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The Reluctant Transformation: Modernization, Religion, and Human Capital in Nineteenth Century Egypt

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The Reluctant Transformation: Modernization, Religion, and Human Capital in Nineteenth Century Egypt*

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Over the nineteenth century, Egypt embarked on one of the world's earliest state-led modernization programs. I examine the impact of this program on inter-religious socioeconomic differentials, which were in favor of non-Muslims. I employ new data sources, the nineteenth century Egyptian censuses. I find that the first state-industrialization wave widened the inter-religious occupational gap, but the second wave generated upward mobility among Muslims and Christians, without altering the gap. Educational and military reforms, however, favored Muslims. Religious occupational and educational segregation was not attenuated, because guilds remained as the major skill-building routes, and because modernization's mobility venues were segregated.

Keywords: state industrialization; religion; modern schools; regular army; segregation

JEL classification: N35; O14

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1. Introduction

> *Look at this battalion… There are there Arabs and Copts, Mussulmans and Christians, that march in the same rank. I assure you that not one of them troubles himself about his comrade's religion. Equality between them is complete.*
>
> Ismail, Khedive of Egypt (1863-79)[1]

Over the nineteenth century, Egypt, at the time an autonomous Ottoman province, embarked on one of the world's earliest state-led modernization programs in production, education, and the army, preceding the Japanese program by half a century. Even though the program failed to transform Egypt into a developed economy,[2] the creation of westernized institutions triggered a *social* transformation. In 1848, state production projects employed 8 percent of the adult active male population of urban Egypt, and in 1868 3 percent.[3] By the end of the century, the railways became the largest employer in the country (Toledano 1998, p. 261), and workers in state transportation enterprises were the pioneers of the workers' collective action movement in the early twentieth century.[4] The newly established army (which grew to be 5 percent of Egypt's adult active male population in 1868) played a pivotal role in the nationalist movement, and the graduates of the modern schools (despite serving only 1 percent of males 5-25 years of age in urban Egypt) were the pioneers of Egyptian "enlightenment."[5]

Do religious groups benefit equally from modernization? Do modern institutions integrate the occupationally-segregated religious groups as Khedive Ismail believed? Following a long medieval

[1] Charmes (1883, p. 161).
[2] The average annual growth rate of real GDP per capita in Egypt stood at a low level of 0.4 percent in 1820-70, in contrast to 1.1 percent in the U.S. and Western Europe, or to 0.7 percent in the non-industrialized neighboring Lebanon over the same period (Pamuk 2006).
[3] Author's calculations from the Egyptian 1848 and 1868 digital census samples (Section 3).
[4] Examples include the workers' strikes at Cairo tramways and the national railways in 1908 and 1911, and their role in establishing the first workers' union in Egypt in 1909 (Beinin and Lockman 1987, pp. 57-82).
[5] See K. Fahmy (1998, pp. 263-8) for an insightful discussion of the "unintended" impact of creating a regular army on building the national sentiments in Egypt. Heyworth-Dunne (1938, pp. 159-63, 177-80, 253-64, 269-71, 304-7, 326-9) provides biographies of the prominent graduates of the modern schools.

tradition, non-Muslims in Egypt enjoyed better socioeconomic outcomes than Muslims (figure 1).[6,7] Traditional institutions (guilds and elementary religious schools or *kuttabs*) preserved these differentials for centuries, via noncompetitive policies that constrained access to skills and made occupations hereditary within each religious group (Section 2.1). Modern institutions may affect socioeconomic differentials between religious groups via two channels: First, the technological change embodied in state production projects shifts the relative demand for skills, and may thus affect between-group occupational and wage inequality (Acemoglu 2002; Goldin and Katz 1998; Atack et al. 2004; Goldin and Sokoloff 1982). This effect should arise if the initial skill distribution varies across groups because of the religiously-segregated access to skills. Second, modern institutions create new routes for acquiring skills: job training in state production projects, education in modern public schools, and military promotion in the army, and may thus affect the relative supply of skills. Black and Lynch (1996) demonstrated that job training has a positive impact on productivity, and Yuchtman (2010) found a positive effect of educational modernization in nineteenth century China on economic outcomes. Costa and Kahn (2006) found a positive effect of military experience on integrating minorities in the labor market. The impact of these routes may differ by religious group if there is between-group variation in access to these new opportunities.

I evaluate the effect of state-led modernization on occupational differentials between religious groups using a new and unique data source: individual-level samples of the Egyptian 1848 and 1868 censuses that I digitized from the original manuscripts. I focus on three aspects of state-led modernization: (i) the two waves of state industrialization in 1816-48 and 1848-68, (ii) the public higher-education schools of engineering, medicine, veterinarian medicine, and translation that operated between 1827 and 1854, and (iii) the promotion of Egyptians into middle- and high-ranked commissioned officers starting from 1854-

[6] School enrollment in *kuttabs* (elementary religious schools) among male children aged 5 to14 years in 1848 Cairo was 34 percent for Muslims, 51 percent for Christians, and 80 percent for Jews. See section 2.2 for a discussion of the quality differences between Muslim, Christian, and Jewish *kuttabs*, and section 3 for the data source.

[7] In a different paper, I trace the origins of the Christian-Muslim socioeconomic differentials to the imposition of the Islamic poll-tax on non-Muslims upon the Islamic conquest of the then-Coptic Christian Egypt in 640 AD, which led to the widespread conversion of poor and uneducated Coptic Christians to Islam to avoid paying the tax, and to the shrinking of Copts into a better off minority (Saleh 2012c).

63 and the conscription of non-Muslims as soldiers in the army starting from 1856. I also examine whether occupational/educational segregation between religious groups in the modern institutions (state production projects, modern schools, and the post-reforms army) was different from that in the traditional institutions. I distinguish between two hypotheses: (1) what I call *integrated modernization*, in which modernization acts as a "melting pot" reducing both religious occupational/educational segregation *and* differentials, and (2) *segregated modernization*, in which modernization fails to reduce religious segregation but the differentials can either increase or decrease.[8] The data allow me to evaluate these hypotheses because they include information on religion, occupation, school enrollment, and work establishment/school, in addition to geographic and demographic information.

I examine the impact of state industrialization, defined as employment in state production projects, on the occupational differentials between religious groups using the traditional production sector in each census year as a counterfactual.[9,10] I attempt to disentangle the mechanisms of this impact: a shift in the relative demand for skills (self-selection) versus a shift in the relative supply of skills (job training). To evaluate the impact of educational and military modernization on the inter-religious occupational differentials, I exploit the variation between birth cohorts in the exposure to these "treatments." Finally, I provide cross-tabulations and segregation indexes in order to examine the occupational/educational segregation between religious groups in the modern institutions. Throughout the analysis, I draw on both quantitative methods and historical evidence to support the findings.

The economics literature has long examined the impact of ethno-religious segregation on economic performance (e.g. Alesina and La Ferrara 2005). It is known in this literature that segregation is

[8] This distinction is inspired by the modernization literature in sociology and political science (Newman 1991). "Melting pot modernization theory" predicts that the role of religion subsides as societies modernize and move to "organic" solidarity, which is based on division of labor rather than religion (Durkheim 1984, pp. 126-46). "Conflictual modernization theory" suggests to the contrary that modernization invigorates religious conflicts through the competition of previously segregated groups over the new economic opportunities that modernization creates (Rogowski 1985). While it is not my goal in this paper to evaluate the impact of modernization on religious conflicts, examining the impact of modernization on religious socioeconomic differentials and the occupational integration of religious groups has its implications for this literature.

[9] Endogeneity of religion is not a concern since my goal is to examine the *changes* in inter-religious occupational differentials that were caused by modernization rather than to examine the *levels* of these differentials.

[10] I use the 1848 census to evaluate the first state industrialization wave and the 1868 census to evaluate the second.

endogenous and can be altered by deliberate institutional changes. The paper provides perhaps the first empirical evidence on the impact of state-led modernization on the integration (or lack thereof) of minorities within the same occupations/schools/military ranks in the labor market. The paper also contributes to the literature on the impact of state industrialization or the so-called "forced industrialization" on the skill level of the labor force and how the strength of traditional labor market institutions may hamper the efforts of the state (Gerschenkron 1962, pp. 5-30). In addition, the paper has implications for the long-standing debate in sociology and political science on whether modernization increases or reduces the possibility of ethno-religious conflicts (Durkheim 1984; Rogowski 1985; Newman 1991).

The paper provides the first rigorous quantitative analysis of two of the most important and intriguing questions in Middle Eastern economic history: (i) Egypt's "failed" state-led modernization in the nineteenth century and its impact on guilds and other traditional institutions (Baer 1964; Owen 2002; Marsot 1984; Ghazaleh 1999; M. Fahmy 1954; K. Fahmy 1998; Heyworth-Dunne 1938), and (ii) the "privileged" position of non-Muslim minorities in the Middle East (Courbage and Fargues 1997; Tagher 1998; Issawi 1981). The digitized census samples allow me to provide not only the first quantitative evidence on these two phenomena, but also the first examination of the impact of state-led modernization on the socioeconomic differentials between religious groups, a question that received less attention in the literature. The findings shed light on the historical reasons behind the persistence of these differentials in the Middle East, despite allegedly early attempts at modernization and integration of non-Muslims.

The rest of this paper is organized as follows. Section 2 provides a historical background. Section 3 describes the data. I introduce the empirical analysis and the results on state industrialization in section 4, and on educational and military modernization in section 5. Finally, section 6 concludes.

2. Historical Background

2.1 Guilds and State Production Projects

At the turn of the nineteenth century, the Egyptian labor market was organized through the guild system (*ta'ifa*) that encompassed almost all labor force in cities (Baer 1964, pp. 16-48). Apprenticeship, the sole route for skill-acquisition and accession to mastership, and the *jedik*, a fee required to practice a craft in a workshop, both made guild membership hereditary and thus restrained occupational mobility (Baer 1964, pp. 49-76, 107; Raymond 1973, pp. 544-51). Barriers to entry were higher in artisanal and trade (high-skilled) occupations than in transport and services (low-skilled) occupations, since the latter had neither a clear-cut apprenticeship (Baer 1964, p. 62) nor a *jedik* system. Apprenticeship complemented *kuttabs* as a route for acquiring skills in white-collar occupations (Heyworth-Dunne 1938, p. 87),[11] and there were significant barriers to entry into such occupations even in the government.[12] With the growth of state power in the nineteenth century, the authority of the guild headmen increased as they became responsible for resolving conflicts between the government and guild members (Baer 1964, pp. 77-84).

Inter-religious segregation of guilds reflected inter-religious *occupational* segregation. Figure 1 shows the occupational distribution of the adult active male population of each religious group in the traditional sector in 1848-68. Christians and Jews were relatively more concentrated in white-collar and high-skilled guilds (scribes, carpenters, merchants, jewelers, moneychangers, tailors).[13] A similar pattern of segregation existed in the late eighteenth and early nineteenth centuries. Up to the nineteenth century, there was no religious segregation *within* occupations, and "mixed" occupations, i.e. those that had sizeable memberships from different religions, had *single* guilds (Raymond 1973, pp. 524-6).

[11]Dor Bey, the Swiss education inspector under Ismail (1863-79), pointed out that "Coptic (Egyptian Christian) children have acquired a skill in arithmetic through practical exercises when accompanying their fathers to government offices" (Tagher 1998, p. 213).

[12] Lord Cromer, the British consul-general of Egypt (1883-1907), observed that Copts limited access to white-collar occupations, such as scribes and accountants, by making the accounting system "archaic" and "incomprehensible to anyone but themselves." They resisted all attempts at reform or simplification of the system. The duke of Harcourt, a French contemporary author, emphasized the peculiarity of the Coptic accounting system and how it allowed Copts to dominate administrative and fiscal jobs for centuries (Tagher 1998, pp. 212-3).

[13] All the statistics come from the author's calculations from the digitized census samples (Section 3).

In 1816, Muhammad Ali (1805-48), the Ottoman viceroy of Egypt, launched the first wave of state industrialization by establishing the first textiles manufactory in Egypt (Owen 2002, p. 69). This was followed by a series of manufacturing projects throughout his reign that, in 1848, included textiles (66 percent of modern sector employment), military industries (17 percent), and other industries (17 percent), such as printing, paper, coin making, and wood (Al-Gritli 1952, pp. 51-65; M. Fahmy 1954, pp. 21-54). 70 percent of these production projects were in the two major cities, Cairo and Alexandria,[14] and they differed from traditional workshops in both technology and size. Unlike traditional workshops, state projects employed machines that were a crude imitation of the technology used in Western Europe at the time. A few manufactories used steam power to operate the machines, but the vast majority resorted to animal power. The estimated median size of the manufactory in the 1848 sample is 163 workers, much larger than the median size of a traditional workshop.

To fund his ambitious projects, M. Ali monopolized internal and external trade, and centralized the tax system (Owen 2002, pp. 65-6). Nonetheless, by 1868, 67 percent of his manufactories closed down, and employment in the surviving ones in Cairo and Alexandria dropped by 75 percent. Traditional accounts for this failure center around: (1) the Anglo-Turkish commercial convention (1838) which abolished monopolies and reduced tariffs in the Ottoman Empire, and (2) the London treaty (1841) which limited the size of the Egyptian army, the raison d'être of the manufactories (Owen 2002, pp. 75-6). Owen, however, suggests that there were structural causes for the failure such as the fading centralized power of the state since 1837, the unqualified personnel, the fuel and power problems, and, perhaps most importantly, the failure to create an entrepreneurial class.

M. Ali's successors (1848-68) focused on transportation in the second wave of industrialization. Projects such as railways (1853), telegraph (1854), steam navigation companies (1856 and 1863), and Alexandria tramways (1861) (Al-Hitta 1967, pp. 215-91) recruited 58 percent of Egypt's modern sector employment in 1868. The share of military industries remained stable at 22 percent, while the share of textiles fell sharply to 3 percent. Other industries, such as printing, tannery, and coin making recruited 17 percent of

[14] Author's calculations, based on the production projects observed in the 1848 census sample.

modern sector workers. Cairo and Alexandria were still the major centers of industrialization (86 percent of the projects), although railways, steam navigation, and telegraph served most of the country. The technology used in these projects was presumably more sophisticated than the technology of the 1848 manufactories, but the median size of the plant dropped to 60 workers. Both internal and external debts were used to fund the second wave, and the increased debt (especially for the Suez Canal which was opened in 1869) was the major reason behind Egypt's fall under British occupation in 1882. Generally, however, state transportation enterprises were more successful than the earlier manufactories and many of these enterprises survived until today.

2.2 *Kuttabs* and Modern Schools

In 1800, religious institutions were the sole providers of education through the *kuttabs* (Heyworth-Dunne 1938, pp. 2-7, 84-92). The curricula of these elementary schools were mainly religious, but there were important differences between Muslim, Coptic (Christian), and Jewish schools. Coptic schools taught arithmetic and geometry besides religious subjects, perhaps to prepare the students for their future careers in the administration,[15] a preparation that was later supplemented by apprenticeship.[16] Little evidence exists on Jewish schools at the time, but it appears that Hebrew was "taught not only for religious reasons but also for practical purposes" (Heyworth-Dunne 1938, p. 92). Yet, Muslim *kuttabs* focused only on learning Arabic orthography through memorizing the Quran. Moreover, 20 percent of the teachers in Muslim *kuttabs* in 1848 were blind, and were thus unable to teach reading and writing, unlike teachers in Coptic and Jewish *kuttabs*. Higher education was provided solely through Muslim religious institutes and

[15]Heyworth-Dunne (1938, p. 85) mentions the following passage as the earliest account on Coptic schools written by Sadlier (1693): "... the children were taught *religion, good manners, to read and write Arabic and Coptic*... and were taught geometry and arithmetic because *these two sciences are very useful and necessary on account of the overflowing of the Nile, whereby the limits are lost; so that it becomes necessary for them to measure out their land, and by the benefit of the first of these sciences they compute the yearly increase.*" Italics are mine to identify the words of Sadlier (1693).

[16]See the discussion in section 2.1 and footnote 11.

was thus focused on the preparation of the *ulama*.[17] Overall, the non-Muslim educational system was more inclined towards "useful" knowledge than the Muslim system.[18]

Public modern schools were introduced in 1816 in reverse order starting with higher schools, and then followed by secondary and finally primary schools. Four public higher-education schools stand out as the most significant: medicine (1827-54), engineering (1834-54), veterinarian medicine (1827-51), and translation (1836-51).[19] Non-Muslims were **not** admitted to public modern schools of higher-education until 1873 (Sami 1928, p. 1123),[20] and thus they presumably had no access to higher education until then (Heyworth-Dunne 1938, p. 87). Nonetheless, most of the public modern schools were closed in the 1850s (Heyworth-Dunne 1938, pp. 223-43, 288-301, 313-23).

2.3 National Regular Army and Military Reforms

In 1822, M. Ali ordered the conscription of Egyptian Muslims into the army for the first time in centuries (K. Fahmy 1998, pp. 89-92). The measure was taken in order to build a regular army, following the style of Napoleon's army that conquered Egypt in 1798-1801, and to replace the *Mamluk* irregular military regiments which were mainly formed of slaves and mercenaries (K. Fahmy 1998, pp. 79-84). Two military reforms are perhaps the most critical: First, starting from 1854-63, Egyptians were allowed promotion to middle- and high-ranked commissioned officers, which were previously preserved for the ruling Turkish (Muslim) elite (Al-Raf'i 1987, p. 35). Non-Muslims were not excluded from this reform.[21]

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[17] Al-Azhar was the foremost renowned Islamic higher educational institution in Egypt since the tenth century. The *ulama* are the Muslim clergy.

[18] See Mokyr (2002 and 2005) on the concept of "useful" knowledge.

[19] Although the schools of medicine and engineering were reopened in 1856 and 1858 respectively, they were so frequently reopened and closed that they became generally in a bad condition until 1863, the year of accession of Ismail to power (Heyworth-Dunne 1938, pp. 320-3). Therefore, it is reasonable to conclude that the indicated periods of operation were indeed the *effective* ones until 1868.

[20] Non-Muslim students were allowed to enter public modern schools at the pre-higher education stage starting from 1867 (Heyworth-Dunne 1938, p. 363).

[21] Although Heyworth-Dunne (1938, p. 338) reports that the Coptic Pope's request to allow Copts to become army officers was not met until the Pope's death in 1861 when it was dropped, there are reasons to believe that non-Muslims were not banned from becoming commissioned officers, although they may well have been subject to state discrimination. First, there is the factual evidence of observing two Coptic officers in the 1868 sample as opposed to the 1848 sample where there is none. Second, Dunn (2005, p. 25) points out that Sa'id allowed *both* Copts and (Muslim) peasants to become officers. Third, there are no theoretical grounds for banning non-Muslims from becoming officers since conscripting them was, by itself, a violation of Islamic law. Finally, Ismail (1863-79)

Second, starting from 1856, non-Muslims were conscripted as soldiers for the first time, a reform that may have led to the integration of non-Muslims in the army (Tagher 1998, pp. 203-4).[22]

3. Data

To examine the impact of state-led modernization, individual-level data with information on religion, occupation, and work establishment are required. I digitized two nationally representative samples (about 80,000 records each) of the 1848 and 1868 Egyptian censuses from the original Arabic manuscripts, which are preserved at the National Archives of Egypt, and I also constructed an oversample of non-Muslims in Cairo in both years.[23] The Egyptian censuses are perhaps the earliest individual-level census records in the Middle East to include information on *every* member in the household including females, children, and slaves. They include information on a wide range of variables including location (province, district, quarter/village, street/section, dwelling number), dwelling ownership, dwelling owner's name, dwelling type, dwelling size, name, household relationships, age, gender, ethnicity, nationality, religion, place of origin (province, district, village), legal status (free or slave), occupation (for males), school enrollment (for male children), enterprise/school (for active individuals), and infirmities. This list generally exceeds that of the 1850 U.S. census.[24]

In this paper, I restrict the sample to adult males who are at least 15 years old. Four key variables in the empirical analysis require close attention: First, in the absence of wage information, my socioeconomic measure is based on occupations. Occupational titles were first recorded in full text in Arabic as they appeared in the manuscripts. I then manually coded the occupational titles (about 3,700 distinct titles in each census) following the five-digit *Historical International Standard Classification of Occupations*

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recruited foreign non-Muslim officers widely in the army, and it is hard to believe that there was an official ban that applied only to local non-Muslims.

[22] This occurred in response to the abolition of the Islamic poll-tax on non-Muslims in 1855 (Tagher 1998, p. 204). Conscription was carried out on an arbitrary basis, by the village headmen, and not through a universal scheme (K. Fahmy 1998, pp. 97-9).

[23] Sampling rates are 8-10 percent in Cairo and Alexandria and 1 percent in the provinces. The oversampling of non-Muslims is at the rate of 25 percent. The data source and sampling strategy are described in Saleh (2012a).

[24] The additional variables in the Egyptian censuses are detailed geographic location, dwelling ownership, dwelling type, religion, detailed place of origin (internal migration can be identified), and enterprise/school. The 1850 U.S. census records two additional variables: literacy and real estate value.

(HISCO) scheme, where I created new codes for the titles that were not found in HISCO. Based on this occupational coding, I constructed my main occupational outcome measure, *Social Status Index* (henceforth SSI), which classifies occupational titles into 12 ordered categories (from unskilled farm workers to higher managers). There are four criteria used in this classification: manual vs. non-manual, supervisory vs. non-supervisory, skill level (from low to high), and primary sector vs. non-primary.[25] I also created an alternative outcome, *Occupational Group*, where I collapsed the 12 ordered categories of the SSI into three: white-collar workers, skilled workers, and unskilled workers.

Second, religion is recorded for most observations in 1848 but not in 1868, where I inferred an individual's religion from his name. The main religious groups are Muslims, Christians, and Jews. The last two groups can be broken down further by denomination, when combined with ethnicity. Christian denominations include Copts (Egyptian Christians), Armenians, Levantines, and *Ruum* (Ottoman Greeks), while Jewish denominations are *Rabbanites* and *Karaites*.

Third, the state industrialization measure (*Modern*) is a dummy that takes the value of one if the individual is employed in a state production project. The census takers are generally keen on distinguishing between being employed by the state (*miri*) and working in the private sector (*barrani*). For almost all the individuals employed by the state, the establishment of work is recorded in the occupation field. I constructed a list of state production projects, by project's name, industry, and location in both 1848 and 1868, based on information from secondary historical sources (M. Fahmy 1954; Al-Gritli 1952; Sami 1928). I then combined the list with the digitized census samples in order to decide whether an individual's establishment of work is a state production project.[26]

[25] See Data Appendix and van Leeuwen and Maas (2005) for details.

[26] The criteria for constructing the SSI, including primary sector vs. non-primary, are inferred from the occupational title *only*. Information on work establishment that is used to construct the state industrialization index is **not** used in constructing the SSI. Thus, a livestock worker is assigned the same SSI regardless of being employed in a given "modern" state textiles manufactory or in a "traditional" farm.

Finally, I created the *MainIndustry* dummy to indicate whether an individual is working in the main modernized industry in each state industrialization wave. In particular, the index takes the value of one if the individual works in the textiles (transportation) industry in 1848 (1868), and zero otherwise.[27]

Table 1 shows the descriptive statistics for the sample of adult males who are at least 15 years, including those with missing age. Around 3 percent (5 percent) in urban Egypt are "Without Occupation," 3 percent (3 percent) are out of labor force (students and retired), and 8 percent (12 percent) have missing occupational titles in 1848 (1868). In rural provinces, the percentages of unemployed and out of labor force are negligible but the percentage missing is particularly large at 27 percent (31 percent) in 1848 (1868). About half of the adult active males in urban Egypt are unskilled workers, but the percentage is much higher in rural Egypt at more than 80 percent, since this category includes farmers. The religious composition is quite stable across the two years and across urban and rural provinces, with Muslims constituting the vast majority (about 90 percent), followed by Christians (6-7 percent), and Jews (1 percent), but the latter are mainly urban.[28] Throughout the empirical analysis (sections 4 and 5), the sample is restricted to active males who are at least 15 years old and who have non-missing values for all the variables in the analysis.

4. Empirical Analysis: State Industrialization

This section examines the impact of the two waves of state industrialization, defined as being employed in a state production project (*Modern*), on the inter-religious occupational differences, using the traditional sector in each wave as the counterfactual. Access to skills in the traditional sector was constrained by guilds, and each group's skill distribution was determined by the guilds the group dominated.[29] Conceptually, the effect of state industrialization operates via two channels: (a) Technological change (mechanization and larger firm size) in state production projects shifts the relative

[27] An animal-driver and a scribe in the railways both belong to the "transportation" industry.

[28] The vast majority of Christians are Coptic Christians (86 percent). Non-Coptic Christians are concentrated in Cairo and Alexandria where they constitute 40 percent of Christians. Almost all Christians in rural Egypt are Copts (98 percent). Jews are urban, and in Cairo are either *Rabbanite* (56 percent), *Karaite* (29 percent), or unspecified.

[29] For example, Jews, despite having higher school enrollment than Christians in 1848 Cairo, did not work as scribes, which was a Christian-dominated guild. They instead dominated the moneychangers' guild.

demand for skills, via creating a new job structure which may differ from that of the traditional sector. It may thus alter the inter-religious occupational differentials, if the initial skill distribution varies by religious group. (b) State production projects provide job training, thus shifting the relative supply of skills, possibly differentially across religious groups. In these channels, state industrialization may affect the relative wage of skilled workers (or the skill premium) and thus the inter-religious wage differential. However, since I do not have information on wages, my empirical analysis is limited to the impact on occupational outcomes, which is determined by the job structure in state production projects. I first introduce the results on the impact of state industrialization on the inter-religious occupational differentials. I then attempt to disentangle the mechanisms of this impact. I next address the threats to the empirical strategy. Finally, I explore the effect of state industrialization on occupational segregation between religious groups.

4.1 State Industrialization, Religion, and Occupational Attainment

Did state industrialization reduce or aggravate the inter-religious occupational differentials? Did this impact vary by industrialization wave or by industry? I estimate the following difference-in-differences equations in order to tackle these questions:

$$(1) Probability\ (Occupational\ Attainment_{ij} = m) = F\big(\alpha_j + \beta Modern_{ij} + \gamma Christian_{ij} + \pi Jew_{ij} + \delta(Modern_{ij} \times Christian_{ij}) + \theta X_{ij} + \varepsilon_{ij}\big)$$

$$(2) Probability\ \big(SSI_{ij} = m\big) = F\Big(\alpha_j + \beta Christian_{ij} + \gamma Jew_{ij} + \delta MainIndustry_{ij} + \theta\big(MainIndustry_{ij} \times Christian_{ij}\big) + \varphi Modern_{ij} + \mu\big(MainIndustry_{ij} \times Modern_{ij}\big) + \pi\big(Modern_{ij} \times Christian_{ij}\big) + \tau(MainIndustry_{ij} \times Modern_{ij} \times Christian_{ij}) + \rho\, X_{ij} + \varepsilon_{ij}\Big)$$

Where the probability that the *Occupational Attainment* (SSI or *Occupational Group*) of an individual *i*, residing in district *j*, takes the value *m* is a function $F(.)$ that depends in (1) on *Modern*, dummies for religious affiliation (*Christian* and *Jew*), and the interaction of *Modern* and *Christian*. I do not include the

interaction of *Jew* and *Modern* because of the tiny number of Jews in the modern sector. In (2), I also include the *MainIndsutry* dummy, its interactions with *Modern* and *Christian*, and the interaction of the three dummies. X_{ij} is a vector of individual characteristics: age, slave dummy, foreigner dummy, black dummy, and immigrant dummy. α_j are district of residence fixed effects to account for the variation in spatial proximity to the state production projects. ε_{ij} is an error term.

Table 2 reports factor changes in odds ratios (which imply a positive effect if larger than one) of the ordered logit estimations of equations (1) and (2) where SSI is the dependent variable. Working in the modern sector reduces a Muslim's odds of having the highest SSI value versus the combined lower values in 1848 (i.e. downward occupational mobility) compared to Muslims in the traditional sector, but improves his odds in 1868. For Christians, the effects are positive in both waves (upward mobility). For example, the predicted probability of working as a clerk (SSI = 9) for a Muslim in the modern sector, is lower by 0.06 [CI = (-0.07, -0.05)] in 1848 but is higher by 0.06 in 1868 [CI = (0.01, 0.11)], compared to a Muslim in the traditional sector. However, for Christians in the modern sector, the effects are 0.12 [CI = (0.07, 0.16)] in 1848 and 0.15 [CI = (0.09, 0.20)] in 1868 (upward mobility). Overall, state industrialization widens, on average, the Christian-Muslim socioeconomic (SSI) gap in 1848, but does not alter it in 1868. Moreover, the impact varies by industry: Working in state textile manufactories in 1848 implies downward occupational mobility for Muslims but state transportation enterprises in 1868 improved their lot. Christians, however, enjoyed upward occupational mobility in *both* industries in 1848 and 1868.

These results are summarized in figure 2, which depicts the Christian-Muslim difference in predicted probability of each SSI value in both the traditional and modern sectors. The gap is positive, *on average*, in the traditional sector in both 1848 and 1868: Christians have lower predicted probability than Muslims of the low SSI values, and higher probability of the high SSI values. Employment in state production projects makes the gap wider, on average, in 1848, but does not seem to alter it in 1868.

As an alternative specification, I use *Occupational Group* as the dependent variable in equation (2), and I estimate a multinomial logit model. The rationale is to relax the *proportional odds assumption* and to allow the coefficients to vary by occupational outcome. The estimated average partial effects are in table 3. Christians and Jews in the traditional sector in 1848 and 1868 have higher probability of being skilled or white-collar workers. Recruitment in the modern sector reduces a Muslim's probability of being a white-collar worker by 0.05 [CI = (-0.07, -0.03)] in 1848, but increases it by 0.20 [CI = (0.14, 0.26)] in 1868, compared to a Muslim in the traditional sector. For Christians in the modern sector, the effects are 0.29 [CI = (0.16, 0.43)] in 1848 and 0.34 [CI = (0.13, 0.56)] in 1868. The Christian-Muslim white-collar gap is hence wider in the modern sector than in the traditional sector in 1848 but not in 1868.

To summarize, the first state industrialization wave in 1816-48, which focused on textile manufactories, increased the relative demand for low-skilled workers. Compared to their coreligionists in the traditional sector, Muslims in state manufactories were more likely to work in unskilled occupations such as laborers and factory workers. Christians, however, were more likely to work in white-collar occupations, such as scribes. By contrast, the second wave in 1848-68, with its transportation enterprises, increased the relative demand for white-collar workers, and both Muslims and Christians were now more likely to work in white-collar jobs: Muslims as low-ranked clerks, engineers, railways signalers, ticket conductors on trains and trams, and telegraphers, and Christians as scribes. In general, state industrialization widened the Christian-Muslim occupational gap in 1848, but did not affect it in 1868.[30]

4.2 Mechanisms of State Industrialization: Demand or Supply of Skills?

Two mechanisms may account for the findings in tables 2 and 3: (i) *Self-Selection*: State production projects shift the relative demand for skills and recruit workers based on the skills they acquired via guilds and *kuttabs* without providing an alternative skill-building route (i.e. without affecting the relative supply of skills). (ii) *Job Training*: State projects shift the relative supply of skills via job training.

[30] The findings seem to be consistent with the evidence from industrialized countries. Goldin and Sokoloff (1982) showed that textiles made an intensive use of women and children, as unskilled workers, in the early phases of U.S. industrialization. Also, improvements in transportation increased the relative demand for skills in the U.S. in the early twentieth century (Goldin and Katz 1995).

To disentangle these channels, I classify occupations in the modern sector into two types: "overlapping" or "guild-based" occupations, i.e. those that exist in *both* traditional and modern sectors; and "new" or "training-based" occupations, i.e. those that exist solely in the modern sector and are thus presumably *created* by state industrialization.[31] On the one hand, "guild-based" occupations, recruiting 73 percent and 66 percent of modern sector employment in 1848 and 1868 respectively, proxy for the self-selection effect: Since these occupations exist in the traditional sector as well, guilds presumably controlled the access to them. The effect of state industrialization on the inter-religious differential in these occupations can thus be attributed to pure self-selection. "Training-based" occupations, on the other hand, proxy for the job training effect: These new occupations did not possess guilds and thus state production projects had to provide job training to its recruits. This observation seems to be supported by historical evidence.[32] In order to measure the two effects, I create a dummy "*New*" that takes the value of one if the individual works in a "new" occupation, and I extend equation (1) to be:

$$(3) Probability(SSI_{ij} = m) = F\big(\alpha_j + \beta Modern_{ij} + \gamma Christian_{ij} + \pi Jew_{ij} + \rho\,(Modern_{ij} \times New_{ij}) + \delta(Modern_{ij} \times Christian_{ij}) + \tau(Modern_{ij} \times New_{ij} \times Christian_{ij}) + \theta X_i + \varepsilon_{ij}\big)$$

Notice that the self-selection effect for Muslims in the modern sector is captured by *Modern*, while the additional job training effect for Muslims is captured by the interaction of *Modern* and *New*. For Christians, the two effects are augmented by *Christian*. In this model, the job training effect can be either

[31] "New" occupations include, for example, telegraphers, train drivers, ticket conductors on trains and trams, factory workers, and printing workers. Almost every occupation that exists in the traditional sector has a guild, and so it is safe to assume that the "overlapping" occupations are "guild-based." A few "overlapping" occupations, such as engineers, physicians, and military officers are education-based or military-based rather than guild-based, and are thus an outcome of state-led modernization in its broader sense. Also job training might have been provided for some of the "overlapping" occupations. I will examine the impact of state-led modernization on professional and military occupations in section 5. However, since my interest here lies in identifying the job training effect of state industrialization per se, I chose a conservative definition of "new" occupations that can be safely attributed to job training provided by state production projects.

[32] Job training was provided in state production projects for occupations such as: glass manufacturing (Sami 1928, Vol.2, p. 368 and 376), sugar refining (Vol. 2, p. 376), cotton spinning and weaving (Vol. 2, p. 384), silk spinning and weaving (Vol. 2, p. 421), telegraph (Vol. 3, p. 240), machine building (Vol. 3, p. 331), printing (Vol. 3, p. 659), and gun making (Vol. 2, p. 384 and Vol. 3, p. 992). An 1866 state order (Vol. 3, p. 652) introduced telegraph as one of the subjects to be taught to students in public schools to satisfy the need for telegraphers in the railways.

positive or negative depending on the difference between the average SSI of the "training-based" occupations in the modern sector and the average SSI of the "guild-based" occupations in the same sector. The estimated factor changes in odds ratios are reported in table 4. In 1848, the self-selection effect for a Muslim in the modern sector reduces his odds of having the highest SSI (versus the combined lower values) by a factor of 0.43. The additional job training effect reduces the odds for a Muslim in a "new" occupation of having the highest SSI by a factor of 0.07 compared to a Muslim in an "overlapping" occupation in the modern sector. For Christians the two effects operate in opposite directions but the self-selection effect dominates: there is a positive self-selection effect of 2.85 (0.43*6.63), but a negative additional job training effect of 0.004 (0.07*0.05). In 1868, the self-selection effect for both Muslims and Christians is positive but is *stronger* for the latter: it increases a Muslim's (Christian's) odds of having the highest SSI by a factor of 1.91 (5.39). The additional job training effect is statistically insignificant for Muslims and is negative for Christians.

The results of tables 2 and 3 are thus mainly explained by self-selection. Christians, who were more skilled than Muslims in the traditional sector, were more likely to self-select into white-collar occupations in both the 1848 and 1868 state industrialization waves (compared to Christians in the traditional sector). By contrast, compared to their coreligionists in the traditional sector, Muslims were more likely to self-select into low-skilled occupations in 1848 (because of the low-skill-bias of the state textile manufactories), but were more likely to self-select into white-collar occupations in1868 (because of the high-skill-bias of the state transportation enterprises). The effect of job training in both waves was either negative or insignificant because the average SSI of the "training-based" occupations was lower than (or not different from) that of the "guild-based" occupations in the modern sector.

4.3 Examining the Validity of the Empirical Strategy

There are a number of possible threats to the empirical strategy. The empirical strategy attributes the effect of state industrialization to shifts in the relative demand for or supply of skills. However, profit-maximization may not have been the underlying incentive behind state industrialization and recruitment of individuals may not have been based on their skills. For example, state projects deviated from the free-

markets norm in their recruitment policies. While the 1868 projects recruited individuals who applied voluntarily for jobs (i.e. self-selected into occupations), many workers were forcibly *drafted* into the 1848 state manufactories (Owen 2002, p. 76; Marsot 1984, pp. 181-5), where headmen of districts carried out the drafting procedure (Ghazaleh 1999, p. 122; Sami 1928, Vol. 2, p. 374). Many workers were hence discontent about the working conditions in state manufactories and cases of flight were recorded (Ghazaleh 1999, pp. 122-3). Overall, however, historical evidence suggests that matching skills with job requirements was the main recruitment criterion, be it through drafting or through voluntary application.[33] But does the traditional sector in each census year represent a valid counterfactual that captures what the inter-religious occupational differentials would have been like *before* state industrialization? This assumption is violated if state industrialization led to the crowding-out of private producers via competition in the output markets.[34] To examine this possibility, I first observe that the inter-religious occupational differences in the traditional sector in 1848 and 1868 are similar to what was documented in the late eighteenth and early nineteenth century, i.e. before state industrialization (Raymond 1973, pp. 524-6). Second, the employment share of the modern sector is 8 percent and 3 percent of adult active male population in Cairo and Alexandria in 1848 and 1868 respectively. The percentages are even lower in the other provinces at 2 percent and 0.3 percent.[35] These numbers indicate a modern sector which is not large enough to generate crowding-out effects. This observation is confirmed by estimating the following panel regression at the district-level, which exploits the between-districts variation in the *change* in intensity of state industrialization in a given industry between 1848 and 1868:

$$(4) ThreatIndustry_{jt} = \alpha_j + \beta_{1868} + \gamma Projects_{jt} + \varepsilon_{ij}$$

[33] A state order in Sami (1928) (Vol. 2, p. 279) asserts that recruits (drafts?) into the cotton spinning and weaving manufactories have to be of those who had some knowledge of spinning and weaving. Similar examples are found regarding recruiting (drafting?) turners, carpenters, and blacksmiths who were to imitate the imported European machines (Owen 2002, p. 70), railways engineers (Sami 1928, Vol. 3, p. 242), *tarboush* (hats) weavers and dyers (Vol. 3, p. 24), shipbuilding engineers (Vol. 3, p. 330), and telegraphers (Vol. 3, p. 459).

[34] Forced crowding-out through drafting of private producers into state production projects is also possible and was documented in Owen (2002, p. 69) especially in the case of textile workers.

[35] Marsot (1984, p. 181) cites a much higher employment at 20-25 percent of adult males who are at least 15 years old in 1833. If her estimates are accurate, employment must have fallen sharply in the 1840s, and what one observes in 1848 is already a low point in the employment of state production projects. This might be in line with the general decline of state-led modernization in response to the London treaty of 1841. Compare to footnote 40.

ThreatIndustry is the percentage of adult active males in the traditional sector in the district who work in a "threatened" industry; i.e. an industry for which a state production project was established. *Projects* is the number of state production projects in the "threatened" industry in the district. α_j are district fixed effects, and β_{1868} is an 1868 year dummy to capture any general time trend in the employment share of a given "threatened" industry. I estimate equation (4) for each "threatened" industry separately, and I conduct the analysis at the district-level to have a justifiable output market size. The results are shown in table 5. A crowding-out effect implies a negative coefficient on *Projects*. However, in all three industries: textiles, transportation, and military, the coefficient on *Projects* is either insignificant or positive, thus suggesting no crowding-out effects.

Finally, there may have been a difference in the inter-religious *bias* of the recruitment policies across the traditional and modern sectors, which is driving the results. For example, state production projects may be discriminatory against a specific religious group differentially from the recruiters in the traditional sector (guilds). To examine this possibility, I compare the religious composition of the "guild-based" occupations across the traditional and modern sectors. My rationale is that if the inter-religious bias of the recruitment policies differs across the two sectors, one should observe different religious compositions of the "guild-based" occupations. In 1848, the (weighted) average percentage of Christians across all "guild-based" occupations in the traditional and modern sectors is 8 percent and 6 percent respectively. In 1868, the percentages are almost identical across the two sectors (7 percent).[36] In figure 3, I show the percentage of Christians in the "large" (at least 9 workers in each sector) "guild-based" occupations in both sectors. These occupations constitute 55 percent (53 percent) of modern sector employment in 1848 (1868). Overall, the religious composition of these occupations is very similar across the two sectors, thus suggesting no significant difference in the inter-religious bias of recruitment policies.[37]

[36] The z-statistic for test of equality of percentages across the two sectors is 0.005 and -0.003 in 1848 and 1868 respectively. The number of "guild-based" occupations in 1848 and 1868 is 44 and 43 respectively, and is equal, by construction, across traditional and modern sectors. The average percentage of Christians across all "guild-based" occupations in the sector is weighted by the occupation size.

[37] Results may also be driven by religiously discriminatory recruitment policies in the "training-based" occupations. For example, Heyworth-Dunne (1938, p. 338) mentions that the government did not hire Copts as printing workers.

This evidence seems to be consistent with historical evidence: Recruitment policies of state production projects generally preserved the (religiously-segregated) guild structure. The 1823 account book of the largest textile manufactory in Egypt in 1848 classified workers by guilds (Ghazaleh 1999, p. 131). There are many cases where the government resorted to guilds headmen to resolve conflicts with workers in the state manufactories (Ghazaleh 1999, pp. 122-3). Baer (1964, p. 94) states that Muhammad Ali used guilds to supply workers for his manufactories. Along the same lines, an 1876 document in Amin (1928, p. 1304) elaborates the role of the guilds headmen in resolving conflicts between the state and workers in a state transportation enterprise: Port of Alexandria. Baer (1964, p. 108) makes a similar argument when mentioning that the state steam navigation companies demanded the opening up of the labor market to get rid of the control of the pilots' guild over the supply of workers.

4.4 State Industrialization and Inter-Religious Occupational Segregation

Did state production projects integrate religious groups within the same occupations compared to the traditional guilds? I measure inter-religious occupational segregation by two indexes, dissimilarity and isolation: The dissimilarity index measures the share of the Christian population that would need to change occupation so that Muslims and Christians become evenly distributed across occupations, while the isolation index measures the percentage of Christians in the occupation practiced by the average Christian (Cutler and Glaeser 1997).

Table 6 shows the inter-religious occupational segregation indexes in the traditional and modern sectors in 1848 and 1868, for the "old," "overlapping," and "new" occupations, where "old" occupations are those that exist in the traditional sector *only*. In general, inter-religious occupational segregation is not attenuated by state industrialization: The work force in state production projects are equally religiously segregated as the work force in the traditional sector. Interestingly, inter-religious occupational segregation is observed in the "new" occupations as well as in the "overlapping" ones.

However, the analysis in subsection 4.2 suggests that the findings are mainly explained by self-selection across guild-based occupations, which is in turn affected by the recruitment policies in these occupations only.

5. Empirical Analysis: Educational and Military Modernization

Did state-led modernization provide alternative venues to acquire skills away from guilds and *kuttabs*? The previous section suggested that job training in state production projects was **not** a significant upward mobility device. In this section, I examine the impact of two other "mobility" venues on inter-religious differentials in occupational attainment: (a) public modern schools of higher education, and (b) the military reform that allowed Egyptians to be promoted to middle- and high-ranked commissioned officers. The impact of these reforms is, however, limited to the right tail of the occupational distribution (i.e. affecting a small percentage of the population) via generating upward mobility towards "high-profile" occupations.

5.1 Educational Modernization

In this subsection, I first evaluate the impact of four major public modern schools of higher education: engineering, medicine, veterinarian medicine, and translation that operated over the period (1827-54) on the inter-religious differentials in occupational attainment. Public modern schools of higher education in Egypt did **not** admit non-Muslim students until 1873, and thus their effect is expected to be confined to Muslims. I then examine whether modern schools (both public and private schools at pre-higher and higher educational stages) that emerged in the first half of the nineteenth century, acted as integrating devices for religious minorities, or they were rather equally segregated as the traditional religious schools. In order to address the first question, I estimate the following linear probability regression:

$$(5) Professional_{ij} = \alpha_j + \beta_t + \gamma Nonmuslim_{ij} + \delta\, Tcohort_{ij} + \pi\, Ycohort_{ij} + \theta\big(Nonmuslim_{ij} \times Tcohort_{ij}\big) + \tau\big(Nonmuslim_{ij} \times Ycohort_{ij}\big) + \rho\, Z_{ij} + \varepsilon_{ij}$$

Professional is a dummy that takes the value of one if the individual is engineer, physician, pharmacist, veterinarian, medical assistant, nurse, translator, or interpreter; β_t is an 1868 census year dummy; *Nonmuslim* is a dummy for being non-Muslim; *Tcohort* is a dummy for the "treated" cohort born in 1812

to 1834 that was poised to benefit from the schools in 1827 to 1854;[38] *Ycohort* is a dummy for the young cohort born in 1839 to 1847 that reached higher-education age after the schools were closed down. The control cohort here is the one born in 1797 to 1807 that was past higher-education age by the time the schools were first opened. Finally, *Z* is a vector of controls: dummies for slave, foreigner, black, and immigrant, and the interactions of the foreigner dummy with the cohort of birth.

The results are shown in the first column of table 7. The estimated impact of the modern schools should be interpreted as the lower bound of their true impact for two reasons: (a) Graduates of these schools may have worked in other professional occupations not directly related to their fields of study.[39] (b) In a population with a low level of human capital, education is expected to generate large spillovers that are not captured in this regression. Holding this caveat in mind, I find that the schools have a positive impact on Muslims: Those born in the treated cohort are more likely to work as a professional by 0.4 percentage point than Muslims in the control cohort. This upward mobility effect seems to be driven by the schools rather by a mere cohort effect: In particular, the outcome of younger Muslims born in 1839 to 1847 who did not benefit from the schools is **not** statistically different from the control cohort. Non-Muslims, on the other hand, are not affected by the schools: The sum of the estimated δ and θ is negative but statistically insignificant. Overall, the schools reduced the inter-religious difference in probability of working as a professional (the estimated θ is negative and significant).

Given the ban on non-Muslims from entering public modern schools, the gateway to professional jobs, 72 percent of non-Muslim professionals in the sample are foreigners, compared to only 0.1 percent among Muslim professionals. Thus, the negative coefficient on the interaction of the foreigner dummy with the treated cohort dummy suggests that Egyptian Muslims, who benefited from the public modern schools, replaced foreign non-Muslims in professional occupations.

[38] I assume that students entered these schools for a period of five years, from age 15 to 20, which is consistent with the admission system in these schools (Sami 1928, Vol. 3(3), p. 1123).

[39] Biographies of prominent graduates of these schools confirm this possibility. Many of these graduates worked as managers of governmental departments and state production projects, judges, and lawyers (Heyworth-Dunne, 1938, pp. 159-63, 177-80, 253-64, 269-71, 304-7, 326-9).

But did modern schools integrate religious groups? Table 8 shows the religious composition of students in religious and modern schools (both public and private) at the pre-higher and higher education stages in 1848 and 1868.[40] First, modern schools were equally religiously segregated as religious schools, with Muslims enrolled in public schools and non-Muslims in private ones. Second, although the share of students enrolled in modern schools (out of the total number of students) increased between 1848 and 1868, the increase is larger among non-Muslims: 40 percent of non-Muslim students (76 out of 192) were enrolled in modern schools in 1868, as opposed to only 4 percent among Muslim students.

5.2 Military Modernization

Promoting Egyptians to middle- and high-ranked commissioned officers and conscripting non-Muslims in the army are two major reforms in the military history of Egypt. In this subsection I first examine whether the promotion reform benefited Egyptian Muslims and non-Muslims equally. I then investigate whether the post-reforms army in 1868 integrated non-Muslims at all military ranks, as Khedive Ismail propagated. To address the first question, I estimate the following linear probability regression:

$$(6) CommOfficer_{ij} = \alpha_j + \beta_t + \gamma Nonmuslim_{ij} + \delta Mcohort_{ij} + \theta\left(Nonmuslim_{ij} \times Mcohort_{ij}\right) + \rho\, Z_{ij} + \varepsilon_{ij}$$

CommOfficer is a dummy for being a commissioned officer of any rank. *Mcohort* is a dummy for the "treated" cohort born in 1838 to 1843 that was poised to benefit from the promotion reform.[41] The control cohort in this regression is the cohort born in 1798 to 1808 that was past-retirement age at the time of the reform. The results are shown in column 2 of table 7. There are two caveats in this regression: (a) Age is missing for 32 percent of the commissioned officers in the sample,[42] and (b) there are an extremely small number of non-Muslim commissioned officers in the sample (only 2 officers!). Bearing these caveats in

[40] Sample includes males currently enrolled in schools in 1848 and 1868 with non-missing religion. Low enrollment in public schools is consistent with the historical evidence on the closures of most of the public schools after 1841. Compare to footnote 35.

[41] Since I could not find a specific date for the promotion reform, I assume that it took place in the middle of the period (1854-63), i.e. in 1858. I also assume that the promotion to middle- and high-ranked commissioned officer's ranks occurs at 25 years of age, i.e. 5 years past 20, the typical age of graduation from military schools, and that commissioned officers retire at 50 years of age.

[42] Military personnel are usually not enumerated in the censuses as they were to be enumerated separately in their barracks. Their census returns thus only include name, location, occupation, and nationality (Saleh 2012a).

mind, I find that the promotion reform increased Muslims' access to commissioned officers' ranks: Those born in the treated cohort are more likely to be commissioned officers than Muslims in the control cohort. The reform also increased the inter-religious difference in probability of working as a commissioned officer in favor of Muslims.

The second question that I address here is: Did the post-reforms army in 1868 integrate non-Muslims at all military ranks? Table 9 compares the religious and nationality composition of the Egyptian army in the sample across 1848 and 1868. The army is overwhelmingly Muslim in both 1848 and 1868, but there is a modest increase in the share of non-Muslims in the army from 1 to 3 percent between the two years. However, although Egyptian non-Muslims, in principle, gained access to commissioned officers' ranks by 1868 because of the promotion reform, their representation in the army remained confined to the soldier rank. Egyptian Muslims, on the other hand, increased their access to commissioned officers' ranks vis-à-vis foreigners (mainly Turks) from 40 percent of the commissioned officers' body in 1848 (24 out of 60) to 68 percent in 1868 (97 out of 143). Thus, it appears that the promotion reform benefited Egyptian Muslims almost exclusively, while the non-Muslims' conscription reform increased non-Muslims' access to the army as soldiers, although their representation even at the lowest military rank remained below their population share of 7 percent.

6. Conclusion

The model of state-led modernization was widely adopted throughout various parts of the world in both the nineteenth and the twentieth centuries. Using samples that I digitized from the 1848 and 1868 Egyptian census manuscripts, I examined the effect of the Egyptian nineteenth century program, one of the earliest state-led modernization programs in the world, on the long-standing socioeconomic inequality between religious groups, which was traditionally in favor of non-Muslims. I found that the first state industrialization wave in 1816-48 (textiles), which was low-skill-biased, widened the inter-religious occupational difference in favor of Christians: Muslims were more likely to work in low-skilled occupations, while Christians enjoyed upward occupational mobility as they were more likely to work in

white-collar occupations. The second wave in 1848-68 (transportation), which was high-skill-biased, led to upward mobility among both Muslims and Christians, who were both more likely to work in white-collar occupations, yet without altering the occupational difference. The results are generally driven by self-selection across guild-based occupations in the state production projects rather than by a job training effect. I also found that the public modern schools of higher education and the promotion of Egyptians into middle- and high-ranked commissioned officers benefited Muslims almost exclusively, and increased their access to high-profile jobs (professionals and commissioned officers), although these upward mobility effects were limited to the right tail of the occupational distribution. In all three modern institutions, state production projects, modern schools, and the army, inter-religious segregation was not attenuated both because guilds and *kuttabs*, remained the main venues for acquiring skills in state production projects, and because the new channels for upward mobility (job training, public modern education, and military promotion) were themselves religiously segregated or exclusive to one group.

The findings of the paper have implications for understanding the impact of state-led modernization on the human capital of the population and on between-group educational and occupational segregation. In particular, the limited success of the program in improving the occupational attainment of Muslims and in reducing the inter-religious occupational gap suggests that a more successful state-led modernization program should establish alternative routes to acquire skills to the unprivileged group, which can effectively replace the traditional gap-preserving institutions (guilds and traditional schooling). Focusing instead on establishing *pure* production projects that recruit people based on the skills they acquired through the traditional venues, results in a largely *superficial* state-led modernization process. Hence, convergence in educational and occupational outcomes between religious groups in Egypt had to await the second major Egyptian state-led modernization program under Nasser (1952-70). It is the emphasis on providing access to modern schooling to the Egyptian Muslim masses in the latter program in 1953-6 that made it relatively more successful than its nineteenth century precedent in improving the lot of Egyptian Muslims and reducing their socioeconomic gap vis-à-vis Egyptian non-Muslims (Saleh 2012b).

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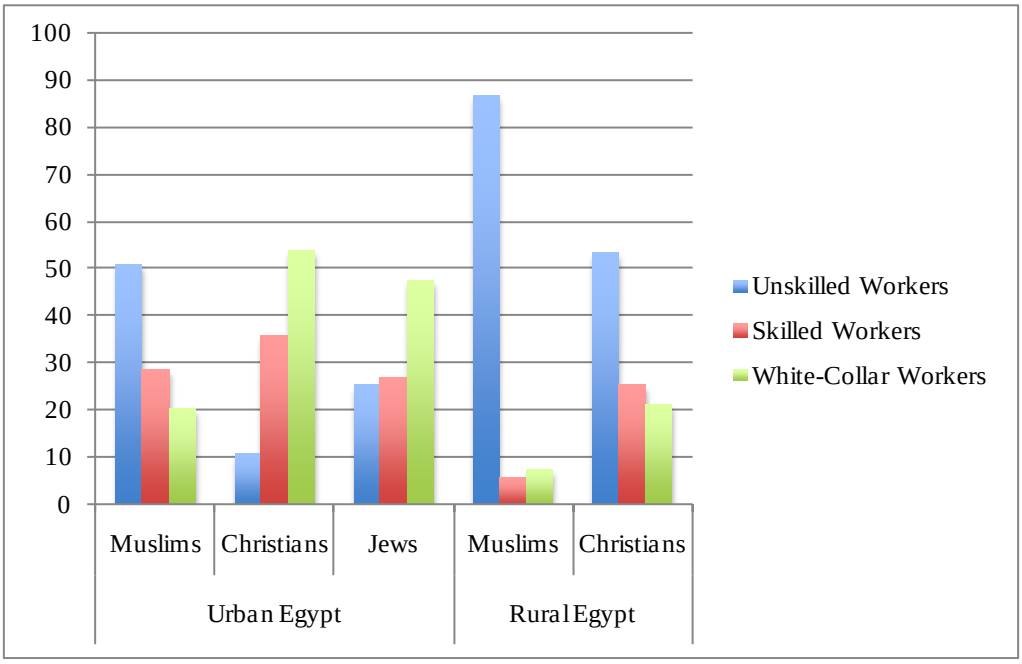
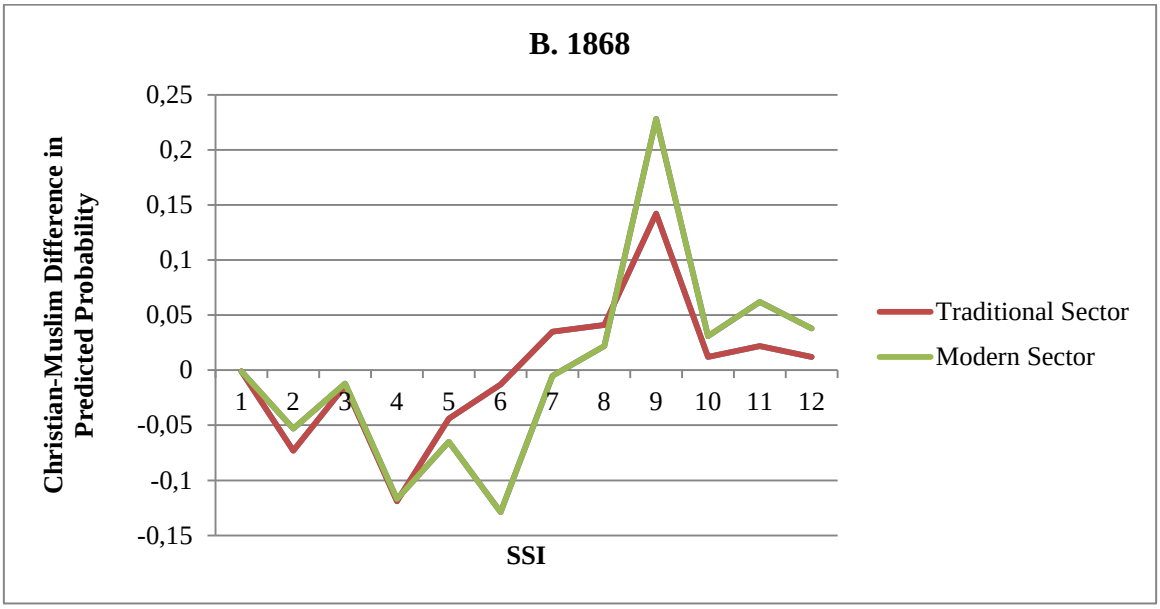
Figure 1: Occupational Distribution by Religious Group in 1848-68 Egypt (Traditional Sector)



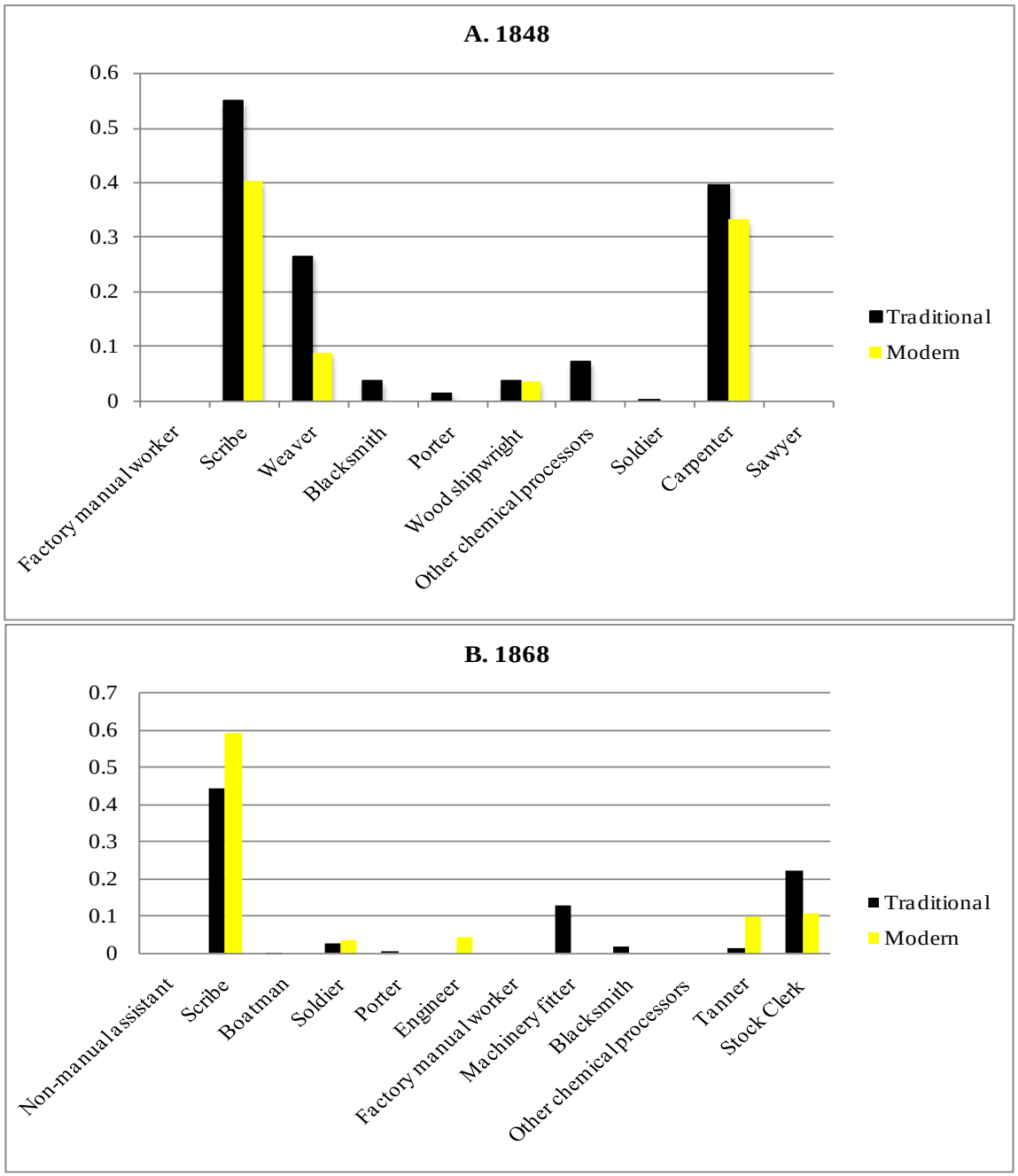
Sample is restricted to males employed in the traditional production sector who are at least 15 years old, including those with missing age. Statistics are based on the systematic sample only, and are weighted to account for the different sampling rates across provinces. Urban Egypt is defined as Cairo and Alexandria, while rural Egypt includes all the other provinces.

Figure 2: State Industrialization and the Christian-Muslim SSI Gap
(Christian-Muslim Differences in Predicted Probability of Each SSI Value)



The Christian-Muslim differences in the predicted probability of each SSI value in the traditional and modern sectors are based on the estimates of the ordered logit regressions of table 2, columns 1 and 3. Predicted probabilities are calculated for a free, non-black, non-foreigner, and non-immigrant individual, while all other regressors are set to their mean values. See Data Appendix for definitions of SSI values. The predicted probabilities of the 12 SSI values for a Muslim in the traditional sector in 1848 are 0.01, 0.1, 0.02, 0.13, 0.36, 0.20, 0.05, 0.04, 0.07, 0.01, 0.01, and 0.00. In 1868, they are 0.00, 0.11, 0.02, 0.22, 0.12, 0.27, 0.08, 0.05, 0.11, 0.01, 0.01, and 0.01. All differences in predicted probabilities are statistically significant at the 5 percent level in 1848. In 1868, they are all statistically significant except at SSI=6 in the traditional sector and at SSI=7 in the modern sector. The difference-in-differences estimates (differences in the inter-religious differences across the two sectors) are statistically significant at all SSI values at the 5 percent level in both years, where the standard errors are estimated using the delta method.

Figure 3: Percentage of Christians in the Large "Overlapping" Occupations in the Traditional and Modern Sectors



Sample is restricted to males who are employed in the "overlapping" occupations in the traditional and modern sectors, and are at least 15 years old, including those with missing age. Statistics are based on the systematic sample only. A large occupation is an occupation with at least 9 workers in each of the traditional and modern sectors. Occupations are ordered in the figure by the occupation's size in the modern sector, from the largest to the smallest.

Table 1: Descriptive Statistics

	1848		1868	
	Cairo and Alexandria	Other Provinces	Cairo and Alexandria	Other Provinces
Employment Status	N=11,324	N=12,457	N=19,110	N=5,878
Employed (%)	86.11	72.57	80.20	68.36
Unemployed (%)	3.26	0.37	4.51	0.41
Out of labor force (%)	2.83	0.04	3.00	0.43
Missing (%)	7.80	27.02	12.29	30.76
Occupational Attainment	N=9,792	N=9,040	N=15,286	N=4,021
White-collar worker (%)	21.96	7.73	23.69	9.80
Skilled worker (%)	27.80	6.73	29.55	8.26
Unskilled worker (%)	50.24	85.54	46.76	81.94
Social status index (Mean)	5.43	5.01	5.67	5.21
Modernization	N=9,792	N=9,040	N=15,286	N=5,878
Employed in the modern sector (%)	7.55	1.75	3.33	0.32
Military personnel (%)	4.15	1.50	2.31	6.53
Professional occupation (%)	0.90	0.00	0.85	0.00
Religion	N=11,324	N=12,457	N=19,110	N=5,878
Muslim (%)	89.90	92.65	86.44	89.79
Christian (%)	7.14	6.34	6.06	6.74
Jew (%)	1.16	0.03	1.01	0.00
Non-Muslim (unspecified) (%)	0.31	0.02	3.43	0.00
Missing (%)	1.07	0.96	3.07	3.47
Demographic				
Age (Mean)	37.46 (N=10,593)	40.45 (N=12,294)	35.51 (N=17,071)	38.18 (N=5,858)
Slave or emancipated slave (%)	1.56 (N=11,316)	1.33 (N=12,454)	1.42 (N=19,024)	1.97 (N=5,742)
Outside governmental control (%)	10.99 (N=11,018)	1.13 (N=12,419)	12.26 (N=19,004)	0.68 (N=5,864)
Abyssinian, black, or Nubian (%)	3.35 (N=10,794)	0.12 (N=12,336)	5.56 (N=17,852)	2.94 (N=5,846)
Immigrant (%)	58.36 (N=9,948)	6.23 (N=12,286)	35.26 (N=18,369)	3.67 (N=5,644)

Sample is restricted to adult males who are at least 15 years old, including those with missing age. Sample size varies from one variable to another to reflect the missing values for each variable. Sample weights are used to adjust for the different sampling rates across provinces. Descriptive statistics are based on the systematic sample only. See Data Appendix for definitions of variables.

Table 2: Impact of State Industrialization on Inter-religious Occupational Differentials- Ordered Logit Model

(Dependent Variable: Social Status Index- Factor Changes in Odds Ratios Reported)

	1848		1868	
Christian	2.833***	2.992***	3.137***	2.889***
	(8.28)	(7.79)	(10.48)	(10.38)
Jew	1.268	1.303	1.594***	1.459**
	(0.76)	(0.86)	(2.62)	(2.10)
Modern	0.183***	0.987	1.742***	0.477***
	(-6.93)	(-0.05)	(2.67)	(-2.52)
Christian × Modern	12.703***	2.393**	1.602	6.248***
	(8.60)	(2.55)	(1.42)	(3.43)
Textiles × Modern		0.020***		
		(-10.29)		
Textiles × Modern × Christian		51.432***		
		(6.67)		
Textiles		2.575***		
		(9.23)		
Textiles × Christian		0.388***		
		(-3.87)		
Transportation × Modern				45.476***
				(10.03)
Transportation × Modern × Christian				0.190**
				(-2.23)
Transportation				0.141***
				(-16.85)
Transportation × Christian				0.740
				(-0.78)
District fixed effects	Yes	Yes	Yes	Yes
Pseudo R-squared	0.053	0.059	0.033	0.053
# Observations	18,039	18,039	18,526	18,526

Robust Z-values, clustered at the village/urban quarter level, are in parentheses. Sample is restricted to active males who are at least 15 years old with non-missing values for all variables included in the regression. Additional controls in each regression are: age, foreigner dummy, slave dummy, immigrant dummy, and black dummy. * indicates significance at 10 percent level, ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

Table 3: Impact of State Industrialization on Inter-religious Occupational Differentials- Multinomial Logit Model

(Dependent Variable: Occupational Group- Partial Derivatives of the Probability of Outcome *j* with Respect to the Regressor of Interest Reported)

	(1) Outcome: Unskilled Worker	(2) Outcome: Skilled Worker	(3) Outcome: White-Collar Worker
Panel A: 1848			
Christian	-0.387***	0.107***	0.276***
	(0.031)	(0.023)	(0.032)
Jew	-0.111**	0.023	0.088
	(0.058)	(0.014)	(0.058)
Modern	0.052	0.002	-0.054***
	(0.021)	(0.014)	(0.012)
Christian × Modern	-0.361	-0.012	0.371***
	(0.131)	(0.028)	(0.115)
District fixed effects	Yes	Yes	Yes
Predicted Probability of Outcome	0.806	0.076	0.113
Pseudo R-squared	0.190	0.190	0.190
# Observations	18,039	18,039	18,039
Panel B: 1868			
Christian	-0.436***	0.141***	0.295***
	(0.026)	(0.025)	(0.033)
Jew	-0.175***	0.014	0.161**
	(0.047)	(0.062)	(0.067)
Modern	-0.214***	-0.007	0.222***
	(0.039)	(0.027)	(0.035)
Christian × Modern	-0.092	-0.024	0.115
	(0.154)	(0.080)	(0.136)
District fixed effects	Yes	Yes	Yes
Predicted Probability of Outcome	0.600	0.202	0.198
Pseudo R-squared	0.130	0.130	0.130
# Observations	18,526	18,526	18,526

All columns in each year are from the same multinomial logit regression. Partial derivatives are reported. Standard errors, calculated by the delta method, are in parentheses, where the original robust standard errors are clustered at the village/urban quarter level. Sample is restricted to active males who are at least 15 years old with non-missing values for all variables included in the regression. Additional controls in each regression are: age, foreigner dummy, slave dummy, immigrant dummy, and black dummy. * indicates significance at 10 percent level, ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

Table 4: Mechanisms of State Industrialization- Ordered Logit Regression

(Dependent Variable: Social Status Index- Factor Changes in Odds Ratios Reported)

	1848	1868
Christian	2.855***	3.134***
	(8.20)	(10.44)
Jew	1.241	1.589**
	(0.68)	(2.60)
Modern	0.429***	1.913
	(-3.09)	(2.92)
Modern × New Occupation	0.070***	0.757
	(-8.39)	(-0.70)
Christian × Modern	6.629***	2.816***
	(6.27)	(3.46)
Christian × Modern × New Occupation	0.055***	0.180***
	(-7.54)	(-3.29)
District fixed effects	Yes	Yes
Pseudo R-squared	0.056	0.033
# Observations	18,039	18,526

Odds ratios are reported. Z-values are between parentheses. Robust standard errors are clustered at the village/urban quarter level. Sample is restricted to active males who are at least 15 years old with non-missing values for all variables included in the regression. Additional controls in each regression are: age, foreigner dummy, slave dummy, immigrant dummy, and black dummy. * indicates significance at 10 percent level, ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

Table 5: Crowding-out Effects of State Industrialization

(Fixed Effects Panel Regression- Dependent Variable: Percentage in a Threatened Industry Out of the Traditional Sector Employment)

	Textiles	**Transportation**	**Military**
Projects	-0.004	-0.008	0.028**
	(0.010)	(0.042)	(0.012)
1868 Effect	-0.004	0.021	-0.002
	(0.005)	(0.023)	(0.003)
Constant	0.024	0.044	0.004
	(0.003)	(0.012)	(0.002)
R-squared (Overall)	0.003	0.005	0.256
# Districts	150	150	150

Standard errors are in parentheses. Percentage in a threatened industry is calculated out of the adult active male population who are at least 15 years old in the traditional sector in the district. Systematic sample only is used in the calculation. * indicates significance at 10 percent level, ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

Table 6: Inter-Religious Occupational Segregation in the Traditional and Modern Sectors

	Traditional			Modern		
	Old	Overlapping	Overall	Overlapping	New	Overall
1848						
Dissimilarity	0.423	0.756	0.525	0.749	0.06	0.635
Isolation	0.932	0.919	0.928	0.948	0.969	0.953
# Occupations	180	44	224	44	4	48
1868						
Dissimilarity	0.433	0.664	0.528	0.82	0.721	0.786
Isolation	0.946	0.93	0.939	0.928	0.919	0.925
# Occupations	162	43	205	43	15	58

"Old" occupations are the occupations that exist only in the traditional sector. See text for definitions of "Overlapping" and "New" occupations. Only the systematic sample of adult active males who are at least 15 years old with non-missing religion is used in the calculations. The sample is collapsed at the occupation-level.

Table 7: Impact of Educational and Military Reforms on Inter-Religious Occupational Differentials- Linear Probability Model

	(1) Dependent Variable = Professional Index	**(2) Dependent Variable = Commissioned Officer Index**
Non-Muslim	0.007	-0.006**
	(0.007)	(0.003)
Born in 1812-34	0.004***	
	(0.001)	
Born in 1839-47	-0.001	
	(0.002)	
Born in 1838-43		0.009***
		(0.003)
Non-Muslim × Born in 1812-34	-0.011*	
	(0.006)	
Non-Muslim × Born in 1839-47	-0.002	
	(0.007)	
Non-Muslim × Born in 1838-43		-0.013***
		(0.005)
Foreign	0.020	0.005
	(0.015)	(0.007)
Foreign × Born in 1812-34	-0.025*	
	(0.014)	
Foreign × Born in 1839-47	-0.027*	
	(0.014)	
Foreign × Born in 1838-43		0.009
		(0.012)
Adjusted R-squared	0.013	0.01
District fixed effects	Yes	Yes
# Observations	21,309	11,938

Robust standard errors, clustered at the village/urban quarter level, are between parentheses. The two census samples are pooled. Pooled sample is restricted to active males who are at least 21 years of age in regression 1, and 25 years of age in regression 2, with non-missing values for all the variables included in the regressions. Sample is

restricted in regression 1 to those born in 1797-1807, 1812-34, and 1839-47, and in regression 2 to those born in 1798-1808 and 1838-43. The control cohort in regression 1 is the one born in 1797-1807, and in regression 2, the one born in 1798-1808. Additional controls in each regression are: foreigner dummy, slave dummy, immigrant dummy, and black dummy, 1868 census dummy, and interactions of foreigner dummy with dummies for birth cohorts 1812-34 and 1839-47 in regression 1, and with birth cohort 1838-43 in regression 2. * indicates significance at 10 percent level, ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

Table 8: Religious Composition of Religious and Modern Schools in 1848 and 1868
(M: Muslim Students; NM: Non-Muslim Students)

	Religious Schools				Modern Schools			
	Muslim Schools		Non-Muslim Schools		Public Schools		Private Schools	
Students	**M**	**NM**	**M**	**NM**	**M**	**NM**	**M**	**NM**
1848								
Pre-Higher	692	0	0	280	6	0	0	0
Higher Education	111	0	0	0	7	0	0	0
Total	803	0	0	280	13	0	0	0
1868								
Pre-Higher	1,561	0	0	115	42	0	6	76
Higher Education	266	0	0	1	23	0	0	0
Total	1,827	0	0	116	65	0	6	76

Sample is restricted to male students who are currently enrolled in schools in the 1848 and 1868 censuses with non-missing religion. Sector (public or private) and level (pre-higher or higher) of modern schools are inferred from school names which are recorded in the census records, combined with information on public modern schools from Heyworth-Dunne (1938).

Table 9: The Composition of the Egyptian Regular Army by Religion and Nationality in 1848 and 1868
(E: Egyptians; F: Foreigners; U: Unknown Nationality; T: Total)

	Muslim Military Personnel				Non-Muslim Military Personnel			
	E	**F**	**U**	**T**	**E**	**F**	**U**	**T**
1848								
Soldier	310	22	68	400	3	0	0	3
Non-Commissioned Officer	23	10	3	36	1	0	0	1
Commissioned Officer	24	16	20	60	0	0	0	0
Total	357	48	91	496	4	0	0	4
1868								
Soldier	396	8	0	404	13	1	0	14
Non-Commissioned Officer	11	1	1	13	0	0	0	0
Commissioned Officer	97	40	4	141	2	0	0	2
Total	504	49	5	558	15	1	0	16

Sample is restricted to military personnel who are 21-70 years old with non-missing religion, but including those with missing age. There are 27 (7) military personnel in the sample with missing religion in 1848 (1868). Their occupational distribution in 1848 (1868) is as follows: 20 (3) soldiers, 1 (0) non-commissioned officer, and 6 (4) commissioned officers.