Islam, Trade, and Innovation Alireza Naghavi University of Bologna

This chapter provides a discussion on the of pervasiveness of innovation, or the lack thereof, at different points of history in the Muslim world. The idea put forth is the interconnection of innovation with trade, and the puzzle is the cease of the former despite the continuation of the latter in the contemporary world. The first step is to present a brief overview of core Islamic principles that encourage trade but discourage innovation by the inclusion of property right matters in Islamic law. We then look at the historical contribution of trade in uniting the Muslim world and initially triggering innovation and achieving the golden age of Islam. Finally, the chapter suggests reasons why innovation eventually came to a halt in Islamic lands, including political economy arguments, tolerance, diversity, and institutions.

Introduction

Trade fosters innovation. This is by now a well-established fact in the economics literature. The seminal theoretical work on trade, innovation, and growth goes back to Grossman and Helpman (1989, 1990) among others. Theories that follow suggest that trade liberalization essentially affects innovation through two channels. The first channel is improved access to foreign markets. Higher profits brought about by a larger market create incentives to innovate (Acemoglu and Linn, 2004). Trade also opens the gate to a more competitive marketplace, which in turn creates a threat to profits and induces firms to innovate new varieties to continue to benefit from monopoly rents (Aghion, et al., 2005). Grossman and Helpman (2017) also show an adverse effect of competition as successful innovators must share the market with foreign competitors. They, however, show that the market size effect offsets this negative effect and that open economies tend to innovate and grow more than closed ones. Furthermore, Coelli, Moxnes, and Ulltveit-Moe (2016) show striking evidence that indeed around seven percent of the increase in global knowledge over the 1990's can be attributed to freer trade.

The trade and innovation nexus tends to be absent in the Muslim world today. Naghavi and Pignataro (2018) show that countries with the highest percentage of Muslim population tend to produce the lowest level of patents worldwide. These countries practically include the core of the Islam, or historically the greater Muslim empire, and consist of Iran, Saudi Arabia, Syria, Tunisia, Egypt, Yemen, Algeria, Jordan, Pakistan, Morocco, Bangladesh, Tajikistan, Uzbekistan, Turkey, and Sudan. At the same

time, we know that Islam is a religion of trade. Prophet Muhammad was himself a Meccan merchant. A large part of those involved in the gradual manifestation of Islamic law were also craftsmen or merchants or at least came from such backgrounds (Cohen, 1970). Also, trade as a profession held a more favored position in the Islamic world than in Europe (Skeen, 2008). Michalopoulos, Naghavi, and Prarolo (2016) argue that trade played a critical role in the formation of Islamic principles. A main argument they put forth is the role of Islam as an agreement to secure safe passage across the desert against raids and ensure redistribution required a commitment device to make cooperation between tribes viable.

Trade and Islamic Principles

Islam is particularly known to have conferred economic benefits to individuals through the institutional advantages it created by facilitating trade. Michalopoulos, Naghavi, and Prarolo (2016) describe the role of the waqf as a dynamic redistribution system that spread wealth inter-generationally and stalled its concentration, making Islam work as a self-enforcing cooperation treaty that unified tribes of different natures into an Islamic community. Ensminger (1997) offers case studies comparing trade within Muslim and non-Muslim indigenous African societies, stressing how the institutional guarantee of Islam provided an additional impetus for trade by facilitating the flow of credit. An important advantage of Islam with respect to previous arrangements was the fact that it offered a powerful ideology with built-in sanctions that created non-material interest in holding to the terms of contracts. The existence of informal and formal punishments in Islam, such as those related to ridda (apostasy), gave Islam an edge over similar pre-existing, short-lived attempts. Although the focus of Michalopoulos, Naghavi, and Prarolo (2016) was the mitigation of conflict between trading merchants and Bedouin tribes in arid lands though the Islamic institutional complex, a reduced form variant of the theory can be used to illustrate the role of Islam as a commitment device in the following game.

Think of merchants travelling on trade routes who must cross the desert and the possibility of their caravans being raided by Bedouins, who lack merchandise to engage in long-distance trade themselves. A confrontation between the trading caravan and the Bedouins may take place in the desert and result of a loss of their cargo. There is, however, the possibility of redistributing a part of the potential profits from trade to the Bedouins. An agreement could be made between the two sides to furnish a redistribution of rents from those who can benefit from trade to the less-advantaged portion of the society and secure safe passage across the route. It is easy to show a game, in which the unique

subgame perfect Nash equilibrium would be to not redistribute by the merchants and raid by the Bedouins, resembling a prisoner's dilemma interaction where both sides end up in a socially inefficient equilibrium. This situation illustrates why the pre-Islamic redistribution attempts between tribes in the Arabian Peninsula, such as the case of ilaf, were temporary, highlighting the need for a credible commitment device to achieve the socially efficient outcome. This was the role played by Islam as a religion. Indeed, the terms of Muhammad's agreements with the tribes were always the same: the tribe agreed to pay the zakat and to refrain from attacking other Muslims and their allies (Lewis, 1993). Adding an apostacy cost or, in general, a cost of deviating from Muslim law that proposes a (Redistribute, Not Raid) equilibrium serves as a credible punishment device to make the cooperative solution the unique equilibrium outcome which could also be Pareto optimal.

Intellectual Property and Islamic Law

The mechanism is not the same, if not the opposite, with innovation in Islam. Naghavi and Pignataro (2018) highlight how it is exactly the fundamentals in Islamic principles that could lead to the demise of innovation in Muslim countries. This occurs due to the existence of a fallacy with respect to the protection of intellectual property in Islamic law. Although the concept of protection is more emphasized in Islam than other religions, the enforcement is left to the morality of the agents in the society creating a situation of adverse selection. The intellectual property environment is different in other religions, where legal institutions rather than religious scripts take charge in enforcing intellectual property rights.

The Sharia law includes clauses that resemble modern intellectual property considerations. The Caliphs in early Islam for example bought books and only made copies after paying an adequate compensation to the author (Malkawi, 2013). Indeed, Sharia draws close connections between intellectual property and Islamic law, albeit not explicitly regulating intellectual property rights with precise rules as it does for tangible property rights. In short, ownership of property can be acquired by appropriation, under which one may acquire ownership by developing it and making it productive to reward individuals for the fruits of their effort. The Sharia text does not limit such ownership to tangible assets, and is hence compatible with offering economic incentive to intellectual property owners by entitling them to exclusive right to enjoy the benefits of their creativity.

Nevertheless, the prohibition of intellectual property rights piracy in Islam has been limited to the Muslim judges' use of qiyas, though without a clear punishment such as that for material theft. An

interesting analogy regarding the separation of tangible and intangible assets in Islam lies in the Hedaya, which suggests that one does not amputate the hand of a thief for stealing a book because the thief's intention is not to steal the book as paper, but the ideas in the book, which is not tangible property (Al-Marghinani, 1791). The existence of this gray area when partial enforcement is left to Sharia has impeding consequences for business relationships and investment incentives that are key for innovation and economic development. Naghavi and Pignataro (2018) show that formal enforcement of intellectual property rights through legal institutions that are not linked to religious guidance could break the fallacy that emerges in a world of asymmetric information by encouraging moral agents to engage in technological effort in sectors less sensitive to intellectual property rights, while preventing expropriation by the amoral agents in sectors with more valuable technologies.

Trade as the Powerful Gravity of Islam

Michalopoulos, Naghavi, and Prarolo (2018) provide evidence that a main factor in the fast and expansive spread of Islam was the interests of merchants who wanted to gain access to the widest possible network of trade routes. Indeed, they show Islam predominantly spread across trade routes in the Old World. They argue that after the initial phase of the expansion of Islam throughout the first century after its birth within a certain radius around Mecca through military conquests, the religion gained control over a vast strategic location from North Africa passing through the Middle East all the way to the Indian sub-continent. This put the Islamic region in the center of a network of the most important traditional trade routes that connected the Old World and included the whole Western half of the Silk Road. It also linked maritime trade of the Mediterranean and the Indian Ocean. Merchants in those regions therefore had extra incentives to adopt the religion to gain advantages via cooperation and favorable laws reserved only within Muslim trading networks and access to valuable contacts to expand their trade. Islam at the same time spread along trade routes through propagation as Muslims themselves travelled long-distance along the routes when they engaged in trade.

It is likely that trade and innovation went together and reinforced each other in the advent of Islam, during the flourishing years of the Muslim territories. The Islamic empire stretched from Spain to the borders of China in inner Asia, creating a unique unified economic region, facilitating movement of not only merchants and goods, but also craftsmen and scholars. The ease of trade in the Islamic also allowed new ideas, techniques, and inventions to travel freely. Skeen (2008) provides a simple example of a rug made in China, that could be traded as far as Algeria within a year, and the technique of its manufacture

could be copied by local craftsmen. Last, but not least, trade also nurtured a swift movement of books across the Islamic world.

The Big Bang and the Big Crunch of Innovation in the Islamic World

Science and technology in the medieval Muslim world surpassed that in the West and China by far (Huff, 2003). Several very practical and important innovations took place during the golden age of Islamic civilization under the Abbasid dynasty, especially in agriculture. Improved methods of irrigation allowed more land to be cultivated, and new types of mills and turbines were used to reduce the need for labor. The cultivation of rice and the production of textile were among major innovations of the era. Crops and farming techniques were adopted from remote neighboring cultures such as India, China and Africa. Islamic famers contributed to eventually bringing crops such sugar and citrus fruits to the West, and distributing the cultivation of cotton to Iraq and Egypt (Wilson, 1983). Major scientific inventions associated with the Abbasids were also in fields of mathematics algebra, geometry, science, astronomy, medicine, anatomy. In medicine, the 9th century saw over 800 doctors in Baghdad, and many discoveries with regards to anatomy and diseases were achieved. Also, the invention of techniques to make thicker, more useful paper was an achievement of Baghdad (The Saylor Foundation, n.a.; Syed, et al., 2011).

The reborn Umayyad caliphate in Córdoba, after being overthrown by the Abbasid revolution and their relegation to Al-Andalus of Spain, also represented a peak of scientific and artistic achievements of the Muslim world. The Umayyads wanted to be seen as intellectual competitors of the Abbasids who led to their collapse, and pushed Córdoba to have libraries and educational institutions to rival those of Baghdad. Despite the rivalry between the two powers, which created competition, freedom to travel between the two Caliphates was allowed and helped spread fresh ideas and innovations over time. There was, however, a radical switch in the link between Islam and innovation in the aftermath of the Umayyads. This occurred when smaller unstable independent Taifas first took power for about 50 years, after which they were forced to call for the help of North African (Berber) caliphates. The Almoravids came to their rescue but soon took control themselves, and where succeeded by the Almohads. These dynasties were more aggressive, and at the same time more unstable (and hence under threat), lasting 70 years each and losing more and more territory over time during the Reconquista period. In principle, they were more of a ruling military elite in al-Andalus than intellectuals. Under the Almoravids and

Almohads there was a decline in cultural and social exchange and increased persecution of religious minorities, with a switch to more fundamentalist forms of Islam (Jayyusi, 1994).

Innovation as a Sacrifice for Power

The great economic divergence described in depth in Kuran (2010) has been related to the nature of Islam discouraging curiosity and preventing risk-taking activities by the Muslim society. In line with the narratives on religion and science in medieval Spain, Cinnirella, Naghavi, and Prarolo (2018) look directly at intellectual achievements in Spanish municipalities based on the number of years they have been under Muslim rule. Looking at literacy rate in 1900 and the number of historical patents achieved during the period of 1878-1939 in each municipality, they find that both measures of human capital or innovation are lower for municipalities that have been under Muslim rule for a longer period. There are several factors and historical narratives that can explain the negative correlation between religion, or particularly Islam, and innovation. I pick three recent interrelated analyses that are relevant for the argument in this chapter and provide a brief description of each below.

A recent analysis on the potential role of Islam in impeding innovation comes in Chaney (2016). Collecting data on intellectual production (from Harvard's library collection and a catalog of books from 17th century Istanbul) he establishes that Islamic societies flourished with scientific and technological production in the medieval period, but produce a disproportionately small share of world scientific output today. He focuses on the Sunni Revival, namely the 11th century surge in political power of religious leaders, as the decisive historical landmark. The hypothesis argues that increased political power came together with a replacement of scientific institutions that contributed to human capital development with religious educational centers such as madrasas. The elite promoted religious institutions as centers of knowledge production by requiring scholars to specialize in religious knowledge as a prerequisite to being appointed to any posts. This reduced the payoff to the production of scientific knowledge and shifted preferences in favor of production of religious knowledge. The evidence revolves around the newly empowered religious leaders and how they intentionally limited the production of scientific knowledge to avoid tampering with religious beliefs in society. The hypothesis is in line with previous argument in Mokyr (2002) that human capital formation and religion can be interrelated. In this context, we are talking about a political economy setting where religious elites believe that human capital accumulation could weaken their grip on power and control over the population.

Bènabou, Ticchi, and Vindigni (2015) is another contribution in literature that refers to the clash between innovation and religious doctrines in general. They show that the number of patents filed is decreasing in both religiosity and belief in god both across countries and across US states. Here the blame goes to a state that incorporates religious rule, which may repress new discoveries to protect religious beliefs. The model provided views that the diffusion of scientific discoveries brings productivity gains, but also neglect religious beliefs by contradicting the doctrine. The key mechanism suggested in this study is the potential belief-eroding characteristic of innovation. The government can impede innovation from spreading by blocking the spread of belief-eroding science. Muslim authorities started perceiving innovations as a potential threat in the beginning of the 12th century; the anti-science attitudes are still observable in the Muslim world today. The most striking case of knowledge blocking in the case of Islam is the decree in the Ottoman Empire that ruled the practice of printing punishable by death until the beginning of the 19th century.

Muslim religious authorities used their political power to advocate laws that inhibited economic development, such as regulations that inhibited the spread of knowledge (against printing press) and human capital development (against mass education). Conservative Islamic clerics in the background who enjoyed a strong political seat saw such important advancements as a threat to their power, and the state which was strongly tied to religion, saw it in their own interest to rule in their favor (Rubin, 2017). The crux of the argument behind the Muslim anti-printing attitude has been described to be the reliance of political authorities under Islam on legitimacy by religious authorities, the attainment of which depended on their conforming to the corresponding religious rules. This environment reduced enthusiasm for introducing novel technologies, including the printing press (Cosgel, Miceli, and Rubin, 2012). More specifically, the power of religious authorities depended on their role in the transmission of knowledge, an essentially oral process in early Ottoman society prior to the introduction of the printing press. Skepticism in Islam with regards to unsupervised writings as reliable means of communication granted religious authorities a monopoly position in the transmission of knowledge. They used their position to provide Ottoman rulers with legitimacy by producing loyalty, in return for compensations such as the incorporation of religious institutions into the state. Ottoman rulers banned printing because they believed it may undermine the comparative advantage of religious authorities to confer legitimacy, thereby increasing the costs of tax collection. The Ottomans eventually granted permission to printing in Arabic script in the 18th century only upon the emergence of new sources of legitimacy (Rubin, 2017).

The Missing Role of Tolerance

Tolerance is a concept often associated with the impact of religion on innovation. The argument on tolerance is not confined to Islam, but works for any belief by creating diversity and synergy between diverse people (Cinnirella and Streb, 2017). The Muslim empire is known to have been tolerant towards followers of other religions (Lapidus, 2002). Also, the output of Arab science during the golden age of Islam shows that there is no fundamental barrier to tolerance and progress in the Islamic world (Ofek, 2011). Iyer, Tucku, and Shrivastava (2017) show that even when Muslims were engaged in destroying holy sites of other religions, they did not oppose their presence. The unique evidence found in their research shows that Muslims desecrated temples to diminish the authority of the enemy, the Hindu state, during war.

Interestingly, Jha (2013) shows that a factor that has led to religious tolerance in Islam is trade. Due to advantages enjoyed by Muslims brought about by full control over Indian Ocean shipping, ethnic complementarities between them and Hindus for exchange and provision of services were highest in medieval trading ports. This led to development of institutional mechanisms that supported interethnic cooperation, and reduced probability of riots and violence between different ethnic groups of the two religions. The role of trade on religious tolerance has also been given several alternative compatible explanations. Clingingsmith, Khwaja, and Kremer (2009) for instance, connects tolerance to Islam through the role of the Hajj pilgrimage, a pillar of Islam. Their study argues that a global gathering as such creates unity within an Islamic world through exposure to global Islamic practices, with a spillover of increased belief in peace, harmony, and equality among adherents of different religions. This concept indirectly links with trade and innovation as Hajj gatherings also facilitated economic trade and the diffusion of economic, cultural, and scientific ideas (Bose, 2006).

Then why has a tolerant Muslim religion led to the great economic divergence with respect to adherents of other religions? As mentioned above, a switch in the level of religiosity and its view of new inventions could have taken place after the start of the Crusades. Once again, an environment of war may have changed the perspective of Muslims and led to a less tolerant version of Islam (Gutas, 1998). This may have also led to intolerance in other religions towards Islam, and hence reduced diversity and interreligion interaction. An example of this is the reduced human capital and innovation in areas of Spain longer exposed to Islam after the periods of Reconquista that was accompanied by forced conversions and expulsion of Muslims (Cinnirella, Naghavi, and Prarolo, 2018). As for countries with a Muslim majority today, Bosker, Buringh, and van Zanden (2013) relate the economic and intellectual stagnation of the Muslim world to reasons not related to tolerance, namely a different choice of main transport mode (camel versus ship) and failure to develop local participative governments as in Europe that made cities less dependent on centralized decision-making states. **They show that Islamic lands failed to keep** up with the rest of the world as the methods of trade and urbanization eventually limited potential for growth. This is in line with Michalopoulos, Naghavi, and Prarolo (2016), who argued that Islamic principles designed to limit wealth inequality and escape a state of constant feuding blocked the accumulation of capital indispensable for growth in the era of large-scale shipping trade and industrialization.

Conclusion

Theory and empirical evidence in the economics literature has reached consensus that trade and innovation reinforce each other in nurturing development. Although this was also observed throughout the Muslim world in its flourishing years of the preindustrial era, innovation in Islamic countries whose economies continue to be based on commerce is lagging behind with respect to the world technology frontier. Historical narratives that have also been recently put to data show that trade has been a catalyst for the spread of Islam. The golden age of Islam some of the most important inventions in history. The progress in the Muslim world however came to a halt, even if trade continued to be the core instrument in the further spread of to Sub-Saharan Africa, Inner Asia, and East and Southeast Asia. A number of studies relate the interruption in innovation and growth in Islam to the behavior of the ruling elite to maintain power and rent, and the influence of religion in the state. Lack of religious tolerance and diversity of ethnic groups and ideas are often blamed for the lack of enthusiasm in the society for innovation, though evidence has shown Islam to be a tolerant religion towards other beliefs. Some recent works have also linked the lack of technological progress to the gaps and fallacies with regards to intellectual property in Islamic law, and even their choice of transport, or the centralization of the state as opposed to powerful smaller local governments that for example emerged in Europe. Despite several recent empirical analyses that support alternative explanations of the relationship between Islam, innovation, and trade, economic research on this front is in its infancy and we call for further in-depth study of the issue.

References

Acemoglu, D., and Linn, J. (2004) Market size in innovation: Theory and evidence from the pharmaceutical industry. Quarterly Journal of Economics 119 (3): 1049-1090.

Aghion, P., Bloom, N., Blundell, R., Griffith, R. and Howitt, P. (2005) Competition and innovation: An inverted u relationship. Quarterly Journal of Economics 102 (2): 701-728.

Al-Marghinani, B. (1791) The Hedaya: C. Hamilton Translation. London: T. Bensley.

Bènabou, R., Ticchi, D., and Vindigni, A. (2015) Forbidden fruits: The political economy of science, religion, and growth. NBER Working Paper No. 21105.

Bose, S. (2006) A Hundred Horizons: The Indian Ocean in the Age of Global Empire. Cambridge: Harvard University Press.

Bosker, M., Buringh, E., and van Zanden, J. L. (2013) From Baghdad to London: Unraveling urban development in Europe, the Middle East, and North Africa, 800-1800. Review of Economics and Statistics, 95 (4): 1418-1437.

Chaney, E. (2016) Religion and the rise and fall of Islamic science. mimeo, Harvard University.

Cinnirella, F., Naghavi, A., and Prarolo, G. (2018) Mecca or mechanization: Islam and innovation in historical Spain, University of Bologna, mimeo.

Cinnirella, F. and Streb, J. (2017) Religious tolerance as engine of innovation. CEPR Discussion Paper 12466.

Clingingsmith, D., Khwaja, A. I., and Kremer, M. (2009) Estimating the impact of the Hajj: Religion and tolerance in Islam's global gathering. Quarterly Journal of Economics 124 (3): 1133-1170.

Coelli, F., Moxnes, A. and Ulltveit-Moe K. H. (2016) Better, faster, stronger: Global innovation and trade liberalization. CEPR Discussion paper 11506.

Coşgel, M. M., Miceli, T. J., and Rubin, J. (2012) The political economy of mass printing: Legitimacy, revolt, and technology change in the Ottoman Empire, Journal of Comparative Economics 40 (3): 357-371.

Cohen, Hayyim J. (1970) The economic background and the secular occupations of Muslim jurisprudents and traditionists in the classical period of Islam (Until the middle of the eleventh century). Journal of the Economic and Social History of the Orient 13: 16-61.

Ensminger, J. (1997) Transaction costs and Islam: Explaining conversion in Africa, Journal of Institutional and Theoretical Economics 153 (1): 3-29.

Grossman, G. M., and Helpman E. (1989) Product development and international trade. Journal of Political Economy 97 (6): 1261-1283.

Grossman, G. M., and Helpman E. (1990) Trade, innovation, and growth. American Economic Review 80(2): 86-91.

Grossman, G. M., and Helpman E. (2017) Growth, trade, and inequality. Econometrica, forthcoming.

Gutas, D. (1998) Greek Thought, Arabic Culture: The Graeco-Arabic Translation Movement in Baghdad and Early Abbasid Society. New York: Routledge.

Huff, T. (2003) The Rise of Early Modern Science: Islam, China and the West. Cambridge: Cambridge University Press.

Iyer, S., Tucku, R., and Shrivastava, A. (2017) Holy wars? Temple desecrations in medieval India. Cambridge Working Papers in Economics 1705.

Jayyusi, S. K. (1994) The Legacy of Muslim Spain, 2 vol. Leiden: Brill.

Jha, S. (2013) Trade, institutions, and ethnic tolerance: Evidence from South Asia, American Political Science Review 107 (4): 806-832.

Kuran, T. (2010) The Long Divergence: How Islamic Law Held Back the Middle East. Princeton: Princeton University Press.

Lapidus, I. M. (2002) A History of Islamic Societies. Cambridge: Cambridge University Press.

Lewis, B. (1993) The Arabs in History, 6th Edition. Oxford: Oxford University Press.

Malkawi, B. H. (2013) Intellectual property protection from a sharia perspective. University of St. Thomas Law Journal 16: 87-122.

Michalopoulos, S., Naghavi, A., and Prarolo, G. (2016) Islam, inequality and pre-industrial comparative development, Journal of Development Economics 120: 86-98.

Michalopoulos, S., Naghavi, A., and Prarolo, G. (2018) Trade and geography in the spread of Islam, Economic Journal, forthcoming.

Mokyr, J. (2002) The Gifts of Athena. Princeton: Princeton University Press.

Naghavi, A. and Pignataro, G. (2018) The fallacy of intellectual property rights in Islamic law, University of Bologna, mimeo.

Ofek, H. (2011) Why the Arabic world turned away from science. The New Atlantis 30: 3-23.

Rubin, J. (2017) Rulers, Religion, and Riches Why the West Got Rich and the Middle East Did Not. Cambridge: Cambridge University Press.

The Saylor Foundation (n. a.) The Abbasid dynasty: The golden age of Islamic civilization. Retrieved from http://www.saylor.org/hist101.

Skeen, B. A. (2008) Trade and exchange in the medieval Islamic world. In Crabtree, Pam J. Encyclopedia of Society and Culture in the Medieval World. New York: Facts on File, Inc.

Syed, M. H., Akhtar, S. S., and Usmani B. D. (2011) A Concise History of Islam. New Delhi: Vij Books India Private Limited.

Wilson, A. M. (1983) Agricultural Innovation in the Early Islamic World: The Diffusion of Crops and Farming Techniques, 700-1100. Cambridge: Cambridge University Press.