1

Property Law around the World

An Empirical Overview

This chapter provides an empirical overview of property laws around the world. More concretely, all the property doctrines covered in this book – and beyond – are considered together in an unsupervised machine-learning algorithm called "hierarchical clustering." The goal is to draw a legal family tree in a dendrogram that quantitatively summarizes degrees of similarity among the 136 studied jurisdictions. These jurisdictions are divided into ten legal families for expositional purposes.

The study of legal families is what Zweigert and Kötz (1998: 46) describe as "international comparative law," while legal scholars often engage in what Zweigert and Kötz (1998: 46) call "national comparative law" – that is, starting with a domestic law issue, studying how another country has dealt with the same issue, and then proposing reforms or new interpretations accordingly. In East Asia, at least, the compared countries are often those considered to fall within the same legal family, or those with a similar legal structure or legal substance – most notably, Germany. Thus, this chapter also provides several figures that show the correlation coefficients of property doctrines between several countries and all of the other studied countries.

I Legal Families

In all, my data set contains 156 jurisdictions. A total of 279 binary variables were included in the machine-learning analysis.[1] All except North Korea that have fewer than 25 variables that take the value of 1 are excluded, as this suggests that either my sources are incomplete or the regulatory density in these countries is very low. (North Korea is included because it has a civil code; thus, the concern over incomplete sources is attenuated.)

[1] Technically speaking, one included variable is a constant, as all the 136 jurisdictions left (but not 11 of the 20 excluded jurisdictions) all have the co-ownership form discussed in Chapters 7 and 8.

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Twenty jurisdictions are thus excluded.[2] If they were included in the hierarchical clustering analysis, they would form a supercluster themselves, as the missing information or lack of stipulation would be treated the same (coded as 0). This supercluster also affects the relations among other jurisdictions. Still, some jurisdictions that pass the arbitrary threshold and show up as similar in Figure 1.1 (Rwanda and Democratic Republic of Congo, for instance) have low regulatory density and their similarities should be interpreted with a grain of salt.

In the following subsections, this chapter reverses the usual order of empirical works and discusses first, in Section A, the findings and their implications, while technical details regarding methods and their constraints are relegated to Section B. General readers may skip Section B.

A Findings and Implications

1 Legal Family Tree

Figure 1.1 shows the relative positions and percentages of disagreement of the 136 jurisdictions in a property-law family tree. The scale at the top shows the Gower distance, which is simply the percentage of disagreement. Among the 279 variables, if a pair of countries has the same values (both 0 or both 1) in 200 variables and different values in the remaining 79 variables, the percentage of agreement is 72% (=200/279) and the percentage of disagreement is 28% (=79/279). The Gower distance is thus 0.28. If two countries both copy, say, the Portugal Civil Code, their Gower distance is 0.

Figure 1.1 quantitatively summarizes dissimilarities of the 136 studied jurisdictions, arranged vertically. At the bottom (the left side) of the dendrogram, each jurisdiction is considered its own cluster. The horizontal axis (the scale at the top) of the dendrogram indicates the Gower dissimilar coefficients. The "height" of the 135 nodes (or joining points), visualized as vertical line in Figure 1.1, thus represents the Gower dissimilar coefficients when two clusters merge. Figure 1.1 reports average-linkage clustering, under which the intercluster distance equals the average distance between all intercluster pairs of jurisdictions. As one moves up the tree (from left to right), the groupings of merged jurisdictions become

[2] The 20 excluded jurisdictions are Benin, Bhutan, Bosnia and Herzegovina, Botswana, Brunei, Central African Republic, Liberia, Malawi, Maldives, Mali, Mauritania, Myanmar, Nepal, Oman, South Pacific countries (coded as one jurisdiction), Sri Lanka, Swaziland, Tanzania, Zambia, and Zimbabwe.

more dissimilar. Groupings continue until, at the far right of the dendrogram, all observations appear in a single supercluster. Figure 1.1 shows that the maximal dissimilarity between any dyad of jurisdictions in terms of property law is no more than 35%.

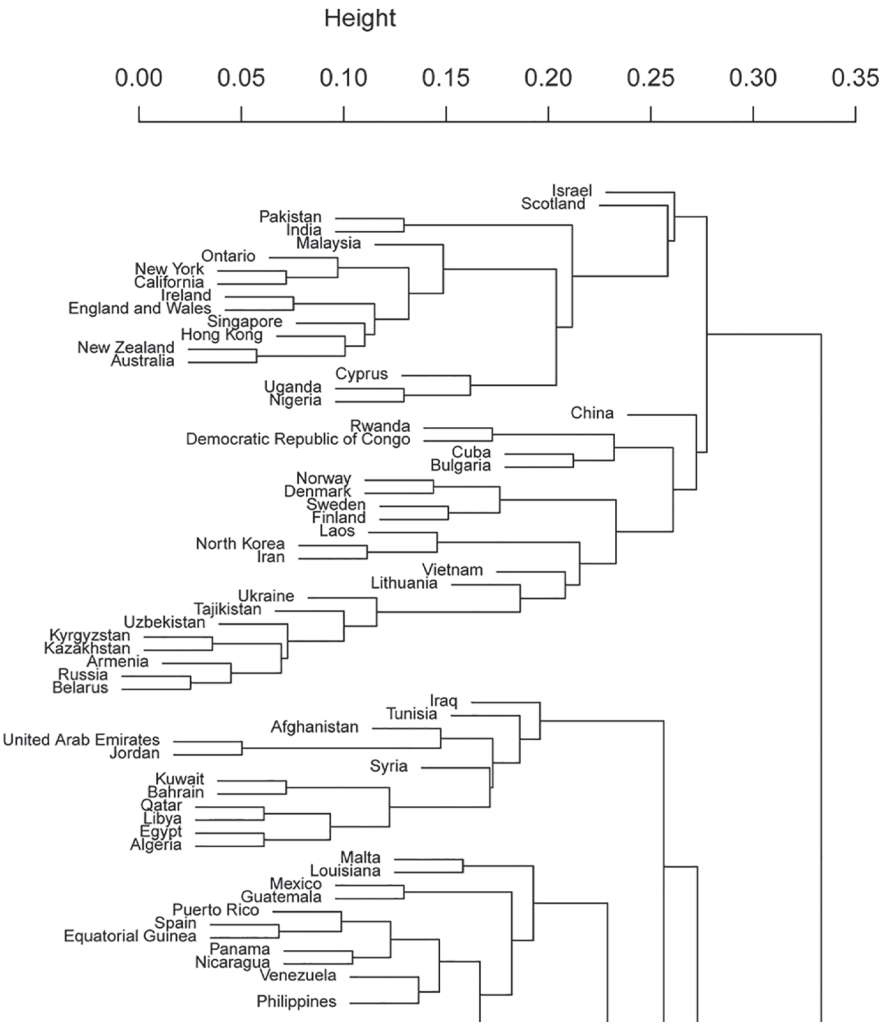
My quantitative approach can produce *any* number of legal families. This chapter arbitrarily picks ten groups for expositional purposes. Ten, or any number of, groups can be identified by moving a vertical line from the right-hand side and moving leftward until ten horizontal lines appear to the right of the vertical line. Below, the ten groups are also labeled according to conventional wisdom to make it easier to refer to.[3] The algorithm in no way knows or reveals that members in a certain group have been heavily influenced by, say, Germany or England.

In Figure 1.1, from top to bottom, the first cluster is the English group (numerically labeled as Group 3 in the data released along with this book). The English group contains all the well-known common-law jurisdictions, plus Scotland and Israel, which are less similar with the core common-law jurisdictions.

The second cluster is China alone (Group 10). In my previous work (Chang et al. 2021), China's 2020 Civil Code was found to be similar to Mongolia's 1995 Civil Code. The similarity greatly attenuates after this book used the coding of Mongolia's 2002 Civil Code. The following chapters demonstrate that China's 2020 Civil Code is often idiosyncratic in content (though German and Taiwanese in structure) and stingy in spelling out many key property doctrines. Russian (USSR) legal scholarship was influential in China before the 1980s, though many Chinese scholars would be surprised that China is still closer to the Socialist family that contains many former USSR republics than to the German family. As conjectured in the following text, the similar lack of many standard property doctrines may explain the resemblance of the Chinese property law to the Russian property law.

The third cluster is the Socialist group (Group 1). Civil codes in several former USSR republics have been influenced by the Russian Civil Code (Burnham et al. 2009: 353–354). Notable members also include the four Scandinavian countries: Denmark, Norway, Finland, and Sweden. They are closer to one another than to other countries. Note that many jurisdictions are grouped together in this cluster also because many variables take the value of 0, as the property doctrines do not exist. Inevitably, the design of my codebook is more affected by Western European, East Asian, and

[3] Table 1.1 lists the jurisdictions in two, three, ten, and twenty groups.



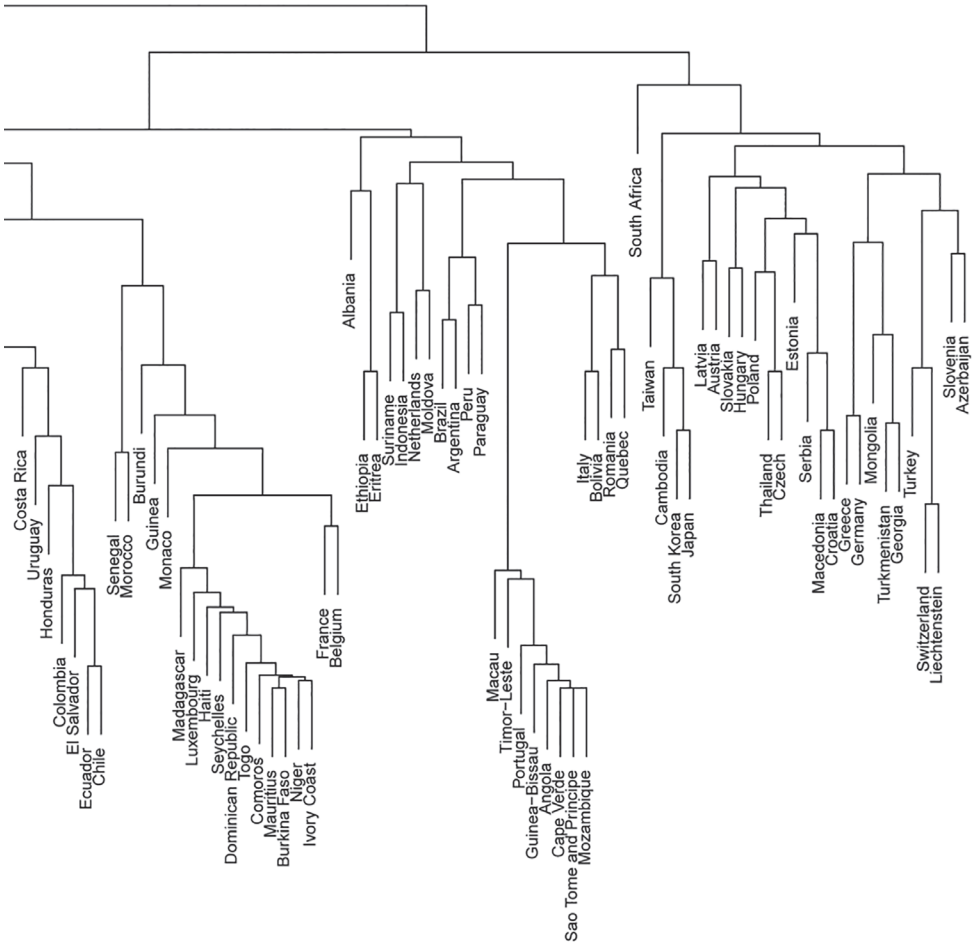


Figure 1.1 Legal family tree

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American laws, with which I am more familiar. Those doctrines may not exist in this group perhaps because (1) there has not been such disputes (e.g., the Scandinavian countries), (2) the regulatory density of property law is low (e.g., North Korea), or (3) disputes arising under those doctrines may be dealt with in completely different ways.

The fourth cluster, the biggest, is the French group (Group 2). France and its former colonies constitute a subcluster. Spain and many of the Spanish-speaking Latin American countries form another subcluster. The Code Napoleon was forced upon Spain in the early nineteenth century, but Spain broke away from the French code later on. The inspiration of property law in Latin American countries is complicated and beyond the scope of this chapter. However, it is worth noting that Spanish-American colonies achieved independence before Spain adopted a French-oriented code; thus, they received the French civil law through voluntary transplant (Berkowitz et al. 2003b; Oto-Peralías and Romero-Ávila 2014: 576). Here it is shown that Latin American countries are close to one another, and closer to Spain, than to France. Besides, several jurisdictions from the Middle East and North Africa form another subcluster. These countries emulate French law without having any colonial history (Klerman et al. 2011), but do not buy the French property law wholesale. Notably, members of this group are the non-European part of the Ottoman Empire. Before its dissolution, the Ottoman Empire imported French commercial law and public law, though its private law is local and Muslim (Xu 2007: 303–304). This history partly explains its French inclination. Indeed, reading civil codes of, for example, Iraq and the United Arab Emirates, a private law scholar familiar with French law will certainly smell champagne and cheese.

I call the fifth and sixth clusters "semi-French" (Group 9) and "quasi-French" (Group 5), respectively, as they are part of the larger supercluster influenced by the Napoleonic Code. Portugal and its former colonies are here, as are a number of countries that have learned from non-French sources. Quebec is a famous mixed jurisdiction, also influenced by English law. Brazil has borrowed from French, German, and English laws (Pargendler 2012a: 810–812). The Netherlands is between (and beyond) the French and German systems.

The seventh cluster has a sole member, another famous mixed jurisdiction – South Africa (Group 8), which has both a Roman-Dutch tradition and an English legal heritage.

The final three clusters are all affected by German law. The Japanese cluster contains three other (South-)East Asian jurisdictions: Taiwan,

South Korea, and Cambodia. The affiliation of Japan is more complicated than commonly thought. The Japanese Civil Code of 1898, in its drafting stage, was heavily influenced by the French Civil Code. While Japanese private law scholarship later turned to German jurisprudence for inspiration – note that the German Civil Code did not go into effect until two years later, in 1900 – the Japanese Civil Code itself retains the French rules (Note 1906: 73; Belli 1959: 137). When South Korea's civil code went into effect in 1960, it was indirectly affected by the German code through the Japanese code and Japanese scholarship (Kwon 2013: 114). The Taiwanese Civil Code, on the other hand, was enacted in 1930, when the Nationalist Party ruled mainland China. The Taiwanese Civil Code's *Book of Things* is a hybrid of traditional Chinese law, Swiss law, and German law. Japanese scholars played an instrumental role in the drafting of the 1930 code (Chang et al. 2022: 23). When the *Book of Things* in the Taiwanese Civil Code was reformed between 2007 and 2010, the Japanese influence, partly due to the colonial experience in 1895–1945, is obvious (Chang 2016a: 228). The 2007 Cambodia Civil Code was drafted with assistance from Japanese scholars (Upham 2018: 109). Had I coded the 2020 Laos Civil Code, it would be likely to be grouped here as well, as Japanese scholars again played an instrumental role in the drafting stage of Laos' code.

The penultimate cluster is Quasi-German (Group 6). The members are the Eastern European neighbors of Germany. The Austria Civil Code predates the German Civil Code and has its own style.

The final cluster is the German group (Group 4). Members contain several European neighbors of Germany, including Turkey. Turkey was the heart and soul of the Ottoman Empire, but in 1926, drafters of its new civil code under the Kemal administration adopted the Swiss Civil Code as their model (Xu 2007: 314).

The big-picture, takeaway point is that common versus civil law divide is not the most salient dichotomy in property law. Chang et al. (2021), using 170 binary variables (most of which are included here), find that a French influence versus the lack thereof drives the classification. Here, the French supercluster is still salient. The (Quasi-/Semi-)German, Socialist, and English groups are parts of the large non-French supercluster in Chang et al. (2021). Here, with 279 binary variables, the German supercluster is deemed to be closer to the French supercluster. Still, standing on the other side of the German-French supercluster are civil-law Socialist countries spearheaded by Russia, Scandinavian countries, China, and English common-law countries. Civil law is plural, and common law is heterogeneous.

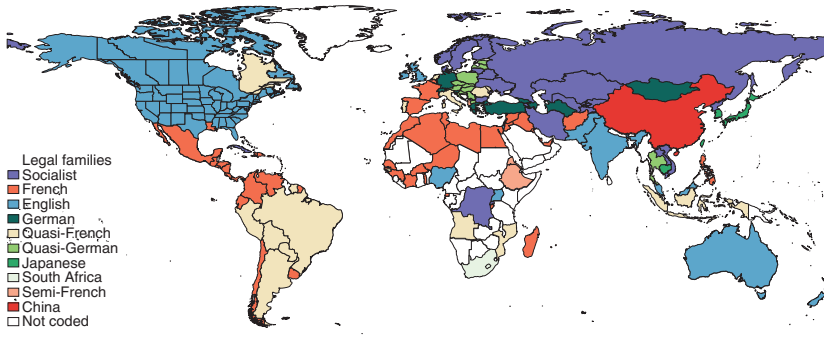

Figure 1.2 Legal families in world map

Figure 1.2 shows the ten groups in a world map. The three broadly speaking French clusters are in different shades of orange and yellow, whereas the three broadly speaking German clusters are in different shades of green (see also Table 1.1).

2 Distinctive Features

What are the key variables that drive the legal families? A supervised machine-learning method called "sparse linear discriminant analysis" (Gaynanova et al. 2016) produces Figure 1.3. The rows are the key variables that contribute to the classification of legal families. Numbers in column heads represent the numeric group labels. The large positive numbers in the cells mean that variables taking the value of 1 contribute greatly to a certain grouping. The large negative numbers in the cells mean that when variables take the value of 1, it reduces the likelihood of being classified into a certain grouping. The numeric scale on the right-hand side shows the minimal and maximal coefficients contained in the cell. Blue numbers are positive, whereas red numbers are negative. The larger the number, the darker the color. The absolute values in the cell do not mean anything; what matters is the relative size of the values.

According to Figure 1.3, the English group (Group 3) is featured by the voidable rule and entrustment rule in the good-faith purchase doctrine (Chapter 10). China (Group 10) has many one-of-a-kind rules, and the algorithm picks out the co-ownership quorum rule for sales – China requires supermajority votes rather than unanimity.

The French group (Group 2) and the Quasi-French group (Group 5) have the right of use, disallow right of use and right of habitation to be

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Table 1.1 *Classification of jurisdictions into legal families*

Jurisdiction name	Dichotomy	Trichotomy	10 groups	20 groups
Afghanistan	French & German	French	2	2b
Albania	French & German	French	9	9
Algeria	French & German	French	2	2b
Angola	French & German	French	5	5a
Argentina	French & German	French	5	5c
Armenia	English & Socialist	English & Socialist	1	1a
Australia	English & Socialist	English & Socialist	3	3a
Austria	French & German	German	6	6c
Azerbaijan	French & German	German	4	4b
Bahrain	French & German	French	2	2b
Belarus	English & Socialist	English & Socialist	1	1a
Belgium	French & German	French	2	2a
Benin	N/A	N/A	N/A	N/A
Bhutan	N/A	N/A	N/A	N/A
Bolivia	French & German	French	5	5a
Bosnia and Herzegovina	N/A	N/A	N/A	N/A
Botswana	N/A	N/A	N/A	N/A
Brazil	French & German	French	5	5c
Brunei	N/A	N/A	N/A	N/A
Bulgaria	English & Socialist	English & Socialist	1	1b
Burkina Faso	French & German	French	2	2a
Burundi	French & German	French	2	2a
California	English & Socialist	English & Socialist	3	3a
Cambodia	French & German	German	7	7
Cape Verde	French & German	French	5	5a
Central African Republic	N/A	N/A	N/A	N/A
Chile	French & German	French	2	2a
China	English & Socialist	English & Socialist	10	10
Colombia	French & German	French	2	2a
Comoros	French & German	French	2	2a
Costa Rica	French & German	French	2	2a
Croatia	French & German	German	6	6a
Cuba	English & Socialist	English & Socialist	1	1b
Cyprus	English & Socialist	English & Socialist	3	3a

Table 1.1 (*cont.*)

Jurisdiction name	Dichotomy	Trichotomy	10 groups	20 groups
Czech	French & German	German	6	6a
Democratic Republic of Congo	English & Socialist	English & Socialist	1	1b
Denmark	English & Socialist	English & Socialist	1	1a
Dominican Republic	French & German	French	2	2a
Ecuador	French & German	French	2	2a
Egypt	French & German	French	2	2b
El Salvador	French & German	French	2	2a
England and Wales	English & Socialist	English & Socialist	3	3a
Equatorial Guinea	French & German	French	2	2a
Eritrea	French & German	French	9	9
Estonia	French & German	German	6	6a
Ethiopia	French & German	French	9	9
Finland	English & Socialist	English & Socialist	1	1a
France	French & German	French	2	2a
Georgia	French & German	German	4	4a
Germany	French & German	German	4	4a
Greece	French & German	German	4	4a
Guatemala	French & German	French	2	2a
Guinea	French & German	French	2	2a
Guinea-Bissau	French & German	French	5	5a
Haiti	French & German	French	2	2a
Honduras	French & German	French	2	2a
Hong Kong	English & Socialist	English & Socialist	3	3a
Hungary	French & German	German	6	6b
India	English & Socialist	English & Socialist	3	3a
Indonesia	French & German	French	5	5b
Iran	English & Socialist	English & Socialist	1	1a
Iraq	French & German	French	2	2b
Ireland	English & Socialist	English & Socialist	3	3a
Israel	English & Socialist	English & Socialist	3	3c
Italy	French & German	French	5	5a
Ivory Coast	French & German	French	2	2a
Japan	French & German	German	7	7

Table 1.1 (*cont.*)

Jurisdiction name	Dichotomy	Trichotomy	10 groups	20 groups
Jordan	French & German	French	2	2b
Kazakhstan	English & Socialist	English & Socialist	1	1a
Kuwait	French & German	French	2	2b
Kyrgyzstan	English & Socialist	English & Socialist	1	1a
Laos	English & Socialist	English & Socialist	1	1a
Latvia	French & German	German	6	6c
Liberia	N/A	N/A	N/A	N/A
Libya	French & German	French	2	2b
Liechtenstein	French & German	German	4	4b
Lithuania	English & Socialist	English & Socialist	1	1a
Louisiana	French & German	French	2	2a
Luxembourg	French & German	French	2	2a
Macau	French & German	French	5	5a
Macedonia	French & German	German	6	6a
Madagascar	French & German	French	2	2a
Malawi	N/A	N/A	N/A	N/A
Malaysia	English & Socialist	English & Socialist	3	3a
Maldives	N/A	N/A	N/A	N/A
Mali	N/A	N/A	N/A	N/A
Malta	French & German	French	2	2a
Mauritania	N/A	N/A	N/A	N/A
Mauritius	French & German	French	2	2a
Mexico	French & German	French	2	2a
Moldova	French & German	French	5	5d
Monaco	French & German	French	2	2a
Mongolia	French & German	German	4	4a
Morocco	French & German	French	2	2a
Mozambique	French & German	French	5	5a
Myanmar	N/A	N/A	N/A	N/A
Nepal	N/A	N/A	N/A	N/A
Netherlands	French & German	French	5	5d
New York	English & Socialist	English & Socialist	3	3a
New Zealand	English & Socialist	English & Socialist	3	3a
Nicaragua	French & German	French	2	2a
Niger	French & German	French	2	2a
Nigeria	English & Socialist	English & Socialist	3	3a
North Korea	English & Socialist	English & Socialist	1	1a
Norway	English & Socialist	English & Socialist	1	1a

Table 1.1 (*cont.*)

Jurisdiction name	Dichotomy	Trichotomy	10 groups	20 groups
Oman	N/A	N/A	N/A	N/A
Ontario	English & Socialist	English & Socialist	3	3a
Pakistan	English & Socialist	English & Socialist	3	3a
Panama	French & German	French	2	2a
Paraguay	French & German	French	5	5c
Peru	French & German	French	5	5c
Philippines	French & German	French	2	2a
Poland	French & German	German	6	6a
Portugal	French & German	French	5	5a
Puerto Rico	French & German	French	2	2a
Qatar	French & German	French	2	2b
Quebec	French & German	French	5	5a
Romania	French & German	French	5	5a
Russia	English & Socialist	English & Socialist	1	1a
Rwanda	English & Socialist	English & Socialist	1	1b
Sao Tome and Principe	French & German	French	5	5a
Scotland	English & Socialist	English & Socialist	3	3b
Senegal	French & German	French	2	2a
Serbia	French & German	German	6	6a
Seychelles	French & German	French	2	2a
Singapore	English & Socialist	English & Socialist	3	3a
Slovakia	French & German	German	6	6b
Slovenia	French & German	German	4	4b
South Africa	French & German	German	8	8
South Korea	French & German	German	7	7
South Pacific	N/A	N/A	N/A	N/A
Spain	French & German	French	2	2a
Sri Lanka	N/A	N/A	N/A	N/A
Suriname	French & German	French	5	5b
Swaziland	N/A	N/A	N/A	N/A
Sweden	English & Socialist	English & Socialist	1	1a
Switzerland	French & German	German	4	4b
Syria	French & German	French	2	2b
Taiwan	French & German	German	7	7
Tajikistan	English & Socialist	English & Socialist	1	1a
Tanzania	N/A	N/A	N/A	N/A
Thailand	French & German	German	6	6a

Table 1.1 (*cont.*)

Jurisdiction name	Dichotomy	Trichotomy	10 groups	20 groups
Timor-Leste	French & German	French	5	5a
Togo	French & German	French	2	2a
Tunisia	French & German	French	2	2b
Turkey	French & German	German	4	4b
Turkmenistan	French & German	German	4	4a
Uganda	English & Socialist	English & Socialist	3	3a
Ukraine	English & Socialist	English & Socialist	1	1a
United Arab Emirates	French & German	French	2	2b
Uruguay	French & German	French	2	2a
Uzbekistan	English & Socialist	English & Socialist	1	1a
Venezuela	French & German	French	2	2a
Vietnam	English & Socialist	English & Socialist	1	1a
Zambia	N/A	N/A	N/A	N/A
Zimbabwe	N/A	N/A	N/A	N/A

Figure 1.3 Key factors driving the grouping

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(e.g., how long the prescription period is) and stylistic dimensions (e.g., whether mortgage is included in the Book of Obligation or the Book of Property), while I decide to use only categorical difference on legal substance in the analysis here. (5) Regarding certain variables like statutory lien and the right of first refusal, I am concerned that relying on civil codes only would be highly incomplete and running the risk of coding nominal differences (e.g., some countries opt to regulate statutory liens in tax statutes); thus, these variables have largely been omitted in the analysis here.

Unless otherwise noted, the machine-learning methods used in this chapter follow Chang et al. (2021). For brevity, the method details are not repeated here.

How robust is our result? How can readers be assured that the reported legal family tree is not merely one of the million very different family trees? We address these concerns by running a million bootstrap iterations (Hennig 2007) (for results, see Table 1.2) to measure the cluster stability of each group in the reported family tree. The stability value shows the percentage of cluster agreement. The goal of the cluster analysis is to group the individual countries into clusters such that every jurisdiction in a cluster is more similar to other jurisdictions in the same cluster than it is to jurisdictions in other clusters. A critical issue when evaluating clusters is whether a given cluster is substantively real and not an artifact of the clustering algorithm. Clustering algorithms often produce clusters that represent the actual structure in the data, but sometimes the algorithms produce a bucket that represents a "miscellaneous" cluster of data points that have no real relationship to each other and do not fit into any other cluster.

More specifically, first, I run the hierarchical clustering analysis described above and derive 10 legal families from this analysis (Figure 1.2).

Second, we use the "clusterboot" function from the "fpc" R package. The "clusterboot" function uses bootstrap resampling to evaluate the stability of a given cluster from the original data set of 136 jurisdictions. It then applies the same kind of average-linkage cluster analysis with Gower distance to the new data set. Bootstrapping is a general statistical methodology that relies on random sampling with replacement of subsets of the original data and measures accuracy for sample quantities. That is, the bootstrapping method, in each iteration, creates a new data set with the same number of jurisdictions (here, 136) but each data set may contain multiple country A and country B, while it does not contain country C.

Third, for every legal family in the original clustering, the "clusterboot" function finds the most similar legal family in the new clustering and records the Jaccard similarity coefficient, which is computed by J(A,B) =

Table 1.2 *Stability values for 10 groups*

Group name	Numeric label	Stability value
English	3	0.90
Chinese	10	0.55
Socialist	1	0.78
French	2	0.76
Semi-French	9	0.44
Quasi-French	5	0.56
South African	8	0.54
Japanese	7	0.47
Quasi-German	6	0.51
German	4	0.56

Notes: If a dichotomy of legal family is used, Groups 1, 3, and 10 are one supercluster, while other groups are the other supercluster. If a trichotomy of legal family is used, Groups 1, 3, and 10 again are one super-cluster (English and socialist); Groups 2, 5, and 9 are another (French); and Groups 4, 6, 7, and 8 constitute the third (German). See Table 1.1.

$|A \cap B|/|A \cup B|$. Assuming that Group 1 in our reported family tree has 10 countries, and the group that is most similar to Group 1 in the first bootstrap iteration (Group 1′) has 9 + 2 countries (meaning nine countries are the same, and two countries are new), the Jaccard similarity coefficient is $9/(9 + 1 + 2)$. If Group 1′ is 10 + 3, the coefficient is $10/(10 + 3 + 0)$.

Fourth, the second and third steps are repeated one million times and we compute the average of the one million Jaccard similarity coefficients for each legal family. As a rule of thumb, clusters with a stability value of less than 0.6 should be considered unstable. Values between 0.6 and 0.8 (some would say 0.75) indicate that the cluster measures a stable pattern in the data, but which points should be clustered together is not highly certain. Clusters with stability values above about 0.80 (some would say 0.85) can be considered highly stable.

As Table 1.2 shows, most groups are stable or close to stable, suggesting that our reported result is not a random outcome. Given our data, in which many clusters merge at a relatively high Gower distance, groups with few members tend to be less stable. If jurisdictions are divided into 20 groups, so that the within-group heterogeneity is lower, stability values increase. As shown in Table 1.3, 17 of the 20 groups have stability values above 0.6, and again smaller groups tend to have lower values.

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Table 1.3 *Stability values for 20 groups*

Group name	Numeric label	Stability value
English	3a	0.97
	3b	0.63
	3c	0.63
Chinese	10	0.63
Socialist	1a	0.72
	1b	0.53
French	2a	0.70
	2b	0.97
Semi-French	9	0.72
Quasi-French	5a	0.71
	5b	0.64
	5c	0.80
	5d	0.72
South African	8	0.59
Japanese	7	0.73
Quasi-German	6a	0.66
	6b	0.45
	6c	0.62
German	4a	0.81
	4b	0.69

Machine-learning is a fast-developing field. The hierarchical clustering algorithm used here is cutting-edge and powerful. Yet, clearly it has limitations. For one, depending on whether the studied jurisdictions are sorted in alphabetical, or reverse alphabetical, orders (the latter is used here), the dendrogram would be slightly different. If a parameter is tuned, the results reported in Figure 1.3 would change as well. More than one machine-learning methods exist, Ho et al. (2023, forthcoming) use the same data set and run additional algorithms that summarize the similarity and relationship among the studied jurisdictions. All the algorithms provide the same big picture, but classifications of certain jurisdictions vary.

II Correlation of Property Law

The property data set enables me to summarize how similar a pair of countries (often called a dyad) is in multiple ways. The hierarchical clustering

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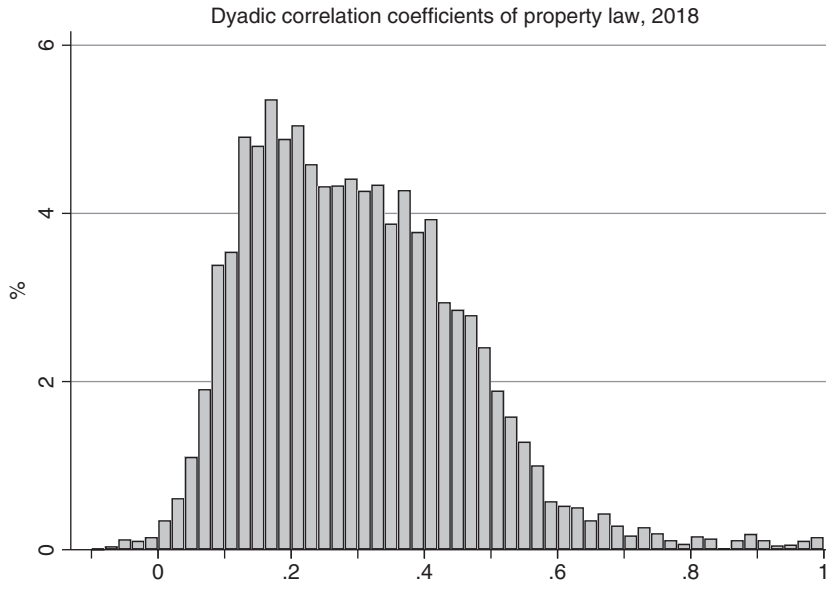

Figure 1.4 Distribution of correlation coefficients

method uses the Gower distance, which is the percentage of disagreement. Another method is to compute the correlation coefficients of each pair of countries. More specifically, for example, I have coded the same 279 dimensions of property law in China and Germany. Using the 279 zero-or-one values, I calculate the correlation coefficient. A value of 1 indicates a perfectly positive correlation, which happens when a pair of country has the same property doctrines (at least those studied). The Gower distance of these two countries is 0. A value of –1 means a perfectly negative correlation, which happens when a pair of country has made opposite decisions in all property doctrines. The Gower distance of these two countries is 1. A value of 0 means the property law in the two countries is uncorrelated. As Figure 1.4 shows, property laws in almost all country dyads are positively correlated.

In this part, I intentionally use "countries" instead of "jurisdictions" because the unit of analysis here is indeed nation-states. Many international data sets collect information at the nation-state level. The GDP and population data are prime examples. Outside of private law, many legal fields operate at the nation-state or federal level; hence, there is no subnational variation. In a prior work (Bradford et al. 2021), in order to compare property law with antitrust law, which is operated and coded at

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the nation-state level, the nine subnational jurisdictions in my property data set were adjusted in the following way: New York was used as a proxy for the USA, England was used as a proxy for the UK, and Ontario was used as a proxy for Canada. California, Hong Kong, Louisiana, Macau, Quebec, and Scotland were dropped. In addition, following Farran (2013), South Pacific countries were coded as one jurisdiction in the property data set, but left out in the cross-country comparison. Hence, there were $156 - 9 - 1 + 3 = 149$ countries in the property data set. For each of the $149 \times 149 = 22{,}201$ country dyads, correlation coefficients were computed. The analysis in this part follows Bradford et al. (2021) in creating the 22,201 dyads and computing the correlation coefficients.

With the dyadic data, new research questions can be explored. Bradford et al. (2021), using the previous version of the property data (based on 170 binary variables), inquire whether legal origins predict legal substance in property law and antitrust law. In short, in terms of property law, a dyad with a shared legal origin is to a small extent more similar with each other than a dyad without a shared legal origin. By contrast, whether a dyad shares a legal origin is unrelated to its similarity in antitrust law. The results suggest that legal origins may be an important predictor of legal substance in well-established legal fields, but do little to explain substantive variation in more recent areas of law. Countries with shared legal origins are not more likely to have similar antitrust regimes than countries without shared legal origins. This is likely for several reasons. First, countries' antitrust laws have been shaped through regulators' and policy makers' engagement in various international organizations and trans-governmental networks. Another important factor is that antitrust laws are largely a more recent phenomenon, with most countries adopting them after 1990 (Bradford and Chilton 2019). By that time, these countries had many models to emulate. The EU in particular offered an attractive template to emulate given the specific and detailed nature of EU antitrust laws, as well as their availability in many languages (Bradford et al. 2019b). The EU's active push to export its antitrust laws through trade agreements, and extend regulatory cooperation and technical assistance for new antitrust regimes likely further explains why the EU's influence prevails over that exerted by legal traditions. EU law also diffuses through its member states.

Moreover, as the law and development literature often proclaim that formal property rights are necessary in facilitating economic growth (but cf. Upham 2018; Chang 2022c), Chang (2023 forthcoming-b) uses the dyadic data to explore whether the similarity in property doctrines

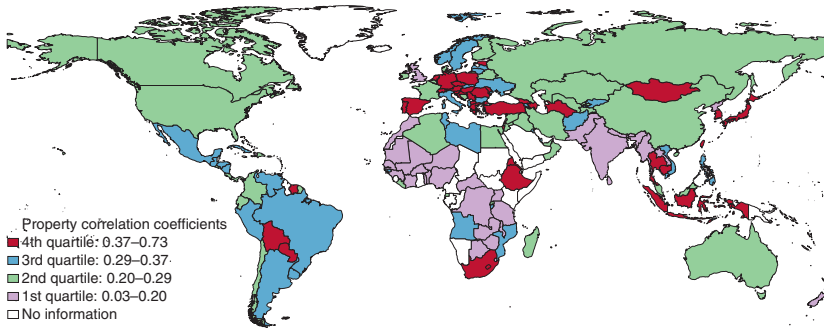

Figure 1.5 Correlation coefficients with German property law

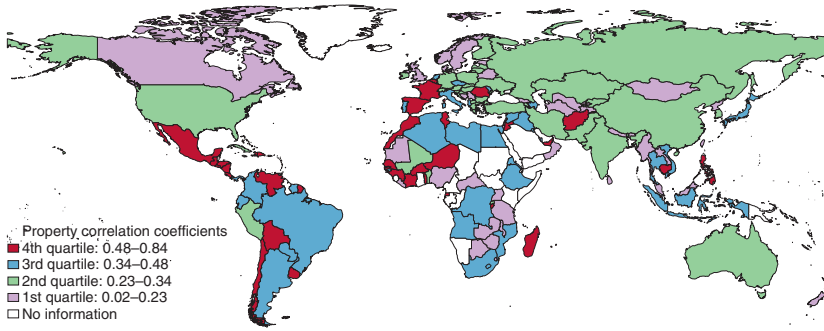

Figure 1.6 Correlation coefficients with French property law

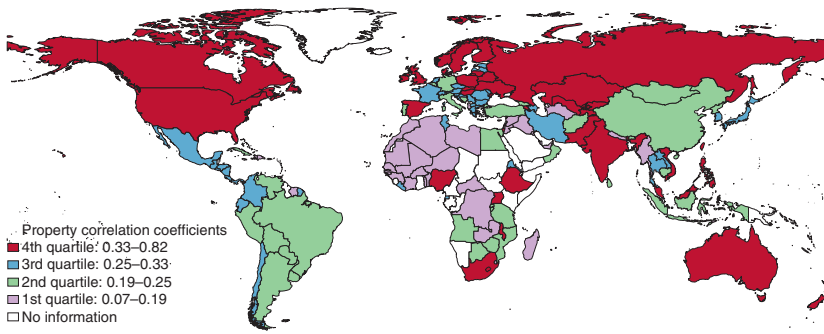

Figure 1.7 Correlation coefficients with American property law (proxied by New York law)

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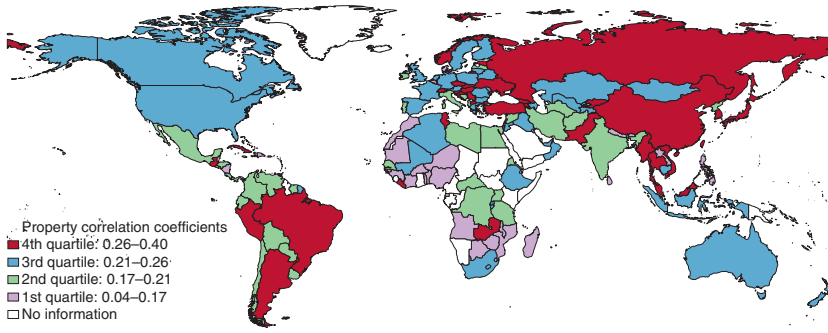

Figure 1.8 Correlation coefficients with Chinese property law

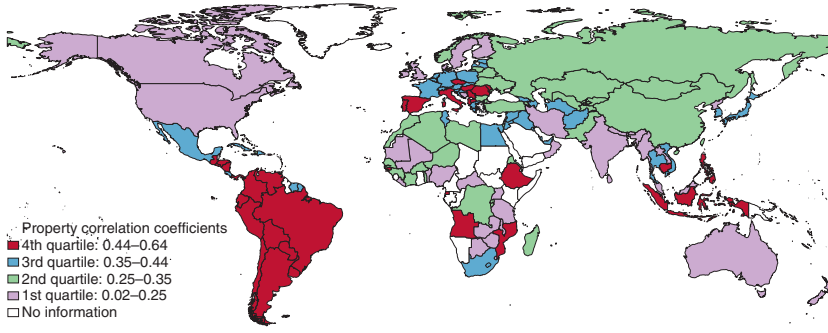

Figure 1.9 Correlation coefficients with Brazilian property law

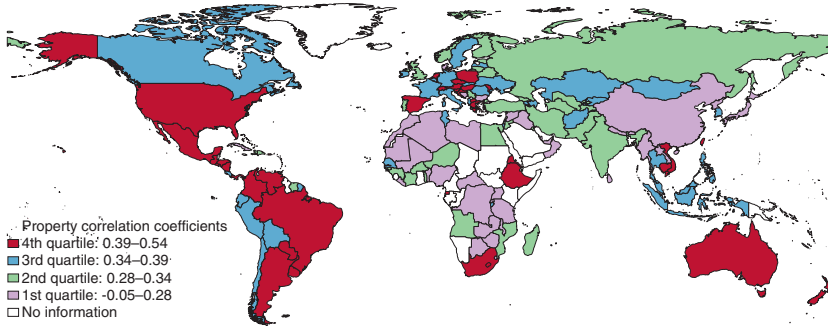

Figure 1.10 Correlation coefficients with South African property law

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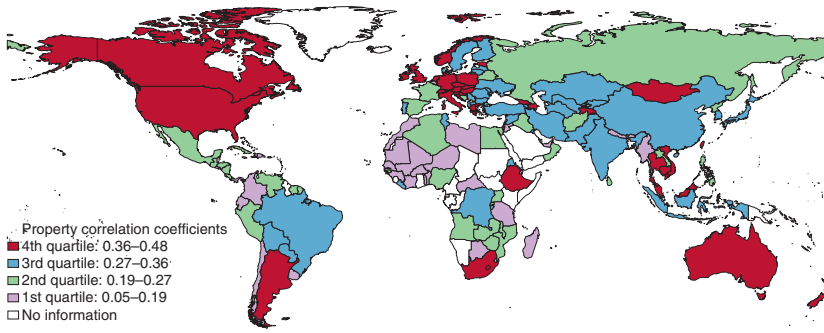

Figure 1.11 Correlation coefficients with Israeli property law

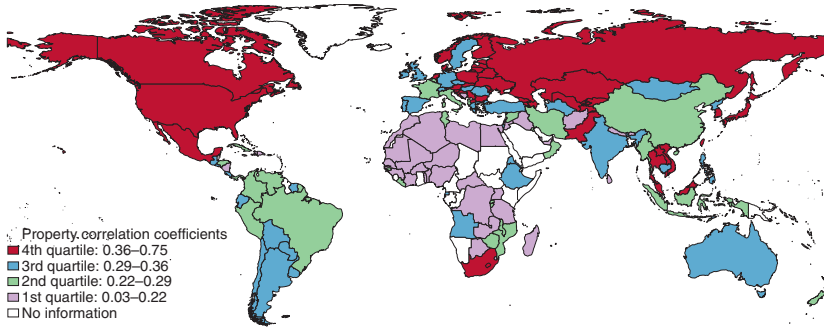

Figure 1.12 Correlation coefficients with Ukrainian property law

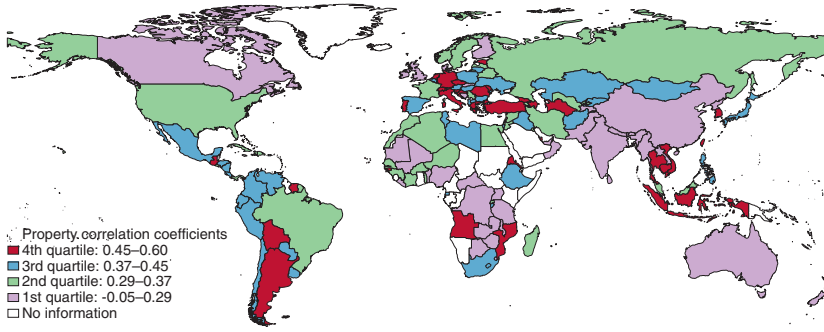

Figure 1.13 Correlation coefficients with Dutch property law

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is correlated with similarity in the pattern of economic growth and finds that, no matter whether in developed countries or developing countries, no such a correlation exists.

The dyadic data can be used in a less ambitious way. As said, comparative lawyers may seek guidance only from countries with similar laws. My works in Chinese have criticized this practice. Nonetheless, given the practice, and it is certainly not wrong to consider a country's most comparable fellow country, Figure 1.5 (Germany), Figure 1.6 (France), Figure 1.7 (the U.S.A.), Figure 1.8 (China), Figure 1.9 (Brazil), Figure 1.10 (South Africa), Figure 1.11 (Israel), Figure 1.12 (Ukraine), and Figure 1.13 (the Netherlands) show how similar in property law the chosen countries are to other countries. The correlation coefficients of each chosen country with the other 148 countries are divided into four quartiles and shown in each world map.

III Conclusion

Based on the substance of property law, this chapter provides a classification of legal families that is not entirely the same as the previous comparative law literature has suggested. This is partly because the prior comparative law works did not focus on legal substance alone (rather, some include, say, legal culture), and they certainly did not focus on property law alone. Still, the gap may also be attributed to the difficulty of comparing sophisticatedly across so many jurisdictions across so many legal fields (not to mention when the temporal dimension is added to the mix) without a methodical means of recording what the law is in every jurisdiction and an objective way to analyze the legal materials at hand. This chapter demonstrates a new approach to comparative law – empirical comparative law – that is gaining traction. While the machine-learning tools are still in an early, rapidly developing stage, they already show promises to shed new light on our understanding of laws around the world.