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**Guns and Books: Legitimacy, Revolt and Technological Change
in the Ottoman Empire**

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Abstract

New technologies have not always been greeted with great enthusiasm. Although the Ottomans were quick to adopt advancements in military technology, they waited for almost three hundred years to allow the first book to be printed in Arabic script. We explain differential reaction to technology through a political economy approach centered on the legitimizing relationship between the rulers and their agents (e.g., military or religious authorities). The Ottomans readily accepted new military technologies such as gunpowder and firearms because they increased the net revenue available to the ruler and reduced the expected value of revolting against him. But they objected to the printing press because it would have decreased the ruler's net revenue by undermining the legitimacy provided by religious authorities, and it would have raised the probability and expected value of a revolution. The printing press was allowed in the eighteenth century after alternative sources of legitimacy emerged.

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Guns and Books:

Legitimacy, Revolt, and Technological Change in the Ottoman Empire

A fundamental puzzle of technological history is why some societies have foregone free lunches by failing to adopt technological advancements (Olson, 1982; Mokyr, 1990). In one of the best-known and most puzzling cases of foregone opportunity, it took the Ottomans almost three hundred years after the invention of the moveable type to allow the first book to be printed in Arabic script in Istanbul in 1729. The delay has led to numerous speculations about Muslim reaction to new technologies, inviting various types of explanations. Some historians have attributed the delay to cultural values such as religious conservatism and obscurantist thought, others looking for the answer in socio-economic factors such as entrenched interests and institutional rigidity.¹

For a satisfactory explanation of when a society adopts a new technology and why there may have been delays, we need to identify not just the factors that may have obstructed change in some technologies but also those that have facilitated the swift adoption of technological advancements in other areas. The case of the printing press becomes even more puzzling when we consider it in relation to other technologies that were adopted quickly during the same time period. Contrary to the image of the religious and technological conservatism that seems consistent with the delayed adoption of the printing press, the Ottomans were eager to adopt the latest advancements in military technology such as the use of gunpowder and firearms (Agoston, 2005). In adopting the printing press and gunpowder weapons, often considered the most important inventions of the late Middle Ages, the Ottomans reacted quite differently, displaying

¹ For a review of this literature, see Sabev (2006: 47-67).

a mixed image between conservatism and openness and making it difficult to explain their reaction through ad hoc factors.

We also need to account for why some of the initially suppressed technologies were eventually adopted. Although the Ottomans banned the printing press in the fifteenth century and continued the ban for a long time, they eventually did allow it. We thus need a framework that will account not just for the swift adoption of some technological advancements or the suppression of others but also the initial suppression and eventual adoption of others. For a complete explanation of Ottoman reaction to technological change, we need to explain why they readily accepted advancements in military technology, initially suppressed the printing press, and eventually accepted the printing press.

We answer these questions through a political economy approach centered on the legitimizing relationship between rulers and their agents. We use a simple analytical framework to capture the basic elements of the strategic interaction between rulers and institutional (e.g., religious, military) authorities, using the framework to generate comparative statics that explain observed outcomes. In this framework, the authorities choose either to legitimize the ruler or to incite a revolt against him, and the ruler decides whether or not to share his revenue with them to ensure their support. The payoffs associated with each outcome depend on technology. Since the introduction of a new technology could change these payoffs, it could sometimes be in the best interest of the ruler to suppress the new technology to preserve the status quo.

A new technology could affect the ruler's welfare in two ways. It could change the expected value of a revolt against him, through its effect on the deadweight loss associated with the revolt and the probability that the revolt will succeed. It could also affect the net revenue available to him absent a revolution, depending on the technology's effect on the gross revenue he could

collect from the citizenry and the share of this revenue he could claim legitimately. The latter would depend on the ability of religious, military, and other authorities to legitimize the ruler.

These factors explain the differential reaction of the Ottomans to advancements in military and printing technologies. They readily accepted new military technologies such as gunpowder and firearms because they reduced the expected value of a revolution against the ruler and increased the net revenue he could collect from the citizenry. But they objected to the printing press because it would have raised the probability and expected value of a revolution, and it would have decreased the ruler's net revenue by undermining the legitimacy provided by religious authorities. They allowed the printing press to be established in the eighteenth century after alternative sources of legitimacy emerged.

Our approach shares insights with the literature on how interest groups influence the choice of technology. Powerful groups with vested economic interests in the prevailing technology may oppose a new technology in order to protect their rents, and their opposition may succeed if the ruler or the political process prevents the new technology from being established (Krusell and Rios-Rull, 1996). Our approach is also related to the recent work emphasizing the political replacement effect, where the introduction of a new technology may erode the incumbency advantage and political power of the elites. Using this approach, Acemoğlu and Robinson (2006) have shown how political leaders, fearing replacement, have blocked economic development in history and how as a result England, Germany, Russia and Austria-Hungary have displayed different patterns of industrialization.

Although our approach is similar to studies emphasizing the roles of interest groups and political elites, we differ in our stress on not just the economic or political rents of these groups but on their ability to legitimize the ruler. Rather than take the ruler's relationship with these

groups as independent of technology, we examine how technological change may alter the legitimizing relation between them. Although blocking a technological development may appear to be protecting the interest of a certain group, the ruler's reaction to the new technology could more fundamentally be shaped by its influence on his legitimacy. This approach accounts for the salient interactions between institutions or other players who are likely to determine the degree to which innovation is "harmful" to the political authority.

Our approach also differs from a considerable body of literature focused on how the choice of technology was shaped by religious and cultural factors. This view has been particularly common among Eurocentric approaches and in the generalist literature.² The problem with these types of explanations is that they often lack a coherent whole and make ad hoc generalizations about how religious and cultural factors affect economic motivations and outcomes. Rather than start with questionable generalizations that would ultimately fail in the face of closer scrutiny, we make standard economic assumptions about the motivations of the Ottomans and their agents, and we use a simple political economy model and historical analyses to explain their reactions to new technologies. In what follows, we first formalize our argument in a general economic framework. We then use this framework to explain the reaction to technological change in the Ottoman Empire, namely why the Ottomans accepted military technology swiftly, why they initially suppressed the printing press, and why they eventually adopted it.

LEGITIMACY, POLITICAL ECONOMY, AND NEW TECHNOLOGY

To formalize the basic argument in a simplified framework, we present a political economy model of legitimization and technological change. The model involves a game played

² See, for example, Cipolla (1966), Jones (1987: Chapter 9), Goldschmidt (2002: Chapter 9), and Lewis (1982: Chapter 9). For a classic criticism of this approach, see Said (1978).

between the ruler and an agent whose role it is to support, or legitimize, the ruler. The agent could represent a religious authority, a military authority, or an aristocratic class (nobility). The citizenry exists as a purely passive group whose only function is to produce a gross surplus equal to S , which is limited by resources and technology. The objective of the ruler is to extract as much of that surplus as possible for his private consumption.

The agent chooses either to legitimize the ruler or to incite a revolt. Legitimacy can come from various sources (Beetham, 1991). In an approach similar to Wintrobe's (1998) analysis of the sources of power in dictatorships, we divide sources of legitimacy into two groups, force and loyalty, each produced by capital and labor inputs. Force, for example, can be produced by weapons and soldiers.³ Loyalty can similarly be produced by books and educators. We do not make a priori assumptions about the functional form of the production of legitimacy and will discuss different possibilities in more detail below.

If the agent legitimizes the ruler, the latter is able to extract a fraction β of the gross surplus, or βS , where $0 < \beta < 1$, which he then shares with the agent in the form of a payment T . The parameter β reflects the degree to which citizens view the ruler as legitimate: a higher value means that the ruler is seen as being more legitimate, which makes citizens less resistant to paying taxes. Since the primary function of the agent in our model is to provide legitimacy, β can be interpreted as an index of how influential the agent is in performing this function.

Alternatively, the agent can choose to incite a revolt against the ruler rather than to support him. Let p be the probability that the revolt succeeds in deposing the ruler. If the revolt succeeds, the agent obtains the surplus; if it fails, the ruler retains the surplus and the agent

³ For a recent analysis of coercive legitimacy, see Hurrell (2005).

receives nothing. In either case, however, we assume that there is a deadweight loss associated with the revolt, leaving a net surplus of αS for the winner, where $0 < \alpha < 1$.

The minimum payment that will induce the agent to support the ruler must leave the agent just as well off as inciting revolt. Thus, $T = p\alpha S$. The resulting payoff to the ruler is given by

$$\beta S - T = S(\beta - p\alpha), \quad (1)$$

which is positive provided that $\beta > p\alpha$. Alternatively, the ruler could allow the agent to incite a revolt, which yields the ruler an expected payoff of $(1-p)\alpha S$. We assume, however, that purchasing support from the agent strictly dominates revolt. This will be true if $\beta > \alpha$.

Now consider the introduction of a technological innovation that increases the available surplus. Let θ denote the technology, and let $S(\theta)$ be the surplus under the new technology, where $S(\theta) > S$ by assumption. Also let $\beta(\theta)$, $p(\theta)$, and $\alpha(\theta)$ be the legitimacy function, the probability of a successful revolt, and the fraction of the surplus surviving a revolt under the new technology. Although the technology increases the available surplus, the ruler may nevertheless choose to suppress or oppose it if it lowers his net payoff. This will be true if

$$S(\theta)[\beta(\theta) - p(\theta)\alpha(\theta)] < S(\beta - p\alpha) \quad (2)$$

This will tend to be more likely as the new technology (i) reduces the ability of the agent to legitimize the ruler (i.e., $\beta(\theta) < \beta$), (ii) increases the probability of a successful revolt (i.e., $p(\theta) > p$), and (iii) reduces the losses from a revolt ($\alpha(\theta) > \alpha$). The size of the surplus is also a

contributing factor because (iv) smaller $S(\theta) - S$ will tend to make (2) more likely. Intuitively, the first and the final effects lower the value to the ruler of the agent's support, while the second and third increase the bribe that the ruler must pay for support. As a result, the ruler's private payoff under the new technology will be lower as compared to the status quo. Table 1 reports these comparative static results.

Table 1: Effect of Increase of Parameter on Probability of Technology Suppression

	Increase in the following parameter:			
	$S(\theta)$	$\beta(\theta)$	$p(\theta)$	$\alpha(\theta)$
Effect on probability of technology suppression	↓	↓	↑	↑

THE SWIFT ADOPTION OF MILITARY TECHNOLOGY

As one of the key players in the Eurasian power struggles of the late medieval and early modern periods, the Ottomans paid close attention to advancements in military technology. Contrary to some of the earlier writings that viewed the Ottomans as being cultural and technological conservatives and unable or unwilling to keep pace with western military

technology, recent scholarship has shown that they were quite receptive to these advancements.⁴ As Agoston (2005: 192) has argued, the Ottomans “were quick to realize the advantages of firearms” and that “[t]he pragmatism and flexibility of the Ottoman ruling elite led to the relatively smooth integration of gunpowder weapons in the Ottoman army.” The Ottomans not only kept pace with developments in gunpowder, firearms, and cannons but displayed ingenious organizational skills by pioneering the establishment of a permanent standing army (the Janissaries) specialized in the use of these weapons well before the European powers. They showed such remarkable success in assimilating gunpowder technology into their army and navy that by the mid-fifteenth century they achieved a clear logistical and firepower superiority over their European and Asian adversaries. Although the Ottomans may have at times lagged behind in some advancements in military technology, this was more an exception than a rule and more a matter of feasibility than indicative of a negative reaction to the technology itself.

The Ottomans were eager to accept new military technologies during this period because they expected these advancements to raise the net revenue available to them and reduce the value of a revolt against their rule. In terms of the model presented above, advancements in military technology were accepted because they were expected to raise the size of the available surplus (i.e., $S(\theta) > S$), increase the ability of military authorities to legitimize the ruler ($\beta(\theta) > \beta$), reduce (or have a negligible effect on) the probability of a successful revolt ($p(\theta) < p$), and raise the losses from a revolt ($\alpha(\theta) < \alpha$). Economic theory and historical evidence support these claims, as discussed in detail below.

⁴ For examples of previous claims made in the secondary generalist literature, see Cipolla (1966), Jones (1987: Chapter 9), Goldschmidt (2002: Chapter 9), Lewis (1982: Chapter 9). See also Agoston (2005: 7-13) for a critical review and refutation of these claims.

First, the Ottomans expected advancements in military technology to raise the size of the surplus available to them by expanding their revenue base through conquests and tributes or helping them protect existing revenues from being confiscated by adversaries equipped with the new technology. In game-theoretic terminology, adopting the new technology was their dominant strategy in maximizing the surplus, all else being the same. If other nations did not adopt it, it was in the best interest of the Ottomans to adopt the new technology and use it against others to confiscate their property. If other nations did adopt it, the Ottomans still had no choice but to adopt it in order to protect their own property rights against the threat of invasion. Regardless of what their adversaries chose to do, it was in their best interest to adopt new military technologies in order to maximize the surplus available to them.⁵

The second factor contributing to Ottomans' eagerness to accept advancements in military technology was the effect of new technology on legitimacy. As discussed earlier, legitimacy could come from two sources, force and loyalty, and the production of force depended on military technology. The military authorities could produce force by using manpower and weapons as inputs. The cost of acquiring legitimacy through force was therefore the cost of obtaining and maintaining manpower and weapons used to make citizens less resistant to paying taxes. A fall in this cost was equivalent to a rise in β .

A new military technology could enhance the ability of military authority to confer legitimacy by raising its coercive capacity and lowering the cost of producing force. For example, consider the technological advancements associated with the invention of the gunpowder. Prior to the invention of gunpowder weapons, the military authorities could generate credible force required to tax the citizenry only by sheer size, relying on significant

⁵ For the importance of gunpowder weapons in Eurasian warfare, see Black (1999) and Parker (1988). See also Murphey (1999) for Ottoman warfare between 1500 and 1700.

manpower equipped with swords, bows, and arrows with limited power. Medieval states thus had to incur high cost to control or maintain large armies which prevented opposition to taxes or evasion from them. With the invention of firearms, the output of soldiers and weapons rose significantly, and the cost per unit of producing force fell. A single soldier with a firearm could be more effective in enforcing tax collection than several soldiers with mere swords. The result was a significant improvement in the ability of military authorities to confer legitimacy to the ruler and a significant fall in the amount of expenditures for the production of force required to obtain the surplus.

The Ottomans used the military extensively in tax collection. Under a prebendal mechanism of tax collection called the *timar* system, provincial cavalrymen (*sipahis*) collected taxes directly from the peasantry as remuneration for their military services to the state. Military personnel were also used in various capacities in the collection of other tax revenues. For example, according to finance department registers, a vast majority of those collecting the *cizye*, a poll tax collected from religious minorities, were military personnel (Darling, 1996: 169). They were also increasingly involved in some capacity in tax-farming and in the collection of occasional taxes called the *avarız* and various other tax revenues for provincial offices or the central treasury (Darling, 1996: Chapter 5).⁶ By equipping soldiers with the latest weapons the military authorities could thus increase their effectiveness not just on the battlefield but also in tax collection.

It took only a few decades from the time the Ottomans were acquainted with firearms in the 1380s for the Janissaries to start using them. The proportion of Janissaries using the firearms rose significantly during the fifteenth century, and by the mid-sixteenth century most of them

⁶ For example, according to tax-farming registers of 1603-4, almost two-thirds of tax-farmers were of military origin (Darling, 1996: 179).

were carrying the new weapons (Agoston, 2005: 23). The Ottomans also established artillery units and various other infantry troops armed with gunpowder weapons, using foreign experts as necessary for technical improvements.⁷

The effect of new military technology on the probability of revolt (p), the third factor identified by the model, was negligible or even negative during this period. The probability could rise if the introduction of new technology could cause dissent and rebellion among the military ranks or if those already opposing the ruler could improve their position by acquiring the new weapons. The Ottomans sought to prevent the spread of firearms by banning their use by the general public, but they were not completely successful. Indeed, the presence of firearms in the countryside became a major problem at the end of the sixteenth century. To meet its increasing manpower needs for military campaigns, the government established new corps (generally known as *sekbān* or *levend* companies) and employed irregular arms-bearing troops from among the general population, mostly the unemployed youth (Finkel, 1988). This became a problem at the end of the campaign, however, when these troops could not find employment and joined the banditry or uprisings in the countryside, such as the threats known as the *celālī* disorders in Anatolia (Barkey, 1994; İnalcık, 1975). One could thus argue that the presence of firearms made revolt a greater threat.

Although the firearms may have thus increased the probability of revolt, the effect was small, and it did not significantly alter the ruler's eagerness towards technological advancements. In addition to banning the use of firearms by the general public, the Ottomans took a variety of distinct measures to control the state apparatus and maintain their monopoly in organized

⁷ Although there was some delay in the introduction of firearms to provincial cavalrymen, this was primarily because of the inadequacy of early firearms to cavalry corps and the desire of the central government to control the spread of weapons in the countryside.

violence. As Barkey (1994) has argued, they were able to control rural banditry by striking bargains with their leaders and incorporating bandits into the system by recruiting them as irregular soldiers. To control the janissaries, they used the *devşirme* system of recruitment, where talented boys from newly conquered non-Muslim lands were conscripted before adolescence and acculturated into the Ottoman ranks to ensure sole allegiance to the ruler. Unlike their European adversaries who had to depend on local power holders for manpower, the Ottomans were able to command a permanent armed force under their immediate control. Although the Janissaries occasionally revolted against the ruler, their discontent typically came from threats to their economic interests, and the likelihood of revolt increased with their growing size and involvement in palace politics rather than their ownership of gunpowder weapons. Another distinctly Ottoman mechanism was a system of periodic rotation of offices, where each official was rotated on a more or less regular schedule. By restricting the duration of tenure at each office or location, the Ottomans prevented government officials from potential alliances with rebellious movements (Barkey, 1996). Armed provincial personnel did not stay in any one office or location long enough to join or organize revolts through local affiliations.

One type of military technology that gave a definite advantage to rulers and reduced the probability of revolt was the artillery. Despite government restrictions, the general public was able to obtain handheld firearms and even use them against the state, but the state maintained absolute monopoly in artillery weapons and ammunition. To the extent that superior capability in cannons and siege warfare were deterrents against revolt, the state had the upper hand because of its vast financial and organizational resources, which were required to maintain specialized troops capable of handling the artillery pieces. The rulers eagerly accepted advancements in artillery technology not just for greater success in siege warfare against external enemies but to

maintain monopoly in violence, deter organized violence against the state, and to lower the probability of revolt.

In general, new military technology did not raise the likelihood of dissent caused by vested interests in the old technology. In most cases, firearms and soldiers were strongly complementary inputs during the late medieval and early modern periods, causing no concerns about the possibility of new weapons replacing the soldiers. The complementarity between manpower and early firearms may have been weak for the cavalymen, who are said to have found the new weapons awkward and undignified (Agoston, 2005: 57), but their resistance did not materialize in revolt. Even when the military took part in uprisings, their dissent typically originated from economic concerns such as falling or delayed payments for their services, rather than fears from their manpower being replaced by the new weapons. The effect of new technology on the probability of revolt caused by fears from soldiers being replaced by firearms was low.

Finally, in terms of their effect on the size of the net surplus available to the winner after the revolt (α), new military technologies were welcomed by the rulers because they raised the destructive power of weapons and lowered the minimum amount the ruler had to pay to induce the military authority to legitimize the ruler rather than incite a revolt against him. Gunpowder weapons raised the cost of armed conflict immensely, both during and after the conflict. All parties had to incur substantial cost in preparing for, carrying out, and repairing after a conflict, which raised the deadweight loss of revolts and lowered the net gains to the winner. The cost of revolt could be high not just to the soldiers and rebels in terms of death and injury but also to the general public in terms of the damage or destruction of confiscable property and the disruption of taxable trade and activity. All else being the same, because of the greater destructive capacity of

new weapons, the military authorities had less to gain by inciting a revolution, and the ruler could pay them less to induce their support.

WHY THE PRINTING PRESS WAS SUPPRESSED

The Ottoman eagerness towards military technology contrasts sharply with their attitude towards the printing press. In 1485, within decades after the appearance of Gutenberg's first book published by the moveable type in Germany, the Ottoman sultan issued an edict that banned printing in Arabic characters (which was used to write Turkish as well) (Savage-Smith, 2003: 656). The process of accepting the printing press was so prolonged that it was not until the nineteenth century that the widespread use of mass printing technologies was fully established. Although the rulers started to relax the ban in 1726, they continued to regulate the operation heavily by granting permission only to selected individuals, prohibiting publication in religious subjects, and appointing a committee of scholars to review and proofread contents for accuracy.⁸ The operation faced numerous obstacles in its early history, and handwritten manuscripts dominated the market well into the nineteenth century. Until then, the Ottomans showed no eagerness towards fully adopting the printing press.⁹

The slow adoption of the printing press was not because the Ottomans did not know about the invention or because of technical problems. Religious minorities were allowed to set up their own presses with the provision that they could only print in non-Arabic characters. Jewish immigrants from Spain and Portugal, for example, were allowed to establish a press in

⁸ See Atiyeh (1995: 284-5) for an English translation of the 1726 royal order.

⁹ For history of the printing press in the Ottoman Empire and various explanations of the delay in adopting it, see Adivar (1943: Ch. 6), Gerçek (1939), Kut (1991), Robinson (1993), Sabev (2006), Savage-Smith (2003), and Szyliowicz (1986).

Istanbul in 1493, soon publishing the Torah and other religious and secular texts in Hebrew characters. Armenians were similarly able to establish a press in the 1560s, printing books in the Armenian alphabet with fonts brought from abroad (Gerçek, 1939: 26-29). Although the Ottoman subjects thus possessed the necessary skills to adopt the printing press as early as the fifteenth century, the ban on printing in Arabic characters continued.

Although the peculiarities of the Arabic script presented unique challenges, they were not insurmountable. Indeed, several parties managed to print in Arabic characters outside of the Empire as early as the beginning of the sixteenth century. The Qur'an, possibly the first book printed in Arabic, was printed in Venice at this time (Kut, 1991: 795). In 1588, two Italian merchants received permission from the Ottoman sultan to import books. Among those imported from abroad were Christian religious texts printed in Arabic. Several presses were established in Italy, Paris, and even Lebanon that were capable of printing in Arabic characters long before the Ottomans finally sanctioned the technology in the eighteenth century.

Although sanctioned printing in Arabic characters commenced in the 1720s, the industry did not take off until the middle of the nineteenth century. Initially, İbrahim Müteferrika petitioned the Sultan with a short treatise on the benefits of printing and received the first permission with his partner Sait Efendi to print in Arabic characters.¹⁰ Within a few years after the first book was printed in 1729, Sait Efendi quit the partnership. Although Müteferrika continued the business, he was able to publish only 17 books until he fell ill in 1743. From his death in 1745 to the end of the century, the industry underwent a long period of intermissions and failed restarts, producing only 16 additional books. It was not until the nineteenth century that one could see signs of a sufficiently eager ruler and an established industry (Kut, 1991: 802).

¹⁰ For the personal history of Müteferrika and the early history of printing in the Ottoman Empire, see Babinger et al. (2004), Berkes (1962), Sabev (2006), and Topdemir (2002).

Mass printing technologies have had a profound effect on a variety of developments in world history. Its influence has been felt most directly in the intellectual sphere. As Eisenstein (1979) has argued, it has been “an agent of change” in religious, social, and scientific thought in European history, setting off significant events such as the Protestant Reformation, the rise of modern science, and the spread and permanence of Renaissance in Europe. Others have viewed its influence as extending far beyond intellectual thought to the realm of economic abilities and performance. For example, noting the high correlation between reading ability and human capital formation, Baten and van Zanden (2008) have recently used per capita book production as a proxy variable for advanced literacy skills and found a significant relationship between book production and the onset of modern economic growth in Europe.

If the Ottomans adopted the printing press swiftly, they could similarly promote economic growth and realize higher tax revenues, though the effect could have been less significant than it was in Europe. Wages and literacy rates were significantly lower in the Ottoman Empire than in western Europe. Özmucur and Pamuk (2002) have recently estimated real wages of skilled and unskilled workers in Istanbul and other Ottoman cities to be significantly lower than those in northwestern Europe as early as the beginning of the sixteenth century. All else being the same, lower incomes in the Ottoman Empire meant lower willingness to pay for books and a less extensive and profitable book industry. More important, low incomes and low demand for books would have prevented the likelihood of forming a cycle of intensified reading activity that could have led to higher levels of human capital and incomes.

Literacy rates were also most likely lower in the Ottoman Empire than in western Europe during this period, though there are no systematic studies that can confirm this reliably. Historians generally consider literacy rates to be very low in the Ottoman Empire, around 2-3

percent, even as late as the beginning of the nineteenth century, compared to much higher rates ranging between 10 and 30 percent in western Europe in the sixteenth century (Quataert, 2000: 167; Baten and van Zanden, 2008: 221).¹¹ Yet, these differences may be a *result* of the relatively early introduction of printing in Europe – as more books (beyond bibles) were produced, feedback between the demand and supply of books increased the quantity of readable material as well as the literate population.

Although mass printing could have had a less significant impact on economic activity in the Ottoman Empire than in western Europe, the expected effect on the ruler's revenue was still positive. By adopting the printing press soon after its introduction, the Ottomans could have improved economic productivity, thus raising the size of the revenue available to them for taxation. Indeed, as noted above, one of many ways that introducing the press would have increased productivity ($S(\theta) - S$) was through its effect on human capital, as increased access to readable material encourages investment in literacy. The puzzle that needs an explanation is why they decided to forego this opportunity and suppress the technology.

We argue that the Ottomans were unenthusiastic about the printing press from its invention until the nineteenth century because they expected it to lower the net revenue available to them and feared that it could raise the net payoff others could expect from a revolt against their rule. More specifically, as we detail below, even though the printing press could raise the size of the available surplus (i.e., $S(\theta) > S$), it could possibly lower the ruler's legitimacy ($\beta(\theta) < \beta$) by a greater magnitude by undermining the ability of religious authorities to confer legitimacy through loyalty. Moreover, even though the printing press could be expected to have

¹¹ This is consistent with the strength of oral tradition in the transmission of knowledge in the Islamic world (Nasr, 2005; Robinson, 1993).

an insignificant effect on the losses from a revolt ($\alpha(\theta) \approx \alpha$), it could raise the probability of a successful revolt ($p(\theta) > p$).

The rulers objected to the adoption of the printing press because they were fearful of its effect on their legitimacy. By undermining the ability of religious authorities to confer legitimacy, the printing press could have raised the cost of collecting taxes and lowered the net surplus available to the ruler. As discussed earlier, religious authorities could confer legitimacy through a different mechanism than that used by military authorities, namely loyalty. This mechanism was a process through which religious authorities encouraged the citizens to believe that the Ottoman sultan had the right to rule and the power to provide protection and other public goods and services – and that he should therefore have the right to collect taxes. Given the power of religious belief, their word could provide a single, coherent, and effective source of legitimacy (Greif 2002).

In early modern Ottoman society, prior to the introduction of the printing press, religious authorities had a monopoly in providing legitimacy through loyalty because the transmission of knowledge depended on oral technology and the authorities had a vast comparative advantage in this type of transmission. The production of loyalty was a labor intensive process through which religious authorities could support the ruler or the state through sermons and speeches delivered as part of their official function. To ensure the stability of loyalty-based legitimacy, Ottoman rulers incorporated the legal and religious institutions into the state bureaucracy and sought to control religious authorities by supporting them financially and acquiring the right to appoint their leaders (Coşgel, Miceli, and Ahmed, 2009).

The introduction of the printing press was potentially a significant threat to the stability of this process and to the ability of religious authorities to provide legitimacy. Once adopted,

mass printing could alter the technology of transmitting knowledge and diminish the comparative advantage of religious authorities. The general public could obtain knowledge directly from books or from literate individuals not necessarily affiliated with religious authorities. The authorities could lose their monopoly in the transmission of knowledge and their power in convincing the public on the legitimacy of the ruler. As developments around the world later showed, such fears were well-founded because mass printing gradually led to a decline in the power of religious authorities in both Europe and the Islamic world (Eisenstein, 1979; Robinson, 1993: 245-46). The rulers ultimately stood to lose from this development because they faced the risk of declining control over the provision of legitimacy through loyalty. It was in their best interest to ban the printing press to avoid the threat to their legitimacy.

The Ottoman sultans opposed the printing press also because it raised the net payoff others could expect to collect by revolting against their rule. Although the printing press could have a negligible effect on the losses from a revolt (α), it could raise the probability of a successful revolt (p) significantly. The direct impact of mass printing on the deadweight loss associated with a revolt was negligible because unlike gunpowder weapons the printing press had no destructive power. The indirect effect was also negligible. True, mass printing could also affect the loss through its impact on the migration of people or capital after a revolt. By facilitating higher levels of literacy and human capital, it could raise the likelihood of skilled individuals fleeing the land during revolt and thus reduce the overall wealth available to the winner for taxation or confiscation. In the early modern Ottoman Empire, however, this was a limited possibility. The means for transportation was too limited in most regions of the Empire for the migrants to move their belongings, financial markets were not sufficiently developed for them to transform their wealth to liquid assets, and various linguistic, religious, and occupational

constraints reduced their chances of success elsewhere. Moreover, members of guilds and agricultural producers were subject to regulations that imposed substantial costs on their migration to other parts of the Empire. The direct or indirect effect of mass printing on the deadweight loss associated with revolt was therefore negligible.

The rulers still had reason to fear mass printing because of its effect on the probability of a successful revolt. Although the sultan was able to control religious authorities by financing and overseeing their activities, he could not guarantee their continual and unconditional support. If religious authorities decided to incite a revolt against the ruler, the probability of success was greater with the printing press than without it. Mass printing could be a very effective weapon against the ruler. Although (as argued above) the new technology could threaten the ability of religious authorities to legitimize the ruler, it could also complement their expertise in oral transmission when used to spread revolutionary ideas through pamphlets and political literature. There are numerous examples of revolutionary ideas being spread through print media in history. Thomas Paine earned the title “The Father of the American Revolution” because of his pamphlet *Common Sense*, which helped spread pro-independence ideas in the American British Colonies. Mass printing could be effective even in societies with low levels of literacy, as was seen in the use of broadsides and caricatures by the Protestants in anti-papist propaganda in the sixteenth century (Eisenstein, 1979: 304). The Ottoman rulers opposed the printing press because it raised the probability of a successful revolt.

Despite the positive effect of mass printing on the size of the surplus available to the ruler, the Ottomans suppressed it because of its effect on legitimacy and revolt. If introduced, the printing press would have undermined the ability of religious authorities to confer legitimacy, thus reducing the net surplus. Moreover, although it could have little effect on the deadweight

loss from a revolt, it would have raised the probability of a successful revolt, thus raising the minimum payment required to induce their support. The net overall effect was negative, forcing the Ottoman rulers to suppress the technology.

WHY THE PRINTING PRESS WAS EVENTUALLY ACCEPTED

The next episode in the Muslim reaction to mass printing was the adoption of the technology from the eighteenth century onwards. The Ottomans lifted the ban on the printing press in 1726, giving exclusive rights to certain individuals to print in Arabic characters. Following a shaky, intermittent, and heavily regulated presence in the eighteenth century, during which only 33 books were published, the industry grew fast in the nineteenth century. The ban on Islamic subjects was lifted in 1802, and the lithographic press was adopted soon after its invention in Germany. In the decade following the creation of *Takvimhane-i Âmire* in 1831 to print the first official newspaper, six new presses were founded, publishing a total of 278 books. Sixty (22%) of these books were on religious subjects. Thirteen new presses were launched in the next decade, altogether publishing a total of 394 books (31% on religious subjects).¹² The industry was well-established by mid-nineteenth century, the state getting actively involved through school books, official newspapers, and various administrative publications.

The adoption of the printing press was closely related to two parallel developments. The first was a significant change in the internal organization of the religious establishment, particularly in appointments and incentives. Appointment was increasingly centralized during the seventeenth and eighteenth centuries, recruits coming primarily from schools in Istanbul rather than provinces, promotions being based on connections and wealth rather than merit or

¹² Calculated from the information presented in Baysal (1968: 40-42).

seniority, and prominent families dominating the highest ranks over several generations.

Privilege was institutionalized in an aristocratic organization, as 12 of the 42 chief jurisconsults (*şeyhülislam*) who occupied the top of the hierarchy during the seventeenth century came from only five families. The proportion rose in the eighteenth century, half of the 58 chief jurisconsults appointed between 1708 and 1839 coming from 11 families (Zilfi, 1988: 47-48).

The structure of incentives also changed because of the misalignment between the leadership and rank and file and growing resentment among membership at the lower local levels. Corruption, though always present in previous centuries, rose to unprecedented levels during the seventeenth century, affecting the delivery of services at the local level and diminishing the reputation of the religious establishment as a whole (Zilfi, 1988: Chapter 1).

The second development was the rising importance of the notables (*a'yān*) in Ottoman provincial society and administration (İnalcık, 1977; Özkaya, 1994; Hourani, 1968). The Ottoman government had long relied on distinguished inhabitants of provincial towns as informal intermediaries between the central administration and general public. These notables assisted the central government by gathering information, enforcing regulations, and providing protection at the local level. The importance of notables grew significantly during the seventeenth century. Acquiring official status, they gained greater political power as recognized representatives of local interests to the central government.

These developments altered the parameters of the ruler's decision on the printing press drastically, tilting the balance in favor of allowing its adoption. The immediate impact was on legitimacy. As religious authorities suffered a loss in reputation and capacity to offer services at the local level, they also left behind their ability to legitimize the ruler. By actively participating in palace politics in the seventeenth century, they had put their influence at risk, and the

establishment was no longer a monolithic entity in supporting the ruler (Zilfi, 1988: 110-21). Estranged from the leaders, members at the lower local levels could have greater incentives to turn against authority than to promote the sultan's right to rule and collect taxes (Heyd, 1961: 72).

Corresponding to the shift in the relative importance of the notables and religious authorities, their comparative advantages in providing legitimacy also changed. The notables could produce legitimacy from a different source than religious indoctrination. Elected by the local subjects and approved by the ruler, they derived power from representing the people vis-à-vis the government. As Göçek (1996: 62) documents from the Ottoman archives, they built power through political ties with the subjects, "ties that the sultan could not obliterate." As providers of justice, protection, and other public goods, they acquired an enormous capacity to legitimize the ruler, emanating not from the ruler but from his subjects. While the religious authorities experienced a decline in their ability to confer legitimacy, that of the notables rose during this period.

As returns from religious and representational sources of legitimacy changed in the seventeenth and eighteenth centuries, the Ottomans gradually reduced their investment in religious authorities and shifted support toward the ability of the notables to confer legitimacy. The primary instrument of support was the ruler's prerogative to appoint individuals to collect taxes on behalf of the government. From the seventeenth century onward, the government increasingly appointed local notables as tax farmers, facilitating their rise to prominence in the provinces. By eighteenth century they had assumed "both de facto and de jure authority formerly exercised exclusively by the governors" (İnalçık, 1977: 32). If some members of the religious establishment also received appointments as tax farmers, they did so primarily by

joining the ranks of the notables. To prevent opportunistic behavior, the Ottomans introduced the institution of lifetime farms (*mālikāne*), aligning the interests of the notables with those of the ruler in taxation. Since the notables, as lifetime tax farmers, had an interest in maximizing taxable revenues and minimizing resistance to taxation, any resource allocated to the notables was ultimately an investment toward promoting the ruler's legitimacy.

As the primary sources of legitimacy changed, mass printing was no longer a significant threat to the legitimacy of the ruler in the eighteenth century. The notables did not risk losing their ability to confer legitimacy with the introduction of the printing press. In fact, they could even improve this ability if higher literacy and greater knowledge enhanced their reputation among the citizenry and their success as representatives. Their ability to legitimize depended on their capacity to provide representation and local public goods, not on a monopoly over the transmission of knowledge. By turning from religious authorities to local notables for legitimacy, the rulers effectively removed one of the obstacles to the introduction of the printing press.

The potential effect of the printing press on the size of the ruler's surplus had also increased significantly between the fifteenth and eighteenth centuries. The size of the market had grown because of increases in demand and supply. The demand for books and other publications had most likely grown during this period because of higher rates of literacy and urbanization, though we have no direct data to confirm this expectation reliably. The supply of books had improved, owing to various technological improvements, such as in the casting of fonts and the production of paper, which lowered the cost of production significantly. True, the Ottoman publication industry did not take off immediately after the adoption of the printing press in the eighteenth century. But this was more a result of the ruler's regulation of the industry as a

government-granted monopoly and restrictions on permissible publications than an indicator of its capacity to generate profits. As discussed above, the industry did ultimately take off in the nineteenth century, soon after the government relaxed the regulations and restrictions. It performed well enough in the nineteenth century to indicate that the productive capacity of mass printing in the Ottoman Empire had vastly improved during this period, allowing for growth not only in the profits of the industry but also in the economy as a whole and in the size of the ruler's revenue.

While the effect of the printing press on the net revenue available to the ruler rose significantly between the fifteenth and eighteenth centuries, its effect on the net payoff others could expect to collect by revolting against the ruler remained the same, perhaps even decreased. As before, there was no reason to expect the printing press to have a significant effect on the deadweight loss associated with a revolt (α). Similarly, its effect on the probability of a successful revolt had similarly not changed significantly during this period. Although some of the changing circumstances, such as rising rates of literacy and urbanization, may have raised the probability of revolt, the Ottomans were able to counter this by aligning the interests of the notables with their own. To minimize the effect of printing press on rebellion in the eighteenth century, they monitored its activities closely. As they deregulated the industry in the nineteenth century, they sought to reduce its effect on the probability of revolt by attempting to shape public opinion through official newspapers.

The Ottomans eventually allowed the printing press because its cost and benefits had changed significantly between the fifteenth and eighteenth centuries. By then they could expect it to add more to their net revenue than to the net payoff others could expect from inciting a revolt. The printing press no longer presented a threat to the ruler's legitimacy in the eighteenth

century, and its expected benefits to the ruler's surplus had grown even larger. Although mass printing could still raise the probability of a successful revolt, the Ottomans prevented this threat by regulating the industry heavily. They allowed the technology in 1726 because they were then better off adopting the printing press than suppressing it.

CONCLUSION

The political economy of technological advancements explains the differential reaction of the Ottomans to military and mass printing technologies. A new technology could change not just the productivity of workers but also the legitimizing relationship between the rulers and their agents. The rulers needed support from military, religious, and other authorities to reduce the cost of collecting taxes, and these agents had a choice between supporting the ruler and revolting against him. The outcome depended on the ability of agents to legitimize the ruler under the prevailing technological regime, the probability of a successful revolt, and the size of the deadweight loss associated with revolt. Since a new technology could alter these parameters, the rulers' choice of whether to allow or suppress the technology depended on how it affected their net surplus or the expected value of a revolt.

The Ottomans were eager to accept new military technologies in the late medieval and early modern periods because they expected these advancements to raise the net revenue available to them and to reduce the value of a revolt against their rule. Using economic theory and historical evidence, we have argued how advancements in military technology raised the size of the available surplus, increased the ability of military authorities to legitimize the ruler, reduced the probability of a successful revolt, and raised the losses from a revolt.

The Ottoman reaction to the printing press was different. Although mass printing could have raised economic productivity and the size of the surplus available to the ruler for taxation, they chose to forego the opportunity and suppress the technology for a long time. They were not initially enthusiastic about the new technology because they expected it to lower their net revenue by undermining the ability of religious authorities to generate loyalty, and they feared that it could raise the net payoff others could expect from a revolt against their rule.

The Ottomans eventually allowed the printing press in the eighteenth century. New sources of legitimacy emerged in the intervening centuries, and hence it did not matter that the printing press threatened the ability of religious authorities to produce loyalty. Its expected benefits to the ruler's surplus had also increased, and the Ottomans found ways to minimize its effect on revolt. They allowed the technology when its expected benefits exceeded the cost.

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