Logical Models for Private International Law

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C5S1

I. Introduction

C5P1 The literature on the use of formal logic in the law is immense.[1] An examination of it reveals that interactions among distinct normative systems had interested some scholars in both legal theory and AI & Law with regard to the allocation of jurisdiction and choice-of-law characterizing private international law (PIL). The issues of legal pluralism and the fundamental mechanisms of conflict of laws had consequently been studied through argumentation and logics.[2] The focus had been maintained on legal dogmatics or at the level of virtual conflicts between legal systems, each considered as potentially competent to rule the case: precisely the kind of conflicts that PIL in fact prevents.

C5P2 More recently, an increasing attention has been paid to the application of canons and interpretation of the foreign provision when, eg, the conflicting rule identifies it as the applicable law to the particular case in front of national judges. Filling this gap in the literature, Malerba and others[3] build on the research hypothesis, according to which those virtual conflicts between normative systems, avoided by PIL, can still occur at the level of interpretation and of interpretive canons. In spite of the difficulties faced to get acquainted with both foreign law content and its interpretation, domestic courts are nevertheless required to apply it as if they were the foreign court, as it happens, eg, in the Italian legal system. Indeed, applying a foreign piece of legislation within the domestic legal system means to tackle conceptual misalignments, to deal with normative or interpretive gaps, and to solve clashes between canons of interpretation.

C5P3 This essay accounts for the use of logics in PIL:[4] we will attempt to gently introduce the reader to the contribution offered by the literature. We will not present many technical details, but we will rather focus on the main intuitions.

[1] For some overviews, cf Henry Prakken, *Logical Tools for Modelling Legal Argument* (Kluwer 1997); Henry Prakken and Giovanni Sartor, 'Law and Logic: A Review from an Argumentation Perspective' (2015) 227 Artificial Intelligence; Jaap Hage, *Studies in Legal Logic* (Springer 2005); Giovanni Sartor, *Legal Reasoning: A Cognitive Approach to the Law* (Springer 2005).

[2] cf Sartor, *Legal Reasoning* (n 1); Phan Minh Dung and Giovanni Sartor, 'The Modular Logic of Private International Law' (2011) 19 Artificial Intelligence and Law; Hage, *Studies* (n 1); Alessandra Malerba, Antonino Rotolo, and Guido Governatori, 'Interpretation Across Legal Systems' in Floris Bex and Serena Villata (eds), *Legal Knowledge and Information Systems - JURIX 2016: The Twenty-Ninth Annual Conference* (IOS Press 2016); Alessandra Malerba, Antonino Rotolo, and Guido Governatori, 'A Logic for the Interpretation of Private International Law' in Shahid Rahman, Matthias Armgardt, and Hans Christian (eds), *New Developments in Legal Reasoning and Logic* (Springer 2021).

[3] Malerba and others, 'Interpretation' (n 2); Malerba and others, 'Logic' (n 2).

[4] Parts of this chapter elaborate materials and ideas from Dung and Sartor, 'The Modular Logic' (n 2); Malerba and others, 'Interpretation' (n 2); Malerba and others, 'Logic' (n 2).

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C5S2

II. Why Logics for the Law?

C5P4 Although it is not the purpose of this chapter to defend legal logic as such, we briefly recall for the non-expert reader some common criticisms of the use of logic in the law.

C5P5 The application of formal logic in the legal domain has been the object of several criticisms, which can be classified into three distinct categories:

C5P6 • A first group of objections, which we could define *radical objections*, has to do with the presumed impossibility to apply the logic to normative reasoning in general;

C5P7 • A variant of the first type of criticism, which we could define *doctrinal objections*, claims that the legal logic is pointless since it is based on debatable theories of law;

C5P8 • A third type of objections, which we can instead define *moderate*, sees logic as a method only capturing a few (and easy) aspects of legal reasoning.

C5P9 The *first category of criticism* can undermine the root of any research which aims at using formal logic as an instrument of conceptual clarification of legal analysis and reasoning. In this sense, as Alchourrón and Bulygin (1981) have recalled, two fundamental problems have to be addressed if logic should be applied to norms. On the one hand, it is stated that no logic of norms can properly exist because the norms do not have any truth value, in contrast with descriptive statements.[5] On the other hand, Kelsen,[6] among others, argued that the logic of legal norms is in general groundless because there is no significant logical relationship among legal norms: in fact, norms are valid, and their validity is a qualification which is *constitutive* of the act of will of those subjects that create or apply them. Kelsen maintained that the validity of a legal norm *n*' that comes as derived from a more general one *n* does not depend in any way from the logical correctness of the inference of *n*' from *n*, but from the validity of *n* insofar as it empowers the subject producing *n*' to issue it. In this sense, the production of *n*' is based on the will of a subject empowered by the legal system.

C5P10 Many counterarguments have been presented in the literature, which attempted to circumvent this radical obstacle. Some argued that logic should not necessarily be applied only to sentences susceptible of truth or falsity, but that, otherwise, it mainly works on a syntactic notion of consequence relation.[7] In addition, if semantics is needed, a dichotomy of the type $(1,0)$ is sufficient (denoting any dichotomy such as valid/invalid, issued/unissued, just/unjust, etc).[8] Others have conceded that there is no genuine logic of norms, but pointed out that it is nevertheless possible to develop a logic of normative propositions, or rather of descriptive propositions about norms.[9] Some have instead defended the view in favour of the

[5] A classic formulation of such a scepticism is the so-called Jørgensen dilemma: Jørgen Jørgensen, 'Imperatives and Logic' (1937-1938) 4 Erkenntnis. Some arguments supporting this thesis, which are very popular among legal philosophers, have been offered by Kelsen and by von Wright: Hans Kelsen, *Allgemeine Theorie Der Normen* (Manz 1979); George H von Wright, *Norm and Action: A Logical Inquiry* (Routledge 1963). For a more recent formal analysis of this topic, see: David Makinson, 'On a Fundamental Problem of Deontic Logic' in Paul McNamara and Henry Prakken (eds), *Norms, Logics and Information Systems. New Studies in Deontic Logic and Computer Science* (IOS Press 1999).

[6] Kelsen, *Allgemeine Theorie* (n 5).

[7] Carlos E Alchourrón and Antonio Martino, 'Logic Without Truth' (1990) 3 Ratio Juris.

[8] Georges Kalinowski, 'Théorie Des Propositions Normatives' (1953) 17 Studia Logica.

[9] von Wright, *Norm and Action* (n 5).

existence of an ideal normative dimension to which the norms could somehow match, and thus be qualified *latu sensu* as true or false.[10]

C5P11 Other counterarguments can be mentioned. For example, consider the following. As is well known, if we approach logical deduction semantically, we are usually able to focus on a very important property of it, ie, the fact that deduction is truth-preserving: an argument is deductively valid if there is no interpretation (in the semantics) in which its premises are all true and its conclusion false. However, one may affirm that a logical inference with norms does not transmit the truth to the conclusion of the premises (*truth-preservation*), but it rather preserves normative validity (*validity-preservation*).[11] A stronger position is the one defended by Ota Weinberger, who admits that the logic of norms must be understood as distinct from the logic of descriptive utterances, but who also is highly critical towards those who, like Kelsen, believe that we cannot conceptualize logical relations between legal norms.[12] According to Weinberger, in fact, validity-preservation is not the only relevant type of logical relation between norms: if a norm *n* is valid in the legal system *S* iff *n* belongs to *S*—as would be the case if *n* is enacted by an authorized subject in *S*—then the logical principle of subsumption must apply at any rate, otherwise it is not possible to 'apply' a power-conferring norm to empower this subject. Of course—Weinberger argues—this argument is necessarily relevant (in Kelsen's view) only with respect to the presupposed basic norm, which has not itself been enacted: but, overall, logic is needed precisely to make this basic norm applicable, thus providing the foundations for the entire legal system.

C5P12 *A second type of criticism*, which is perhaps a variant of the first one, is that legal logic is pointless since it is based on a wrong conception of the law. Consider, just to mention one example among others, the critique of American legal realism against Langdell's formalism and mechanical jurisprudence. Indeed, formalism held that 'judges decide cases on the basis of distinctively legal rules and reasons, which [formally] justify a unique result in most cases (perhaps every case)', but this is wrong because judicial decision-making does not proceed on a formal basis[13] and the law is not 'a set of preexisting concepts of fixed scope but a tool of government which would and should be reshaped as the desires of the community'. This may amount to rejecting 'the use of deductive logic to derive the outcome of a case from premises accepted as authoritative'. Indeed, the use of logic, even when accepted, is limited because the justification for premises of judicial reasoning 'cannot be logic. Logic is used to go from the premises to the conclusion, not to obtain the premises'.[14]

C5P13 This last comment above leads to *the third category of criticism*, ie, that, even when legal logic is accepted as relevant, we can see it only as capturing a few aspects of legal reasoning.[15]

[10] Georges Kalinowski, *La Logique Des Normes* (PUF 1972).

[11] Alf Ross, *Directives and Norms* (Routledge 1968).

[12] Ota Weinberger, *Normentheorie Als Grundlage Der Jurisprudenz Und Der Ethik. Eine Auseinandersetzung Mit Hans Kelsens Theorie Der Normen* (Düncker & Humblot 1981); Ota Weinberger, *Rechtslogik* (Düncker & Humblot 1989).

[13] Brian Leiter, 'American Legal Realism' in W Edmundson and M Golding (eds), *The Blackwell Guide to Philosophy of Law and Legal Theory* (Wiley 2005) 50.

[14] Richard A Posner, 'Legal Formalism, Legal Realism, and the Interpretation of Statutes and the Constitution' (1986) 37 Case Western Reserve Law Review 184, 181, 192. See, however, the analysis of Michael S Green, who argues that the legal realists' criticisms of logic were really directed at other issues: Michael S Green, 'Logic and Legal Realism' in Dieter Krimphove and Florian Simon (eds), *Research Handbook in Law and Logic* (Düncker & Humblot 2017).

[15] See, for a broad discussion, among others: Robert Alexy, *A Theory of Legal Argumentation* (Clarendon 1989); Aleksander Peczenik, *On Law and Reason* (Kluwer 1989); D Neil MacCormick, *Rhetoric and the Rule of Law: A Theory of Legal Reasoning* (OUP 2005).

This criticism was responded to in the logic literature by broadening the scope and the techniques of legal logic. Indeed, for a long time the criticism was directly linked to the limits of judicial syllogism in reconstructing judicial decisions and reasoning. Of course, logics go beyond syllogistic inferences, thus offering new tools and methods—also covering the dialectical aspects of argumentation[16]—that grasp a large variety of issues in the law.

C5P14 While we agree with the above-mentioned literature rejecting the first type of criticism, we are instead more neutral in regard to the other two types. On the one hand, we do argue that the logical modelling of PIL is not necessarily associated with a single and specific legal philosophy: legal logicians are not committed, eg, to mechanical jurisprudence. Our approach rather falls within the philosophical tradition of conceptual analysis,[17] which is—at least in principle and under some conditions—compatible with many jurisprudential schools (including American legal realism, as argued by Posner[18]). On the other hand, we do not claim that formal logic is able to clarify the structure of all aspects of law—as we will show in the case of PIL—but it is nevertheless useful for clarifying some relevant problems and ideas.

C5S3

III. Why Logics for PIL?

C5P15 PIL consists in the body of rules and principles governing the choice of law to be applied when there are conflicts in the domestic law of different countries related to private legal facts and transactions.[19] Of course, this is relevant whenever private individuals exhibit aspects of extraneousness with respect to a specific domestic system, and these aspects refer to the law of other countries.

C5P16 The legal doctrine and judicial practice in different legal systems also distinguish among a number of canons for interpreting legal statutes, ie, different rules that are employed in legal systems as patterns for constructing arguments aimed at justifying certain interpretations, while attacking other interpretations.[20] Hence, when applying and interpreting the foreign law in cross-border disputes, domestic courts are required to show fidelity to foreign law, which is often understood as behaving as the foreign court would, and, at the same time, to protect the inner coherence of their own legal system: this raises interpretive doubts of many kinds.

C5P17 From an argumentation perspective, for instance, applying the same canon of interpretation to the same normative provision in different legal systems could produce opposite outcomes; in this case, we have incompatible interpretive arguments and we need for effective ways to cope with them in the national system. To illustrate this problem, terms like 'privacy' or 'good faith', which occur in a provision, can lead to incompatible legal outcomes when they are interpreted using the same canon based on the coherence with the constitutional values of two different national systems.

[16] See Prakken and Sartor, 'Law and Logic' (n 1).
[17] See Frank Jackson, *From Metaphysics to Ethics: A Defence of Conceptual Analysis* (OUP 1998).
[18] Posner, 'Legal Formalism' (n 14).
[19] See P Stone, *EU Private International Law* (Edward Elgar 2014); JG Collier, *Conflict of Laws* (Cambridge University Press 2012).
[20] D Neil MacCormick and Robert S Summers (eds), *Interpreting Statutes: A Comparative Study* (Ashgate 1991).

C5P18 Several formal methods can be used to model how domestic courts should reason about foreign law and handle conflicting legal arguments that are relevant to interpret the identified foreign law. Reasoning in the context of PIL and concerning the application and interpretation of foreign law means to also consider the following:[21]

C5P19 • we need to establish a priority ordering among norms from different systems;

C5P20 • canons of interpretation may refer to at least two legal systems, the domestic and the foreign, but both systems may consist of normative sub-systems, and may be part of larger systems, eg, EU system: assuming the existence of many legal systems $LS_i, \ldots, LS_z$, from a set-theoretical perspective, each LS_i is either included in or including other systems (more and more often, both cases hold), with which it is in various relations;

C5P21 • in the foreign legal system, priority may be given to interpretive arguments that are hardly or not used in the domestic one (eg, the argument from precedent, common in the USA, is not so familiar to civil law courts);

C5P22 • interpretive conditions may change from one system to the other;

C5P23 • an ordering among all interpretations has to be made: this will depend on the legal system taken as the main reference and on the goals and values it refers to.

C5P24 Theoretically, problems such as the following often arise.

C5P25 **Case 1 (Existence of Overriding Mandatory Rules).** *There exists a domestic piece of legislation that is considered mandatory. Mandatory rules prevent and override any other rule, included conflict rules and the possible foreign law they identify, which is ex ante seen as incompatible with the domestic legal system and its fundamental goals.*

C5P26 **Case 2 (Public Policy Exception).** *Reasoning about interpretive canons is relevant to public policy exception: whatever interpretive canon is appropriate concerning foreign law, if it yields content that is contrary to the forum's public policy, the exception will apply.*[22]

C5P27 **Case 3 (Same Interpretive Canons Conflict).** *The same interpretive canon can give opposite interpretive results in the foreign and in the domestic legal systems.*

C5P28 The cases above show that PIL must handle two distinct rational processes:

C5P29 • Conflict-detection and conflict-resolution among legal rules belonging to different legal systems;

C5P30 • Conflict-detection and conflict-resolution among interpretive canons used in different legal systems.

C5P31 In the following sections, we will explain different logical intuitions that capture in PIL such interactions among different legal systems.

[21] For an extensive discussion, cf Alessandra Malerba, *Interpretive Interactions Among Legal Systems and Argumentation Schemes* (PhD thesis, University of Bologna 2017).

[22] Usually, public policy functions in a negative way here: 'once the exception has been raised, it prevents the court to apply the foreign law supposedly contrary to it, so inevitably challenging the legal system about how the left normative gap should be filled': ibid 100–01.

C5S4

IV. Logical Intuitions for PIL

C5P32 As we have argued, methods for conflict of laws may occur when norms of different systems collide, or when interpretive canons or arguments collide when used in distinct systems.

C5P33 Consider the following two examples that illustrate both cases.

C5P34 **Example 1**. *[Contract Law] 'An Italian company and a British one make a contract according to which the Italian company has to deliver certain goods. A clause says that the contract is governed by US law. The English company sues the Italian company for breach of contract. The [jurisdictional] issue, [under] both English and Italian law, has to be decided on the basis of the Brussels Convention (on Jurisdiction and the Enforcement of Judgments in Civil and Commercial Matters), which establishes the jurisdiction of the Italian judge. However, the Italian judge has to apply the law chosen by the parties, ie, US law, on the basis of the Rome Convention (on the Law Applicable to Contractual Obligations)'*.[23]

C5P35 In this example, it is crucial whether a contract is regulated by Italian or US law: the two legal systems lead to different outcomes. As argued by Dung and Sartor,[24] Italian law tends to limit liability of the diligent defaulting party, while US law is stricter in this regard: in several cases, if Italian law had to be applied the diligent defaulting party would not pay damages. On the contrary, under US law damages have to be paid. Here, we have a clear *conflict of norms*.

C5P36 **Example 2**. *[Interpretation in PIL] 'A woman, a Cameroonian citizen, put forward in an Italian court a paternity action with respect to her daughter, also a Cameroonian citizen, underage at the time, on the basis of Art. 340 Cameroonian Civil Code and Art. 33 Law no. 218/1995. She alleged that the child was born within a relationship she had with an Italian citizen, who initially took care of the girl and provided financial support for her, then refused to recognise the child. The judicial question is thus the recognition of the legitimate paternity in favour of the girl, whose main legal consequence would be to burden the presumed father with the duty to give her due support in the form of maintenance and education.*

C5P37 *. . . We have to consider the legal provisions involved in such a typical cross-border case. In particular, after ascertaining that the factual premises for applying the Italian private international law hold (ie, Law no. 218/1995) (the case presents links with two legal systems) and that no other private international law provisions apply (eg, EU regulations), the appropriate rule of conflict are those that identify the national law of the child at the moment of the birth as the applicable law.*

C5P38 *Art. 340, Civil Code of Cameroon, states that the judicial declaration of paternity outside marriage can only be done if the suit is filed within the two years that follow the cessation, either of the cohabitation, or of the participation of the alleged father in the support [*entretien*] and education of the child. At a first glance, it appears crucial to properly interpret the term* entretien *for it represents a condition for lawfully advancing the judicial request of paternity. Different interpretations of this term can be offered in Cameroon's law, and may fit differently within the Italian legal system'*.[25]

C5P39 In this second example, once it is made clear which norm has to be applied (Civil Code of Cameroon, art 340), we have still a potential conflict to solve because the Italian judge

[23] Dung and Sartor, 'The Modular Logic' (n 2).
[24] ibid.
[25] Malerba and others, 'Interpretation' (n 2) 84–85.

may interpret such a piece of foreign legislation using different interpretive standards. The interpretation of the term *entretien* under Cameroonian and Italian law might in fact be different, but also incompatible interpretive solutions can be taken from the Cameroonian legal system. In all these cases, here, we rather have a *conflict of interpretations*.

C5P40 A logical analysis of PIL has therefore to develop formal models to manage and solve normative conflicts among legal systems. In the logical literature, we have two fundamental paradigms for handling conflicts, defeasible reasoning and belief revision.

C5P41 *Defeasible reasoning* addresses normative conflicts through reasoning: conflicting norms coexist in the same knowledge base (legal system), but are processed by taking into account their relative importance, as well as their scope of application.

C5P42 Alternatively, *belief revision* addresses normative conflicts through change, ie, through models for rational update: when new norms are added, which are incompatible with the existing ones, the system is revised in order to keep consistency while minimizing change.

C5P43 As argued by Dung and Sartor,[26] PIL provides in principle a third way, because it addresses normative conflicts between legal systems 'by allocating a case to the courts of a certain country, and by determining according to which legal system these courts have to decide. Thus, conflicts between norms belonging to different legal systems (eg, Italian and English law) are solved by being put aside: such conflicts do not provide dilemmas for the concerned judge, since the latter will have to apply only one system, the one selected by private international law'. This is true, but with some caveats. First of all, the doctrine of renvoi may require a court to consider the choice-of-law rules of another state, and, through it, to apply sometimes norms of another legal system: if so, we cannot exclude that conflicts indirectly may arise (see Section IV.A). Second, beyond the doctrine of renvoi we still cannot exclude that genuine conflicts may directly occur. In the US, for example, many states use an approach, called interest analysis, that in fact recognizes that genuine conflicts of laws might occur. Therefore, in PIL we still have the problem of solving potential conflicts, insofar as the foreign norm can generate inconsistencies with other norms (eg, the constitution) in the system where the court operates. Thus, defeasible reasoning and belief revision are still options.

C5S5

A. Basics

C5P44 Logic deals with reasoning by identifying sound *arguments* in a given formal language. The language is meant to represent the piece of knowledge on which we reason. Classically, reasoning can be conceived in terms of a logical consequence, such that, if $\mathcal{A} = \langle \Gamma, C \rangle$ is valid argument, this means that C is *logically deducible* from Γ, where[27]

C5P45 • the elements of Γ and C are expressed in a certain formal language $\mathcal{L}$, ie, they are well-formed formulae of $\mathcal{L}$, and

C5P46 • C is obtained from Γ by using certain principles for reasoning about statements expressed in that language.

[26] Dung and Sartor, 'The Modular Logic' (n 2) 235.

[27] cf Patricia Blanchette, 'Logical Consequence' in Lou Goble (ed), *The Blackwell Guide to Philosophical Logic* (Blackwell 2001).

C5P47 In other words, once the language $\mathcal{L}$ is defined we can introduce a logical system $\mathcal{D}$ working on expressions of $\mathcal{L}$, ie, a set of reasoning principles that guarantee in $\mathcal{D}$ to correctly derive conclusions from any Γ and to build *proofs* of these formulae, given Γ. A well-known reasoning rule in most propositional logics is Modus Ponens.

C5P48 Roughly, a proof for a formula C consists in a finite number of steps, ending with C, which satisfy the principles in $\mathcal{D}$. In this way, if we write $\langle \Gamma, C \rangle_{\mathcal{D}}$ we can say that C is *deducible* or *provable* in $\mathcal{D}$ from Γ. In a nutshell:

C5P49 **Definition 1** (Logical consequence as deducibility). *Any well-formed formula C is a logical consequence in $\mathcal{D}$ of a set Γ of well-formed formulae, ie, $\Gamma \vdash_{\mathcal{D}} C$, iff C is deducible in $\mathcal{D}$ from Γ, ie, iff there is a proof from Γ to C that satisfy principles in $\mathcal{D}$. We write $\Gamma \vdash_{\mathcal{D}} \Delta$, where Δ is a set of formulae, to mean that each member of Δ is deducible from Γ and, if Δ is finite, that the logical conjunction of all elements of Δ is deducible from Γ.*

C5P50 When $\Gamma \vdash_{\mathcal{D}} C$, we can say that there is *an argument for C* in $\mathcal{D}$ from Γ.

C5P51 Most logical approaches to the law assume that a legal system can be accurately represented in a formal language $\mathcal{L}$ and as a meaningful set of formulae of $\mathcal{L}$.[28] Consider, for instance, the Italian civil code and suppose we have a system consisting only of the following two norms:

C5P52 **Article 1176 [Diligence in contractual performance]**: In performing obligations the debtor shall act in good faith and with due diligence. . . .

C5P53 **Article 1218 [Liability of debtor]**: The debtor who fails to perform is liable to damages unless she proves that the non-performance . . . was due to a cause not imputable to her.

C5P54 The concept of non-imputability is complex, but, for the sake of simplicity, we assume that the usual interpretation, in the Italian legal system, is typically that those contracting parties who fail to perform but act in good faith are not liable. Hence, if we use the language of Classical Propositional Logic, we can have a system as follows:

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$$\begin{aligned} S_{ITA} = \{ & Perform\_Obligation \wedge Party \rightarrow Obl\_GoodFaith, \\ & Obl\_GoodFaith \wedge GoodFaith \wedge Fail \rightarrow \neg Liable \\ & Obl\_GoofFaith \wedge \neg GoodFaith \wedge Fail \rightarrow Liable \}. \end{aligned}$$

C5P56 Under this reading of legal systems, reasoning about a case means applying the norms of $\mathcal{S}_{ITA}$.

C5P57 Assume, eg, that $F = \{Perform\_Obligation, Party, GoodFaith, Fail\}$ is the set of true facts describing our case. Then, we obtain

[28] Logicians very often model any normative system $\mathcal{S}$ by stating that it consists of the closure under logical consequence of the norms N in $\mathcal{S}$, ie, consisting of N and those norms that are the logical consequences of N. See the discussion in: Carlos E Alchourrón and Eugenio Bulygin, *Normative Systems* (Springer 1971); Carlos E Alchourrón, Peter Gärdenfors, and David Makinson, 'On the Logic of Theory Change: Partial Meet Contraction and Revision Functions' (1985) 50 Journal of Symbolic Logic; David Makinson and Leendert van der Torre, 'Permission from an Input/Output Perspective' (2003) 32 Journal of Philosophical Logic. We can ignore this issue at the moment.

C5P58 $$S_{ITA} \cup F \vdash_{\mathbf{CPL}} \{Obl\_GoodFaith, \neg Liable\}$$

C5P59 where *CPL* stands for Classical Propositional Logic.

C5P60 Let us now move to PIL and work on Example 1. If so, we can reasonably assume that $\mathcal{S}_{ITA}$ models how the Italian legal system handles the case. Instead, we can say that the US system simply works as follows:

C5P61 $$S_{USA} = \{Perform\_Obligation \wedge Party \rightarrow Obl\_GoodFaith, \\ Party \wedge Fail \rightarrow Liable\}.$$

C5P62 It is clear that $\mathcal{S}_{ITA}$ and $\mathcal{S}_{USA}$ are incompatible in *CPL* when *Perform_Obligation*, *Party*, *GoodFaith*, and *Fail* are true, since such systems imply respectively $\neg$*Liable* and *Liable*. The example explains that the Italian jurisdiction is the competent one, but Italian judges should use the norms of $\mathcal{S}_{USA}$. Following Dung and Sartor,[29] one may argue that there is no real normative conflict between the systems: the Italian judge will simply use $\mathcal{S}_{USA}$ and conclude that the debtor is liable.

C5P63 However, things are more complicated. Suppose, for instance, that the contracting party is a public legal entity and that the public official operating on behalf of it acts in good faith but fails to perform. Under some circumstances, one could argue, according to the Italian Constitution, that the public official, though in principle liable, is not so in this case. How can an Italian judge apply US law here and ignore the Italian Constitution? Or suppose that some other norms in US law imply something that is incompatible with some other norms in the Italian legal system. Can we avoid the problem by considering only some norms in isolation?

C5P64 Viewed as parts of a bigger system, if norms are holistically considered to be uninterpretable if taken in isolation, and they acquire meaning only by relating to other norms in the system, then a correct treatment of PIL cannot avoid the problem of solving normative conflicts. Indeed, the principle behind this approach—'no logic of norms without attention to the normative systems in which they occur'[30]—suggests this. This idea draws inspiration also from the pioneering works by Stenius,[31] which focuses on the fact that normative conclusions derive from norms as interplaying together in normative systems.

C5P65 It is thus very hard in abstract terms to isolate the norms that should be considered and those which must be excluded. We thus believe that defeasible reasoning and belief revision are still crucial methods for handling PIL.

C5S6 B. Defeasible Reasoning for PIL

C5P66 In legal theory, HLA Hart was the first who illustrated the idea of defeasible reasoning by saying, for instance, that 'there are positive conditions required for the existence of a valid contract' but there are reasons that can defeat that existence claim, 'even though all these

[29] Dung and Sartor, 'The Modular Logic' (n 2).
[30] Makinson, 'On a Fundamental Problem' (n 5).
[31] Erik Stenius, 'Principles of a Logic of Normative Systems' (1963) 16 Acta Philosophica Fennica.

conditions are satisfied'.[32] The concept of defeasibility may have different connotations in the law.[33] One key idea of most logical accounts of the law is that legal reasoning is defeasible, namely, that we may have reasons to abandon certain legal conclusions even though there was no apparent mistake in previously supporting them.

C5P67 When looking at the law through an argumentative lens, we may distinguish different types of defeasibility.[34] Here we focus on one of them, which covers the fact that legal conclusions, though correctly supported by certain pieces of information, cannot be derived when the knowledge base including that information is expanded with further pieces of information. *In the case of PIL, this happens whenever the knowledge base is expanded by foreign norms colliding with the domestic ones.*

C5P68 Defeasible reasoning has been largely investigated in philosophy, logic, and AI, usually by working on the concept of *inference-based defeasibility*.[35] In this sense, defeasibility is formally interpreted within non-monotonic logics, namely, in logics whose underlying consequence relation does *not* enjoy monotonicity, where monotonicity means that conclusions do not decrease if more knowledge is added. Since non-monotonicity means that a logic lacks a property, its positive interpretation is open to many options. In regard to modelling legal reasoning, since the Nineties the most preferred one (especially in the AI & Law community) has been to develop argumentation systems.[36]

C5P69 The advantage of all these approaches, also for PIL, is that they intuitively capture the dialectal nature of legal reasoning by clearly considering its different layers. In particular, we need at least to distinguish a logical layer, a dialectical layer, and a procedural layer of legal arguments.[37]

C5S7 ## 1. Logical Layer

C5P70 The logical layer deals with the underlying language that is used to build legal arguments. Many languages and reasoning methods can be used for this purpose. If the underlying language refers to logic **L**, the language of **L** can be used to represent norms or interpretive statements, and arguments can roughly correspond to proofs in *L*.[38]

C5P71 Suppose we resort to a rule-based logical system where rules have the form $\phi_1,\ldots,\phi_n \Rightarrow \phi$ and represent defeasible legal norms in PIL: this means that if $\phi_1,\ldots,\phi_n$ jointly occur (ie, the

[32] HLA Hart, 'The Ascription of Responsibility and Rights' in A Flew (ed), *Logic and Language* (Blackwell 1951) 152.

[33] For a comprehensive overview, see: Sartor, *Legal Reasoning* (n 1); Henry Prakken and Giovanni Sartor, 'The Three Faces of Defeasibility in the Law' (2004) 17 Ratio Juris.

[34] cf Prakken and Sartor, 'The Three Faces' (n 33).

[35] cf David Makinson, *Bridges from Classical to Nonmonotonic Logic* (King's College Publications 2005).

[36] See, eg, Henry Prakken and Giovanni Sartor, 'A Dialectical Model of Assessing Conflicting Arguments in Legal Reasoning' (1996) 4 Artificial Intelligence and Law. Although it does not consider the most recent proposals, a good introductory discussion can still be found in: Henry Prakken and Giovanni Sartor, 'The Role of Logic in Computational Models of Legal Argument: A Critical Survey' in *Computational Logic: Logic Programming and Beyond* (Springer 2002).

[37] See Prakken and Sartor, 'The Role' (n 36); Henry Prakken and GAW Vreeswijk, 'Logics for Defeasible Argumentation' in DM Gabbay and F Guenthner (eds), *Handbook of Philosophical Logic* (2nd edn, Kluwer 2002). Here, for space reasons we briefly discuss the first and second layer, referring the reader for the third one to: Thomas F Gordon, *The Pleadings Game: An Artificial Intelligence Model of Procedural Justice* (Kluwer 1995); Henry Prakken, 'Relating Protocols for Dynamic Dispute with Logics for Defeasible Argumentation' (2001) 127 Synthese. The procedural layer considers the ways through which conclusions are dynamically reached in legal disputes, as disputes can be reconstructed in the form of dialogues. A well-known question of the procedural layer regards how to govern and allocate the burden of proof, which is quite relevant for PIL as well.

[38] See Prakken and Sartor, 'The Role' (n 36).

comma corresponds to logic conjunction), then ϕ defeasibly follows as the legal effect of the norm. An argument for a legal conclusion ϕ can typically have a tree-structure, where nodes correspond to literals[39] and arcs correspond to the rules used to obtain these literals; hence, the root corresponds to ϕ, the leaf nodes to the primitive premises, and for every node corresponding to any literal ψ, if its children are $\psi_1,\ldots,\psi_n$, then there is a rule whose antecedents are these literals.[40]

C5P72 In the case of PIL, as done in Section IV.A, we can partition the set of all norms in different subsets, each of them denoting a distinct legal system. For the sake of clarity, if we introduce a set of labels $\mathrm{LS}_1,\mathrm{LS}_2\ldots,\mathrm{LS}_n$ denoting different legal systems, two norms can be distinguished by labelling their arrows with the systems in which they occur: the norm $\phi_1,\ldots,\phi_n \Rightarrow_{\mathrm{LS}_1} \phi$ belongs to LS_1, the norm $\phi'_1,\ldots,\phi'_m \Rightarrow_{\mathrm{LS}_2} \phi'$ to LS_2.

C5P73 **Example 3**. *[Contract Law, cont'd] If we consider Example 1, we can represent two norms as follows:*

C5P74
$$n_1 : Obl\_GoodFaith, GoodFaith, Fail \Rightarrow_{ITA} \neg Liable$$
$$n_2 : Party, Fail \Rightarrow_{USA} Liable$$

C5P75 *Clearly, if norms n_1 and n_2 are both applicable, we have a logical conflict and defeasible reasoning is needed.*

C5P76 In the jargon of defeasible reasoning, we call any set of conclusions $E(\Gamma)$ of a knowledge base of norms Γ as an extension of Γ. It is a standard result that there is no guarantee that if $E_1(\Gamma)$ and $E_2(\Gamma)$ are both extensions of Γ, then the intersection of them is also an extension. Some systems are said to be credulous: the reasoner allows to select any extension of Γ and believe all of the members of it, even though many of the resulting conclusions will involve propositions that are missing from other extensions (and may even be contradicted in some of those extensions). Other systems are not credulous but sceptical, which amounts to refraining from concluding any of the two conflicting conclusion, unless we know that one of the two norms prevails over the other. This means that one superiority relation $>$ must be introduced that establishes the relative strength of norms: $n_2 > n_1$ means that n_2 is stronger than n_1.

C5P77 Conflicts between legal arguments and conclusions can thus be solved using the superiority relation for modelling specific legal-domain dependent priority criteria such as *lex specialis*, *lex superior*, and *lex posterior*.[41] As far as PIL is concerned, relevant criteria are of course *jurisdiction* and *choice of law*. In Example 4, eg, once we know that the USA system must be applied in contrast with the Italian system, we can establish that norms with the arrow $\Rightarrow_{USA}$ are stronger than the ones with $\Rightarrow_{ITA}$, unless constitutional norms of the competent jurisdiction apply: in this case, we can adopt a sceptical approach and refrain from concluding anything.

[39] A literal is an atomic formula or its negation.

[40] Guido Governatori and others, 'Argumentation Semantics for Defeasible Logics' (2004) 14 Journal of Logic and Computation.

[41] Prakken, *Logical Tools* (n 1). Henry Prakken and Giovanni Sartor, 'Argument-Based Extended Logic Programming with Defeasible Priorities' (1997) 7 Journal of Applied Non-Classical Logic.

C5S8 2. Dialectical Layer

C5P78 The dialectical layer addresses many interesting issues, such as when legal arguments conflict, how they can be compared, and what legal arguments and conclusions can be justified.

C5P79 As for the general case, different types of attacks and defeat relations can apply to PIL as well as to legal arguments. John Pollock's original distinction between *rebutting* and *undercutting*[42] is almost universally accepted in the legal-argumentation literature.[43] An argument A_1 rebuts an argument A_2 when the conclusion of A_1 is equivalent to the negation of the conclusion of A_2. The rebutting relation is symmetric. When arguments are built using rules representing legal norms from different legal systems, a conflict of this type at least corresponds to a clash between the conclusions obtained from two norms and different systems. The clash of rules in Example 4 corresponds to a case of rebutting. The undercutting is when an argument challenges a rule of inference of another argument. This attack relation is not symmetric and occurs when an argument A_1 supporting the conclusion ϕ has some ground ψ but another argument A_2 states that ψ is not a proper ground for ϕ. To put it very simply, if one builds an argument A_1 for ϕ using the rules $\Rightarrow \psi$ and $\psi \Rightarrow \phi$ but we contend that ψ is not the case, then we undercut A_1. Consider the following example for undercutting.

C5P80 **Example 4**. *[Contract Law, cont'd] Consider again Example 1 and assume as before that*

C5P81
$$n_1 : Obl\_GoodFaith, GoodFaith, Fail \Rightarrow_{ITA} \neg Liable$$
$$n_2 : Party, Fail \Rightarrow_{USA} Liable$$

C5P82 *and that $n_2 > n_1$ because USA law should apply instead of the Italian one. However, suppose that the following holds as well:*

C5P83
$$n_3 : \neg ExplicitConsent \underset{USA}{\Rightarrow} \neg Party$$

C5P84 *ie, that without consent, nobody can be considered a contracting party and that this norm is applicable. In this case, the argument supporting the conclusion* Liable *is undercut.*

C5P85 In general, assessing conflicting legal arguments cannot work if we only examine single pairs of arguments. In fact, we need to consider all the arguments to establish what legal conclusions win and are justified in a legal dispute. Argumentation theory usually distinguishes among *justified*, *defensible*, and *overruled* arguments.[44] Justified arguments are those which basically survive all attacks, the defensible ones leave the dispute undecided, and the overruled ones are those defeated by a justified argument.[45] *When PIL is considered, one research issue is precisely to define the set of arguments that should be considered if more legal systems are involved.*

[42] John L Pollock, *Cognitive Carpentry: A Blueprint for How to Build a Person* (MIT Press 1995).
[43] See Prakken and Sartor, 'The Role' (n 36); Prakken and Sartor, 'The Three Faces' (n 33).
[44] Phan Minh Dung, 'On the Acceptability of Arguments and Its Fundamental Role in Nonmonotonic Reasoning, Logic Programming and n-Person Games' (1995) 77 Artificial Intelligence.
[45] Prakken and Vreeswijk, 'Logics' (n 37).

C5S9

C. Belief Revision for PIL

C5P86 Belief revision is a branch of logic that proposes formal methods for modelling changes of any theory, ie, any knowledge base. We should notice that this research line was initiated precisely in the legal domain for modelling legal dynamics.

C5P87 In the logic of belief revision, a belief state is a set of sentences. The major operations consist in the introduction or removal of a sentence. In both cases, changes affecting other sentences may be needed (for instance in order to retain consistency). Rationality postulates for such operations have been proposed, and representation theorems have been obtained that characterize specific types of operations in terms of these postulates.

C5P88 Alchourrón and Makinson were the first to logically study the changes of a *legal code*.[46] The addition of a new norm n causes an enlargement of the code, consisting of the new norm plus all the regulations that can be derived from n. They distinguish two other types of change. When the new norm is incoherent with the existing ones, we have an *amendment* of the code: in order to coherently add the new regulation, we need to reject those norms that conflict with n. Finally, *derogation* is the elimination of a norm n together with whatever part of the legal code that implies n.

C5P89 Alchourrón, Gärdenfors, and Makinson inspired by the work above proposed the so-called general AGM framework for belief revision.[47] In the AGM model, the set representing the belief state or a theory is assumed to be a belief set, ie, the logical closure of the set of sentences. As mentioned above and as is well known, the AGM framework distinguishes three types of change operation over belief sets. *Contraction* is an operation that removes a specified sentence ϕ from a given belief set Γ(as we said, a logically closed set of sentences) in such a way as Γ is set aside in favour of another belief set Γ^{-}_{ϕ} which is a subset of Γ not containing ϕ. *Expansion* operation adds a given sentence ϕ to Γ so that the resulting set Γ^{+}_{ϕ} is the smallest logically closed set that contains both Γ and ϕ. *Revision* operation adds ϕ to Γ but it is ensured that the resulting belief set Γ^{*}_{ϕ} be consistent. In AGM this means, in virtue of the so-called Levi Identity principle, that Γ^{*}_{ϕ} amounts to $\left(\Gamma^{-}_{\neg\phi}\right)^{+}_{\phi}$, ie, that Γ revised by ϕ is equal to Γ contracted by not-ϕ (to ensure consistency) and then expanded by ϕ.

C5P90 Let us now consider PIL and Example 1, assuming that our knowledge base is represented in **CPL**. We thus work on the following scenario, which was already discussed in Section IV.A:

C5P91

$$
\begin{aligned}
F &= \{Perform\_Obligation, Party, GoodFaith, Fail\} \\
S_{ITA} &= \{Perform\_Obligation \wedge Party \rightarrow Obl\_GoodFaith, \\
&\quad Obl\_GoofFaith \wedge GoodFaith \wedge Fail \rightarrow \neg Liable \\
&\quad Obl\_GoofFaith \wedge \neg GoodFaith \wedge Fail \rightarrow Liable\} \\
S_{USA} &= \{Perform\_Obligation \wedge Party \rightarrow Obl\_GoodFaith, \\
&\quad Party \wedge Fail \rightarrow Liable\}.
\end{aligned}
$$

[46] Carlos E Alchourrón and David C Makinson, 'The Logic of Theory Change: Contraction Functions and Their Associated Revision Functions' (1982) 48 Theoria.

[47] Alchourrón, Gärdenfors, and Makinson, 'On the Logic' (n 28).

C5P92 Assume again that the Italian jurisdiction is the competent one but Italian judges should use US relevant norms. This idea can be logically reconstructed by consistently adding such US norms to $\mathcal{S}_{ITA}$, ie, by appropriately revising such a set of rules.

C5P93 Since $Perform\_Obligation \wedge Party \rightarrow Obl\_GoodFaith$ is both in $\mathcal{S}_{ITA}$ and $\mathcal{S}_{USA}$, then the revision of $\mathcal{S}_{ITA}$ simply amounts to

C5P94 $$Party \wedge Fail \rightarrow Liable. \qquad (1)$$

C5P95 However, this cannot be done by a simple expansion, because adding (1) to the Italian systems,
C5P96 given F, makes it logically inconsistent, ie

C5P97 $$F \cup \left(S_{ITA}\right)^{+}_{Party \wedge Fail \rightarrow Liable} \vdash \bot$$

C5P98 What we have to do is rather

C5P99 $$\left(S_{ITA}\right)^{*}_{Party \wedge Fail \rightarrow Liable}$$

C5P100 such that

C5P101 $$F \cup \left(S_{ITA}\right)^{*}_{Party \wedge Fail \rightarrow Liable} \nvdash \bot .$$

C5P102 In other words, we have to remove the minimal information from $\mathcal{S}_{ITA}$ in such a way that the new version of $\mathcal{S}_{ITA}$, in combination with F—which cannot be changed since it corresponds to facts and not norms—does not lead to any contradiction.

C5P103 What we have to do is thus

C5P104 $$\left(\left(\left(S_{ITA}\right)^{-}_{\neg(Party \wedge Fail \rightarrow Liable)}\right)^{+}_{(Party \wedge Fail \rightarrow Liable)}\right)^{*}_{F}$$

C5P105 which is equivalent in this case to removing

C5P106 $$Obl\_GoodFaith \wedge GoodFaith \wedge Fail \rightarrow \neg Liable$$

C5P107 from $\mathcal{S}_{ITA}$.

C5P108 In general, AGM operations enjoy several properties or postulates. Some AGM postulates seem to be rational requirements in a legal context, whereas they have been criticized when imposed on belief change operators.[48]

[48] For a discussion regarding the law, see: Guido Governatori and Antonino Rotolo, 'Changing Legal Systems: Legal Abrogations and Annulments in Defeasible Logic' (2010) 18 The Logic Journal of IGPL; Audun Stolpe, 'Norm-System Revision: Theory and Application' (2010) 18 Artificial Intelligence and Law; Antonino Rotolo, 'Retroactive Legal Changes and Revision Theory in Defeasible Logic' in Guido Governatori and Giovanni Sartor (eds), *Proceedings of the 10th International Conference on Deontic Logic in Computer Science (DEON 2010)*

C5S10

V. Recent Trends of Legal Logic in PIL

C5P109 As was mentioned in Section I, two independent research efforts have been addressed in the last decade in regard to the use of logic in PIL. On the one hand, Dung and Sartor[49] proposed new logical models for argumentation for conflict-detection and conflict-resolution among legal rules belonging to different legal systems. On the other hand, Malerba, Rotolo, and Governatori[50] developed new defeasible logics for conflict-detection and conflict-resolution among interpretive canons in PIL. The following two sections briefly recall the basic intuitions of both frameworks.

C5S11

A. Modular Argumentation in PIL

C5P110 Dung and Sartor proposed a formal model of resulting interactions between legal systems based on the so-called modular argumentation, namely, an argumentation system where reasoning in regard to different legal contexts is managed by separate knowledge bases (modules).[51]

C5P111 As expected, the authors assumed the existence of different legal systems $LS_i,\ldots,LS_z$. Each system LS_k, includes three sets of rules:

C5P112 • a set of *choice of jurisdiction rules* $ChJur(LS_k)$,

C5P113 • a set of *choice of competence rules* $ChComp(LS_k)$, and

C5P114 • a set of *choice of law rules* $ChLaw(LS_k)$.

C5P115 These rule-sets establish, respectively, whether courts of LS_k can decide the case (jurisdiction), what particular court of LS_k can do that (competence), and what set of norms, of LS_k's or of another legal system, that court should apply (applicable law).

C5P116 When proceedings are started in front of a court k of a legal system LS_k, first of all k should consider the issue of jurisdiction: if $ChJur(LS_k)$ establishes LS_k's jurisdiction, then k should move on with the case; otherwise k should reject the case, declaring lack of jurisdiction.

C5P117 Having established jurisdiction for the courts of its legal system LS_k court k will have to address competence, ie, to establish whether k itself, among all courts of LS_k, has the task to decide that case, according to $ChComp(LS_k)$. Again, if $ChComp(LS_k)$ selects k, then k should decide the case, if $ChComp(LS_k)$ does not select k, then k should reject the case, declaring lack of competence.

C5P118 Having established its own competence, court k should apply $ChLaw(LS_k)$ in order to establish according to what legal system LS_j (that could possibly be different from LS_k) the case should be decided. Then k should apply LS_j to the relevant facts and adjudicate on the case accordingly.

(Springer 2010); Guido Governatori and others, 'Legal Contractions: A Logical Analysis' in *Proceedings of ICAIL-2013* (ACM 2013).

[49] Dung and Sartor, 'The Modular Logic' (n 2).
[50] Malerba and others, 'Interpretation' (n 2); Malerba and others, 'Logic' (n 2).
[51] Dung and Sartor, 'The Modular Logic' (n 2).

C5P119 Since a representation of PIL refers to distinct sets of legal rules, modular argumentation offers itself as an appropriate platform for representing PIL and different national laws as it allows knowledge to be split in separate modules. Moreover, it enables the different knowledge modules (which may represent legal systems or part of them) to be used by referring to each one of them specific issues. This is done by calling the relevant module and asking it to answer specific queries. Modular argumentation also facilitates the representation of legal doctrines (different views on what legal rules exist in a certain domain, as a result of different interpretations or constructions of legal sources) concerning both private international laws and substantive laws. This may be obtained by having different modules for the different doctrines, and using these different modules in the context of credulous inferences, ie, inferences that extract all the alternative incompatible conclusions obtainable from non-prioritized arguments attacking one another.

C5P120 According to Dung and Sartor, a legal reasoner who has to take into account multiple legal doctrines should not reason sceptically, ie, refrain from deriving any conclusions when alternative outcomes are dependent on the adoption of incompatible doctrines. Whenever distinct doctrines could lead to incompatible legal outcomes for the same case, a credulous approach enables us to make a better use of the limited knowledge in our possession, getting awareness of the alternative possibilities, an awareness which is precluded to a merely sceptical reasoner. In fact, for each relevant issue on which alternative doctrines are available, one doctrine is going to be adopted by the decision maker, who will reach one of the alternatively possible conclusions, but we do not know in advance with certainty what doctrine will be adopted. Thus the safest thing is to reason credulously, ie, consider all incompatible doctrines and their alternative implications as outcomes that may be derived from the available knowledge.

C5P121 For instance, assume that in a legal system LS_k different doctrines are used for the interpretation of a legislative rule on contractual liability, that according to one interpretation (possibly included in a separate module M_1 0, called by LS_k) the non-fulfilling party is always liable, according to the other interpretation (possibly included in a separate module M_2, also called by LS_k), fault is required for liability. If a legal system LS_j asks system LS_k about the liability of a party having failed to fulfil the contract without fault, the answer should not be that LS_k does not entail liability for this case, but rather that liability is only credulously entailed by LS_k, according to one doctrine (M_1), since an argument for non-liability is also available in LS_k, according to a different doctrine (M_2).

C5P122 In conclusion, by allowing multiple knowledge modules, and different modes of reasoning (including both sceptical and credulous reasoning), modular argumentation offers a natural way to capture the fact that legal reasoners need to apply different legal systems, according to different legal doctrines.

C5S12 B. Logics for Interpretive Canons in PIL

C5P123 Alessandra Malerba, Rotolo, and Governatori[52] proposed a Defeasible Logic for reasoning about interpretive canons in PIL. As is well known, interpretive canons are different

[52] Malerba and others, 'Interpretation' (n 2); Malerba and others, 'Logic' (n 2).

doctrinal methods that are employed in legal systems as patterns for constructing arguments aimed at justifying certain interpretations.[53] Examples are:

C5P124 **Argument by coherence:**

C5P125 A statutory provision should be interpreted in light of the whole statute it is part of, or in light of other statutes it is related to.

C5P126 **Teleological argument:**

C5P127 A statutory provision should be interpreted as applied to a particular case in a way compatible with the purpose that the provision is supposed to achieve.

C5P128 **Argument from substantive reasons:**

C5P129 If a fundamental goal can be promoted by one rather than another interpretation of a statutory provision, then the provision should be interpreted in accord with the goal.

C5P130 The logical structure of interpretive arguments must be analysed using a rule-based logical system. In particular, interpretation canons are represented by *interpretation rules*, where

C5P131
- antecedent conditions of interpretation rules can be of any type (assertions, obligations, etc), including the fact that another canon is refuted or that another legal provision ought to be interpreted in a certain way;

C5P132
- the conclusion of rules is an interpretive act, such as I, of a provision n leading to an interpretive result for n and thus to a sentence a which expresses such an interpretation and paraphrases n.[54]

C5P133 An example of an interpretation rule is the following:

C5P134
$$s : \mathrm{OBL}\,|_{s}^{\mathrm{LS}_j}\left(n_2^{\mathrm{LS}_i}, d\right) \Rightarrow^{I}|_{c}^{\mathrm{LS}_j}\left(n_1^{\mathrm{LS}_i}, p\right)$$

C5P135 Rule s states that, if provision n_2 belonging to the legal system LS_i ought to be interpreted in another system LS_j by substantive reasons (I_s) as d, then the interpretive canon to be applied in legal system LS_j for provision n_1 is the interpretation by coherence (I_c), which returns p.

C5P136 Reasoning about interpretive canons across legal systems thus requires one to specify in the formal language to which legal systems legal provisions belong and in which legal system canons are applied. In addition, we need:

C5P137
- the introduction of meta-rules to reason about interpretation rules;

C5P138
- that such meta-rules support the derivation of interpretation rules; in other words, the head of meta-rules are interpretation rules, while the antecedents may include any conditions.

C5P139 Consider, for instance, the following meta-rule:

C5P140
$$r : \left(\mathrm{OBL}\,|_{t}^{\mathrm{LS}_j}\left(n_1^{\mathrm{LS}_i}, p\right), a \Rightarrow_{C} \left(s : \mathrm{OBL}\,|_{s}^{\mathrm{LS}_j}\left(n_2^{\mathrm{LS}_i}, d\right) \Rightarrow^{I}|_{c}^{\mathrm{LS}_j}\left(n_1^{\mathrm{LS}_i}, p\right)\right)\right)$$

[53] See MacCormick and Summers (eds), *Interpreting Statutes* (n 20).

[54] Bartosz Brozek, 'Legal Interpretation and Coherence' in Michal Araszkiewicz and Jaromir Savelka (eds), *Coherence: Insights from Philosophy, Jurisprudence and Artificial Intelligence* (Springer 2013).

C5P141 Meta-rule r states that, if (a) it is obligatory the teleological interpretation (I_t) in legal system LS_i of legal provision n_1 belonging to that system and returning p, and (b)a holds, then the interpretive canon to be applied in legal system LS_j for n_1 is the interpretation by coherence, which returns p as well, but which is conditioned in LS_j by the fact that n_2 in this last system is interpreted by substantive reasons as d. In other words, r allows for importing interpretive results from LS_i into LS_j in regard to the legal provision n_1 in LS_i which can be applied in LS_j.

C5P142 Since different competing canons can be employed, different conflicting interpretation rules and meta-rules can be accordingly applied for interpreting legal provisions. *Interpretation rules are thus defeasible* and preferences over interpretive rules and meta-rules can be introduced in a way similar to the one recalled in Section IV.A.

C5P143 For the sake of illustration, the following elaborates the case in Example 2.

C5P144 **Example 5**. *Suppose that the domestic literal interpretation of art. 340, Civil Code of Cameroon, returns* p, *saying that the judicial declaration of paternity outside marriage refers to a rather minimal idea of* entretien, *which can even consist in some discontinuous support. With children under 14, teleological interpretation in Cameroon's system, instead, would interpret* entretien *as regular support (q), but literal interpretation is institutionally preferred. In Italian private law (art. 147, Italian Civil Code), instead,* mantenimento, *which corresponds to* entretien, *means regular support (q), a reading which depends by coherence on art. 30 of the Italian Constitution.*[55] *One can argue we should align to the case considered in Cameroon's law (under 14) but resorting to an interpretation by coherence that takes art. 30 of the Italian constitution into account.*

C5P145 *The following theory illustrates the case:*

C5P146
$$F = \left\{ \mathrm{OBL}\,|_{l}^{LS_{it}} \left(\mathrm{art.30}^{LS_{it}}, a \right) \right\}$$
$$R^{I} = \left\{ \begin{array}{l} r_3 : \Rightarrow^{I}|_{l}^{LS_{cam}} \left(\mathrm{art.340}^{LS_{cam}}, p \right), r_4 : children\_under14 \Rightarrow^{I}|_{t}^{LS_{cam}} \left(\mathrm{art.340}^{LS_{cam}}, q \right) \\ r_5 : \mathrm{OBL}\,|_{l}^{LS_{it}} \left(\mathrm{art.30}^{LS_{it}}, a \right) \Rightarrow^{I}|_{c}^{LS_{it}} \left(\mathrm{art.147}^{LS_{it}}, q \right) \end{array} \right\}$$
$$R^{C} = \left\{ r_6 : \mathrm{OBL}\,|_{l}^{LS_{it}} \left(\mathrm{art.30}^{LS_{it}}, a \right) \Rightarrow^{C} \left(r_7 : children\_under14 \Rightarrow^{I}|_{c}^{LS_{it}} \left(\mathrm{art.340}^{LS_{cam}}, q \right) \right) \right\}$$
$$> = \left\{ r_3 > r_4, r_7 > r_3 \right\}.$$

C5P147 *r_7 is applicable and r_7 is provable. This determines a conflict with* r_3, but r_7 is stronger than r_3.

C5S13

VI. Further Research Perspectives

C5P148 In the reasoning models that we have so far considered, we have assumed a set of rules that link to certain aspects of a case the application of the rules of a certain legal system. It is often assumed that this is indeed the fundamental purpose of PIL: to enable the determination of (jurisdiction and) applicable law to be done in a smooth uncontroversial (neutral) way without the need to engage with policy choices. This approach is usually said to go back to Friedrich Carl von Savigny, who argued that the law to be applied should

[55] '*It is the duty and right of parents to support, raise and educate their children, even if born out of wedlock. . . . The law ensures such legal and social protection measures as are compatible with the rights of the members of the legitimate family to any children born out of wedlock.*'

be determined according to simple and neutral rules, which should always select the law of the country most connected to the dispute, taking into account the nature of the legal relationship. Consider, for instance, the rules according to which personal statuses are governed by the national laws of the involved parties, real property disputes by the law where property is located, torts by the law of the place in which the harmful event or the harm has taken place, contracts by the law of the state of the party in the absence of an agreement between the parties, etc. While this approach has certainly important merits, its universal and straightforward application is challenged in the present social and economic context. Indeed today, many legal disputes are relevant to multiple countries, or present critical transnational aspects. Relatively to such disputes, the standard rules of PIL often fail to identify the law that is most suitable to equitably govern the complex interests at stake. For instance, it has been argued that the need to protect human rights may justify limiting the application of foreign laws, or rather extending it, in ways that are incompatible with the straightforward application of the rules of PIL. Similarly, considerations pertaining to preventing environmental damage, or ensuring compensation, addressing harms taking place in multiple places, may also require overcoming the allocation provided by standard PIL rules.[56] Finally, the reasons for rejecting, extending, or adapting the application of foreign law may go beyond the interests of the involved states, appealing rather to ethical considerations.[57]

C5P149 Here we cannot address the many substantive legal issues that are raised by these challenges. We shall rather focus on the extent to which the tools provided by logic may enable us to address them. We should indeed reject the view that legal logic is wedded to 'mechanical jurisprudence' in the domain of PIL (as in other domains, as we have argued above). Legal logic does not coerce us into the straightforward application of conflicts of law rules, without considering possible implications for the implementation of legal and ethical principles. On the contrary, the tools developed by research on legal logic—particularly in the context of AI & Law research—may support the kind of reasoning that is needed to make PIL more responsive to social-economical circumstances and ethical sensibilities.

C5P150 Different lines of research may be relevant to this effect. One such lines focuses on ways to address conflicts between legal norms (both rules and principles). This line of research builds upon approaches to argumentation and defeasibility and supplements them with the idea that conflicts between norms can be addressed not only by 'formal principles' (eg, preferring, between incompatible norms, the more recent, hierarchically higher, or more specific one) but also by substantive principles (eg, by preferring the norms that are more intensely supported by more important values).[58]

C5P151 Within AI & Law research, a number of ideas have indeed been proposed for dealing with teleological issues in legal reasoning, ie, to assess how different legal solutions promote or

[56] Horatia Muir Watt, 'Private International Law Beyond the Schism' (2011) 2 Transnational Legal Theory.

[57] Ralf Michaels, 'Private International Law as an Ethic of Responsivity' in Veronica Ruiz Abou-Nigm and Maria Blanca Noodt Taquela (eds), *Diversity and Integration in Private International Law* (Edinburgh University Press 2019).

[58] Trevor JM Bench-Capon and Giovanni Sartor, 'A Model of Legal Reasoning with Cases Incorporating Theories and Values' (2003) 150 Artificial Intelligence. Trevor JM Bench-Capon and others, 'Argument Schemes for Reasoning with Legal Cases Using Values' in *Proceedings of the 14th International Conference on Artificial Intelligence and Law* (ACM 2013).

demote interests and values at stake and determine legal outcomes correspondingly.[59] This approach could be useful, within PIL, to approach cases in which, for instance, standard PIL rules appear to clash with human rights and or collective values (eg, the preservation of the environment).

C5P152 Another line of research has focused on the determination and comparison of the impacts of legal decisions and decision policies on multiple interests and values, providing an analysis of proportionality inspired by logic and decision theory.[60] This approach can be usefully applied to address issues in PIL where different policies and ethical values are in conflict (eg, where the status of a person is addressed by foreign laws in which that appears to be incompatible with principles of the domestic jurisdictions).

C5P153 A third line of research builds upon the idea of factors. Factors are fact patterns that favour (pro-factors) or oppose (con-factors) certain legal conclusions (eg, the application of a certain foreign or national law). They are used for linking precedents to (or disconnecting them from) new cases, using a fortiori reasoning, analogies, and distinctions. The fundamental idea is presence of additional pro-factors or the absence of con-factors gives a stronger support to the application of the precedent. A development of the idea of a factor is the idea of a dimension, which is a scalable property, the presence of which to a higher degree more strongly supports a legal conclusion.[61]

C5P154 The use of models based on factors and dimensions, possibly in combination with value-based assessments, can be useful to approach controversial cases in PIL—eg, those cases in which a tension exists between the certainty and expediency provided by traditional PIL, and the need to protect values at stake, or between state interests and human right—by relying on precedents.

C5S14 VII. Conclusion

C5P155 This chapter offered an introduction to philosophical questions regarding the use of logic for modelling PIL. We discussed the benefits and limits of formal methods as applied to PIL, by sketching ideas on how to use classical logic, defeasible reasoning, and belief revision techniques. Some recent trends on modular argumentation and logics for reasoning about interpretive canons were illustrated.

C5P156 We have shown that several logical intuitions can capture in PIL the interactions among different legal systems and in particular,

[59] Among the first contributions, see: Donald H Berman and Carole D Hafner, 'Representing Teleological Structure in Case-Based Reasoning: The Missing Link' in *Proceedings of the Fourth International Conference on Artificial Intelligence and Law (ICAIL)* (ACM 1993); Bench-Capon and Sartor, 'A Model' (n 58).

[60] Giovanni Sartor, 'The Logic of Proportionality: Reasoning with Non-Numerical Magnitudes' (2013) 14 German Law Journal; Matthias Grabmair, 'Predicting Trade Secret Case Outcomes Using Argument Schemes and Learned Quantitative Value Effect Tradeoffs' in *Proceedings of ICAIL-2017* (ACM 2017); Marc Lauritsen, 'On Balance' (2015) 23 Artificial Intelligence and Law.

[61] Kevin D Ashley, *Modeling Legal Argument: Reasoning with Cases and Hypotheticals* (MIT Press 1990); Henry Prakken and Giovanni Sartor, 'Modelling Reasoning with Precedents in a Formal Dialogue Game' (1998) 6 Artificial Intelligence and Law; John Horty, 'Reasoning with Dimensions and Magnitudes' in *International Conference on Artificial Intelligence and Law, ICAIL2017* (ACM 2017); Trevor JM Bench-Capon and Katie Atkinson, 'The Roles of Dimensions and Values in Legal CBR' in Friedrich Lachmayer and others (eds), *Formalising Jurisprudence: Festschrift for Hajime Yoshino* (Weblaw 2018).

C5P157
- Conflict-detection and conflict-resolution among legal rules belonging to different legal systems;

C5P158
- Conflict-detection and conflict-resolution among interpretive canons used in different legal systems.

C5P159 Finally, a discussion is offered in the regard to further research trends, especially related to balancing of values and principles for selecting in the context of PIL the applicable law.