Institute for Economic Studies, Keio University

Keio-IES Discussion Paper Series

Persistent Divides in Beliefs, Conflict, and Innovation

Alexander Mihailov, 大垣 昌夫

Keio University

CALAMVS GLADIO FORTIOR

1858

Persistent Divides in Beliefs, Conflict, and Innovation

Alexander Mihailov, 大垣 昌夫

【要旨】

　　Many Christian supporters of Mr. Donald Trump favored restrictive immigration policies against Libya, Syria and other Muslim countries during his presidency. A cause behind this seems to be a persistent divide in certain beliefs between Christianity and Islam, even though the two religions also share many common beliefs. This paper builds a simple model in which such divide over a historical fact can persist even when strong scientific evidence exists in favor of the fact and all agents are using Bayesian learning. In the model, both innovation and conflict are more likely to occur in firms with more diversified workers, while education can reduce the probability of conflict to occur. Given these results, we argue that education to honor and understand other people's beliefs (rather than educating that one particular view is rational or justified and the others are not) is beneficial for promoting innovation, in addition to impeding conflict.

Alexander Mihailov

Department of Economics, University of Reading

Whiteknights, Reading RG6 6AA, United Kingdom

a.mihailov@reading.ac.uk

大垣 昌夫

慶應義塾大学経済学部

〒108-8345　東京都港区三田2-15-45

mogaki@econ.keio.ac.jp

Persistent Divides in Beliefs, Conflict, and Innovation[*]

Alexander Mihailov[†]   Masao Ogaki[‡]

March 16, 2021

Abstract

Many Christian supporters of Mr. Donald Trump favored restrictive immigration policies against Libya, Syria and other Muslim countries during his presidency. A cause behind this seems to be a persistent divide in certain beliefs between Christianity and Islam, even though the two religions also share many common beliefs. This paper builds a simple model in which such divide over a historical fact can persist even when strong scientific evidence exists in favor of the fact and all agents are using Bayesian learning. In the model, both innovation and conflict are more likely to occur in firms with more diversified workers, while education can reduce the probability of conflict to occur. Given these results, we argue that education to honor and understand other people's beliefs (rather than educating that one particular view is rational or justified and the others are not) is beneficial for promoting innovation, in addition to impeding conflict.

JEL codes: M14, O30, D74

Keywords: Bayesian learning, beliefs, diversity, education

[†]Department of Economics, University of Reading, Whiteknights, Reading, RG6 6AA, United Kingdom; e-mail: a.mihailov@reading.ac.uk

[‡]Faculty of Economics, Keio University, 2-15-45 Mita, Minato-ku, Tokyo 108-8345, Japan; e-mail: mogaki@keio.jp

Contents

1 Introduction

Many socioeconomic divides persist, and affect policies. A prominent recent example is that Christian supporters of former President Donald Trump in the United States favored restrictive immigration policies against Libya, Syria and other Muslim countries. But where does such a persistent belief divide come from? If the divide arises from irrationality, communication is very difficult if not impossible, and a reasonable policy may be to try to educate the rational view and to impose immigration restriction on the people who persistently hold to irrational views. If the divide is not necessarily originating in irrationality, then a more reasonable policy is to educate people about common and different elements in different belief systems (such as religions), and about the techniques of basing the communication on the common elements while honoring the different elements.

It is worth noting that persistent belief divides exist even with strong scientific evidence in favor of a historical fact that has accumulated over years of research or even centuries of history. Examples include the Holocaust and the effect of human activities on the global warming since the Industrial Revolution. An important divide between Christianity and Islam is over a historical fact of the crucifixion of Jesus of Nazareth. In Christianity, the crucifixion of Jesus of Nazareth is central to its belief system, while in Quran, Jesus of Nazareth was not crucified, but someone who resembled him was crucified. Scientific evidence from many historical documents seems to favor that he was crucified.

To explore issues of persistent divides in beliefs in an organized way, we propose to begin with trying to understand the reason behind divides over historical facts. We first need to address this simpler question, before hoping to understand why we have many divides as well on more general or more complicated spiritual matters, for instance, the resurrection of Jesus, or was Jesus really the son of God?

Given these motivations, the purpose of this research is threefold, and we aim to answer three research questions. First, why does strong scientific evidence in favor of a historical fact not necessarily imply emergence of consensus of beliefs of people in the long run even when each person is rationally learning? Second, given there is the cost of possible conflict when people with different beliefs work together, what may the benefit be from working together? Third, how can education help people with different beliefs to work together?

For this purpose, we first develop a simple theoretical model in which very different beliefs about a historical fact can persist even in the asymptotic limit in spite of strong scientific evidence and even when each agent is using Bayesian learning. We then extend the model to reflect findings in empirical work that both conflict and innovation are more likely to occur when workers have more diverse beliefs. Finally, we modify the model to

add an effect of education to decrease the probability of conflict to occur but at the same time promoting innovation.

Given that our model shows that different beliefs over a historical fact can persist even when each agent is using Bayesian learning, we think that it is not beneficial to try to persuade people to change their beliefs even when we have strong scientific evidence. One way to deal with divides in beliefs is to promote segregation, such as former US President Trump's restrictive immigration policies. A cost of such policies, however, is less innovation. This must be an important reason why many companies which benefit from innovation are against such policies. One way to mitigate the effects of divides on conflict is to implement a policy of educating both common and different beliefs in different religions. For example, many Christians think that Allah is not God they worship. However, Allah is the Arabic word for God in Abrahamic religions, including Christianity.

Our model can be applied to persistent divides over other historical facts such as the Holocaust and the effect of human activities upon the global warming since the Industrial Revolution. Because we live nowadays in a heterogeneous society on our planet, which is so inter-connected and inter-influenced that news, views and fashions spread in seconds across the world, better understanding of a source of heterogeneity and its consequences can be helpful.

2 The Model

This section specifies the model environment.

As stated, our aim is to develop a model of innovation when firms consist of individuals with different "worldviews", here religion, in a narrower sense, in order to gain insights that might help policymakers, e.g., with regard to education policy, here in deciding to teach one or two religions in school. Our modeling strategy consists in trying to devise the simplest model that would allow us to gain such insights, and we need to sacrifice some realism in a tradeoff with tractability, as is common in theoretical work.

2.1 Bayesian Learning with Heterogeneous Priors

The first building block of our model is Bayesian learning with heterogeneous priors. As an example to motivate this, we consider a belief divide over a historical fact between Christianity and Islam.

A deep question permitting a binary answer by religious believers is "Was Jesus of Nazareth crucified?". Opposite to the Bible, the Quran does not believe Jesus of Nazareth was crucified:

> "And [for] their saying, 'Indeed, we have killed the Messiah, Jesus, the son

of Mary, the messenger of Allah.' And they did not kill him, nor did they crucify him; but [another] was made to resemble him to them. And indeed, those who differ over it are in doubt about it. They have no knowledge of it except the following of assumption. And they did not kill him, for certain." (from https://quran.com/4/157-167?translations=20)

Let C be the event that Jesus of Nazareth was crucified and $S_t : t = 0, 1, 2, ...$ be the i.i.d. stochastic process of scientific evidence where $S_t = 1$ with probability r if C is true and $S_t = 1$ with probability q if C is not true. Here, $t = 0$ is when the scientific method got started to be used. Suppose that agent i has private information which is independent of S_t, and has formed a prior probability $p_i(0)$ that C is true in period 0. Let $p_i(\tau)$ be the posterior probability that C is true after observing $S_t : t = 0, 1, 2, ..., \tau$ when the agent is using Bayes rule in each period. Then

$$p_i(\tau) = \frac{p_i(\tau - 1)r}{p_i(\tau - 1)r + (1 - p_i(\tau - 1))q}. \tag{1}$$

Here, $p_i(\tau)$ is a martingale bounded by 0 and 1, and $p_i(\tau)$ converges with probability one to a real valued number for each i as τ increases (this is a special case of Theorem 2.1 in Aghion *et al.*, 1991). For our purpose, it is important to note that $p_i(\tau) = 1$ for all τ if $p_i(0) = 1$ while $p_i(\tau) = 0$ for all τ if $p_i(0) = 0$ according to Eq. (1).

Assume that $r > q$. In this case, scientific evidence favors C. As long as $p_i(\tau) > 0$, $p_i(\tau)$ converges to 1. On the other hand, $p_i(\tau) = 0$ for all τ if $p_i(0) = 0$.

Assume that $r < q$. In this case, scientific evidence favors the complement of C. As long as $p_i(\tau) > 0$, $p_i(\tau)$ converges to 0. On the other hand, $p_i(\tau) = 1$ for all τ if $p_i(0) = 1$.

Thus, in this simple model, the limit posterior probability is either 0 or 1. As long as there are agents who have the initial priors that are equal to 0 and 1, we have a belief divide even in the limit. We argue that these extreme priors are not necessarily irrational. For example, a person may have adopted a belief system based on the Bible, and then the crucifixion of Jesus can become an axiom for this person. On the other hand, if a person has adopted a belief system based on the Quran, then this person can rationally have the initial prior of 0. Therefore, the "rationality" of priors depends on the worldview in the terminology of Kant (1987, a translation of a book published in 1790).[1] Our point is that the initial prior of $p_i(0) = 1$ should not be written off as neither irrational nor pathological even if scientific evidence favors C in some contexts, such as where the sacred text of a world religion makes an explicit statement against it.[2]

---

[1]See Naugle (2002) for an explation of the history of how the word "worldview" has been used, and Kubota *et al.* (2013) for an example of empirical work in economics that use worldview beliefs.

[2]In a closely related paper by Breen (1999, p. 465), the discussion of different initial priors ignores this type of possibility. Ignoring this possibility may be reasonable in some contexts and not in others.

2.2   Innovation and Conflict

The second building block of our model is motivated by empirical evidence that cultural diversity promotes innovation. For example, Parrotta *et al.*'s (2014) measure of diversity in cultural background is associated with foreign employees' country of origin and is built by using eight categories which include Muslim countries as a category. Their empirical evidence supports the hypothesis that ethnic diversity of the labor force is an important source of innovation. On the other hand, Arbatli *et al.* (2020) establish empirically that interpersonal population diversity has also been pivotal to the emergence, prevalence, recurrence, and severity of intrasocietal conflicts. Our modeling approach, therefore, takes into account both these empirical regularities and checks more formally when their balance or dominance would favor creating a socioeconomic outcome that enhances either innovation or conflict.

In this building block, we assume that each firm hires two workers in each period. Let d be the distance of beliefs of two workers measured by the distance of the probabilities attached to the historical fact. Let $p_j(d)$ be the probability of innovation of firm j, which is an increasing function of d, and $C_j(d)$ be the expected cost of the firm from conflict, which is also an increasing function of d. Let $R_j(d)$ be the expected revenue of the firm.

As an example, let $p_j(d) = p(d) = d$ and $C_j(d) = C(d) = d$. Assume that

$$R_j(d) = \alpha_j p(d) + \beta - C(d) = (\alpha_j - 1)d + \beta. \tag{2}$$

The firms with high values of α_j ($\alpha_j > 1$, higher gain from innovation) favor promoting immigration while the firms with low values of α_j ($\alpha_j < 1$, lower gain from innovation) favor restricting immigration.

2.3   Education

We now modify the model to incorporate effects of education. We motivate this modification by an anecdotal experience by the second author of this paper, M. Ogaki. When Ogaki took Theology courses, one of his professors taught him that "Allah is not God." When Ogaki went to Antakya in Turkey to do experiments at Christian churches there, he was surprised that everyone was saying Allah. Ogaki learned that Allah is the Arabic word for God the Creator who appeared to Abraham. Even for an expert in one religion, it is very easy to have prejudice against other religions. To work together, we need common worldview beliefs and prejudice does not help. Education that aims at explaining both common worldview beliefs and differences in beliefs can help people of different religions to work together.

Let k_i be the type of education (teaching of one religion is $k_i = 1$ and that of both religions is $k_i = 2$) worker i has got. When worker i_1 and i_2 work for firm j, we assume

that the expected cost of the firm depends on the combination of the types of education:

$$C_j(d) = \gamma \left(k_i \left(1 \right), k_i \left(2 \right) \right) d, \tag{3}$$

where $\gamma(1,1)d > \gamma(1,2)d = \gamma(2,1)d > \gamma(2,2)d$ if $d > 0$. Thus, education of both religions has an effect of reducing the expected cost from conflict, as is consistent with related studies and evidence: see, e.g., Nunn *et al.* (1978), who argue that education enhances knowledge and reasoning skills and contributes to fostering tolerance; or McMahon (2009), who stresses that schools and universities also foster tolerance by emphasizing its value.

3   Concluding Remarks

This paper developed a simple model in which a persistent divide in beliefs over a historical fact is possible. Moreover, the divide can increase both the probabilities of conflict and innovation in a multinational and multicultural population.

We live nowadays in such a heterogeneous society on our planet which is so interconnected and inter-influenced that news, views and fashions spread in seconds across the world. This inter-dependent heterogeneous society has been the recent outcome of three major forces or trends: (i) the information technology breakthrough giving birth (and super-transmission and super-influence powers) to the Internet and the related social networks; (ii) the globalization process moving beyond trade and finance into ways of life, sharing of values or opinions, fashions, and the related imitation of lifestyles, worldviews, hobbies (e.g., through "likes" and "follows" in the social media); (iii) the democratization of the global society – not only in terms of international politics helping to fight down local/national dictators and tyrants, and associated claims of national/ethnic/religious/cultural superiority or uniqueness over the rest of the world, that caused perpetual wars in the past, but also in terms of democratization of science and arts, allowing distant education or learning via the Internet and related social networks, as well as (practically) costless access to works of science (pdf files, screen-reading/learning) and arts (images, videos, music, narratives). Because of these three major tendencies or drivers, heterogeneity has surfaced on the Internet in all its diversity and richness (and ambition for fame or influence/recognition, and competition for attention/recognition) around the globe; but ironically, fashions and fads (take the young generation in particular) work in a way opposite to heterogeneity (that was revealed kind of suddenly and almost instantly by the Internet linkage), that is, to uniformize the taste and behavior of the global society too (via the fashions and following of "authorities" or "stars"). This current heterogeneity is both an asset and a danger as in our model. We hope that the general framework we outlined in this paper can be helpful in future research on normative issues regarding the role of education in providing knowledge about social diversity

and enhancing tolerance of different beliefs.

To sum up our key insight, if the heterogeneity arises from two world religions with many believers as in our main motivating example, then it seems good to educate both religions as long as the benefit of innovation exceeds the cost of conflict. On the other hand, the model can also be applied to the historical fact of the Holocaust. It is not clear to us whether it is enough to think about material benefits and costs when we think about normative issues related to education of such beliefs. It may well be that we should add considerations of ethical views other than welfarism based on utility (e.g., virtue ethics in addition to welfarism as in Bhatt and Ogaki, 2019).

References

[1] Aghion, Philippe, Patrick Bolton, Christopher Harris, and Bruno Jullien (1991), "Optimal Learning by Experimentation," *Review of Economic Studies* 58, 621–654.

[2] Arbatli, Cemal Eren, Quamrul H. Ashraf, Oded Galor, and Marc Klemp (2020), "Diversity and Conflict," *Econometrica* 88, 727–797.

[3] Bhatt, Vipul, and Masao Ogaki (2019), "Introducing Virtue Ethics into Normative Economics for Models with Endogenous Preferences," Paper presented as the keynote speaker at the Macroeconomics Development Workshop, August 2019, Deakin University, Melbourne, Australia.

[4] Breen, Richard (1999), "Beliefs, Rational Choice and Bayesian Learning," *Rationality and Society* 11(4), 463–479.

[5] Carroll, John T., and Joel B. Green (1995), *The Death of Jesus in Early Christianity*, Peabody, MA: Hendrickson Publishers.

[6] Kant, Immanuel (1987), *Critique of Judgment: Including the First Introduction.* Translated and Introduction by W. S. Pluhar. Foreword by M. J. Gregor. Indianapolis: Hackett.

[7] Kubota, Kohei, Akiko Kamesaka, Masao Ogaki, and Fumio Ohtake (2013), "Cultures, Worldviews, and Intergenerational Altruism," Paper presented at the European Regional Science Association 2013 Congress.

[8] Naugle, D. K. (2002), *Worldview: The History of a Concept.* Grand Rapids, MI: Eerdmans.

[9] Nunn, C. Z., H. J. Crockett, and J. A. Williams (1978), *Tolerance for Nonconformity*, Jossey-Bass Social and Behavioral Science Series, Jossey-Bass Publishers.

[10] Parrotta, Pierpaolo, Dario Pozzoli, and Mariola Pytlikova (2014), "The Nexus Between Labor Diversity and Firm's Innovation," *Journal of Population Economics* 27, 303–364.

[11] Stubager, Rune (2008), "Education Effects on Authoritarian-Libertarian Values: A Question of Socialization," *British Journal of Sociology* 59, 327–350.