

The Persistent Effect of Language on Preference for
Income Redistribution: Evidence from a Natural
Experiment

by

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Dissertation submitted in partial fulfillment of the requirements for the degree of
Master of Arts in the Department of Political Science
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ABSTRACT

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Abstract

Is there any long-term factor that shapes individual preference for income redistribution and corresponding economic or political behavior? I document the persistent effect of language structure, specifically word order freedom (*WoF*), on preference for redistribution. *WoF* refers to the extent to which word order can be changed without affecting the original meaning. In this article, I develop two formal models to show how languages with more flexibility in word order foster a consciousness of equality and encourage people to be more risk-averse. Empirically, using two general social surveys, I find that people speaking a language with greater *WoF* are more likely to purchase insurance and support to reduce the income gap. Furthermore, I investigate a natural experiment traced back to the Viking age. By using Scandinavian settlements as an instrumental variable, I reveal the causal relationship between language and the variation of human political attitudes and behaviors.

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1

Introduction

Income inequality exists both between and within individual countries. As the most wealthy country, the United States has the least equal distribution of income compared to other developed countries (Gottschalk and Smeeding, 2000). To reduce this inequality, governments adopt progressive taxation and expand social spending. One crucial factor that drives those administrative measures is the individual preference for income redistribution (Corneo and Grüner, 2002). Although political economists have proposed many factors that affect re-distributional preference, in this paper, I argue the preference for income redistribution has been deeply and continue to be shaped by languages we speak.

The diversity of language plays an important role in various social phenomena. Economists find ethnolinguistic fraction impedes economic growth (Alesina et al., 1999, Collier, 1998, Alesina and Ferrara, 2005, Campos and Kuzeyev, 2007); Political scientists provide credible evidence to show how ethnolinguistic heterogeneity sparks civil wars (Collier and Hoeffler, 2004, Wimmer et al., 2009, Fearon and Laitin, 2003, Ordeshook and Shvetsova, 1994). In addition to those macro-level effects, language also affects on individual preferences and behaviors. For example, Chen (2013) rigorously tests the hypothesis that languages emphasizing tense lead speakers to take ‘fewer future-oriented actions’, both positive and negative, like saving money and

smoking.

That languages affect perception and thought is a long-standing hypothesis, called ‘Sapir-Whorf Hypothesis (Lucy, 1998, Kay and Kempton, 1984).’ From linguistics to neuroscience, many experiments and studies have tested the hypothesis (see Gilbert et al. (2008, 2006)). For example, by using functional magnetic resonance imaging, Tan et al. (2008) confirm that language processing brain region participates in neural networks that are responsible for the perceptual decision. In further investigation of this connection, I try to reveal the relationship between language and economic or political decisions and preferences. In particular, I find one grammatical factor of languages —word order freedom (*WoF*) —significantly shapes individual preference for income redistribution as well as risk tolerance.

Almost all existing literature on what affects the preference for income redistribution could be classified into three categories. The first one focuses on the social structural variables, like culture (Alesina and Glaeser, 2004), religion (Neustadt, 2011, Tan, 2006, Huber and Stanig, 2011), labor market segmentation (Alt and Iversen, 2014), and wealth (Doherty et al., 2006, Finseraas, 2009, Fehr and Schmidt, 2006, Keely and Tan, 2008). The second is centered around biological factors like gender and age which are inherent personal properties during the whole life. For example, a great gender gap exists in most political or social phenomena. Croson and Gneezy (2009) have reviewed many economic experiments and concludes women are more risk averse, other-regarding and reluctant to engage in competition than men. The same gap also appears in the preference of redistribution. Consistent with common stereotype, Alesina and Giuliano (2009) find that women are more pro-predistribution. They also find that the effect of age on redistribution preference shows an inverted U curve after they add a squared term to the model. When people get older, they are less likely to support income redistribute at a government level.

The third category, however, directly explores the psychological disposition. The first mental concept about income redistribution that people will come up with is

fairness. If someone values fairness more than others, he or she is more inclined to be favorable to ‘fair income’ by effort rather than luck (see Ballard-Rosa et al. (2017), Alesina and La Ferrara (2005)). As a result, in society, people who believe that wealth is determined by luck, connection or birth prefer a high tax (Alesina and Angeletos, 2005). Besides, fear is also a key psychological feature. For example, Rueda and Stegmueller (2015) argue that the rich have a stronger preference for redistribution in some high-inequality Western European regions because of fearing of crime. In addition, expectation about future social status will affect current preference for redistribution (Piketty, 1995, Checchi and Filippin, 2004). Benabou and Ok (2001) proposed Prospect of Upward Mobility (POUM) hypothesis to stress that the poor majority will not expropriate too much from the rich because they consider their future better position. Alesina and Giuliano (2009) empirically shows that one standard deviation increasing in social mobility are expected to decrease redistribution preference by nearly 3%.

Risk aversion is another interesting psychological factor. As Alesina and Giuliano (2009) points out, risk aversion plays a critical role in the POUM theory. The excessive risk aversion makes individuals much worry about the downward mobility such that reduces the demand for redistribution. This mechanism could be displayed in the left part in figure 1.1.

However, the truth is much more complicated than we thought. Languages invisibly affect our preference and behavior anytime. Roughly speaking, some languages are flexible in the word order, and the others are relatively rigid. When people speak flexible languages like German and Slovenia, they could change the word order in one sentence without changing the original meaning. But if you speak a rigid language like English or Chinese, the fixed word order is necessary to mark the grammatic relationship among words so that one could express correct meaning. One critical condition for higher word order freedom is the clearness and certainty of each word and their grammatic relationship.

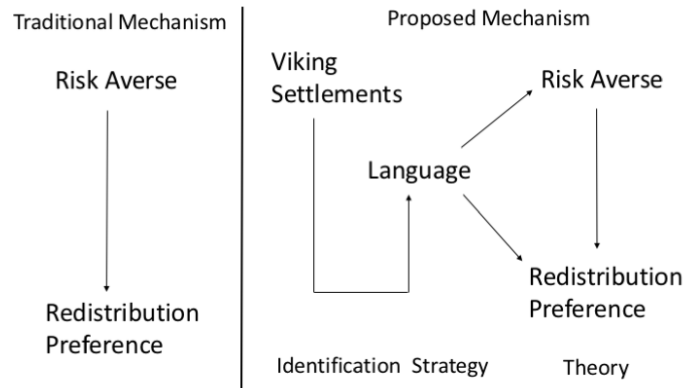


FIGURE 1.1: Mechanisms and Structure: Language and Preference for Income Redistribution

Note: Left part shows the traditional mechanism that risk aversion prompt to the preference for income redistribution. Right part illustrates the structure of the paper. In the theory section, I illustrate how languages potentially affect risk aversion and preference for redistribution; In empirical section, I will use Viking Settlements natural experiment to identify the causal relationship between languages and preferences.

In the theory section, I will use two decision models to show how higher word order freedom languages make individuals much more intolerant to uncertainty (risk) and highly value equality, and then much more prefer income redistribution. In other words, the real mechanism should be the far right part of Figure 1.1. One mechanism is that higher word order freedom leads individuals to be more risk-averse, which then, according to the existent findings, results in much more supporting income redistribution. And the second direct mechanism is higher word order freedom make individuals equally treat everybody and thus prefer income redistribution.

Figure 1.2 illustrates my macro findings. It shows the relationship between word order freedom and government social spending in OECD countries. The independent variable is the rank of word order freedom where small numbers denote higher *WoF*. We could clearly identify a pattern that governments in countries with rigid languages spend fairly less on social infrastructure than those with higher *WoF*.

This figure also reflects that we are still trapped in the ‘language dilemma’. Although our preference and decision are deeply influenced by languages, we could have

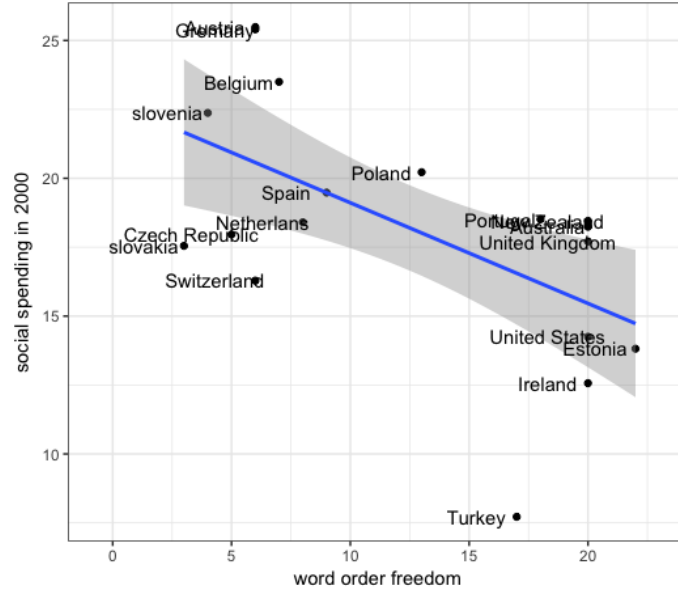


FIGURE 1.2: Word Order Freedom and Government Social Spending

Note: The fitted line with shade shows 0.9 confidence interval. If extreme value Turkey is removed, the outcome is still robust.

devised political institutions to reduce the magnitude of this invisible factor. But it seems that we still fail to get rid of this language trap.

More rigorous empirical tests with country-level and individual-level data can be found in the result section. First, in the baseline model, I use World Value Survey data (N=22433) with ordered probit model showing a strong correlation between flexible language and preference for income redistribution across countries. Then, with SHARE dataset (N=34946) which contains insurance purchasing data in European Countries, I test the language-risk aversion mechanism. Third, in order to remove the cultural confounding factor, I conduct within country regression. Even though the small samples reduces the statistical significance, all coefficients are consistent with the theory.

To address the causal relationship, I investigate a natural experiment which can be traced back to the Viking Age. Since 800 AD, for three centuries, North-West Europe was exposed to violent attacks and colonization by Scandinavians. Linguists shared a belief that the interaction between locals and Vikings directly affects the

word order freedom. The typical example is English. Old English and Old Norse are similar to each other. Vikings and English speakers were able to communicate with each other. In order to enhance communication, they intentionally pronounced the words with different endings less clearly. Gradually, the clear affixes became less apparent. This directly reduced word order freedom of English. The exact mechanism will be introduced in detail in Natural Experiment section. Then, I compile a Viking settlement dataset and use it as an instrumental variable. The outcomes of 2SLS regression confirm the causal relationship between language and preference for income redistribution. The main structure of the paper and mechanisms are concluded in the figure 1.1.

All in all, word order freedom is an important scope through which we understand the global income inequality. Everyone thinks with words, speak with words. The structure of words (grammar) is the most impressive and fundamental factor that affect our minds, preferences, and decisions. It is true that society and culture may influence the pronunciation and characters. But our variable of interest, word order freedom is much more stable because it is the fundamental structure of any language.

Biological Background

Fifty years ago, the ‘Sapir-Whorf hypothesis’, which was named after linguist Sapir and his student Whorf, was widely known by people. The main point is that the characteristic of each language deeply influences speakers’ perception and thought (Whorf et al., 2012). Although it is quite controversial, increasing evidence from multiple disciplines strengthens the hypothesis. For example, psychologist and neuroscientist Boroditsky (2009) finds in a small Aboriginal community on the western edge of Cape York, the locals use a novel way to talk about the space. Unlike common language English that uses words ‘right’ or ‘left’ to define the relative space, the locals —Kuuk Thaayorre—define the space with ‘cardinal-direction terms,’ i.e., north, south, east, and west. One of the direct results is Kuuk Thaayorre have better ‘navigational ability’ and spatial knowledge compared to other speakers.

Indeed, the ‘Sapir-Whorf hypothesis’ enjoys biological and evolutionary principle that new function often grows out of existing mechanisms. As Hamrick et al. (2018) have shown, the mechanisms underlying language is dedicated to human general-purpose cognitive system, which implicates the deep interaction between language and other cognitive functions. Recently, thanks to the development of medical physics, Magnetic Resonance Imagine allows scientists directly observe the structure

and mechanism of our brain. A group of scientists uses fMRI to detect whether the cortical regions that are largely responsible for language processes participate perception decision (Tan et al., 2008). They find when subjects perform the task, both occipital cortex (for color vision) and the bilateral frontal gyrus (for language) are activated (Tan et al., 2008). The results directly provide neurophysiological evidence for the ‘Sapir-Whorf hypothesis.’

Therefore, it is natural to extend the hypothesis to that language affects our economic and political behavior through some mind mechanisms. For instance, in economics, Mavisakalyan (2015) uses a sample over 100 countries to empirically confirm the claim that countries with gender-intensive language have relative lower female employment rate (though this claim is still hotly debated). Similarly, Prez and Tavits (2017) find language shapes our perspectives about the future-oriented policies. Compared to pronounce or to write, grammar (the logic of a language) depends on deeper mind function. Hence, syntax affects more fundamental cerebral function such as preference and decision. In this paper, I concentrate on how the logic of language —i.e., grammar and word order—invisibly influence ones’ risk tolerance and the preference of income redistribution. Thus, in next section, I will briefly introduce what the word order is and why it matters.

Linguistics and Word Order Freedom

The Ethnologue (published by SIL International) lists 7099 known living languages on the Earth. For the purpose of scientific research, the primary task for linguists is to find some parameters of languages as the criterion and then exclusively classify them (Anderson, 1985). For example, one of the most common classification parameters is genetic-history that categorizes languages into different ‘families’ like Indo-European or Sino-Tibetan languages. To understand the causal relationship between language and individual preference, we need delve into morphology and word order.

3.1 Morphological Typology

Morphological typology deals with the patterns of word-formation. Morpheme is the smallest meaningful unit of a language. For instance, ‘tree’ is a word as well as a morpheme; ‘Discussion’ has two morphemes, -discuss and -ion, but it is one word. Morpheme is a crucial parameter in the word-formation. Generally, languages can be classified by less or tightly packed word form, ranging from *isolating* (or *analytic*) to *agglutinative* to *fusional*.

The typical examples of *isolating languages* are Chinese and Vietnamese. Languages of this category are short of morphological richness (Ralli et al., 2003). In

other words, the ratio of the morpheme to the word is extremely low. One word is a morpheme. For instance,

Chinese: wo(3) you(3) yi(1) ben(1) shu(1) (The number denotes particular tone.)

English: I own one book.

Five morphemes in Chinese correspond to five words, and every word is invariable. No morphological variation is allowed in Chinese when individuals want to express number, tense or other grammatical functions. In English, however, adding ‘-s’ at the end of a word to indicate more than one object. Thus, in the next example, ‘shu’ (book) is always the ‘shu’. There is no ‘shus’ to denote the plural. But ‘book’ can be written in ‘books’.

Chinese: wo(3) you(3) wu(3) ben(1) shu(1) (The number denotes particular tone.)

English: I own five books.

In addition, we use ‘-ed’ to express the past tense in English. However, in *isolating language*, one shows the tense through other functional words or change the word order.

Chinese: wo(3) ceng(4) jin(4) you(3) yi(1) ben(1) shu(1)

English: I owned one book.

Here, ‘ceng jin’ in Chinese means ‘in the past’. People add two words like ‘ceng(4) jin(4)’ to show the past tense in *isolating language* while in English people change the morpheme from ‘own’ to ‘owned’.

Both *agglutinative* and *fusional* languages are abundant in morpheme variation. Through various affixes, speakers show the relationship between words. One way to distinguish those two languages is to compare the power of the morpheme. Turkish,

Japanese and Hungarian are typical cases of *agglutinative* language. The left part of figure 3.1 extracted from Anderson (1985) shows that one morpheme corresponding to one meaning or one grammatical function in Hungarian.

	Singular	Plural	Declension 1		Declension 2	
			Singular	Plural	Singular	Plural
Nominative	<i>ember</i>	<i>ember-ek</i>	<i>dom</i>	<i>dom-a</i>	<i>košk-a</i>	<i>košk-i</i>
Accusative	<i>ember-et</i>	<i>ember-ek-et</i>	<i>dom</i>	<i>dom-a</i>	<i>košk-u</i>	<i>košek</i>
Dative	<i>ember-nek</i>	<i>ember-ek-nek</i>	<i>dom-u</i>	<i>dom-am</i>	<i>košk-e</i>	<i>košk-am</i>
Locative	<i>ember-ben</i>	<i>ember-ek-ben</i>	<i>dom-om</i>	<i>dom-ami</i>	<i>košk-oj</i>	<i>košk-ami</i>

Note: The figure shows the difference between agglutinative and fusional languages.

FIGURE 3.1: Hungarian and Russian Example

For example, ‘ember’ is the stem means ‘man’. The case affix ‘-et’ denotes accusative (the object of certain action). If one want to express both plural and accusative forms, he or she need two affixes, one number affix ‘-ek and one case affix ‘-et.

In contrast, in *fusional* language, like Latin and Russian, one morpheme could indicate multiple meaning. In the right part of figure 3.1, ‘-am’ denotes plural and dative simultaneously in Russian.

In short, *isolating* languages usually are not allowed adding affixes. However, *agglutinative* and *fusional* languages are similar in terms of the word-formation.

3.2 Word Order

Word order concentrates on the order of the syntactic composition of language. Most languages are SVO (Subject –Verb –Object) or SOV. Logically, six distinct orders can be combined by S, V, and O. In ‘The world atlas of language structures’ (Haspelmath, 2005), Dryer(2005) states the least popular order is OSV. Only four known languages use this type.

Compared to Morphological typology, not all languages can be clearly classified into those six word order categories. Many languages can be said in six orders grammatically. Such languages are labeled **flexible order**. Others are fixed, like English

● 1. Subject-Object-Verb (SOV)	497
● 2. Subject-Verb-Object (SVO)	435
● 3. Verb-Subject-Object (VSO)	85
◆ 4. Verb-Object-Subject (VOS)	26
◆ 5. Object-Verb-Subject (OVS)	9
◆ 6. Object-Subject-Verb (OSV)	4
○ 7. Lacking a dominant word order	172
total	1228

Note: The figure comes from (Haspelmath, 2005)

FIGURE 3.2: Word Order Statistics

and Chinese, one could only say ‘I love you’ or ‘wo(3) ai(4) ni(3)’ in SVO order without changing the meaning. Those languages are regarded as **rigid order**.

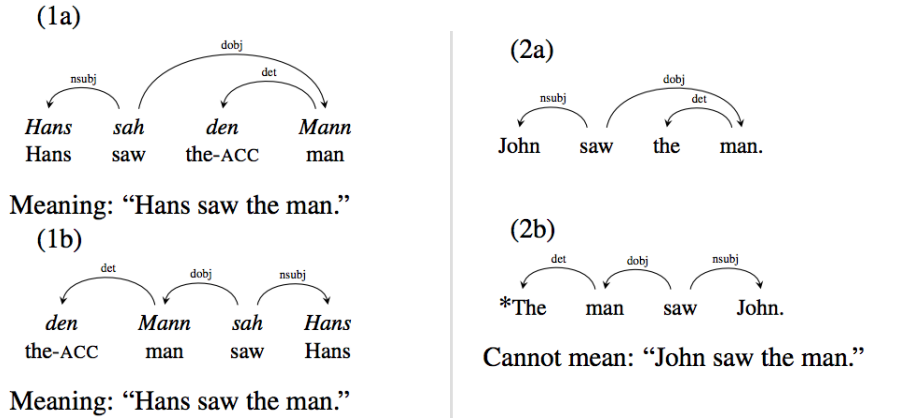
The reader could easily imagine that if each word in the sentence has already been marked the relationship with other words by some special affixes, the word order in the sentence is less important. For example, in Latin, the same sentence (The girl loves the boy) could theoretically be written in six different order (Keller and Russell, 2015). Puella means nominative singular girl (puell is the stem girl, -a is the suffix), Puerum means accusative singular boy (-um is the suffix), and amat means singular he/she loves. Hence, it is pretty clear that Puella is the actor, amat is the action and Puerum is the object(accusative) who is loved by the actor.

English: The girl loves the boy.

Latin:

- Puella amat puerum. Puella puerum amat.
- Amat puella puerum. Amat puerum puella.
- Puerum amat puella. Puerum puella amat.

Another similar example is German. The word next to ‘den’ is the object of an action (accusative). As a result, changing the order does not alter the meaning (1a,1b). However, in English, it is not true (2a,2b). Although English is classified into *fusional* language, it is not flexible as German or Latin. The word position in English encodes a particular syntactic function.



Note: The example shows the word order freedom of German is higher than English.

FIGURE 3.3: Word Order Example: German and English

In general, *isolating* languages are rigid than other two kinds of languages. In order to quantify the exact degree of ‘rigidity’ and ‘flexibility’, we need a new useful concept —Word Order Freedom. This concept is extremely popular in recent years due to the development of machine learning. The different word order between the source and target language is a long-standing challenge for machine translation (Daiber et al., 2016, Kubon et al., 2016). In this paper, I define ‘word order freedom’ the same as Futrell et al. (2015) :

‘the extent to which the same word or constituent in the same form can appear in multiple positions while retaining the same propositional meaning and preserving grammaticality.’

Following the definition, intuitively, German has higher word order freedom than English; The *WoF* of Latin is higher than German. More details will be discussed in the data section.

Linguistic —Preference Mechanisms

Based on the previous brief introduction of morpheme and word order, in this part, I will show the precise mechanisms how word order freedom exactly influences risk tolerance and preference for income redistribution.

4.1 Risk Aversion

If one language has higher word order freedom, which means one could maintain the same meaning of the sentence with different word order, then it must satisfy one critical condition: each word itself indicates particular grammar relationship. Recall the Latin ‘Puella amat puerum’ (The girl loves the boy). Because ‘-a’ and ‘-um’ after Puell (girl) and Puer (boy) denote that girl is nominative while the boy is accusative (the object of certain action), we can flexibly change their order with the same meaning. In figure 3.3, German ‘-den Mann’ is the same case. In other words, high *WoF* language requires the highly clear word with explicit affixes. When these speakers are thinking or talking, every word in their mind has a precise affiliation. On the contrary, each word in the low *WoF* language is much vaguer regarding the grammar relationship. Thus, speakers require particular word order or function word to help them express specific meaning. For example, one could not tell the

single English word ‘boy’ in the previous example is the subject or object while Latin ‘puerum’ is accurately the object.

Therefore, we could infer that, compared to those who speak low *WoF* language, high *WoF* language speakers are more intolerant of uncertainty, or in economic terminology, risk. To be formal, let w be ‘word order freedom’. Then the certainty c is a function of w and $\frac{dc(w)}{dw} > 0$. The increasing word order freedom enhances the certainty of each word. Our crucial assumption which captures the invisible brain operation can be written into:

Assumption 1 (Word Certainty and Risk Tolerance).

$$c(w_1) \leq c(w_2) \iff r_A(u_1, \bar{x}, c(w_1)) \leq r_A(u_2, \bar{x}, c(w_2)) \quad (4.1)$$

where $r_A(\cdot)$ denotes the Arrow-Pratt Measure of Absolute Risk Aversion. To be more specific, let $u(x, c(w))$ (we assume the utility function is concave to model individuals are all risk averse) be an individual’s VNM utility function, and x is the amount of money. Then the assumption says given a certain amount of money \bar{x} , if the certainty of word for individual 1 is lower than individual 2 (or say word order freedom for individual 1 is lower than individual 2), the second person is more risk averse than the first one. Now, let me show how the WOF directly affects risk tolerance then affects insurance purchasing decision, which will be the key mechanism we will test in the next section.

Consider a risk-averse individual with von Neumann-Morgenstern utility function $u(x)$, $u(x)' > 0$ and $u(x)'' < 0$. Following (Schlesinger and vd Schulenburg, 1987), I model three states in which no loss occurs with probability q_1 , a loss happens and is indemnified with probability q_2 and a loss could not be indemnified with probability $q_3 = 1 - q_2$. There are many reasons lead to no compensation like insolvency or questionable hazards. In this case, the utility function for consumers could be represented in:

$$u(x, c(w)) = q_1 u(x_1, c(w)) + q_2 u(x_2, c(w)) + q_3 u(x_3, c(w)) \quad (4.2)$$

where $x_1 = \pi - p$, w is the initial wealth and p denotes insurance premium. Similarly, $x_2 = \pi - p - l + \alpha l$ and $x_3 = \pi - p - l$ where l is the loss and α is the proportion of the loss that could be payed by the company. We assume the price is proportional to the expected payment, which means $p = k\alpha q_2 l$, $k \geq 1$.

Now the utility maximum problem for the consumer is:

$$\max_{\alpha} q_1 u(\pi - p, c(w)) + q_2 u(\pi - p - l + \alpha l, c(w)) + q_3 u(\pi - p - l, c(w)) \quad (4.3)$$

We get the first order condition:

$$u'(x_2, c(w)) - \frac{kq_1}{1 - kq_2} u'(x_1, c(w)) - \frac{kq_3}{1 - kq_2} u'(x_3, c(w)) = 0 \quad (4.4)$$

Now, suppose there are two persons saying different languages and individual 1 has lower word order freedom like English such that $c(w_1) < c(w_2)$. According to our assumption, $r_A(u_1, \bar{x}, c(w_1)) < r_A(u_2, \bar{x}, c(w_2))$, or say $-\frac{u_1''(\bar{x}, c(w_1))}{u_1'(\bar{x}, c(w_1))} < -\frac{u_2''(\bar{x}, c(w_2))}{u_2'(\bar{x}, c(w_2))}$, which equals $u_2(\bar{x}, c(w_2)) = \phi(u_1(\bar{x}, c(w_1)))$ where ϕ is a concave function. In other words, individual 2's VNM utility function is more concave than individual 1. Hence, the FOC for those the first consumers are:

consumer1 :

$$u'(x_2, c(w_1)) - [Au'(x_1, c(w_1)) + Bu'(x_3, c(w_1))] = 0 \quad (4.5)$$

$$A = \frac{kq_1}{1 - kq_2} \quad B = \frac{kq_3}{1 - kq_2}$$

and we evaluate consumer 2 at the optimal insurance level α^* ,

consumer2 :

$$\begin{aligned} \frac{dEU_2}{d\alpha} &= \phi'[u(x_2, c(w_1))]u'(x_2, c(w_1)) \\ &\quad - \{\phi'[u(x_1, c(w_1))]Au'(x_1, c(w_1)) + \phi'[u(x_3, c(w_1))]Bu'(x_3, c(w_1))\} \end{aligned} \quad (4.6)$$

Without loss of generality, we assume $\phi'[u(x_2, c(w_1))] = 1$, then

$$\phi'[u(x_1, c(w_1))] < 1 < \phi'[u(x_3, c(w_1))] \quad (4.7)$$

As long as q_3 is close enough to 0 we get

$$\begin{aligned} \frac{dEU_2}{d\alpha} &= u'(x_2, c(w_1)) \\ &- \{ \phi'[u(x_1, c(w_1))]Au'(x_1, c(w_1)) + \phi'[u(x_3, c(w_1))]Bu'(x_3, c(w_1)) \} > 0 \end{aligned} \quad (4.8)$$

If $k = 1$, it is straightforward to show both of them will purchase full coverage. If $k > 1$, the equation 4.8 shows α^{**} for consumer 2 is larger than consumer 1, which means consumer 2 will buy more insurance than consumer 1. In other words, if the individual speaks a relatively fixed word order language, then he or she is more uncertainty or risk tolerant and choose to purchase less insurance. This hypothesis will be tested in the empirical section. Formally, we can write it as follows:

Proposition 1 (*WoF- Risk-Aversion -Insurance*). *If individuals speak a flexible language, they are less tolerant of the uncertainty. The higher risk aversion leads to buying more insurance.*

4.2 Income Redistribution

Following the above logic, we find words in the high order freedom languages are all ‘marked’ by affixes such that each word can convey enough grammar function independently. Once they are ‘labeled’, then the speaker could relatively free to rearrange them in one sentence. Take the same example, if -a is added to puell, -um is added to puer, and -at is attached to am, then Latin speakers can put them in different order maintain the same meaning. However, in isolating languages like Vietnamese and Chinese, every word should be placed in the particular order to show different grammar meaning. Thus, for those speaking languages with high word order freedom, they treat different marked words more equally. On the contrary, if

you speak a lower *WoF* language, every time you process your language in mind, you treat them unequally and put them in a different hierarchical order. So, we can easily infer that high *WoF* invisibly make individual owns a stronger preference for equality.

Assumption 2 (Word order and equality).

$$\alpha'(w) > 0, \alpha''(w) < 0 \quad (4.9)$$

where w denotes word order freedom and $\alpha(w)$ is a measure of a personal reward from prosociality like affinity or altruism, and in this case, it means the reward for pro-equality. The positive derivative shows people with higher word order freedom get more reward from equality.

In a toy model, I consider an economy with a continuum 1 of agents. A proportion $\theta > \frac{1}{2}$ of those agents are the rich, and the remaining $1 - \theta$ are the poor. Each rich agent is endowed with s^r stock, and each poor agent gets capital s^p where $s^r > s^p$. I set the simplest production function form $y^i = As^i$, where A denotes the aggregate productivity. The utility function of a nonpoor individual can be expressed into two parts. One comes from material feedback like consumption, and the other part comes from spiritual feedback. We suppose the function is in the form like

$$v^i = u[(1 - t)y^i + f] + \alpha(w)[(1 - t)y^i - \bar{y}] \quad (4.10)$$

where t is the income tax rate, f is the lump-sum transfer, and \bar{y} is the average income after taxation. The government budget constraint implies:

$$f = tA[\theta s^r + (1 - \theta)s^p] \quad (4.11)$$

To be simple, we assume the concave utility function u is $\ln(\cdot)$, we get

$$\begin{aligned} v^i = \ln\{(1 - t)As^r + tA[\theta s^r + (1 - \theta)s^p]\} \\ + \alpha(w)\{(1 - t)As^r - (1 - t)[\theta As^r + (1 - \theta)As^p]\} \end{aligned} \quad (4.12)$$

Then, through FOC we get the optimal t choice:

$$t^* = \frac{-\frac{1}{A\alpha(w)} - s^r}{B} \quad (4.13)$$

where $B = \theta s^r + (1 - \theta)s^p - s^r > 0$. The negative tax rate implies no rich individuals prefer to being taxed. However, because of $\alpha'(w) > 0$, as w increasing, this repulsion of taxation decreases. So, we get the second proposition to be tested:

Proposition 2 (*WoF*- income redistribution). *If individuals speak a flexible language, they receive more benefits from the prosociality —equality. As a result, individuals are inclined to support income redistribution.*

Until now, I have proffered two models to illustrate two mechanisms how word order freedom affects preference for income redistribution. The first channel involves risk aversion. People speaking high *WoF* languages are more risk-averse. According to extant literature, people who are more risk averse will prefer income redistribution. The second channel is about one element of the prosociality —equality. People who speak high *WoF* language are more likely to support income redistribution since they get more positive feedback from equality. In the next several sections, I will empirically test these two basic inferences.

5

Data

To test the hypotheses, I need data on *WoF*, preference for income redistribution and insurance purchasing. I mainly use the individual data from World Value Survey (WVS) wave 6 (from 2010-2014) (Association et al., 2014). One of the great advantages of WVS is that it explicitly records the language that responders speak at home. It is the language that deeply affects responders' minds. Also, WVS almost asks all the questions about value, preference, and behavior that we are interested.

In terms of the independent variable *WoF*, the project of quantifying word order freedom was started from last two years. Only three scientific groups have tried to quantify it because the task requires enormous data and sophisticated machine learning algorithms. In the paper, I mainly use the measure from Kubon et al. (2016) and Futrell et al. (2015). Although they utilize different sources and methods to measure word order freedom, the results are quite similar.

In the paper 'Quantifying word order freedom in dependency corpora', Futrell et al. (2015) apply three distinct approaches to measuring the degree of word order freedom for full corpus and subcorpora. Figure 5.1 shows the basic summary of the data I got from the authors. Total 22 languages are measured. Entropy is a physics concept which measures the disorder within a macroscopic system. Here, we use

it to denote the degree of word order freedom. Contrary to our common sense, no apparent correlation of the *WoF* within one continent. The most flexible language in the dataset is Estonian with average value 0.48; The official language of Sri Lanka and Singapore –Tamil –is least flexible, and the value is 0.07.

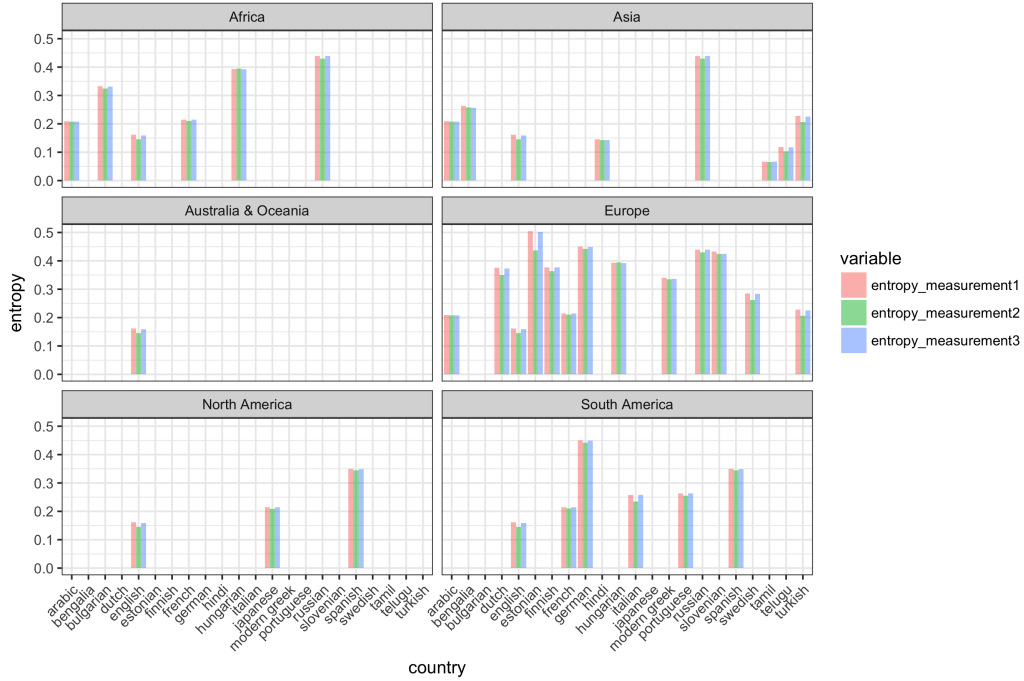


FIGURE 5.1: Three Measures for Word Order Freedom

Regarding dependent variables, according to the proposition 1, I will use insurance purchasing as the proxy for risk aversion. The Survey of Health, Ageing and Retirement in Europe¹ (SHARE)(Börsch-Supan et al., 2013) contains cross-national micro data on health, social and economic. I pick one question to measure individuals’ risk tolerance. That is

‘ Do you have any supplementary health insurance that pays for services not covered by your basic health insurance/national health system/ third party payer. These services may include in-patient services, health examinations, office visits, dental care, other treatments or drugs.’

¹ This paper uses data from SHARE Waves 1, 2, 3 (SHARELIFE), 4, 5 and 6 (DOIs: 10.6103/SHARE.w1.600, 10.6103/SHARE.w2.600, 10.6103/SHARE.w3.600, 10.6103/SHARE.w4.600, 10.6103/SHARE.w5.600, 10.6103/SHARE.w6.600), see Brsch-Supan et al. (2013) for methodological details.

1. Yes, 5. No (I code 0 to denotes ‘No’ instead of 5)

Besides, I also use country-level Hofstede’s cultural dimensions dataset to cross validate my findings of language and risk tolerance (Hofstede and Bond, 1984). Hofstede and Bond (1984) has measured four cultural dimensions —Individualism, Power Distance, Uncertainty Avoidance (UAI) and Masculinity —covering more than 50 countries. UAI could reflect how strongly people avoid uncertainty in one country at a macro-level.

Figure 5.2 shows that the UAI scores are much higher in countries with higher word order freedom. The higher UAI means individuals are more intolerant of uncertainty and risk. This pattern is consistent with our first hypothesis.

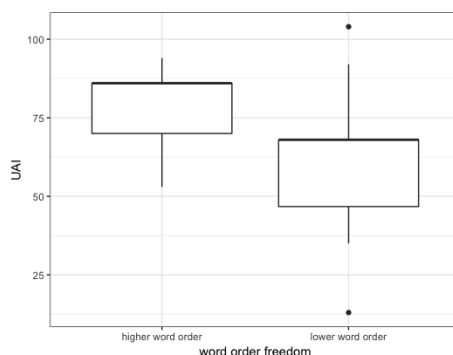


FIGURE 5.2: Word Order Freedom and Uncertainty Avoidance

The best measure of the preference for income redistribution is the answer from WVS Question V96: ‘How would you place your views on this scale? One means you agree completely with the statement on the left; 10 means you agree completely with the statement on the right; and if your views fall somewhere in between, you can choose any number in between. Should incomes be made more equal?’ Moreover, many similar questions can also be used. For example, Question V118: ”The government should take more responsibility to ensure that everyone is provided for.” The response is still be coded into 10 degrees.

At last, table 5.1 shows some basic summary statistics of main variables we will use in the next section. We totally have 22433 observations all over the world. Almost all

Table 5.1: Summary Table

Variables	(1) number	(2) mean	(3) standard dev	(4) min	(5) max
income_redistribution	22,433	4.830	2.905	1	10
scale_income	22,433	4.715	2.049	1	10
gender	22,433	1.530	0.499	1	2
age	22,433	43.86	17.11	16	99
education	22,433	5.778	2.402	1	9
employment	22,433	3.081	2.002	1	7
entropy	22,433	0.315	0.112	0.0670	0.504
interest_politics	22,433	2.640	0.966	1	4
trust	22,433	1.724	0.447	1	2
reglion	22,433	0.513	0.770	0	2
lab_union	22,433	0.200	0.504	0	2
party	22,433	0.164	0.466	0	2
charity_org	22,433	0.206	0.542	0	2
satisfy_finance	22,433	5.972	2.476	1	10
gov_responsibility	22,433	4.424	2.912	1	10
entropy	22,433	0.304	0.109	0.0654	0.443
gdp_per_capita	22,433	12.82	1.911	8.573	16.56
legal_index	22,433	5.075	2.947	0	12
unemployment	22,433	7.642	3.877	0.691	24.92

variables of interest are normally distributed centered around the median value with the small standard deviation (relative to the mean). This balanced dataset effectively reduces bias in the following econometric analysis.

6

Results

In this section, I will use multiple models to test two hypotheses. The first hypothesis makes us expect the positive relationship between higher word order freedom and risk-averse. The second hypothesis should predict the positive relationship between higher *WoF* and preference for income redistribution. Identification strategy used here is selection on variables. The findings are expected to be complementary to the positive relationship between higher risk averse and stronger re-distributional preference.

6.1 Income Redistribution

In the baseline model, I use World Value Survey dataset to test the relationship between word order freedom and preference for income redistribution. I focus on question V96 (see data section). Because the survey answers are coded in ordered variables, I estimate the ordered multinomial probit model by maximum likelihood in the form:

$$Equal_i^* \sim P(equal_i^* | \mu_i = \beta_0 + \beta_1 entropy + \beta_2 X^{country} + \beta_3 X^{indi} + \beta_4 age * gender^{FE} + \beta_5 Continent_i^{FE}) \quad (6.1)$$

with the latent observation mechanism:

$$equal_{ji} = \begin{cases} 1 & \text{for } \tau_{j-1,i} \leq equal_i^* < \tau_{j,i} \\ 0 & \text{for } otherwise \end{cases} \quad (6.2)$$

Individual i choosing j th category ($1 \leq j \leq 10$) with the probability

$$\begin{aligned} Pr(Equal_i = j) &= Pr(Equal_{ji} = 1) = Pr(\tau_{j-1,i} \leq equal_i^* < \tau_{j,i}) \\ &= \Theta(\tau_{j,i} - \mu_i) - \Theta(\tau_{j-1,i} - \mu_i) \end{aligned} \quad (6.3)$$

The function $\Theta(\cdot)$ is the cumulative standard normal function. $X^{country}$ are the country level variables such as GDP per capita, legal origin, and unemployment rate. X^{indi} denotes individual level variables that affect individual preference for income redistribution like gender, education, income, trust, and the party member. I also add $age * gender$ and continent fix effects in the equations.

In table 6.1, the dependent variable of the model is V96 (whether income should be equal). In regression 1, I only control for age and gender fix effects. In this sense, we conclude individuals with the same age and gender have dissimilar preferences for income redistribution because of different languages they speak. In regression 2, I add legal origin and WDI legal-rights index. According (La Porta et al., 2008), different legal systems lead to different economic consequences. The sign of the key explanatory variable entropy is negative and statistically significant, which means as the word order freedom increases (higher entropy), individuals are inclined to be more prefer to income redistribution. Model 3 and 4 control individual specific variables. In regression 5, apart from containing 160 different pairs of $age * gender$ fix effects, I also control continent fix effects. The coefficient is still robust to this strict specification.

Next, I change different measures of entropy in model 5. Figure 6.1 visualizes the regression results with 0.95 and 0.90 confidence intervals. Three coefficients of entropy are all significantly below zero which means my empirical results do not suffer from different measurements.

Table 6.1: Preference for Income Redistribution (WVS)

	Preference for Income Redistribution				
	(1)	(2)	(3)	(4)	(5)
Entropy	-1.865*** (0.486)	-2.752** (1.105)	-2.816*** (1.030)	-2.681*** (0.900)	-2.655*** (0.724)
GDP per capita		-0.0439* (0.0259)	-0.0431* (0.0256)	-0.0526** (0.0227)	-0.0620*** (0.0234)
WDI legal rights index		0.0220 (0.0250)	0.0231 (0.0246)	0.0122 (0.0224)	0.00428 (0.0324)
Unemployment		-0.0154 (0.0160)	-0.0187 (0.0150)	-0.0189 (0.0126)	-0.0198 (0.0133)
Legal Origin = France		0.225 (0.301)	0.291 (0.280)	0.248 (0.258)	0.210 (0.250)
Legal Origin = German		0.272 (0.410)	0.317 (0.385)	0.283 (0.348)	0.177 (0.370)
Legal Origin = Scandinavia		0.168 (0.217)	0.156 (0.208)	0.109 (0.191)	0.0317 (0.297)
Education			0.0157 (0.0101)	0.0179* (0.00978)	0.0160* (0.00914)
Employment status			0.00316 (0.00654)	0.00549 (0.00644)	0.00437 (0.00666)
Income			0.0585*** (0.0141)	0.0369*** (0.0109)	0.0418*** (0.00953)
Interest in politics				0.0169 (0.0282)	0.0119 (0.0253)
Trust				0.00365 (0.0497)	-0.00787 (0.0419)
Religion				0.100*** (0.0239)	0.0866*** (0.0205)
Labor union				0.0133 (0.0229)	0.0139 (0.0219)
Party member				0.0247 (0.0303)	0.00281 (0.0270)
Charity organization				-0.0379 (0.0266)	-0.0312 (0.0251)
Satisfy income				0.0495*** (0.0110)	0.0456*** (0.00954)
Age*Gender FE	Y	Y	Y	Y	Y
Continent FE	N	N	N	N	Y
Observations	22,433	22,433	22,433	22,433	22,433
Pseudo R-squared	0.0117	0.0114	0.0170	0.0210	0.0220
Log Likelihood	-49568	-49581	-49302	-49103	-49048

Note:

*p<0.1; **p<0.05; ***p<0.01

All the standard errors are clustered at the country level.

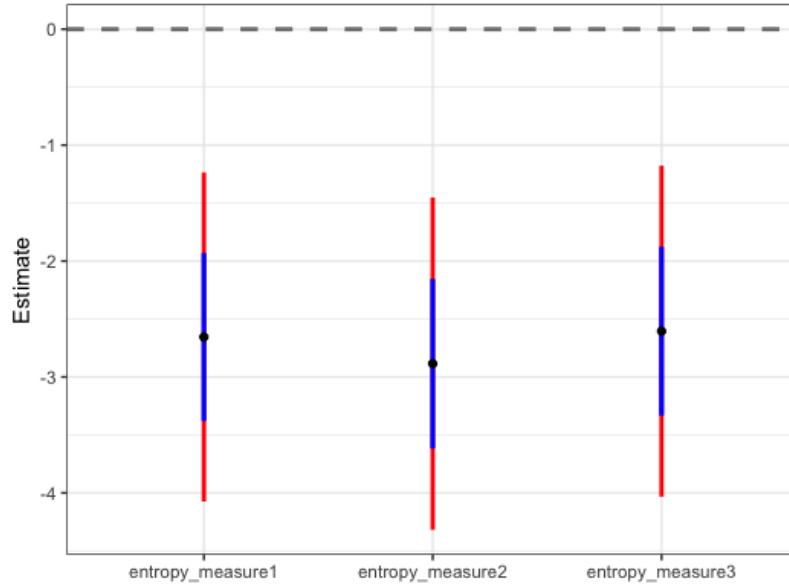


FIGURE 6.1: Robustness Check: Three Measures of Independent Variables

Apart from measurement, people may concern about confounding variable —culture. Before introducing natural experiment, I conduct with-country regression. I have picked most available countries which exist multiple language speakers. The main assumption is that individuals living in the same country are affected by the same culture. The outcomes are shown in table 6.2. Although the small samples reduce statistical significant, all coefficients of WoF are consistent with my theory. Table 6.2 shows in the same culture, people speaking different languages at home shows distinct preferences for income redistribution. Especially in India and the United States, higher word order freedom language speakers are more inclined to choose support narrowing down the income gap.

6.2 Risk Aversion

Now, I test proposition 1 with SHARE dataset to show word order freedom affects individual risk aversion. The dependent variable $insurance_i$ is binary, where 1 denotes that respondent has supplementary insurance and 0 denotes no supplementary insurance. Thus, I estimate the model with ML estimation. The stochastic component

Table 6.2: Within Country (fixed culture) Regression (WVS)

	Preference for income redistribution				
	Armenia	Cyprus	India	Ukraine	United States
	(1)	(2)	(3)	(4)	(5)
entropy	-6.279 (8.895)	-2.842* (1.675)	-6.502* (3.697)	-17.228 (15.257)	-5.780 (3.698)
Observations	5	748	567	498	1,584
R ²	0.142	0.004	0.005	0.003	0.002
Adjusted R ²	-0.143	0.003	0.004	0.001	0.001
Residual Std. Error	2.217 (df = 3)	2.579 (df = 746)	2.538 (df = 565)	2.621 (df = 496)	2.510 (df = 1582)
F Statistic	0.498 (df = 1; 3)	2.878* (df = 1; 746)	3.093* (df = 1; 565)	1.275 (df = 1; 496)	2.443 (df = 1; 1582)

Note:

*p<0.1; **p<0.05; ***p<0.01

is

$$insurance_i \sim Bern(insurance_i | \pi_i) = \pi_i^{insurance_i} (1 - \pi_i)^{1 - insurance_i} = \begin{cases} \pi_i & \text{for } y_i = 1 \\ 1 - \pi_i & \text{for } y_i = 0 \end{cases} \quad (6.4)$$

and the systematic component is

$$E(insurance_i) = Pr(insurance_i = 1) = \pi_i = \phi(\beta_0 + \beta_1 entropy + \beta_2 X^{control}) \quad (6.5)$$

Here, I choose cumulative standard logistic function to be the link function $\Phi(\cdot)$, which yields

$$E(insurance_i) = Pr(insurance_i = 1) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 entropy + \beta_2 X^{control})}} \quad (6.6)$$

Again, entropy is our explanatory variable. Control variables $X^{control}$ is a set of independent variables that describe basic individual information like gender, marital status, income, age, and education.

Model 1 to 5 in the table 6.3 are binomial ones estimated by Maximum Likelihood. I sequentially add variables like gender, age, education, and employment status. The positive signs mean that the higher word order freedom makes people more likely to buy supplementary insurance. Moreover, the 6th regression is the multilevel model grouped at the household level. Our explanatory variable still shows robust significance.

Table 6.3: Insurance Purchasing Regression Results (SHARE)

	whether have any supplementary health insurance					
	(1)	(2)	<i>logistic models</i>		(5)	<i>generalized linear mixed-effects model</i>
			(3)	(4)		(6)
Entropy	5.070*** (0.693)	4.225*** (0.697)	4.646*** (0.712)	4.505*** (0.726)	4.881*** (0.744)	6.979*** (1.146)
Satisfaction		-0.513*** (0.067)	-0.508*** (0.067)	-0.491*** (0.068)	-0.486*** (0.068)	-0.637*** (0.101)
Gender			0.080 (0.102)		0.094 (0.106)	0.153 (0.149)
Marriage			0.067 (0.042)		0.056 (0.043)	0.086 (0.055)
Age			-0.035*** (0.013)		-0.028** (0.013)	-0.032* (0.017)
Education				0.054*** (0.016)	0.049*** (0.016)	0.066*** (0.020)
Income				0.006 (0.005)	0.007 (0.005)	0.009* (0.005)
Job number				0.008 (0.070)	0.010 (0.072)	0.017 (0.081)
Job year				0.003 (0.002)	0.002*** (0.001)	0.002** (0.001)
Constant	-1.707*** (0.262)	-0.368 (0.309)	1.211 (0.838)	-7.706* (3.932)	-4.652*** (1.432)	-4.825*** (2.095)
Observations	1505	1505	1505	1505	1505	1505
Akaike Inf. Crit	2011.5	1942.4	1935.2	1931.9	1911	587.5

Note: Coefficients in model 1-5 are from logistic regressions. Model 6 is multilevel regression. All the standard errors are clustered at the household level. *p<0.1; **p<0.05; ***p<0.01

Natural Experiment: Viking Invasion in Middle Ages

Some elements of languages are changeable. Every year, new words are coined; new special pronunciations are accepted by the public. However, grammar is relatively stable and fixed. At least, the basic syntax and word order remain the same through generations because grammar is the most fundamental condition for us to understand others. Most languages are stable. For example, the Japanese syntax has been the same for many centuries (Kroch, 2001). Even though, we still notice some major syntactic changes in some languages, like English. The dramatic grammatical shift, however, is mainly exogenous, which can be traced back to the Viking Age. The extensive Scandinavian culture provides us an excellent natural experiment to identify credible causal effects.

The history of Viking age is known to be convoluted. From 800 AD, for three centuries, North-west Europe was exposed to violent attacks by Scandinavians. At first, they returned home with huge spoils by plundering the local communities. Gradually, roving bandit leaders, as described by Olson (1993), decided to settle down and build their establishments spread over a large number of European countries.

As early as 793 AD, Viking arrived in the British Isles and soon dominated the sea

routes and coastlines along Norway, Shetland, Orkney, Scotland, Hebrides and Ireland (Sawyer, 2013). Shortly before 800, they conquered and colonized Frisia and Saxony (Goodacre et al., 2005). Toward the end of the eighth century, the Scandinavian emigrants have also established several bases in many parts of Russia. Each summer, Vikings ventured down to raid monasteries and towns. In 845, finally, they reached Paris. Viking leader Rollon was powerful enough to force the emperor of Frankia to cede Normandy to be a part of their settlement on the continent. Besides, Belarusian, Lithuanian, Finnish, Latvian and Estonian also have some Norse loanwords (Jones and Sasada, 1984).

Linguists shared a belief that the frequent interaction between locals and Vikings directly affects the word order freedom. For example, because the Old English and Old Norse are similar to each other, Vikings and English speakers were able to communicate rather well. Many linguistic pieces of evidence show Old English borrows a lot from Old Norse like ‘they’ (Hollmann, 2009). In order to communicate much smoother, speakers pronounced the words with different endings less clearly. Gradually, the clear affixes became less apparent. Recall, one condition for high word order freedom is the clear grammatical relationship of each word which relies on the affixes. Thus, modern English becomes much more inflexible than Old one.

In this sense, Viking colonization was an exogenous shock on word order freedom which happened a thousand years ago and directly decided the language structure we speaking nowadays. We can regard Scandinavian Settlements randomly assign different degrees of word order freedom to languages in Europe. Combined with WVS data sets, treatment group are assigned with the low level of *WoF* including Netherlands, Britain, Estonia, Poland, Russian, France, and any other European countries colonized by Vikings. The rest are assigned to the control group. Moreover, it is hard to think the Viking invasion happened 1200 years ago affects current factors like wealth, GDP, and education that are correlated with preference for income redistribution. The 2SLS regression outcomes are shown in the table 7.1.

Table 7.1: Instrumental Variable Analysis

	<i>Dependent variable: Preference For Redistribution</i>		
	(1)	(2)	(3)
	First Stage	Second stage(OLS)	Second stage(Probit)
entropy		-34.73*** (4.611)	-13.94*** (0.052)
Viking Settlement	-0.021*** (0.002)		
Baseline Controls	Y	Y	Y
Continent FE	Y	Y	Y
Observations	16,165	16,165	16,165

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The negative sign in the first stage means the existence of Viking settlements decreases local word order freedom. After I control for all the baseline variables, in the second stage, negative signs confirm the causal relationship that higher *WoF* results in supporting income redistribution.

Conclusion

Why are some people more risk-averse than others? Why do some countries suffer from huge income inequality? I have argued that languages with different degrees of word order freedom have great long-term impact on economic and political preferences. Specifically, at the individual level, speaking flexible languages such as German and Belgium leads people to be more risk intolerant and strongly supporting income redistribution. At the country level, after aggregating individual preferences, government social spendings also show a corresponding significant pattern where countries with rigid languages like English and Tamil redistribute much less. Therefore, the power of language is still strong enough to affect our current preferences and behaviors.

In this paper, I choose the most representative measure of grammar —word order freedom —to explore how the logic of language shapes individual preference for income redistribution and risk aversion. To empirically test the hypotheses, I use multiple global data resources including World Value Survey, Cultural Dimension Survey, and European Survey of Health, Aging and Retirement and Cultural Dimension Survey. Through baseline models and rigorous robustness checks, word order freedom shows significant effects on insurance purchasing and preference for income redistribution.

In order to reveal the causality, I using Viking settlements as an instrumental variable for *WoF*. The significant 2SLS regression results provide us reliable evidence for the language –preference mechanisms.

By highlighting these findings, my study facilitates policymaking. Compared to other factors like wealth and employment, the power of language is more difficult to be detected. People living in the same country seldom perceive that their average preferences for income redistribution are systematically different from neighboring countries. For example, Americans who speaking English rarely conceive that their average preferences for income redistribution are lower than Germans'. Hence, one possible implication is that politicians should take this average disparity into account when they consider national redistribution or insurance policies. How to enact and effectively implement redistribution policy is a big challenge. Last two decades, in OECD countries, tax-benefit systems have indeed performed well, but this failed to stop increasing income inequality (Immervoll and Richardson, 2011). Now, a new challenge arises. Every country has a distinct satisfactory level of equality due to differences in word order freedom. Politicians confront a tradeoff between reducing the income gap so that they converge to the global trend and catering to residents' re-distributional preferences in the individual country.

Also, the discoveries in this paper contribute a new historically long-term explanation to the global income inequality and redistribution pattern. Apart from contemporary factors that only affect specific individuals, I argue the power of language exerts a stable and standing impact on people. This finding complements with Boix (2010) and other two recent studies that focus on tense and future-oriented preference or behavior (see Chen (2013), Pérez and Tavits (2017)). However, more rigorous research could be performed in the future. For example, we could analyze whether the second language acquired, either higher or lower word order freedom, will strengthen or weaken the effect of the first language. This polylingual analysis could have major implications for the first and second generation migrants. Further-

more, we could explore other properties of languages such as syllable structure and modality.

Overall, as the extensions of classical ‘Sapir-Whorf hypothesis’, I propose word order freedom is one of the determinants of risk aversion and re-distributional preference. Language shows such an impressive and perpetual effects on our preferences, decisions, and behaviors. If my theory is correct, in the future, we can even use word order freedom itself as an instrumental variable in other political economy research.

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