

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

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Abstract

Over the nineteenth century, Egypt embarked on one of the world's earliest state-led modernization programs in production, education, and the army. I examine the impact of this ambitious program on long-standing human capital differentials and occupational segregation between Muslims, Christians, and Jews. I employ a new and unique data source, samples of the 1848 and 1868 Egyptian censuses that I digitized from the original manuscript forms, to answer this question. I find that the low-skill-bias of the technology of industrial modernization in textiles in 1848 affected Muslims adversely but favored the Christian-dominated skills, and thus widened the inter-religious occupational gap that was traditionally in favor of non-Muslims. Nonetheless, in 1868, the high-skill-bias of the technology of transportation industry resulted in upward occupational mobility among *both* Muslims and Christians towards white-collar jobs, but did not alter the gap. Educational and military modernization, on the other hand, favored Muslims who benefited from these institutions almost exclusively, but the impact was too limited to induce a general catching-up effect. Overall, occupational segregation was not attenuated by modernization, both because the traditional institutions in production and education were still the major routes for skill-acquisition, and because the new routes for mobility that modernization created were themselves segregated.

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## I. 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)<sup>1</sup>

Over the nineteenth century, Egypt, at the time an autonomous Ottoman province, embarked on an ambitious state-led modernization program in production, education, and the army in what constitutes one of the earliest experiments in state-led development that preceded that of Japan by half a century. Even though the program failed to transform Egypt into a developed economy,<sup>2</sup> it triggered a *social* transformation because of the effects of its westernized institutions on the populace. The production projects employed 7.6% (and 3.3%) of the adult active male population of Cairo and Alexandria, Egypt’s largest cities, in 1848 (and 1868)<sup>3</sup>, and, by the end of the century, the railways became the largest employer in the country (Toledano 1998, p. 261). Perhaps more notably, the newly established army (1.8% and 5.4% of Egypt’s adult active male population in 1848 and 1868 respectively) later on played a pivotal role in the nationalistic movement, and the students of the modern schools (1% of males 5- 25 years in Cairo and Alexandria in 1848 and 1868) were the pioneers of the Egyptian “enlightenment.”<sup>4</sup>

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<sup>1</sup> Charmes, Gabriel (1883), *Five Months at Cairo and in Lower Egypt*, p. 161.

<sup>2</sup> The average annual growth rate of real GDP per capita in Egypt was standing at a low level of 0.4% over the period (1820-70), in contrast to 1.1% in the U.S. and Western Europe, or even to 0.7% in the non-industrialized neighboring Lebanon over the same period (Pamuk 2006).

<sup>3</sup> All the statistics are based on the author’s calculations from the Egyptian 1848 and 1868 digitized census samples (See section III for data description and sample restrictions).

<sup>4</sup> See K. Fahmy (1998, pp. 263-8) for an insightful discussion of the “unintended” impact of the move to create a regular army on building the national sentiments in Egypt. Heyworth-Dunne (1938, pp. 177-80) provides interesting biographies of the most prominent individuals who benefited from the educational program.

An important social aspect of modernization is its potential impact on long-standing human capital inequalities in the population, and on the integration of traditionally segregated social groups. Following a long medieval tradition, non-Muslims in Egypt were relatively more concentrated than Muslims in white-collar occupations that required literacy and numeracy (scribes, tax-collectors, moneychangers, and merchants). Turn of the nineteenth century institutions such as guilds, the *kuttabs* (religious schools), and the Mamluk irregular regiments helped to preserve these religious differentials by limiting occupational mobility. Production projects, modern schools, and a national regular army, can open new routes for upward (or downward) occupational mobility, and may thus alter the religious occupational differences. In doing so, the new institutions may act as “melting pots” integrating the religious groups within the same occupations, an integration that has implications for the building of the national state. For example, production projects in Egypt formed the nucleus of an urban working force that was a pioneer of the workers’ collective action movement in early 20<sup>th</sup> century (Beinin and Lockman 1987, p. 48-82). Nonetheless, it is unclear if this emerging work force, the modern schools, and the newly established army were less religiously segregated than the traditional institutions.

I collected nationally representative individual-level census records from the Egyptian 1848 and 1868 manuscript censuses to evaluate the effect of state-led modernization in production, education, and the army on (i) inter-religious occupational differentials and (ii) occupational segregation across religious groups. In particular, I focus on the impact of three aspects of institutional intervention: (i) the two waves of industrial modernization in 1816-48 and 1848-68, (ii) the special modern schools of engineering, medicine,

veterinarian medicine, and translation, that operated over the period 1827-54 before they were closed, and (iii) the conscription of non-Muslims as soldiers into the army in 1856, and the promotion of Egyptians into commissioned officers ranks in 1854-63. I distinguish between two possible hypotheses: (1) *integrated modernization*, under which modern institutions act as melting pots reducing occupational segregation between religious groups. In this case, occupational differentials between these groups go down, and (2) *segregated modernization*, under which the modern institutions fail to reduce occupational segregation. In this case, occupational differentials can either go up or down depending on the relative average social status level of the “segregated” occupations in the modern institutions between religious groups. I can evaluate these two hypotheses because my data include individual-level information on religion, occupation, and place of work, in addition to geographic and demographic information.

There is a large body of literature on the impact of ethnic, religious, and linguistic fractionalization on economic performance.<sup>5</sup> What is less understood, however, is the possible endogeneity of fractionalization and how it can be altered by *deliberate* institutional changes. As Jalali and Lipset (1992) pointed out, many sociologists agreed that industrialization, urbanization, and the spread of education lead to the assimilation of minorities, a hypothesis that seemed inconsistent with the reality of the revival of ethno-religious conflicts by the end of the 20<sup>th</sup> century. Using a unique dataset from a pre-modern population in its early transition to modernity, the paper provides, to the best of my knowledge, the first empirical test of this hypothesis, and examines the mechanisms through which state-led modernization would lead to the assimilation (or lack thereof) of minorities in the labor market. On the other hand, although the paper does not evaluate

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<sup>5</sup> See the review in Alesina and La Ferrara (2005).

the economic efficiency of industrial modernization, it has implications for how modernization affects the labor force and labor market institutions and how the strength of these institutions can hamper the efforts of the state. This paper is thus related to the literature on similar experiments of state-led development or “forced industrialization” in nineteenth century Russia, and elsewhere in Eastern Europe (Gerschenkron 1962). The paper is also related to the literature on the impact of technological change on labor market inequality<sup>6</sup>. The technology employed in Egypt was essentially a crude imitation of the technology prevalent in Western Europe at the time of the First Industrial Revolution. I am able to examine technology-skill complementarity and determine whether the impact of technological change differs across religious groups. The paper also contributes to an emerging literature on the transition from traditional schools to modern education (Yuchtman 2010), and on the role of the army as an integrating device for minorities (Costa and Kahn 2006).

The paper has implications for two of the most important and intriguing questions in Middle Eastern economic history: (i) Egypt’s “failed” state-led modernization in the 19<sup>th</sup> 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). My new data source allows me to provide the first quantitative evidence on these two phenomena, and the first examination of the impact of modernization on religious differentials. My findings thus shed light on the historical origins of the persistence of religious tensions in Egypt and

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<sup>6</sup> See the review in Acemoglu (2002).

other parts of the Middle East, despite allegedly *early* attempts at modernization and assimilation of non-Muslims.

## **II. Historical Background**

### **II.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*). According to Baer (1964, pp. 16-48), the system embraced almost all labor force in the cities, including white-collar workers in the government (e.g. scribes, tax-collectors, and land-surveyors) and low-skill workers (e.g. porters, scavengers, and beggars). 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 largely hereditary and thus restrained occupational mobility (Baer 1964, pp. 49-76 and p. 107; Raymond 1973, pp. 544-51). However, barriers to entry were generally higher in artisanal and trade (high-skill) occupations than in transport and services (low-skill) occupations, since the latter had neither a clear-cut apprenticeship (Baer 1964, p. 62), nor a *jedik* system. Historical evidence also suggests that apprenticeship complemented *kuttabs* as the main route for acquiring skills in white-collar occupations (Heyworth-Dunne 1938, p. 87),<sup>7</sup> and that there were significant barriers to entry into such occupations even in the government.<sup>8</sup> Despite the growing centralized power of the state during the nineteenth century, the guilds remained largely

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<sup>7</sup> On the existence of apprenticeships in white-collar occupations, 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).

<sup>8</sup> Lord Cromer, the British consul-general of Egypt (1883-1907), observed that Copts limited access to their dominated white-collar occupations, such as scribes and accountants, by making the accounting system “archaic” and “incomprehensible to anyone but themselves.” They hence 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 financial jobs for centuries (Tagher 1998, pp. 212-13).

intact, although the guilds headmen became some sort of government officials, helping the state in controlling the guild members (Baer 1964, pp. 77-84).

Religious segregation of guilds reflected religious occupational segregation. Figure (1) shows the shares of the top 15 occupational titles (guilds) out of the adult active male population of each religious group in the traditional sector in 1848 Cairo and Alexandria. Notably, most of the top guilds in which Muslims are concentrated are low-skilled. Christians and Jews are relatively more concentrated in white-collar and high-skilled guilds (scribes, carpenters, merchants, jewelers, moneychangers, tailors).<sup>9</sup> The same pattern of religious occupational segregation existed in late 18<sup>th</sup> and early 19<sup>th</sup> centuries (Raymond 1973, pp. 524-6). Interestingly, it appears that up to the 19<sup>th</sup> century, there was no religious segregation *within* occupations, and “mixed” occupations, i.e. those that had sizeable memberships from different religious groups, had *single* guilds (Raymond 1973, pp. 524-6). However, later evidence suggests that segregation within “mixed” occupations along religious lines may have emerged during the 19<sup>th</sup> century (Raymond 1973, p. 526).

In 1816, Muhammad Ali Pasha (1805-48), the Ottoman viceroy of Egypt, launched the first wave of state-led industrial modernization 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% of Egypt’s modern sector employment), military industries (17%), and other industries (17%), such as printing, paper, coin making, and wood (Al-Gritli 1952, pp. 51-65; M. Fahmy 1954, pp. 21-54). About 70% of these production projects were located in Cairo

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<sup>9</sup> All the statistics in this section come from the author’s calculations from the digitized census samples (See section III for data description and sample restrictions).

and Alexandria,<sup>10</sup> and they differed from the traditional workshops in both technology and size. On the one hand, unlike traditional workshops, state projects employed machines that were a crude imitation (by Egyptian blacksmiths under the supervision of European skilled workers) 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. On the other hand, the estimated median size of the manufactory in 1848 sample is 163 workers, much larger than the 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. 65-66). Nonetheless, by 1868, 67% of his manufactories closed down, and employment in the surviving ones in Cairo and Alexandria dropped by 75%. Traditional accounts for this failure center around: (i) Anglo-Turkish commercial convention (1838) which abolished monopolies and reduced tariffs in the Ottoman Empire, and (ii) London treaty (1841) which limited the size of the Egyptian army, the *raison d'être* of the manufactories (Owen 2002, p. 75-76). 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.

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

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<sup>10</sup> Author's calculations, based on the production projects observed in the 1848 census sample.



recruited 17% of modern sector workers. Cairo and Alexandria were still the major centers of modernization (86% 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 these projects, and the increasing debt (especially for Suez Canal which was opened in 1869) was the major reason behind Egypt's fall under British occupation in 1881. Generally, however, the transportation projects were more permanent than the earlier manufactories and many of these projects survived until today.

## **II.2. *Kuttabs* and Modern Schools**

In 1800, religious institutions were the sole providers of education through the so-called *kuttabs* (religious schools) which were religiously segregated (Heyworth-Dunne 1938, pp. 2-7 and 84-92). The curricula of these elementary schools were mainly religious, but there were important differences between Muslim, Coptic (Christian), and Jewish schools. Basically, Coptic schools taught arithmetic and geometry besides religious subjects, perhaps to prepare the students for their future careers in the administration,<sup>11</sup> a preparation that was supplemented later by apprenticeship.<sup>12</sup> 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). In contrast, Muslim *kuttabs* focused only on learning Arabic orthography through memorizing the

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<sup>11</sup> 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).

<sup>12</sup> See the discussion in section II.1 and footnote 7.

Quran. Besides, 20% of the teachers in Muslim *kuttabs* in 1848 were blind, and thus were unable to teach reading and writing, unlike teachers in Coptic and Jewish *kuttabs*. Higher education was provided solely through Muslim religious institutes and was thus focused on religious training for the preparation of the *ulama*.<sup>13</sup> Overall, the non-Muslim educational system was perhaps more inclined towards “useful” knowledge than the Muslim system.<sup>14</sup>

Public modern schools were introduced in 1816 in reverse order starting with higher (special) schools, and then followed by preparatory schools, and finally primary schools. Four public special schools stand out as the most significant: medicine (1827-54), engineering (1834-54), veterinarian medicine (1827-51), and translation (1836-51).<sup>15</sup> Non-Muslims were *not* admitted to these schools until 1873 (Sami 1928, p. 1123),<sup>16</sup> 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 1840s and 1850s, perhaps in the aftermath of the aforementioned London treaty (Heyworth-Dunne 1938).

### **II.3. Mamluk Regiments and the National Regular Army**

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 Bonaparte’s revolutionary army that

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<sup>13</sup> Al-Azhar was the foremost renowned religious higher educational institution in Egypt since the tenth century. The *ulama* are the Muslim clergy.

<sup>14</sup> See Mokyr (2002 and 2005) on the concept of “useful” knowledge.

<sup>15</sup> 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 seems reasonable to conclude that the indicated periods of operation were indeed the “effective” ones.

<sup>16</sup> According to the 1867 law, non-Muslims were to be allowed to enter governmental *kuttabs* and primary schools (Heyworth-Dunne 1938, p. 363).

conquered Egypt in 1798-1801, and to replace the Mamluk irregular military regiments which were inferior to the European armies in organization and tactics (K. Fahmy 1998, pp. 79-84). During Egyptian military history in the nineteenth century, two military reforms are perhaps the most critical: On the one hand, in 1856, non-Muslims were conscripted as soldiers for the first time; an action that may have led to the integration of non-Muslims in the army (Tagher 1998, pp. 203-4).<sup>17</sup> On the other hand, during Sa'id's reign (1854-63), Egyptians were allowed to be promoted to high commissioned officers ranks, which were previously preserved for the ruling Turkish (Muslim) elite (Al-Raf'i 1987, p. 35). It seems that non-Muslims were not officially excluded from this privilege.<sup>18</sup>

### III. Data

I digitized two systematic nationally representative samples (about 80,000 records each) of the 1848 and 1868 individual-level census records, which are preserved in original manuscripts in Arabic at the National Archives of Egypt, and I also constructed an oversample of non-Muslims in Cairo in both years.<sup>19</sup> The census records are perhaps the earliest individual-level census manuscripts in the Middle East that include information on *every* member in the household including females, children, and slaves. They include

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<sup>17</sup> This occurred in the aftermath of the abolition of the poll-tax on non-Muslims in 1855 (Tagher 1998, p. 204). Conscription was carried out on an arbitrary basis, through the village headmen, and not through a universal scheme (K. Fahmy 1998, pp. 97-9).

<sup>18</sup> Although Heyworth-Dunne (1938, p. 338) reports that the Coptic Pope's request to allow Copts to become officers was not met until the Pope's death in 1861 when it was dropped, there are reasons to conclude that non-Muslims were not *entirely* banned from becoming 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) 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.

<sup>19</sup> Sampling rates are 8-10% in Cairo and Alexandria and 1% in the provinces. The oversampling of non-Muslims is at the rate of 25%. The data source and sampling strategy are described in Saleh (2011).

information on a wide range of variables including location (exact address in the city), dwelling ownership, dwelling type, household relationships, age, gender, ethnicity, nationality, religion, place of origin, legal status (free or slave), occupation (for males), school enrollment (for male children), and infirmities.

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, 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* (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*, 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.<sup>20</sup> Based on the constructed index, I created an alternative categorical variable, the *Occupational Group*, where I collapsed the 12 ordered categories of the Social Status Index into three categories only: white-collar workers, skilled workers, and unskilled workers. In the empirical analysis, I use these two occupational outcomes alternatively.

Second, religion is mostly recorded in the census manuscripts in 1848 but not in 1868, where it was inferred from names.<sup>21</sup> The main religious groups in the census manuscripts are Muslims, Christians, and Jews. The last two groups can often be broken down further

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<sup>20</sup> See data appendix for details.

<sup>21</sup> In Egypt, religion is similar to “ethnicity,” and is thus decided by birth, not by choice, due to the extremely high costs of conversion; hence it is straightforward to infer religion from names.

by denomination, especially when combined with ethnicity. Major Christian denominations observed in the census are Copts (Egyptian Christians), Armenians, Levantines, and *Ruum* (Ottoman Greeks). Observed Jewish denominations are *Rabbis* and *Karaites*.

Third, the modernization measure, in the case of production projects, is an index that takes one if the individual is employed in a state “modern” project. Fortunately, the census takers were generally keen on distinguishing between the individuals who were employed by the state (*miri*) and those who were working in the private or “outside” sector (*barrani*). The reason for this interest on part of the census takers lies, perhaps, in the growing central power of the state over the 19<sup>th</sup> century. For most of the individuals employed by the government, the establishment of work was recorded in the occupation field in the census registers. I constructed a dataset of state “modern” projects, by name, industry, and location in both 1848 and 1868, based on information from both secondary historical sources (M. Fahmy 1954; Al-Gritli 1952; Sami 1928) and the census manuscripts. I then combined this list with the individual-level census records in order to construct the individual-level modernization measure.

Finally, I created a categorical measure, “Industry”, to identify the individual’s industrial affiliation in both traditional and modern sectors. The categories include textiles, transportation, military, other modernized industries, and non-modernized industries.<sup>22</sup> The latter are defined as the industries that exist *only* in the traditional sector, while the first four categories exhaust all industries in the modern sector.

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<sup>22</sup> For example, an animal-driver in the traditional sector and a scribe in the railways in the modern sector both belong to the “transportation” industry. See data appendix for documentation.

Table (1) shows the descriptive statistics by year and urban/rural division for the variables included in the empirical analysis for the sample of adult males who are at least 15 years, including those with missing age. Around 3% (5%) of the adult males in Cairo and Alexandria are unemployed, 3% (3%) are out of labor force (students and retired), and 8% (12%) have missing occupational titles in 1848 (1868). In the other provinces, the percentages of unemployed and out of labor force are negligible but the percentage missing is particularly large at 27% (31%) in 1848 (1868). About half of the employed adult males in Cairo and Alexandria are unskilled workers, but the percentage is much higher in the other provinces at more than 80%, since this category includes farmers. Finally, the religious composition is quite stable across the two years and across urban and rural provinces, with Muslims constituting the vast majority (about 90%), followed by Christians (6-7%), and Jews (1%), but the latter are mainly urban.<sup>23</sup> Throughout the empirical analysis (sections IV and V), the sample is restricted to active/employed males who are at least 15 years old and who have non-missing values for all the variables included in the regressions.

#### **IV. Empirical Analysis: Industrial Modernization**

The empirical strategy in this section examines the impact of being employed in the modern production sector (*Modern*) on occupational attainment and whether this impact varies by religion. Conceptually, *Modern* represents the equilibrium in the labor markets of the state modern projects that are introduced exogenously. Thus, the marginal effect of this variable on occupational attainment is a “combined” effect of labor supply and

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<sup>23</sup> The vast majority of Christians nationwide are Coptic Christians (86%). Yet, there are significant spatial variations. Non-Coptic Christians are concentrated in Cairo and Alexandria and constitute around 40% of the Christian community in these two cities. Almost all Christians outside Cairo and Alexandria are Copts (98%). Jews are mainly urban, and in Cairo are either *Rabbi* (56%), *Karaite* (29%), or unspecified (15%).

demand factors. Supply-side factors include most importantly the unobserved individual skill that may affect the decision to apply for a job at the state projects.<sup>24</sup> Demand-side factors include the technology requirements that dictate the job structure in the state projects, the availability of on-the-job-training as an alternative route to acquire skills away from guilds, and the recruitment policies in the projects. All these factors may vary by religious group *differentially* across the modern and traditional sectors. For example, state projects may only draw skilled non-Muslims and unskilled Muslims to apply for jobs. A state project may be discriminatory against recruiting non-Muslims. State modern projects may also restrict on-the-job-training to Muslims only. I introduce the empirical results in subsections IV.1 and IV.2. I then examine the mechanisms of modernization's impact on occupational attainment and the possible threats to the empirical strategy in subsections IV.3 and IV.4 respectively. Subsection IV.5 examines the impact of industrial modernization on occupational segregation.

#### **IV.1. Technology-Skill Complementarity of State Modern Projects**

I first examine the skill complementarity of the technology used in the two waves of industrial modernization, by comparing it to that of the traditional sector: Did the technology employed in each wave increase the demand for skills, compared to the traditional sector, or was it rather low-skill-biased? For example, evidence from the U.S. suggests that the First Industrial Revolution was “de-skilling,” (Goldin and Sokoloff 1982; Atack et al. 2004), but that the demand for skills rose with the Second Industrial Revolution (Goldin and Katz 1998). To this end, I estimate the following individual-level ordered categorical regression for 1848 and 1868 separately:

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<sup>24</sup> Skills were constrained by the guild structure. Jews, despite having higher school enrollment than Christians in 1848, did not work as scribes, which was a Christian-dominated occupation. They instead dominated the financial jobs.

$$(1) \text{Probability} (\text{Social status index}_{ij} = m) = F(\alpha_j + \beta \text{Modern}_{ij} + \delta X_{ij} + \varepsilon_{ij})$$

Where the probability that the *social status index* of an individual  $i$ , residing in district  $j$ , takes the level  $m$  ( $m = 1, \dots, 12$ ) is a function  $F(\cdot)$  that depends on *Modern*, an index for employment in the modern production sector.  $X_i$  is a vector of individual characteristics: age, slave dummy, foreigner dummy, black dummy, and migrant dummy.  $\alpha_j$  are district fixed effects to account for variation in spatial proximity to the modern projects.<sup>25</sup>  $\varepsilon_{ij}$  is an error term.

The results are shown in table (2), panel (A). In 1848, as an individual is recruited in the modern sector, his odds of being at the highest level of the social status index versus the combined lower levels go down by a factor of 0.25, holding other variables constant. In contrast, recruitment in the modern sector in 1868 increases the odds of having the highest social status level versus the combined lower levels by a factor of 2, holding other variables constant. This implies that the technology of the first wave of modernization was *overall* low-skill-biased in the sense that it increased demand for low-skilled workers, while the technology of the second wave was skill-complementary. Moreover, the regional estimates suggest a stronger low-skill-bias of state projects in the rural provinces in comparison to Cairo and Alexandria in the 1848 wave. I do not estimate the regression for the rural provinces in 1868 because of the small number of workers in the modern sector in the sample from these provinces (13 workers).

Relative demand for skills may vary from one industry to another, as technology varies across industries in the state projects. In order to identify which industries account for the

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<sup>25</sup> The limited number of districts in 1848 and 1868 (97 and 53 respectively) relative to the number of observations (18,146 and 18,968) mitigates the concerns about the incidental parameters problem when including district fixed effects in the ordered categorical regression.



technology-skill complementarity or lack thereof in each wave, I estimate the following ordered categorical regression:

$$(2) \text{Probability}(\text{Social status index}_{ij} = m) = F(\alpha_j + \beta \text{Industry}_{ij} + \gamma (\text{Industry}_{ij} \times \text{Modern}_{ij}) + \delta X_{ij} + \varepsilon_{ij})$$

Where the probability now depends on: (i) *Industry*, a full set of dummies for the industrial affiliation of the individual, as defined in section III, and (ii) a full set of interactions between *Modern* and *Industry*. Notice that *Industry* exhausts all industries that exist in the modern sector.

The results are shown in table (2), panel (B). Moving from the traditional textiles industry to a modern textile manufactory reduces the odds of being at the highest social status versus the combined lower levels by a factor of 0.02 (0.07) in 1848 (1868). Working in the traditional textiles industry itself, as opposed to the non-modernized industries in the traditional sector, increases the odds of having the highest social status by a factor of 2.04 (1.40) in 1848 (1868). On the other hand, the move from the traditional transportation industry to a modern transportation project in 1868 increases the odds of the highest social status substantially, by a factor of 24.95 (the effect is positive but statistically insignificant in 1848). Traditional transportation workers, on their part, have much smaller odds of the highest social status compared to their fellows in the non-modernized industries by a factor of 0.08 (0.13) in 1848 (1868).<sup>26</sup> Overall, the impact of modernization is qualitatively similar across urban and rural provinces in 1848.

Hence, the low-skill-bias of the 1848 industrial modernization wave originated primarily from the low-skill-bias of the technology of the textile manufactories, which employed

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<sup>26</sup> Traditional textile workers are primarily skilled artisans, such as weavers, spinners, and dyers, while traditional transportation workers are primarily unskilled workers, such as animal drivers and boatmen.

the largest share of modern sector workers (66%). Conversely, the skill-complementarity of the 1868 wave is mainly because of the modern transportation projects, such as the railways, telegraph, and steam navigation, which increased the relative demand for skills, and which recruited 58% of the workers in the modern sector. Overall, the findings seem to be consistent with the evidence from industrialized countries. For example, Goldin and Sokoloff (1982) pointed out that the textiles industry made an intensive use of women and children, as unskilled workers, in the early industrialization phases in the U.S. Also, improvements in the transportation industry increased the demand for skills in the U.S. in the early 20<sup>th</sup> century (Goldin and Katz 1995).

#### **IV.2. State Production Projects, Religion, and Occupational Differentials**

Having examined technology-skill complementarity in the state production projects, I now turn to examine the impact of industrial modernization in both 1848 and 1868 on inter-religious differentials in occupational attainment: Did religious groups benefit (or were hurt) *equally* by the new demand for labor that the projects created or were specific groups poised to benefit more than others? Put differently, did modernization reduce or aggravate religious occupational differentials?

In table (3), I conduct a simple difference-in-differences exercise in each census year to examine the religious differentials across the traditional and modern sectors with respect to *White-Collar Index*, an index for occupations in the white-collar workers category in the *Occupational Group* measure. I exclude Jews from this exercise because of the very small number of Jewish workers in the modern sector. In the traditional sector, in both 1848 and 1868, Christians are more likely than Muslims to be white-collar workers. The impact of employment in state modern projects seems to vary by religion. In both years,

Christians in the modern sector are more likely to be white-collar workers than their coreligionists in the traditional sector. On the contrary, Muslims in the modern sector are worse off, on average, than Muslims in the traditional sector in 1848, but better off in 1868. Overall, the Christian-Muslim white-collar gap in the modern sector is wider than that in the traditional sector in both 1848 and 1868.

In order to control for individual characteristics, I estimate the following regression:

$$(3) \text{Probability}(\text{Occupational Attainment}_{ij} = m) = F(\alpha_j + \beta \text{Modern}_{ij} + \gamma \text{Christian}_{ij} + \pi \text{Jew}_{ij} + \delta(\text{Modern}_{ij} \times \text{Christian}_{ij}) + \theta X_i + \varepsilon_{ij})$$

Where the occupational attainment of an individual  $i$  in a district  $j$  is a function  $F(.)$  that depends on *Modern*, the index for employment in the modern production sector, *Christian* and *Jew*, indexes for religious affiliation, and the interaction of *Christian* and *Modern*.  $X_i$  and  $\alpha_j$  are defined as in equations (1) and (2).

Column (1) of table (4) introduces the results from the ordered logit regression where *Social Status Index* is the dependent variable. In both 1848 and 1868, the odds of having the highest social status level versus the combined lower levels for a Christian in the traditional sector are about 3 times greater than for a Muslim in the same sector. For a Jew in the traditional sector, the odds of having the highest social status are 1.59 times greater than a for a Muslim in 1868, but are insignificantly different in 1848. Employment in the modern sector has a negative impact on Muslims in 1848 as it reduces the odds of the highest social status by a factor of 0.18, but it increases the odds by a factor of 1.74 in 1868, compared to Muslims in the traditional sector. On the contrary, Christians benefit from employment in the modern sector which increases a Christian's odds of having the highest social status by a factor of 2.29 (0.18\*12.70) in 1848 and 1.74

in 1868, compared to Christians in the traditional sector. Compared to a Muslim in the traditional sector, a Christian in the modern sector has higher odds of being at the highest social status level by a substantial factor of 35.94 ( $2.83 \times 12.70$ ) in 1848, and a much smaller factor of 3.13 in 1868. The Christian-Muslim occupational gap in the modern sector is thus wider than the gap in the traditional sector by a large factor of 12.70 in 1848, but the difference between the two gaps is marginally insignificant (although still positive) in 1868.

As an alternative model, I estimate the multinomial logit regression, where the dependent variable is the alternative unordered occupational measure, *Occupational Group*, where I allow the coefficients to vary by outcome. The results are in columns (2) and (3) of table (4). I find that the better occupational outcomes of non-Muslims than Muslims in the traditional sector are in both skilled and white-collar occupations. For example, compared to Muslims in the traditional sector, a Christian in the same sector has greater odds of working as a skilled worker (a white-collar worker) versus unskilled worker by a factor of 5 (7) in both 1848 and 1868. On the other hand, if a Muslim is employed in the modern sector in 1848, his odds of being a skilled worker are not altered, but his odds of being a white-collar worker are smaller than a Muslim in the traditional sector by a factor of half. In 1868, his odds of being a skilled worker and his odds of being a white-collar worker are both larger by a factor of 1.49 and 3.33 respectively.

In 1848, the Christian-Muslim gap with respect to the odds of being a skilled worker versus an unskilled worker is not altered by employment in the modern projects. However, the gap with respect to the odds of white-collar worker versus unskilled worker

in the modern sector is wider than the gap in the traditional sector by a factor of 7.75 in 1848. In 1868, both gaps are unaltered by modernization.

I finally examine whether the impact of industrial modernization on religious occupational differences varied by industry. In particular, I run the following ordered logit regression:

$$(4) \text{Prob}(\text{Social status index}_{ij} = m) = F\left(\alpha_j + \beta \text{Christian}_{ij} + \gamma \text{Jew}_{ij} + \delta \text{MainIndustry}_{ij} + \theta(\text{MainIndustry}_{ij} \times \text{Christian}_{ij}) + \varphi \text{Modern}_{ij} + \mu(\text{MainIndustry}_{ij} \times \text{Modern}_{ij}) + \pi(\text{Modern}_{ij} \times \text{Christian}_{ij}) + \tau(\text{MainIndustry}_{ij} \times \text{Modern}_{ij} \times \text{Christian}_{ij}) + \rho X_{ij} + \varepsilon_{ij}\right)$$

Where *MainIndustry* = textiles in 1848 and transportation in 1868. The results are shown in column (4). Holding else constant, a Muslim in **modern** textiles (transportation) projects in 1848 (1868) is worse (better) off than a Muslim in the **traditional** non-textiles (non-transportation) sector. He has lower odds of having the highest social status by a factor of 0.05 (0.99\*2.58\*0.02) in 1848, and higher odds, by a factor of 3.06 (0.48\*0.14\*45.48), in 1868. However, a Muslim in **modern** non-textiles manufactories in 1848 does not have significantly different outcome from a Muslim in the **traditional** non-textiles sector, while a Muslim in **modern** non-transportation projects in 1868 is worse off than a Muslim in the **traditional** non-transportation sector by a factor of 0.48.

Unlike Muslims, a Christian in the modern sector in both industries is better off than his coreligionist in the traditional non-textiles (non-transportation) sector in 1848 (1868). In 1848, he has greater odds of having the highest social status by a factor of 2.45 (0.99\*2.39\*2.58\*0.39\*0.02\*51.43), if he is employed in a modern textiles manufactory and 2.37 (0.99\*2.39), if he is employed in a modern non-textiles manufactory. In 1868,

his odds are greater by a factor of 2.69 ( $0.48*6.25*0.14*0.74*45.48*0.19$ ) and 3 ( $0.48*6.25$ ) if he is employed in modern transportation and non-transportation projects respectively. Consequently, the religious occupational gap in both textiles and non-textiles modern manufactories in 1848 is wider than the gap in the traditional non-textiles sector by a factor of 47.93 ( $2.39*0.39*51.43$ ) and 2.39 respectively. In 1868, the gap in modern transportation projects is smaller than the gap in the traditional non-transportation sector by a factor of 0.87 ( $6.25*0.74*0.19$ ) but the gap in modern non-transportation projects is wider by a factor of 6.25.

The findings in table 4 suggest that while modernization widened the Christian-Muslim occupational gap compared to the gap in the traditional sector in 1848, it had less of an effect on the occupational gap in 1868. The underlying reason for that stems from the downward mobility of Muslims in the 1848 modern textile manufactories, and their upward mobility in the 1868 modern transportation projects. Christians, on the contrary, experienced upward mobility by employment in state modern projects in *all* industries and in *both* modernization waves. In the next subsection, I will examine the possible mechanisms that may account for these findings.

#### **IV.3. Mechanisms of Modernization: Technology/Selection or Job Training?**

Two possible mechanisms may account for the major findings in table 4, that modernization widened the religious occupational gap in 1848 (less so in 1868), that Christians experienced upward mobility in both years, and that Muslims experienced downward (upward) mobility in 1848 (1868): (i) *Technology/Selection*: the technology-bias of the modern sector favored the skills which Christians possessed in 1848 but less so in 1868, and so there was positive selection for Christians and negative selection for

Muslims based on their skills, compared to the traditional sector. According to the selection mechanism, the traditional guilds are the sole route for the acquisition of skills, and modern projects are merely “recruiters,” that hire workers based on observed skills.<sup>27</sup>

(ii) *Job Training*: modernization actually provides training to acquire skills away from the guilds, and thus selection on skills plays a lesser role. Training effect can be either positive or negative depending on the relative social status of the jobs (compared to traditional sector) for which training is provided. According to this mechanism there was presumably “positive” training effect on Christians in both 1848 and 1868. The training effect on Muslims was negative in 1848 but positive in 1868.

To examine these mechanisms, I classify occupations in the modern sector into two types: “overlapping” occupations, i.e. those that exist in both traditional and modern sectors, and “new” occupations, i.e. those that exist solely in the modern sector, and were thus presumably *created* by modernization.<sup>28</sup> In this classification, the “overlapping” occupations, which recruited 73% and 66% of modern sector employment in 1848 and 1868 respectively, proxy for “guild-based” occupations, since these occupations have corresponding guilds in the traditional sector, that provided training through apprenticeships. They thus proxy for “technology/ selection” effect. On the other hand,

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<sup>27</sup> The observation that only *three* Jews are observed in the modern sector in the sample, all in modern banks, may also be explained using the technology argument. Since skills were guild-specific, Jews did not have a tradition in administrative occupations, but their comparative advantage lied in financial occupations. Hence, it was only the technology of the modern banks that benefited Jews by increasing the demand for their skills.

<sup>28</sup> Examples for “new” occupations include telegraphers, train drivers, ticket conductors on trains and trams, factory workers, and printing workers. Examples for “overlapping” occupations, on the other hand, include scribes, carpenters, blacksmiths, weavers, and porters. In general, almost every occupation in the traditional sector had a guild (See section II.1). Nonetheless, a few “overlapping” occupations, such as engineers, physicians, military officers, and managers are education-based or military-based rather than guild-based, and are thus an outcome of modernization in its broader sense. Also job training might have been provided for some of these “overlapping” occupations. I will examine the impact of modernization on professional and military occupations in section V. However, since my interest here lies in identifying the training effect of *industrial* modernization per se, I chose a rather conservative definition of “new” occupations that can be safely attributed to job training provided by the state industrial projects.

“new” occupations are a proxy for “training-based” occupations, because they did not possess guilds to provide training to employees prior to recruitment.<sup>29</sup> I construct an index for working in a “new” occupation in the modern sector, “New,” and I extend equation (3) to distinguish between “overlapping” and “new” occupations within the modern sector:

$$(5) Prob(\text{Social status index}_{ij} = m) = F(\alpha_j + \beta \text{Modern}_{ij} + \gamma \text{Christian}_{ij} + \pi \text{Jew}_{ij} + \rho (\text{Modern}_{ij} \times \text{New}_{ij}) + \delta (\text{Modern}_{ij} \times \text{Christian}_{ij}) + \tau (\text{Modern}_{ij} \times \text{New}_{ij} \times \text{Christian}_{ij}) + \theta X_i + \varepsilon_{ij})$$

Notice that the technology/ selection effect on Muslims (i.e. being in an “overlapping” or a guild-based occupation) is captured by *Modern*, while the training effect on Muslims is captured by the interaction between *Modern* and *New*. For Christians, each of the technology and training effects are augmented by *Christian* effect. The results are shown in table (5). In 1848, the technology/selection and training effects on Muslims are both negative (0.429 and 0.07 respectively). On the contrary, Christians’ upward mobility is because of the positive technology/selection effect (0.429\*6.629). The training effect on Christians is, however, negative (0.07\*0.05) and stronger than the effect on Muslims. In 1868, the upward mobility of both Christians and Muslims is because of a positive technology/selection effect that is stronger for Christians. The training effect is insignificant for Muslims but negative on Christians. Finally, I find that job training narrows the religious occupational gap compared to the gap in the guild-based

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<sup>29</sup> There is considerable historical evidence in Sami (1928) on the provision of training for recruits in the “new” occupations in both the 1848 and 1868 waves. Evidence includes workers in glass manufacturing (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 interesting state order in 1866 (Vol. 3, p. 652) introduced telegraph as one of the subjects to be taught to students in public schools in order to satisfy the need for telegraphers in the railways.



occupations in the modern sector and the gap in the traditional sector in both years. Its effect is outweighed, however, by the technology/selection effect.

This analysis suggests that technology/selection is what accounts for the observed wider religious occupational gap in the modern sector in 1848 and to a lesser extent in 1868. The technological change embodied in the state modern projects relatively favored Christian skills in 1848 but to a lesser extent in 1868. State projects created new routes for acquiring skills through job training in the newly created occupations which were presumably more open to individuals than the occupations dominated by the closed guild system. However, the training effect is either negative or insignificant because of the average social status of the “new” occupations created.

#### **IV.4. Examining the Validity of the Empirical Strategy**

Three underlying assumptions in the empirical strategy have to be closely examined: First, that the labor markets in the modern sector are free markets in which everyone *chooses* his occupation. Second, that the traditional sector in each census year represents a valid counterfactual that captures what the individuals’ occupational attainment would have been like in the absence of state-led modernization. Third, that there are no significant differences in the religious *biases* of the recruitment policies across the modern and traditional sectors that may drive the results.

With respect to the first assumption, while the 1868 state projects recruited individuals who applied voluntarily for the jobs, workers were *drafted* into the 1848 manufactories (Owen 2002, p. 76; Marsot 1984, pp. 181-5). Ghazaleh (1999, p. 122) and Sami (1928, Vol. 2, p. 374) describe the procedures by which drafting took place; headmen of urban districts were responsible for arbitrarily drafting a specified number of individuals from

their districts to work in the manufactories upon direct orders from the government. Workers were in general discontent about working in the manufactories and cases of flight were recorded (Ghazaleh 1999, pp. 122-3). Nevertheless, it is unlikely that drafting was applied for recruitment in higher management and white-collar jobs. Also, historical evidence suggests that matching skill with job characteristics was the main criterion used in recruitment, be it by drafting or voluntary application.<sup>30</sup>

The second assumption is violated if state modern projects generate general equilibrium effects, such as crowding-out of private producers via competition in the output markets. Such effects, if any, may distort the occupational structure of the traditional sector making it an invalid counterfactual.<sup>31</sup> To examine the possibility of general equilibrium effects, I first observe that the employment share of the modern sector is 7% and 3% 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% and 0.3%.<sup>32</sup> These numbers indicate a significant modern sector which is not, however, large enough to generate general equilibrium effects. This observation is further confirmed by estimating the following regression at the district-level:

$$(6)ThreatIndustry_{jt} = \alpha_j + \beta_{1868} + \gamma Projects_{jt} + \varepsilon_{ij}$$

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<sup>30</sup> For example, a state order in Sami (1928) (Vol. 2, p. 279) asserts that recruits 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 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).

<sup>31</sup> Forced crowding-out through drafting of private producers into state projects is also possible and has been documented in Owen (2002, p. 69) especially in the case of textile workers.

<sup>32</sup> Marsot (1984, p. 181) cites a much higher employment at 20-25% 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 modern projects.

Where *ThreatIndustry* is the percentage of employed adult males in the district who work in a “threatened” industry in the traditional sector; i.e. an industry in which a state project has been established. *Projects* is the supply of state projects in the “threatened” industry in the district.  $\alpha_j$  is district fixed effects, and  $\beta_{1868}$  is 1868 year fixed effect. I estimate equation (6) for each “threatened” industry separately, and I conduct the analysis at the district- level to have a meaningful output market. The results are shown in table (6). In all three industries: textiles, transportation, and military, the coefficient on *Projects* is either insignificant or positive, thus implying no crowding-out effects.

To examine the third assumption, I compare the religious composition *within* the “overlapping” occupations across traditional and modern sectors. My rationale is that if the religious bias of recruitment policies differed across traditional and modern sectors, one should observe different religious composition of the “overlapping” occupations, on average, across the two sectors. In 1848, the average percentage of Christians in the overlapping occupations in the traditional and modern sectors is 8% and 6% respectively. In 1868, the percentages are almost identical across the two sectors (7%).<sup>33</sup> In figure (2), I show the percentage of Christians in the large (> 9 workers in each sector) “overlapping” occupations in both sectors. These occupations constitute 55% (53%) of the modern sector employment in 1848 (1868). Overall, it appears that the religious distributions

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<sup>33</sup> The z-statistic for test of equality of proportions across sectors is 0.005 and -0.003 in 1848 and 1868 respectively. The number of “overlapping” occupations in 1848 and 1868 is 44 and 43 respectively. It is thus equal, by construction, across sectors. The computed average percentage of Christians in each sector is the average of the percentages of Christians over “overlapping” occupations in that sector, weighted by the occupation size. The occupational percentage of Christians is calculated from the systematic sample only.

within these occupations are very similar across the two sectors. This suggests that the religious bias of recruitment policies did not generally differ across the two sectors.<sup>34</sup>

#### **IV.5. State Production Projects and Religious Occupational Segregation**

Were state modern projects more integrated across religious groups than the traditional guilds? Was the emerging working force in the state modern projects, which constituted the nucleus of the workers' collective action movement in Egypt, more integrative of religious groups? I measure occupational segregation by two segregation indexes, dissimilarity and isolation. Dissimilarity index measures the share of the Christian population that would need to change occupation so that religious groups are evenly distributed across occupations within the sector (traditional or modern). Isolation index, on the other hand, measures the percentage of Christians in the occupation practiced by the average Christian (Cutler and Glaeser 1997).

Table (7) shows the occupational segregation indexes for the traditional and modern sectors in 1848 and 1868, and for each of the “old”, “overlapping”, and “new” occupations, where “old” occupations are those that exist in the traditional sector only. I find that occupational segregation is not attenuated by modernization, and that the working force in the state modern projects was equally segregated as the working force in the traditional sector. Interestingly, occupational segregation is not restricted to guild-based occupations and is equally large in the “new” occupations.

The result seems to be consistent with considerable historical evidence that suggests that recruitment policies of the modern sector generally preserved the guild structure. The

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<sup>34</sup> One concern here is that the religious bias of recruitment policies in the “new” occupations may have been different from the traditional sector. In fact, evidence cited in Heyworth-Dunne (1938, p. 338) suggests that the government did not hire Copts as printing workers (!). However, the analysis in subsection IV.3 shows that the main findings are driven by technology/selection mechanism which is affected by the policies in the “overlapping” occupations only.

account books of the largest textile manufactory in Egypt in 1823 classified workers by guilds (Ghazaleh 1999, p. 131). Ghazaleh (1999, pp. 122-3) cites several events in which the government resorted to the guilds headmen in order to solve problems with workers in the state projects. Baer (1964, p. 94) states explicitly 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 modern industrial institution, Alexandria port. Baer (1964, p. 108) also mentions that the 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.

## **V. Empirical Analysis: Educational and Military Modernization**

### **V.1. Public Modern Schools**

In this subsection, I first evaluate the impact of the four major public civil modern schools of higher education: engineering, medicine, veterinarian medicine, and translation on religious differentials in occupational attainment. I then examine whether the modern schools, both public and private, that emerged in Egypt in the first half of the 19<sup>th</sup> century and grew relatively fast since then, acted as an integrating device for religious minorities, or they were rather equally segregated as the traditional *kuttab*s.

With regard to the first question, I estimate the following linear probability regression:

$$(7) Professional_{ij} = \alpha_j + \beta_t + \gamma Nonmuslim_{ij} + \delta Tcohort_{ij} + \pi Ycohort_{ij} + \theta(Nonmuslim_{ij} \times Tcohort_{ij}) + \tau(Nonmuslim_{ij} \times Ycohort_{ij}) + \rho Z_{ij} + \varepsilon_{ij}$$

In this regression, *Professional* is an index for working in a professional occupation (engineer, physician, pharmacist, veterinarian, medical assistant, nurse, translator, or

interpreter). *Nonmuslim* is an index for being non-Muslim. *Tcohort* is an index for the “treated” cohort (1812-34) that was poised to benefit from the public modern schools that existed over the period 1827-54.<sup>35</sup> *Ycohort* is an index for the younger untreated cohort that was born in 1834-47 and thus did not benefit from the schools which were closed by the time the cohort was in higher education age. The base cohort in the regression is the older untreated cohort that was born in 1778-1812 and was hence too old to enter these schools by the time they were opened. Identifying the effect of modern schools comes from differences in availability of public modern schools across cohorts of birth. *Z* is a vector of individual-level characteristics including slave index, foreigner index, black index, migrant index, census year dummy, and an interaction of the foreigner index with both the treated birth cohort and the younger untreated cohort. I restrict the sample in this regression to employed males who are 21-70 years old in each census year, and I pool the two census years together in order to obtain a reasonable number of individuals in each birth cohort in the professional occupations.

Table (8), column (1), shows the results. The coefficients should be interpreted as the lower bound of the true effects of public modern schools, since graduates of these schools may have worked in other professional occupations such as production managers, and high governmental officials, which are not directly related to the fields they specialized in. Non-Muslims in the older untreated birth cohort are not statistically different from Muslims (although the estimated effect is positive at 0.3 percentage point), holding other variables constant. Muslims in the “treated” birth cohort are more likely to work in a

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<sup>35</sup> I assume that students enter these schools for a period of five years, from age 15 to 20, which is consistent with our knowledge about the admission system in these schools (Sami 1928, Vol. 3(3), p. 1123). Thus, the first cohort eligible for these schools was born in 1812, and the last cohort was the one born in 1834.

professional occupation by 0.4 percentage point than their coreligionists in the older untreated cohort. The difference between the “professional” gap between Muslims and non-Muslims in the treated cohort and the corresponding gap in the old cohort is negative and marginally significant (p-value = 0.15). Equally important here is the finding that the younger “untreated” cohort is insignificantly different from the older untreated cohort, thus lending support to the hypothesis that it was the public modern schools, rather than general trend effects, that explain the observed upward mobility of Muslims towards high-profile occupations in the treated cohort.

The finding that Muslims benefited from public modern schools more than non-Muslims comes as no surprise given the institutional ban on non-Muslims from entering these “special” schools until 1873. Non-Muslims probably had to resort to informal training methods (through guilds), or training outside Egypt, in order to enter these high-profile occupations. It is important to report in this context that 75% of non-Muslims in professional occupations in the sample are foreigners, compared to 0.6% among Muslims. Thus, it is plausible to conclude that public modern schools provided upward mobility routes for local Muslims to replace foreign non-Muslims in professional occupations. In support of this claim, one observes that the foreigner-local professional gap is narrower in both the treated cohort and the younger untreated cohort than in the old cohort (although not significantly).

To examine religious segregation in modern schools, I show in table (9) the religious composition of students in religious schools, public modern school, and private modern schools at both pre-higher and higher educational levels in 1848 and 1868. It is evident from the table that the modern schooling introduced in the 19<sup>th</sup> century was equally

religiously segregated as the traditional religious system. Interestingly, non-Muslim students shifted from religious schools to modern schools in 1868 more so than Muslim students (40% as opposed to 4%), who still resorted to religious schools both at the elementary (*kuttab*) and higher levels. However, while non-Muslims entered private modern schools, which were mostly foreign, modern schooling for Muslims meant only public schools.

## V.2. The National Regular Army

Allowing Egyptians to be promoted to high commissioned officers' ranks under Sa'id (1854-63) provided a major channel for upward mobility. Egyptian officers later played a pivotal role in establishing the national identity in opposition to the ruling Turkish elite and the rising European powers in two major coups in 1881 and 1952. Equally important is conscripting non-Muslims in the army in 1855. My goal in this subsection is to examine whether the first reform benefited both Muslims and non-Muslims equally, and whether both reforms integrated non-Muslims into the newly established army. In particular, I estimate the following regression:

$$(8) CommOfficer_{ij} = \alpha_j + \beta_t + \gamma Nonmuslim_{ij} + \delta Mcohort_{ij} + \theta (Nonmuslim_{ij} \times Mcohort_{ij}) + \rho Z_{ij} + \varepsilon_{ij}$$

In this equation, *CommOfficer* is an index for being a military commissioned officer. *Mcohort* is an index for the "treated" cohort (1838-47) that was poised to benefit from the first reform.<sup>36</sup> The base cohort in the regression is the older cohort that was born in 1778-1838. The other regressors are defined and the sample is restricted as in equation (7).

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<sup>36</sup> Since I could not find a specific date for the first reform, I assume it took place in the middle of Sa'id's reign, i.e. in 1858/59. I assume that the promotion to commissioned officer's rank occurs at 20 years old which is the average age of graduation from military schools.



The results are shown in table (8), column (2). Non-Muslims in the untreated older cohort are less likely to be officers than Muslims, holding other variables constant. Muslims in the treated cohort are more likely to be commissioned officers than their coreligionists in the older cohort (1778-1838), and the gap between Muslims and non-Muslims is even wider in this cohort in favor of Muslims. Interestingly, foreigners in the older cohort are more likely to be officers than locals (since Turks originally dominated the commissioned officers' body before the reform). The foreigner-local gap is not affected by the reform, however.

Two caveats in the previous regression are the missing age for 32% of the officers in the sample,<sup>37</sup> and the extremely small number of non-Muslim officers. These concerns make it impossible to evaluate the second reform, conscripting non-Muslims, using regression analysis. Instead I examine the religious and nationality composition of the body of the Egyptian regular army in the sample (including those with missing age and nationality) across 1848 and 1868 in Table (10). The army is overwhelmingly Muslim in both 1848 and 1868, but there is a rise in the share of non-Muslims in the total military personnel from 1% to 3% (still below their population share of 7%) between the two years, perhaps as a result of the 1856 reform. Although Egyptian non-Muslims had access to commissioned officers' ranks by 1868, their representation in the army remained mainly at the soldier level. Egyptian Muslims, on the other hand, improved their lot vis-à-vis the Turkish officers from 40% of the officers' body in 1848 to 69% in 1868. Thus, overall, it appears that the officers' promotion reform benefited mainly Egyptian Muslims, while the non-Muslims' conscription reform increased their access to the army as soldiers in

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<sup>37</sup> Military personnel were usually not enumerated in the 1848 and 1868 census manuscripts as they were to be enumerated in an "undiscovered" military census. Their census returns thus only include name, location, occupation, and nationality. See Saleh (2011) for more details.

1868. Their representation in the army, however, was still below their national share, thus suggesting they were not fully integrated yet.

## **VI. Conclusion**

State-led modernization in 19<sup>th</sup> century Egypt was perhaps *the* most significant institutional intervention in the Middle East since the Ottoman conquest in the 16<sup>th</sup> century. The state's intense modernization programs in production, education, and the army, strongly shook the inherited medieval institutions that preserved deeply-rooted inequalities, most importantly between religious groups. Using a sample that I digitized of the 1848 and 1868 Egyptian census manuscripts, the earliest individual-level data source in the Middle East, I examined in this paper the impact of perhaps the most important aspects of this modernization experiment on the religious human capital gap and on religious occupational segregation. I found that industrial modernization, because of its technology and its relative demand for skills, widened the religious human capital gap in its first wave, but to a lesser extent in its second wave, where it led to upward mobility among Muslims. Educational and military modernization, on the other hand, benefited Muslims more than non-Muslims, and increased their access to high-profile jobs, such as physicians, engineers, and military high commissioned officers especially in the face of foreign non-Muslims and the Turkish Muslim elite. Nevertheless, I have to emphasize here that the impact of these reforms was limited to a small segment of the Muslim population and thus did not lead to a catching-up effect with respect to the overall human capital gap with non-Muslims. Moreover, in all three modern institutions, industrial establishments, modern schools, and the regular army, religious occupational

segregation was hardly affected and the modern establishments were equally segregated as the old ones.

Despite the Egyptian state's relatively early attempts at modernization and assimilation of non-Muslim minorities, religious occupational divisions persisted throughout the 19<sup>th</sup> century, and were carried over to the emerging modern institutions, which were segregated along new lines that resembled the old institutional divisions. Modernization thus induced a transformation that was yet *reluctant* to integrate religious groups mainly because the traditional institutions in production and education, guilds and *kuttab*s, remained the main route for skill-acquisition. The new channels for occupational mobility, namely, job training in state industrial projects, modern schools, and the access to high military ranks, that were created by modernization, were themselves segregated.

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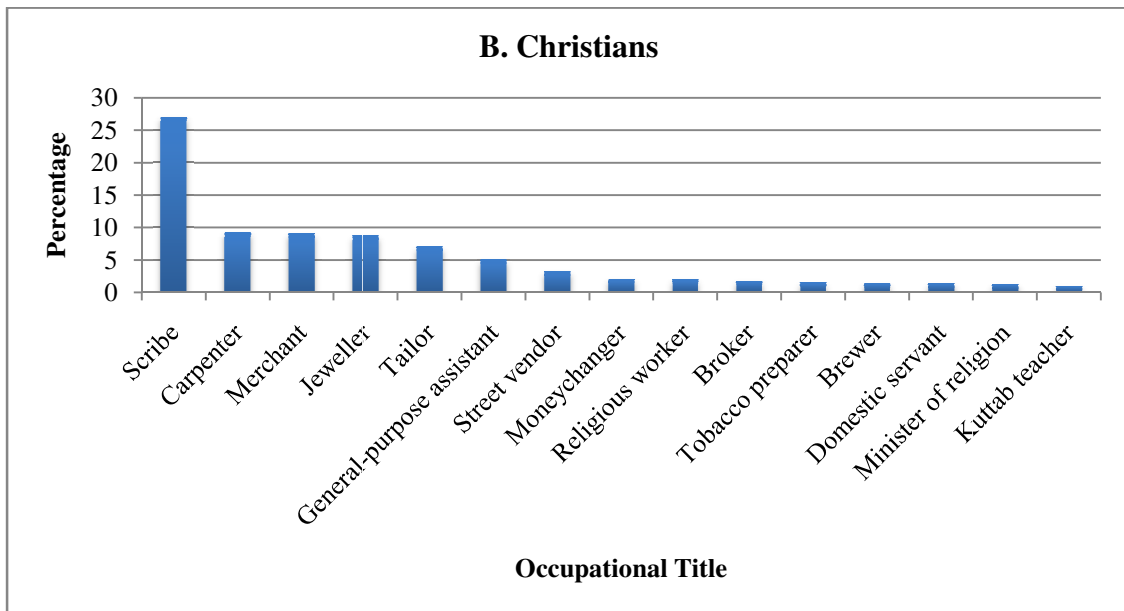
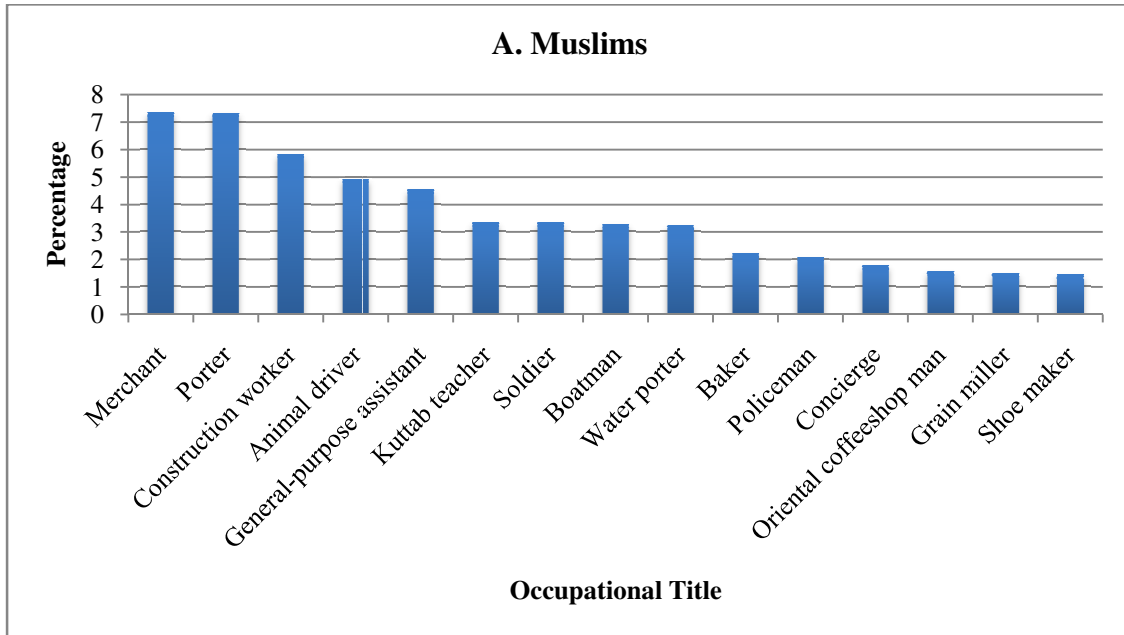
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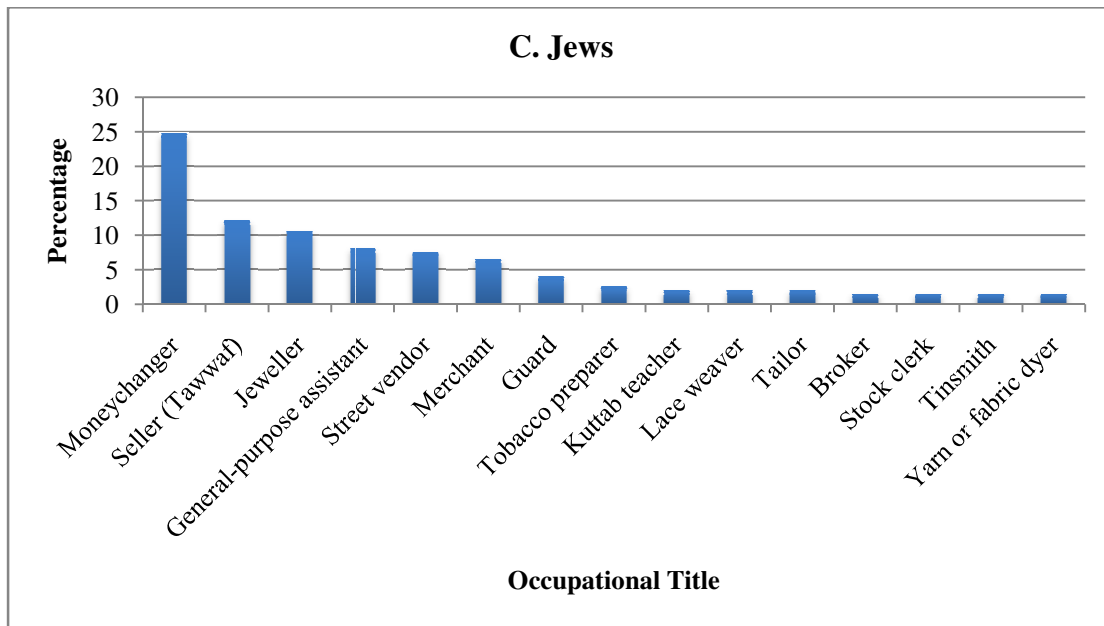
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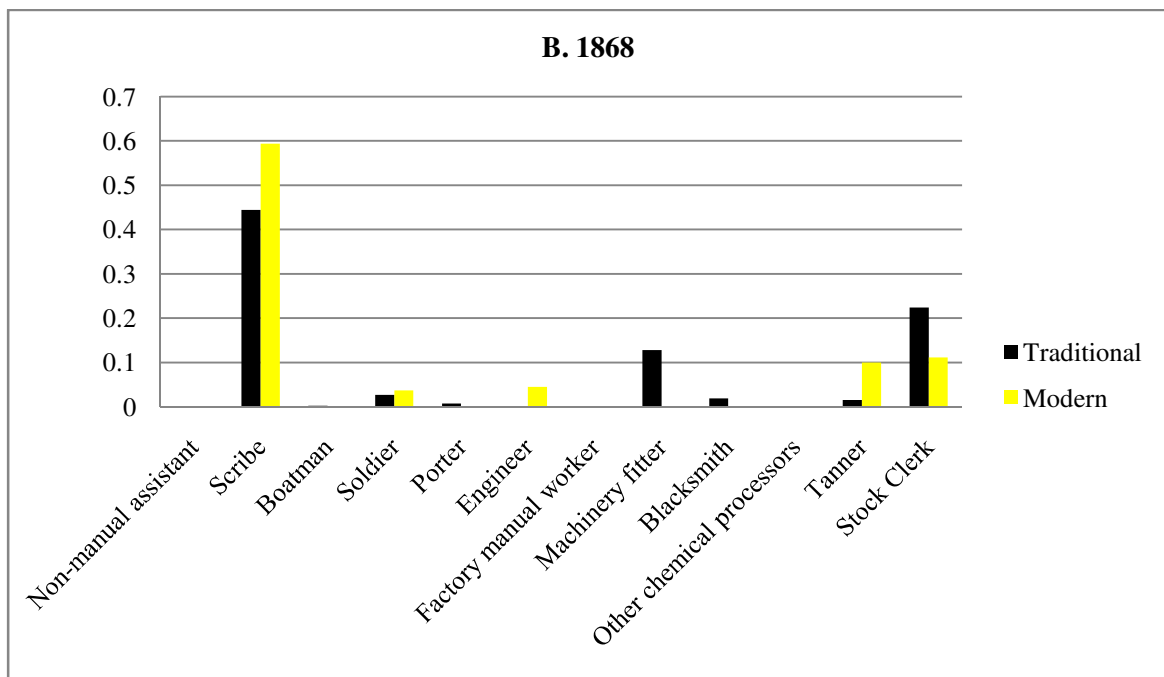
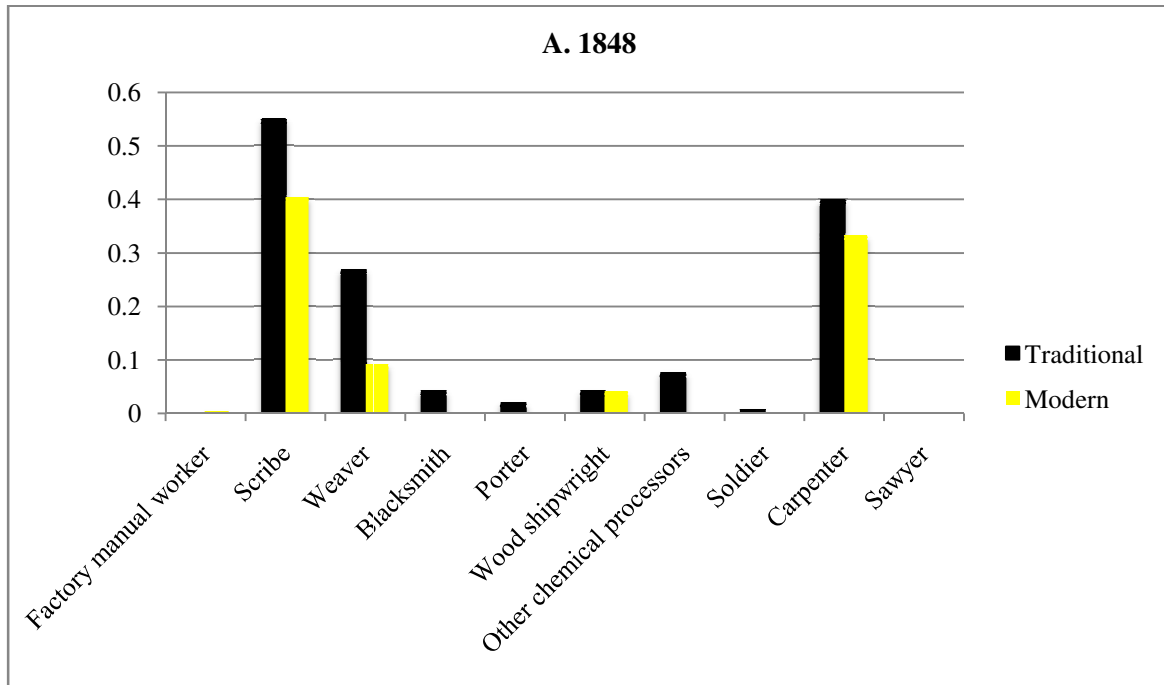
**Figure (1): Shares of Top 15 Occupational Titles by Religious Group in 1848 Urban Egypt**





Sample is restricted to males employed in the traditional production sector who are at least 15 years old, including those with missing age, and who reside in Cairo and Alexandria in 1848. Statistics are based on the systematic sample only, and are weighted to account for the different sampling rates across the two provinces. Each figure represents the occupational distribution within the relevant religious group. N (Muslims) = 8,175; N (Christians) = 687; and N (Jews) = 96.

**Figure (2): Percentages of Christians in the Large "Overlapping" Occupations in Traditional and Modern Sectors**



Sample is restricted to males employed in the “overlapping” occupations in both the traditional and modern sectors who 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 size in the modern sector, from the largest to the smallest.



**Table (1): Descriptive Statistics**

Variable	1848		1868	
	Cairo and Alexandria	Other Provinces	Cairo and Alexandria	Other Provinces
<b>Employment Status</b>	N=11,324	N=12,457	N=19,110	N=5,878
<i>Employed (%)</i>	86.11	72.57	80.20	68.36
<i>Unemployed (%)</i>	3.26	0.37	4.51	0.41
<i>Out of labor force (%)</i>	2.83	0.04	3.00	0.43
<i>Missing (%)</i>	7.80	27.02	12.29	30.76
<b>Occupational Attainment</b>	N=9,792	N=9,040	N=15,286	N=4,021
<i>White-collar worker (%)</i>	21.96	7.73	23.69	9.80
<i>Skilled worker (%)</i>	27.80	6.73	29.55	8.26
<i>Unskilled worker (%)</i>	50.24	85.54	46.76	81.94
Social status index (Mean)	5.43	5.01	5.67	5.21
<b>Modernization</b>	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
<b>Religion</b>	N=11,324	N=12,457	N=19,110	N=5,878
<i>Muslim (%)</i>	89.90	92.65	86.44	89.79
<i>Christian (%)</i>	7.14	6.34	6.06	6.74
<i>Jew (%)</i>	1.16	0.03	1.01	0.00
<i>Non-Muslim (unspecified) (%)</i>	0.31	0.02	3.43	0.00
<i>Missing (%)</i>	1.07	0.96	3.07	3.47
<b>Demographic</b>				
Age (Mean)	37.46 (N=10,593)	40.45 (N=12,294)	35.51 (N=17,071)	38.18 (N=5,858)
Slave (%)	1.56 (N=11,316)	1.33 (N=12,454)	1.42 (N=19,024)	1.97 (N=5,742)
Foreigner (%)	10.99 (N=11,018)	1.13 (N=12,419)	12.26 (N=19,004)	0.68 (N=5,864)
Black (%)	3.35 (N=10,794)	0.12 (N=12,336)	5.56 (N=17,852)	2.94 (N=5,846)
Migrant (%)	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. Statistics are based on systematic sample only. See data appendix for definitions of variables.

**Table (2): Technology-Skill Complementarity in State Modern Projects**

Ordered Logit Regression- Dependent Variable: Social Status Index

	1848			1868	
	All Egypt	Cairo and Alexandria	Other Provinces	All Egypt	Cairo and Alexandria
<b>Panel A: Overall Technology-Skill Complementarity</b>					
Modern	0.254*** (-5.28)	0.356*** (-4.60)	0.083*** (-7.04)	2.021*** (3.94)	1.994*** (4.26)
District fixed effects	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.044	0.043	0.040	0.029	0.03
<b>Panel B: Technology-Skill Complementarity by Industry</b>					
Textiles × Modern	0.018*** (-15.14)	0.039*** (-9.02)	0.006*** (-12.63)	0.072** (-2.53)	0.089*** (-2.61)
Transportation × Modern	2.063 (0.49)	2.537 (0.45)	3.064 (0.63)	24.948*** (14.45)	16.865*** (12.63)
Military × Modern	0.950 (-0.20)	1.154 (0.60)	0.722 (-0.32)	0.590 (-1.35)	0.974 (-0.13)
Other Modernized Industries × Modern	0.265** (-2.46)	0.401** (-2.15)	0.028*** (-2.86)	0.755 (-0.65)	0.749 (-0.71)
Textiles	2.041*** (5.51)	0.922 (-0.46)	7.562*** (24.65)	1.403*** (3.94)	1.234** (2.11)
Transportation	0.081*** (-14.11)	0.168*** (0.033)	0.006*** (-16.35)	0.132*** (-16.81)	0.183*** (-14.32)
Military	1.663*** (3.96)	0.920 (-0.73)	7.284*** (13.23)	1.127 (1.34)	1.003 (0.04)
Other Modernized Industries	0.761*** (-2.73)	0.609*** (-5.33)	2.622*** (2.99)	0.738*** (-4.08)	0.679*** (-5.28)
District fixed effects	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.073	0.067	0.093	0.051	0.051
# Districts	97	15	82	53	19
# Villages/Urban quarters	859	194	665	616	250
# Observations	18,146	9,315	8,831	18,968	15,133

Odds ratios are reported. Z-values are between parentheses. Robust standard errors are clustered at the village/urban quarter level. Sample is restricted to employed males who are at least 15 years old with non-missing values for all variables included in the regression. I do not run the regression for the other provinces in 1868 because the number of workers in the modern sector in the sample is very small (13 workers). Controls in each regression are: age, foreigner dummy, slave dummy, migrant dummy, and black dummy. \* indicates significance at 10% level, \*\* indicates significance at 5% level, and \*\*\* indicates significance at 1% level.

**Table (3): Industrial Modernization, Religion, and Occupational Attainment**

<b>1848</b>				<b>1868</b>			
<b>Difference-in-Differences- Dependent Variable: White-Collar Indicator</b>							
	Christians	Muslims	Difference		Christians	Muslims	Difference
Employed in the Modern Sector	0.635 (0.049) (N=96)	0.094 (0.010) (N=791)	0.542*** (0.034)	Employed in the Modern Sector	0.806 (0.059) (N=72)	0.350 (0.047) (N=468)	0.455*** (0.059)
Employed in the Traditional Sector	0.443 (0.011) (N=2,117)	0.132 (0.003) (N=16,388)	0.310*** (0.008)	Employed in the Traditional Sector	0.482 (0.011) (N=1,958)	0.183 (0.003) (N=16,759)	0.299*** (0.010)
Difference	0.193*** (0.052)	-0.039*** (0.012)	<b>0.231***</b> <b>(0.040)</b>	Difference	0.323*** (0.060)	0.168*** (0.018)	<b>0.156***</b> <b>(0.052)</b>

Sample is restricted to Muslim and Christian employed males who are at least 15 years old. Group-means of the white-collar index are reported. Standard errors are in parentheses. T-tests for differences in means across groups are reported.

**Table (4): Impact of Industrial Modernization on Religious Occupational Differentials**

	(1) OLOGIT (Social Status Index)	(2) MLOGIT (Outcome: Skilled Worker)	(3) MLOGIT (Outcome: White-Collar Worker)	(4) OLOGIT (Social Status Index) (by Industry)
<b>Panel A: 1848</b>				
Christian	2.833*** (8.28)	4.833*** (8.95)	7.277*** (13.21)	2.992*** (7.79)
Jew	1.268 (0.76)	1.486** (2.29)	2.063** (1.97)	1.303 (0.86)
Modern	0.183*** (-6.93)	0.971 (-0.15)	0.501*** (-3.39)	0.987 (-0.05)
Christian × Modern	12.703*** (8.60)	1.521 (0.63)	7.752*** (3.88)	2.393** (2.55)
Textiles × Modern				0.020*** (-10.29)
Textiles × Modern × Christian				51.432*** (6.67)
Textiles				2.575*** (9.23)
Textiles × Christian				0.388*** (-3.87)
District fixed effects	Yes	Yes	Yes	Yes
Pseudo R-squared	0.053	0.190	0.190	0.059
# Observations	18,039	18,039	18,039	18,039
<b>Panel B: 1868</b>				
Christian	3.137*** (10.48)	5.482*** (11.05)	8.405*** (11.98)	2.889*** (10.38)
Jew	1.594*** (2.62)	1.507 (1.22)	2.572*** (3.70)	1.459** (2.10)
Modern	1.742*** (2.67)	1.491* (1.95)	3.326*** (7.03)	0.477*** (-2.52)
Christian × Modern	1.602 (1.42)	1.040 (0.06)	1.870 (0.88)	6.248*** (3.43)
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	0.033	0.130	0.130	0.053
# Observations	18,526	18,526	18,526	18,526

Columns (1) and (4) are two separate ordered logit regressions, while columns (2) and (3) are from the **same** multinomial logit regression, where unskilled workers category is the base outcome. Odds ratios are reported. Z-values are between parentheses. Robust standard errors are clustered at the village/urban quarter level. Sample is restricted to employed 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, migrant dummy, and black dummy. \* indicates significance at 10% level, \*\* indicates significance at 5% level, and \*\*\* indicates significance at 1% level.

**Table (5): Mechanisms of Industrial Modernization:  
Technology or Job Training?**

Ordered Logit Regression- Dependent Variable: Social Status Index

	1848	1868
Christian	2.855*** (8.20)	3.134*** (10.44)
Jew	1.241 (0.68)	1.589** (2.60)
Modern	0.429*** (-3.09)	1.913 (2.92)
Modern × New Occupation	0.070*** (-8.39)	0.757 (-0.70)
Christian × Modern	6.629*** (6.27)	2.816*** (3.46)
Christian × Modern × New Occupation	0.055*** (-7.54)	0.180*** (-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 employed 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, migrant dummy, and black dummy. \* indicates significance at 10% level, \*\* indicates significance at 5% level, and \*\*\* indicates significance at 1% level.

**Table (6): Crowding-out Effects of State Industrialization**

Fixed Effects Panel Regression- Dependent Variable: Percentage in a Threatened Industry

	Textiles	Transportation	Military
Projects	-0.004 (0.010)	-0.008 (0.042)	0.028** (0.012)
1868 Effect	-0.004 (0.005)	0.021 (0.023)	-0.002 (0.003)
Constant	0.024 (0.003)	0.044 (0.012)	0.004 (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 employed adult 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% level, \*\* indicates significance at 5% level, and \*\*\* indicates significance at 1% level.

**Table (7): Occupational Segregation in Traditional and Modern Sectors**

	Traditional			Modern		
	Old	Overlapping	Overall	Overlapping	New	Overall
<b><u>1848</u></b>						
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
<b><u>1868</u></b>						
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. "Overlapping" and "New" occupations are defined as in the text. Only systematic sample of employed adult males who are at least 15 years old with non-missing religion is used in the calculations, and the sample is collapsed at the occupation-level.

**Table (8): Educational and Military Reforms and Religious Human Capital Differentials**  
(Linear Probability Regression)

	(1) Dependent Variable = Professional Index	(2) Dependent Variable = Commissioned Officer Index
Non-Muslim	0.003 (0.002)	-0.009*** (0.002)
Born in 1812-34	0.004*** (0.001)	
Born in 1834-47	-0.000 (0.001)	
Born in 1838-47		0.005** (0.002)
Non-Muslim × Born in 1812-34	-0.006 (0.004)	
Non-Muslim × Born in 1834-47	0.001 (0.006)	
Non-Muslim × Born in 1838-47		-0.008* (0.004)
Black	-0.004 (0.004)	-0.006*** (0.002)
Slave	0.004 (0.010)	-0.004** (0.002)
Foreigner	0.009 (0.011)	0.016*** (0.005)
Foreigner × Born in 1812-34	-0.014 (0.009)	
Foreigner × Born in 1834-47	-0.014 (0.011)	
Foreigner × Born in 1838-47		-0.000 (0.010)
Migrant	0.005** (0.003)	0.004** (0.002)
1868 Index	0.003 (0.002)	0.005*** (0.001)
Constant	0.002 (0.001)	-0.000 (0.001)
Adjusted R-squared	0.012	0.01
District fixed effects	Yes	Yes
# Observations	29,572	29,572

Robust standard errors, that are clustered at the village/urban quarter level, are between parentheses. Sample is restricted to employed males who are 21-70 years old in each census year with non-missing values for all the variables included in the regressions. The two census samples are pooled together. \* indicates significance at 10% level, \*\* indicates significance at 5% level, and \*\*\* indicates significance at 1% level.

**Table (9): Religious Composition of Religious and Modern Schools in 1848 and 1868**

School Sector/Level	Muslim Students				Non-Muslim Students			
	Religious Schools	Public Modern Schools	Private Modern Schools	Total	Religious Schools	Public Modern Schools	Private Modern Schools	Total
<b>1848</b>								
Pre-Higher Education	692	6	0	698	280	0	0	280
Higher Education	111	7	0	118	0	0	0	0
<b>Total</b>	<b>803</b>	<b>13</b>	<b>0</b>	<b>816</b>	<b>280</b>	<b>0</b>	<b>0</b>	<b>280</b>
<b>1868</b>								
Pre-Higher Education	1,561	42	6	1,609	115	0	76	191
Higher Education	266	23	0	289	1	0	0	1
<b>Total</b>	<b>1,827</b>	<b>65</b>	<b>6</b>	<b>1,898</b>	<b>116</b>	<b>0</b>	<b>76</b>	<b>192</b>

Sample is restricted to males who are enrolled in schools in the 1848 and 1868 censuses with non-missing religion. School sector and level are inferred from school names which are usually recorded in the census records, combined with information on schools in Heyworth-Dunne (1938).

**Table (10): The Composition of the Egyptian Regular Army by Religion and Nationality in 1848 and 1868**

	Muslim Military Personnel				Non-Muslim Military Personnel			
	Egyptians	Foreigners	Nationality Unknown	Total	Egyptians	Foreigners	Nationality Unknown	Total
<b>1848</b>								
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
<b>Total</b>	<b>357</b>	<b>48</b>	<b>91</b>	<b>496</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>1868</b>								
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
<b>Total</b>	<b>504</b>	<b>49</b>	<b>5</b>	<b>558</b>	<b>15</b>	<b>1</b>	<b>0</b>	<b>16</b>

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.