Interpretation Across Legal Systems

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Abstract. In this paper we extend a formal framework presented in [6] to model reasoning across legal systems. In particular, we propose a logical system that encompasses the various interpretative interactions occurring between legal systems in the context of private international law. This is done by introducing meta-rules to reason with interpretive canons.

Keywords. Legal Interpretation; Defeasible Reasoning; Private International Law

1. Introduction

Developing formal methods to study legal reasoning and interpretation is a traditional topic of AI and Law (cf., e.g., [4,6,8] and [5] for an overview). The topic has been addressed using argumentation tools, both formally and informally; though, these research efforts had concentrated on interpretive issues arising within one legal system, keeping a mainly inward outlook. An examination of the literature reveals that also interactions among distinct normative systems had interested some scholars in both legal theory and AI and Law with regard to the allocation of jurisdiction and choice-of-law characterising private international law cases. The issues of legal pluralism and the fundamental mechanisms of conflict of laws had consequently been studied through argumentation and logics [7,2,3], but 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 private international law in fact prevents.

Hence, no specific consideration had been given so far to the issue of application of canons and interpretation of the foreign provision when, e.g., the conflicting rule identifies it as the applicable law to the particular case in front of national judges. Filling this gap in the literature, the present paper builds on the research hypothesis, according to which those virtual conflicts between normative systems, avoided by private international law, 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, e.g., 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.

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This paper aims at developing a fresh logical framework, based on Defeasible Logic (DL), which properly addresses the research issue of reasoning about interpretive canons across different legal systems. The proposed framework extends the contribution of [6]. The layout of the paper is as follows: Section 2 describes the theoretical context of our framework, the specific problem we address, and offers an example; Section 3 presents a simplified version of one of the variants of DL of [6]; Section 4 proposes the new system extending the logic of Section 3 to handle the interpretation of legal provisions across legal systems.

2. Reasoning across Legal Systems: The Case of Private International Law

When applying and interpreting the foreign law in cross-border disputes, domestic courts are required to behave as if they were the foreign court and, at the same time, to protect the inner coherence of their own legal system: this raises interpretive doubts of many kinds. From an argumentation perspective, for instance, applying the same canon of interpretation to the same normative provision and obtaining opposite outcomes in different legal systems could correspond to incompatible arguments and, thus, requires for effective ways to cope with them in the national system. The purpose of this paper is to offer a formal method to model how domestic courts should reason about foreign law by handling conflicting interpretive arguments that are relevant to interpret the identified foreign law. Reasoning in the context of private international law and of interpretation of the foreign law means to consider also that:

- canons of interpretation refer to at least two legal systems, the domestic and the foreign one, but both systems may consist of normative sub-systems, and may be part of larger systems, e.g., EU system: assuming the existence of many legal systems $\mathrm{LS}_i, \ldots, \mathrm{LS}_z$, 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;
- in the foreign legal system, priority may be given to interpretive arguments that are hardly or not used in the domestic one (e.g., the argument from precedent, common in the USA, is not so familiar to civil law courts);
- interpretive conditions may change from one system to the other;
- an ordering among all interpretations has to be made: this will depend on the legal system taken as main reference and on the goals and values it refers to.

Summing up, private international law states the principle that courts in a given system have to apply (and somehow import) the law from other systems. This requires sometimes to also use foreign interpretive standards and canons (see, for the Italian case, Article 15 of legislative act 218/1995). We will illustrate our method by elaborating the following real example.

Example 1 *A woman, Cameroonian citizen, put forward an Italian court a paternity action with respect to her daughter, also Cameroonian citizen, underage at the time, on the basis of article 340 Cameroonian Civil Code and article 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 refusing to recognise the child. The judicial question is thus the recognition of the legitimate pa-*

*ternity 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. 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 leal system.*

3. Defeasible Logic for Reasoning about Canons

In [6] we proposed two variants of Defeasible Logic for reasoning about interpretive canons. Let us recall here the simplest one, in which we further simplify language and proof theory for space reasons. This framework handles the overall meaning of legal provisions intended as argumentative, abstract (i.e., non-analysed) logical units. The following basic components (among others) are introduced:

- a set of legal provisions $n_1, n_2, \ldots$ to be interpreted;
- as set of literals $a, b, \ldots$, corresponding to any sentences, which can be used to offer a sentential meaning to any provision n (a literal a is the meaning of provision n);
- a set of interpretative acts or interpretations $\mathsf{I}_1, \mathsf{I}_2, \ldots$ (literal interpretation, teleological interpretation, etc.) that return for any legal provision a sentential meaning for it;
- a set of rules encoding interpretive arguments (i.e., rules that state what interpretive act can be obtained under suitable conditions); these rules expresses modes of reasoning within any given legal system.

Definition 1 (Language) *Let* $\mathrm{PROP} = \{a, b, \ldots\}$ *be a set of propositional atoms,* $\mathrm{NORM} = \{n_1, n_2, \ldots\}$ *a set of legal provisions,* $\mathsf{INTR} = \{\mathscr{I}_1, \mathscr{I}_2, \ldots\}$ *a set of interpretation functions (for example, denoting literal interpretation, etc.),* $\mathrm{MOD} = \{\mathrm{OBL}, \mathsf{Adm}\}$ *a set of modal operators where* OBL *is the modality for denoting obligatory interpretations and interpretation outcomes and* Adm *for denoting the admissible ones.*

1. *The set* $\mathrm{L} = \mathrm{PROP} \cup \{\neg p \mid p \in \mathrm{PROP}\}$ *denotes the set of* literals.
2. *The* complementary of a literal *q is denoted by* $\sim q$*; if q is a positive literal p, then* $\sim q$ *is* $\neg p$*, and if q is a negative literal* $\neg p$*, then* $\sim q$ *is p.*
3. *The set* $\mathrm{ModLit} = \{\Box a, \neg\Box a | a \in \mathrm{L}, \Box \in \mathrm{MOD}\}$ *denotes the set of modal literals.*
4. *The set* $\mathrm{INT} = \{\mathsf{I}_i(n,a), \neg\mathsf{I}_i(n,a) | \exists \mathscr{I}_i : \mathrm{NORM} \mapsto \mathrm{L} \in \mathsf{INTR} : \mathscr{I}_i(n) = a\}$ *denotes the set of* interpretive acts *and their negations: an expression* $\mathsf{I}_i(n,a)$*, for instance, means that the interpretation* I_i *of provision n returns that the literal a is the case.*
5. *The* complementary $\sim\phi$ of an interpretation ϕ *is defined as follows:* [2]

ϕ	$\sim\phi$
$\mathsf{I}_i(n,a)$	$\sim\mathsf{I}_i(n,a) \in \{\neg\mathsf{I}_i(n,a), \mathsf{I}_i(n,b), \mathsf{I}_j(n,c) \mid a \neq b, a \neq c\}$
$\neg\mathsf{I}_i(n,a)$	$\sim\neg\mathsf{I}_i(n,a) = \mathsf{I}_i(n,a)$.

[2] This does not cover cases where, e.g., a is semantically included in b, which was considered in [6].

We will also use the notation $\pm \mathsf{I}_i(n,a)$ *to mean respectively* $\mathsf{I}_i(n,a)$ *and* $\sim \mathsf{I}_i(n,a)$. *Hence,* $\sim \pm \mathsf{I}_i(n,a)$ *means* $\mp \mathsf{I}_i(n,a)$.

6. *The set of* qualified interpretations *is* ModIntr $= \{\Box\phi, \neg\Box\phi \mid \phi \in \text{INT}, \ \Box \in \text{MOD}\}$.
7. *The* complementary of a modal literal or qualified interpretation l *is defined as follows* ($\phi \in \text{L} \cup \text{INT}$)*:*

l	$\sim l$
$\text{OBL}\phi$	$\sim\text{OBL}\phi \in \{\neg\text{OBL}\phi, \text{OBL}\sim\phi, \mathsf{Adm}\sim\phi, \neg\mathsf{Adm}\phi\}$
$\neg\text{OBL}\phi$	$\sim\neg\text{OBL}\phi = \text{OBL}\phi$
$\mathsf{Adm}\phi$	$\sim\mathsf{Adm}\phi \in \{\neg\mathsf{Adm}\phi, \text{OBL}\sim\phi\}$
$\neg\mathsf{Adm}\phi$	$\sim\neg\mathsf{Adm}\phi = \mathsf{Adm}\phi$

We use *defeasible rules* and *defeaters*[3] [1] to reason about the interpretations of provisions; these rules contain literals, interpretations and qualified interpretations in their antecedent, and interpretations in their consequents.

Definition 2 (Interpretation Rules) *Let* Lab *be a set of arbitrary labels. The set* Rule^I *of* interpretation rules *contains rules is of the type*

$$r : A(r) \hookrightarrow^X C(r)$$

where (a) $r \in$ Lab *is the name of the rule; (b)* $A(r) = \{\phi_1, \ldots, \phi_n\}$, *the* antecedent *(or* body*) of the rule is such that each* ϕ_i *is either a literal* $l \in$ L, *a modal literal* $Y \in$ ModLit, *or a qualified interpretation* $X \in$ ModIntr*; (c)* $\hookrightarrow \in \{\Rightarrow^I, \rightsquigarrow^I\}$ *denotes the type of the rule (if* $\hookrightarrow$ *is* $\Rightarrow^I$, *the rule is a* defeasible rule*, while if* $\hookrightarrow$ *is* $\rightsquigarrow^I$, *the rule is a* defeater*); (d)* $C(r) = \psi$ *is the* consequent *(or* head*) of the rule, where* $\psi \in$ INT *is an interpretation.*

Example 2 *Consider the following provision from the Italian penal code:*

> *Art. 575. Homicide. Whoever causes the death of a* man *[*uomo*] is punishable by no less than 21 years in prison.*

Consider now that paragraph 1 of art. 3 of the Italian constitution reads as follows:

> *Art. 3. All citizens have equal social status and are equal before the law, without regard to their sex, race, language, religion, political opinions, and personal or social conditions.*

The interpretation I_s *(interpretation from substantive reasons*[4]*) of art. 3 leads to c, which corresponds to the following sentence:*

> *All* persons *have equal social status and are equal before the law, without regard to their sex, race, language, religion, political opinions, and personal or social conditions.*

The following interpretation defeasible rule could be:

$$r_1 : \mathit{kill\_adult}, \mathit{kill\_female}, \text{OBL}\,\mathsf{I}_s(\mathit{art.3}, c) \Rightarrow^I \mathsf{I}_c(\mathit{art.575}, b)$$

where $b =$ *"Whoever causes the death of a* person *is punishable by no less than 21 years in prison". In other words, if art. 3 of the Italian constitution states formal equality before*

[3] A defeater is a rule which prevents opposite conclusions without allowing to positively deriving anything.

[4] An argument from substantive reasons states that, if there is some goal that can be considered to be fundamentally important to the legal system, and if the goal can be promoted by one rather than another interpretation of the statutory provision, then the provision should be interpreted in accord with the goal.

the law without regard also to gender identity, then b is the best interpretation outcome of art. 575 of the penal code, with I_c *denoting, for example, interpretation by coherence.*

Given a set of rules R, $R^I_{\rightsquigarrow}$ and $R^I_{\Rightarrow}$ denote, respectively, the sets of all defeaters and defeasible rules in the set R; $R^I[\phi]$ is the set of rules with the interpretation ϕ in the head.

Definition 3 (Interpretation theory) *An* Interpretation Theory *D is a structure $(F,R,>)$, where F, the set of facts, is a set of literals, modal literals, and qualified interpretations, R is a set of interpretation rules and $>$, the superiority relation, is a binary relation over R.*

An interpretation theory corresponds to a knowledge base providing us with interpretive arguments about legal provisions. The superiority relation is used for conflicting rules, i.e., rules whose conclusions are complementary.

Example 3 *The following theory reconstructs a very simple interpretive toy scenario in the Italian legal system. Assume that $a =$ "Whoever causes the death of a adult male person is punishable by no less than 21 years in prison" and that I_l stands for literal interpretation or from ordinary meaning.*

$$F = \{kill\_adult, kill\_female, \mathrm{OBL}\,\mathsf{I}_s(art.3,c)\}$$

$$R = \{r_1 : kill\_adult, kill\_female, \mathrm{OBL}\,\mathsf{I}_s(art.3,c) \Rightarrow^I \mathsf{I}_c(art.575,b),$$

$$r_2 :\Rightarrow^I \mathsf{I}_l(art.575,a)\}$$

$$> = \{r_1 > r_2\}$$

Rule r_1 has been already introduced above. Rule r_2 establishes by default that art. 575 be literally interpreted as a. However, when r_1 is applicable, it prevails over r_2.

Let us now present the proof theory.

Definition 4 (Proofs) *A* proof *P in an interpretation theory D is a linear sequence $P(1)\ldots P(n)$ of* tagged expressions *in the form of $+\partial^I_\Box \phi$ and $-\partial^I_\Box \phi$ (with $\phi \in$ INT and $\Box \in$ MOD), $+\partial^\Box l$ and $-\partial^\Box l$ (with $l \in$ L and $\Box \in$ MOD), where $P(1)\ldots P(n)$ satisfy the proof conditions below*[5].

The tagged interpretation $+\partial^I_\Box \phi$ means that the interpretation ϕ is *defeasibly provable* in D with modality $\Box$, while $-\partial^I_\Box \phi$ means that ϕ is *defeasibly refuted* with modality $\Box$. The tagged literal $+\partial^\Box l$ means that l is *defeasibly provable* in D with modality $\Box$, while $-\partial^\Box l$ means that l is *defeasibly refuted* with modality $\Box$. The initial part of length n of a proof P is denoted by $P(1..n)$.

Notice that an interpretation can be *admissible* or *obligatory*. For instance, I of n is admissible, if it is provable using a defeasible interpretation rule; it is obligatory, if this interpretation of n is the only one admissible [6]. Let us work on the conditions for deriving qualified interpretations.

Definition 5 *A rule $r \in R^I$ is* applicable *in the proof P at $P(n+1)$ iff for all $a_i \in A(r)$:*

[5] For space reasons, we present only the positive conditions ($+\partial^I_\Box \phi$ and $+\partial^\Box l$); see [6].

1. *if* $a_i = \Box\psi$, $\psi \in$ INT, *then* $+\partial^I_\Box \psi \in P(1..n)$ *with* $\Box \in$ MOD*;*
2. *if* $a_i = \neg\Box\psi$ *then* $-\partial^I_\Box \psi \in P(1..n)$ *with* $\Box \in$ MOD*;*
3. *if* $a_i = \Box l$, $l \in$ L, *then* $+\partial^\Box l \in P(1..n)$*;*
4. *if* $a_i = \neg\Box l$, $l \in$ L, *then* $-\partial^\Box l \in P(1..n)$*;*
5. *if* $a_i = l \in$ L *then* $l \in F$ *or* $\exists \mathsf{I}_i \exists n : +\partial^I_\Box \mathsf{I}_i(n,l) \in P(1..n)$.

A rule $r \in R^I$ *is* discarded *iff* $\exists a_i \in A(r)$ *such that*

1. *if* $a_i = \Box\psi$, , $\psi \in$ INT, *then* $-\partial^I_\Box \psi \in P(1..n)$ *with* $\Box \in$ MOD*;*
2. *if* $a_i = \neg\Box\psi$, $\psi \in$ INT, *then* $+\partial^I_\Box \psi \in P(1..n)$ *with* $\Box \in$ MOD*;*
3. *if* $a_i = \Box l$, $l \in$ L, *then* $-\partial^\Box l \in P(1..n)$*;*
4. *if* $a_i = \neg\Box l$, $l \in$ L, *then* $+\partial^\Box l \in P(1..n)$*;*
5. *if* $a_i = l \in$ L *then* $l \notin F$ *and* $\forall \mathsf{I}_i \forall n : -\partial^I_\Box \mathsf{I}_i(n,l) \in P(1..n)$.

Let us define the proof conditions for $+\partial_{\mathsf{Adm}}$.
$+\partial^I_{\mathsf{Adm}}$: If $P(n+1) = +\partial^I_{\mathsf{Adm}}\phi$ then
(1) $\mathsf{Adm}\phi \in F$ or OBL$\phi \in F$, or
  (2.1) $\sim\mathsf{Adm}\phi \notin F$, and
  (2.2) $\exists r \in R^I_{\Rightarrow}[\phi]$: r is applicable, and
  (2.3) $\forall s \in R[\sim\phi]$, either
    (2.3.1) s is discarded, or
    (2.3.2) $\exists t \in R[\phi,k]$:
      t is applicable and $t > s$.

$+\partial^{\mathsf{Adm}}$: If $P(n+1) = +\partial^{\mathsf{Adm}} l$ then
(1) $\mathsf{Adm} l \in F$ or OBL$l \in F$, or
(2) $\exists \mathsf{I}_i \in$ INT, $\exists n \in$ NORM :
  $+\partial^I_{\mathsf{Adm}} \mathsf{I}_i(n,l) \in P(1..n)$.

To show that an interpretation ϕ is defeasibly provable as an admissible interpretation, there are two ways: (1) $\mathsf{Adm}\phi$ or OBLϕ are a fact, or (2) $\mathsf{Adm}\phi$ must be derived by the rules of the theory. In the second case, three conditions must hold: (2.1) any complementary of $\mathsf{Adm}\phi$ does belong to the facts; (2.2) there must be a rule introducing the admissibility for ϕ which can apply; (2.3) every rule s for $\sim\phi$ is either discarded or defeated by a stronger rule for ϕ. The result l of an interpretation is admissible if this is a fact, or if there is an applicable rule proving an interpretation supporting l.

Proof conditions for $\pm\partial_{\mathrm{OBL}}$ are much easier but we need to work on the fact that ϕ is an interpretation of any given provision n and we have to make explicit its structure. Indeed, that an interpretation I_i for the provision n is obligatory means that I_i is admissible and that no other (non-conflicting) interpretations for n is admissible.
$+\partial^I_{\mathrm{OBL}}$: If $P(n+1) = +\partial^I_{\mathrm{OBL}} \pm \mathsf{I}_i(n,a)$ then
(1) OBL$\pm \mathsf{I}_i(n,a) \in F$ or
  (2.1) $\sim$OBL$\pm \mathsf{I}_i(n,a) \notin F$, and
  (2.2) $+\partial^I_{\mathsf{Adm}} \pm \mathsf{I}_i(n,a) \in P(1..n)$, and
  (2.3) $\forall s \in R[\pm \mathsf{I}_m(n,b)]$:
    $\mathsf{I}_m(n,b) \neq \sim\mathsf{I}_i(n,a)$, either
    (2.3.1) s is discarded, or
    (2.3.2) $\exists t \in R_{\rightsquigarrow}[\sim \pm \mathsf{I}_m(n,b),k]$:
      t is applicable and $t > s$.

$+\partial^{\mathrm{OBL}}$: If $P(n+1) = +\partial^{\mathrm{OBL}} l$ then
(1) OBL$l \in F$, or
(2) $\exists n \in$ NORM:
  (2.1) $\exists \mathsf{I}_i \in$ INT : $+\partial^I_{\mathsf{Adm}} \mathsf{I}_i(n,a) \in P(1..n)$
    and
  (2.2) $\forall \mathsf{I}_j \in$ INT, $-\partial^I_{\mathsf{Adm}} \mathsf{I}_i(n,x) \in P(1..n)$
    if $x \neq a$.

Example 4 *Consider the theory in Example 3. Facts make rule* r_1 *applicable. Rule* r_2 *has an empty antecedent, so it is applicable, too. The theory assumes that* r_1 *is stronger than* r_2*, thus we would obtain* $+\partial^I_{\mathsf{Adm}} \mathsf{I}_c(art.575,b)$ *(and so* $-\partial^I_{\mathsf{Adm}} \mathsf{I}_l(art.575,a)$*).Trivially, we also get* $+\partial^I_{\mathrm{OBL}} \mathsf{I}_c(art.3,c)$*, and* $+\partial^I_{\mathrm{OBL}} \mathsf{I}_c(art.575,b)$ *is also the case because it is the*

only admissible interpretation of art. 575. We also have $+\partial^{\Box}c$ *and* $+\partial^{\Box}b$*, where* $\Box \in \{\mathsf{Adm}, \mathrm{OBL}\}$.

4. Defeasible Logic for Reasoning about Canons across Legal Systems

Let us now develop a fresh logical framework which properly addresses the research issues outlined in Section 2 and which extends the machinery of Section 3. In this perspective, reasoning about interpretive canons across legal systems requires

- to specify to which legal systems legal provisions belong and in which legal system canons are applied;
- the introduction of meta-rules to reason about interpretation rules;
- that such meta-rules support the derivation of interpretation rules; in other words, the head of meta-rules are interpretation rules, while the the antecedents may include any conditions.

Consider, for instance, the following abstract rule:

$$r : (\mathrm{OBL}\mathsf{I}_t^{\mathrm{LS}_i}(n_1^{\mathrm{LS}_i}, p), a \Rightarrow_C (s : \mathrm{OBL}\mathsf{I}_s^{\mathrm{LS}_j}(n_2^{\mathrm{LS}_i}, d) \Rightarrow^I \mathsf{I}_c^{\mathrm{LS}_j}(n_1^{\mathrm{LS}_i}, p)))$$

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.

Definition 1 requires a few adjustments: Definition 6 only specifies the aspects that are changed in the language.

Definition 6 (Language 2) *Let* $\mathrm{LS} = \{\mathrm{LS}_1, \ldots, \mathrm{LS}_m\}$ *be the set of legal systems and* $\bigcup_{1 \le i \le m} \mathrm{NORM}_{\mathrm{LS}_i} = \{n_1^{\mathrm{LS}_i}, n_2^{\mathrm{LS}_i} \ldots\}$ *the set of legal provisions for each legal system.*

1. *The set* $\mathrm{INT} = \{\mathsf{I}_i^{\mathrm{LS}_k}(n^{\mathrm{LS}_j}, a), \neg\mathsf{I}_i^{\mathrm{LS}_k}(n^{\mathrm{LS}_j}, a) | \exists \mathscr{I}_i : \mathrm{NORM}_{\mathrm{LS}_j} \mapsto \mathrm{L} \in \mathsf{INTR} : \mathscr{I}_i(n^{\mathrm{LS}_j}) = a\}$ *denotes the set of* interpretive acts *and their negations.*
2. *The* complementary of an interpretation ϕ *is denoted by* $\sim\phi$ *and is defined as follows (where, possibly,* $j = k$*):*

ϕ	$\sim\phi$
$\mathsf{I}_i^{\mathrm{LS}_j}(n^{\mathrm{LS}_k}, a)$	$\sim\mathsf{I}_i^{\mathrm{LS}_j}(n^{\mathrm{LS}_k}, a) \in \{\neg\mathsf{I}_i^{\mathrm{LS}_j}(n^{\mathrm{LS}_k}, a), \mathsf{I}_i^{\mathrm{LS}_j}(n^{\mathrm{LS}_k}, b), \mathsf{I}_s^{\mathrm{LS}_j}(n^{\mathrm{LS}_k}, c)$
	$\mathsf{I}_i^{\mathrm{LS}_m}(n^{\mathrm{LS}_k}, b), \mathsf{I}_s^{\mathrm{LS}_m}(n^{\mathrm{LS}_k}, c) | a \neq b, a \neq c\}$
$\neg\mathsf{I}_i^{\mathrm{LS}_j}(n^{\mathrm{LS}_k}, a)$	$\sim\neg\mathsf{I}_i^{\mathrm{LS}_j}(n^{\mathrm{LS}_k}, a) = \mathsf{I}_i^{\mathrm{LS}_j}(n^{\mathrm{LS}_k}, a)$.

Definition 7 (Rules) *Let* Rule_{atom}^I *be the set of rules of Definition 2*[6]*. The set* Rule^I *of rules is defined as*

$$\mathrm{Rule}^I = \mathrm{Rule}_{atom}^I \cup \{\neg(r : \phi_1, \ldots, \phi_n \hookrightarrow \psi) | (r : \phi_1, \ldots, \phi_n \hookrightarrow \psi) \in \mathrm{Rule}_{atom}^I, \hookrightarrow \in \{\Rightarrow^I, \rightsquigarrow^I\}\}$$

[6] Atomic rules do not substantially change, except for the notation for interpretations in Definition 6.

By convention, if r is a rule, $\sim r$ denotes the complementary rule (if $r : \phi_1, \ldots, \phi_n \hookrightarrow \psi$ then $\sim r$ is $\neg(r : \phi_1, \ldots, \phi_n \hookrightarrow \psi)$; and if $r : \neg(r : \phi_1, \ldots, \phi_n \hookrightarrow \psi)$ then $\sim r$ is $r : \phi_1, \ldots, \phi_n \hookrightarrow \psi$).

Definition 8 (Meta-rules) *Let* Lab *be a set of labels.* $\text{Rule}^C = \text{Rule}^C_d \cup \text{Rule}^C_{\rightsquigarrow}$ *is the set of meta-rules such that*
$\text{Rule}^C_d = \{r : \phi_1, \ldots, \phi_n \Rightarrow_C \psi | r \in \text{Lab}, A(r) \subseteq \text{L} \cup \text{ModLit} \cup \text{ModIntr}, \psi \in \text{Rule}^I\}$
$\text{Rule}^C_{\rightsquigarrow} = \{r : \phi_1, \ldots, \phi_n \rightsquigarrow_C \psi | r \in \text{Lab}, A(r) \subseteq \text{L} \cup \text{ModLit} \cup \text{ModIntr}, \psi \in \text{Rule}^I\}$

Definition 9 (Interpretation theory 2) *An* Interpretation Theory *D is a structure $(F, R^I, R^C, >)$, where F, the set of facts, is a set of literals, modal literals, and qualified interpretations, R^I is a set of interpretation rules, R^C is a set of meta-rules, and $>$, the superiority relation, is a binary relation over R such that $> \subseteq (R^X \times R^Y) \cup (R^C \times R^C)$, where $R^X = \{C(r) | r \in R^C[s], s \in \text{Rule}_{atom}\}$.*

In the rest of the paper, to make our presentation more readable, we will omit defeasible arrows for defeasible nested-rules $r^{\Rightarrow_C}$ with the empty body. That is, a defeasible nested rule $\Rightarrow_C (p \Rightarrow^I q)$ will be just represented as $p \Rightarrow^I q$.

Before providing proof procedures to derive rules, let us

- introduce specific proof tags for this purpose. Remember that $\hookrightarrow$ denotes either $\Rightarrow$ or $\rightsquigarrow$ to simplify our presentation. $\pm\partial_C r^{\hookrightarrow}$ means that rule $r \in R^I$ is (is not) defeasibly provable using meta-rules;
- highlight that applicability conditions for meta-rules are exactly as in Definition 5, because the body of meta-rules do not differ from those of interpretation rules.

Defeasible derivations of non-nested rules are based on the following procedures. The general rationale behind the following proof conditions recalls what we discussed in regard to the provability of literals. The proof of a rule runs as usual in three phases. We have to find an argument in favour of the rule we want to prove. Second, all counter-arguments are examined (rules for the opposite conclusion). Third, all the counter-arguments have to be rebutted (the counter-argument is weaker than the pro-argument) or undercut (some of the premises of the counter-argument are not provable). In the case of the derivation of rules using meta-rules, what we have to do is to see when two rules are in conflict: thus, conflict-detection is based on the notion of incompatibility.

Definition 10 *Two non-nested rules r and r' are incompatible iff r' is an incompatible atomic rule of r or r' is an incompatible negative rule of r.*

1. *r' is an incompatible atomic rule of r iff r and r' are atomic rules and $A(r) = A(r')$, $C(r) = \sim C(r')$;*
2. *r' is an incompatible negative rule of r iff either r or r' is not an atomic rule and $A(r) = A(r')$, $C(r) = C(r')$.*

The set of all possible incompatible rules for $r^{\hookrightarrow}$ is denoted by $IC(r^{\hookrightarrow}) = \{r' | r'$ is incompatible with $r^{\hookrightarrow}\}$.

Example 5 *Case 1: $r : a \Rightarrow^I b$ and $a \Rightarrow^I \neg b$ are incompatible. Case 2: $r : a \Rightarrow^I b$ and $\neg(r' : a \Rightarrow^I b)$ are incompatible.*

Let us state the proof procedures for the defeasible derivation of atomic rules in an interpretation theory $D = (F, R^I, R^C, >)$.

$+\partial_C^{\hookrightarrow}$: If $P(n+1) = +\partial_C r^{\hookrightarrow}$, then
(1) $r^{\hookrightarrow} \in R^I$, or
(2) (2.1) $\forall r'' \in IC(r^{\hookrightarrow})$, $\forall r' \in R_s^C[r'']$, r' is discarded and
(2.2) $\exists t \in R_{\Rightarrow}^C[r^{\hookrightarrow}]$: t is applicable, and
(2.3) $\forall r'' \in IC(r^{\hookrightarrow}), \forall s \in R^C[r'']$, either
(2.3.1) s is discarded, or
(2.3.2) $\exists z \in R_{\Rightarrow}^C[r''']$: $r''' \in IC(C(s))$, z is applicable and $z > s$.

The provability condition of $-\partial_C^{\hookrightarrow X}$ is omitted for space reasons. Suppose we want to derive $r : \mathrm{OBL}\mathsf{I}_i^{LS_1}(n_1^{\mathrm{LS}_1}, a) \Rightarrow^I \mathsf{I}_j^{LS_2}(n_2^{\mathrm{LS}_2}, b)$. We have the following options. Condition (1): r is in R^I; or, Condition (2): We use a defeasible meta-rule to derive r. This must exclude, as a precondition, that any rule, which is incompatible with r, is supported: (condition 2.1). That is, rules such as

$$r' : \neg(\mathrm{OBL}\mathsf{I}_i^{LS_1}(n_1^{\mathrm{LS}_1}, a) \Rightarrow^I \mathsf{I}_j^{LS_2}(n_2^{\mathrm{LS}_2}, b)) \qquad r'' : \mathrm{OBL}\mathsf{I}_i^{LS_1}(n_1^{\mathrm{LS}_1}, a) \Rightarrow^I \mathsf{I}_j^{LS_2}(n_2^{\mathrm{LS}_2}, d)$$
$$r''' : \mathrm{OBL}\mathsf{I}_i^{LS_1}(n_1^{\mathrm{LS}_1}, a) \Rightarrow^I \mathsf{I}_k^{LS_2}(n_2^{\mathrm{LS}_2}, d)$$

should not be supported.

With this done, condition (2.2) states that there should exist a meta-rule such as

$$t : d \Rightarrow_C (r : \mathrm{OBL}\mathsf{I}_i^{LS_1}(n_1^{\mathrm{LS}_1}, a) \Rightarrow^I \mathsf{I}_j^{LS_2}(n_2^{\mathrm{LS}_2}, b))$$

such that t is applicable. But this fact must exclude that any meta-rule s supporting, e.g., r', r'', r''' above is applicable. Alternatively, if s is applicable, we have to verify that there exists a meta-rule z that proves r, such as

$$z : e \Rightarrow_C (r : \mathrm{OBL}\mathsf{I}_i^{LS_1}(n_1^{\mathrm{LS}_1}, a) \Rightarrow^I \mathsf{I}_j^{LS_2}(n_2^{\mathrm{LS}_2}, b))$$

such that z is applicable and is stronger that s (see condition 2.3.2).

Given the above proof conditions for deriving non-nested rules, we must also slightly adjust proof conditions for deriving interpretations of Section 3. The only, but substantial, difference is that here, each time a rule r is used and applied, we are required to check that r is provable. Analogously, to discard incompatible rules (when we consider all possible attacks to the rule we want to use), an additional option is that these incompatible rules are not provable in the theory.

$+\partial_{\mathsf{Adm}}^I$: If $P(n+1) = +\partial_{\mathsf{Adm}}^I \phi$ then
(1) $\mathsf{Adm}\phi \in F$ or $\mathrm{OBL}\phi \in F$, or
(2.1) $\sim\mathsf{Adm}\phi \notin F$, and
(2.2) $\exists r \in R_{\Rightarrow}^I[\phi]$: $+\partial_C r$, r is applicable, and
(2.3) $\forall s \in R[\sim\phi]$, either
(2.3.1) $-\partial_C s$, or
(2.3.2) s is discarded, or
(2.3.3) $\exists t \in R[\phi, k]$: t is applicable and $t > s$.

Example 6 *Let us freely elaborate the case described in Example 1. 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*[7]*. 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.*

$$F = \{\mathrm{OBL}\,|_l^{\mathrm{LS}_{it}}(art.30^{\mathrm{LS}_{it}}, a)\}$$

$$R^I = \{r_3 :\Rightarrow^I |_l^{\mathrm{LS}_{cam}}(art.340^{\mathrm{LS}_{cam}}, p),\ r_4 : children\_under14 \Rightarrow^I |_t^{\mathrm{LS}_{cam}}(art.340^{\mathrm{LS}_{cam}}, q)$$

$$r_5 : \mathrm{OBL}\,|_l^{\mathrm{LS}_{it}}(art.30^{\mathrm{LS}_{it}}, a) \Rightarrow^I |_c^{\mathrm{LS}_{it}}(art.147^{\mathrm{LS}_{it}}, q)\}$$

$$R^C = \{r_6 : \mathrm{OBL}\,|_l^{\mathrm{LS}_{it}}(art.30^{\mathrm{LS}_{it}}, a) \Rightarrow^C (r_7 : children\_under14 \Rightarrow^I |_c^{\mathrm{LS}_{it}}(art.340^{\mathrm{LS}_{cam}}, q)\}$$

$$>= \{r_3 > r_4,\ r_7 > r_3\}.$$

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

5. Summary

This paper extended [6]'s contribution to explore the feasibility of formal methods for arguing with canons of interpretation coming from different legal systems, once they have accessed domestic legal systems in private international law disputes. In so doing, we aimed at defining a logic-based conceptual framework that could encompass the occurring interpretive interactions, without neglecting the existing, broader normative background each legal system is nowadays part of.

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[7] "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. [...]".