701	Johann Baptist Stuppa	FRA	1755 - 1767
(35)	StALU	AKT 23/20 C	Von Salis-Zizers	FRA	1776 - 1780
(36)	StALU	COD 1780	Von Salis-Zizers	FRA	1752 - 1794
(37)	StALU	COD 1795	Pfyffer	FRA	1735 - 1792
(38)	StALU	COD 1880	Dunant	ESP	1803 - 1808
(39)	StALU	COD 1880	Jann	ESP	1805 - 1808
(40)	StALU	COD 1885	Ludwig von Sonnenberg	KTS	1825 - 1840
(41)	StALU	COD 1895	Ludwig von Sonnenberg	KTS	1841 - 1849
(42)	StASG	KA R.61a B 1	Bleuler	FRA	1816 - 1830
(43)	StASG	KA R.61a B 1	De Castella	FRA	1812 - 1813
(44)	StASG	KA R.61a B 1	Perrier	FRA	1812 - 1813
(45)	StASG	KA R.61a B 1	Ragettli	FRA	1812 - 1813
(46)	StASG	KA R.61a B 1	Von Affry	FRA	1816 - 1830
(47)	StASG	KA R.61a B 1	Von Högger	FRA	1816 - 1830
(48)	StASG	KA R.61a B 1	Von May	FRA	1812 - 1813

Continued on next page

Table 9 continued

ID	Archive	Signature	Regiment	Employer	Measurement
					Year
(49)	StASG	KA R.61a B 2	Ziegler	NLD	1815 - 1828
(50)	StASH	Militaria OD 10	Stürler	NLD	1736 - 1796
(51)	StATG	4'482'5	Perrier	FRA	1807 - 1812
(52)	StATG	4'482'5	Von May	FRA	1807 - 1812
(53)	StATG	4'482'6	Bleuler	FRA	1816 - 1828
(54)	StATG	4'482'6	Von Högger	FRA	1816 - 1828
(55)	StATG	4'482'8	De Castella	FRA	1806 - 1812
(56)	StATG	4'482'8	Ragettli	FRA	1806 - 1812
(57)	StATG	4'484'2	Ziegler	NLD	1814 - 1828
(58)	StAZG	E 61.15	Auf der Maur	NLD	1816 - 1828
(59)	StAZG	E 61.15	Von Affry	FRA	1816 - 1816
(60)	StAZG	E 61.15	Von Högger	FRA	1816 - 1830
(61)	StAZG	E 61.15	Von Steiger	FRA	1816 - 1830
(62)	StiASG	Bd. 828	Dunant	ESP	1785 - 1795
(63)	StiASG	Rubrik 27 Faszikel 4b	Dunant	ESP	1779 - 1784

Archives: AAEB: Archives de l'ancien Évêché de Bâle, AEV: Archives de l'Etat du Valais, BAR: Bundesarchiv, NA: Nationaal Archief Netherlands, StAAG: Staatsarchiv Aargau, StAAR: Staatsarchiv Appenzell Ausserrhoden, StABS: Staatsarchiv Basel-Stadt, StALU: Staatsarchiv Luzern, StASG: Staatsarchiv St. Gallen, StASH: Staatsarchiv Schaffhausen, StATG: Staatsarchiv Thurgau, StAZG: Staatsarchiv Zug, StiASG: Stiftsarchiv St. Gallen.

Employers: FRA: France, SAR: Sardinia, SWI: Switzerland, GBR: United Kingdom, KTS: Kingdom of the Two Sicilies, NLD: Netherlands, ESP: Spain.

Secondary Sources: (1): [Bregnard \(1996\)](#); (2): [Fayard Duchêne and de Riedmatten \(1997\)](#); (3) and (4): [Gally-de Riedmatten \(2014\)](#); (16): [Krauer \(2024\)](#).