More on Presumptions and Burdens of Proof

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Abstract. This paper extends our previous logical analysis of presumptions and burden of proof by studying the force of a presumption once counterevidence has been offered. In the jurisprudential literature different accounts of this issue have been given: some have argued that a presumption is nullified by counterarguments while others have maintained that this gives presumptions a force that is too slight. We argue that these differences largely are not a matter of logic but of legal policy, and we show how the various accounts can be logically formalised.

Keywords. Evidence, burden of proof, presumptions, argumentation.

1. Introduction

In [5] we studied the logical modelling of presumptions and their effect on the burden of proof. Meanwhile we have come to realise that more can be said on this topic. In our earlier work we proposed to regard presumptions as default rules and we studied their effect on three kinds of burden of proof, namely, the burden of production, the burden of persuasion and the tactical burden of proof. Briefly, we argued that presumptions are a way to fulfill a burden of production and persuasion and, once invoked, they shift the tactical burden to the other party. It may be that they also create a burden of persuasion on the other party, but that is a separate issue, which is not a matter of logic but of law. We also provided a means to express the grounds for presumptions, which in turn allows for debates on whether a presumption holds.

We now want to address the following issues. In jurisprudence and legal theory various accounts have been given of the force of a presumption once counterevidence has been offered (cf. [8]). The main issue is whether the presumption must then be completely disregarded or whether it still has some effect. In particular:

- Some argue that a presumption must be weighed against counterevidence while others argue that this is impossible.
- The existence of a presumption is sometimes but not always taken to imply a shift of the burden of persuasion onto the party who wants to refute it.
- The existence of a presumption is sometimes taken to be relevant for the proof standard regarding the presumed fact once counterevidence has been produced.

In this paper we show how the various approaches to these issues can be formalised with the means we proposed in [5]. The general thrust of our analysis will be that which approach to these issues is better is not a matter of logic but of legal policy, so that we must be able to formalise all approaches that satisfy the minimum standards of rationality.

Below we first summarise our logical framework (Section 2) and how we applied it in [5, 6, 7] to model presumptions and burdens of proof (Section 3). We then discuss the various jurisprudential accounts of presumptions in more detail in Section 4, followed by two alternative logical formalisations of these accounts within our logical framework (Section 5); these two sections are the original contribution of this paper.

2. Logical preliminaries

In this section we briefly review the logical tools that we will use in our analysis.

2.1. The basic inference system (IS)

We first repeat our summary in [5] of the logic of [4] (called IS, for Inference System). IS is a logic for defeasible argumentation that can deal with conflicting rules, rules with assumptions, inapplicability statements and priority rules. Information is expressed as a set of rules in the language of extended logic programming, which has both negation as failure ($\sim$) and classical, or strong negation ($\neg$). Each rule is preceded by a term, its name. Rules are *strict*, represented with $\rightarrow$, or else *defeasible*, represented with $\Rightarrow$. Facts are represented as strict rules with empty antecedents. The input information of the system is a set of strict and defeasible rules, which is called an *ordered theory*. Arguments can be formed by chaining rules, ignoring weakly negated antecedents. Conflicts between arguments are decided according to a binary relation of *defeat* among arguments, which is partly induced by rule priorities, which can be reasoned about as any other legal issue.

There are three ways in which an argument Arg_2 can defeat an argument Arg_1. The first is *assumption* defeat (in [4] called "undercutting" defeat), which occurs if a rule in Arg_1 contains $\sim L$ in its body, while Arg_2 has a conclusion L (note that $\sim L$ reads as 'L cannot be derived'). The other two forms of defeat are only possible if Arg_1 does not assumption-defeat Arg_2. One way is by *excluding* an argument, which happens when Arg_2 concludes for some rule r in Arg_1 that r is not applicable (formalised as $\neg r$). The other is by *rebutting* an argument, which happens when Arg_1 and Arg_2 contain rules that have contradictory heads and Arg_2's rule is not worse than the conflicting rule in Arg_1. Note that all these attacks can be targeted at the final rule or conclusion of an argument but also at each intermediate rule or conclusion.

Arguments are assigned a dialectical status in terms of three classes: the 'winning' or *justified* arguments, the 'losing' or *overruled* arguments, and the 'ties', i.e., the *defensible* arguments. Accordingly, a proposition is *justified* if there exists a justified argument for it, and it is *defensible* if it is not justified but there exists a defensible argument for it.

Whether an argument is justified can be tested in a so-called argument game between a proponent and an opponent for the argument. Proponent starts with an argument that he wants to prove justified and then each player must either defeat the other player's previous argument or move a priority argument that stops the previous argument from defeating its target. Moreover, proponent may not repeat his arguments and his arguments

must *strictly* defeat opponent's arguments, i.e., they may not in turn be defeated by their targets. A player wins if the other player has run out of moves. The initial argument is *justified* if the proponent has a winning strategy in this game. Non-justified arguments are *overruled* if they are defeated by a justified argument, otherwise they are *defensible*. This argument game is sound and complete with respect to grounded semantics.

2.2. The Litigation Inference System (LIS) and its augmented variant (ALIS)

In [2] the IS argument game was extended with the possibility of switching dialectical roles, to allow for the modelling of distributions of the burden of persuasion over the two sides in a dispute, resulting in LIS (Litigation Inference System). The LIS argument game is between two players, called plaintiff (π) and defendant (δ) which at any time can have either proponent role (P) or opponent role (O), depending on the context. The input of LIS is a *LIS theory* $T_{LIS} = (R, \leq, b_\pi, b_\delta)$ where:

- $(R, \leq)$ is an IS theory.
- b_π and b_δ are mutually consistent and disjoint subsets of strong literals (i.e. literals without $\sim$) occurring in the rules in R.

The sets b_π and b_δ contain the burdens of persuasion for plaintiff and defendant respectively, that is, the propositions for which they have to act in proponent role.

In the LIS argument game plaintiff starts as proponent and defendant starts as opponent, but then these roles are reversed each time the player currently having the opponent role moves an argument for a conclusion for which the sets b_π and b_δ allocate the burden of persuasion to him. The player then becomes the proponent with regard to that conclusion and thus he has to strictly defeat the other player's arguments. Thus while in IS plaintiff is always proponent and defendant is always opponent, in LIS the parties of the litigation can change their dialectical role. LIS thus enables us to represent distributions of the burden of persuasion over the parties.

Finally, in [6] we modified LIS into ALIS, with the possibility to argue about allocations of the burden of persuasion. To this end, the language of ALIS includes a two-place predicate `burden` and a naming convention for strong literals of the language. Formulas of the form `burden`(p, l) say that player p has the burden of persuasion for the literal denoted by the term l. Justified conclusions of this form then determine the dialectical role of the players in the logical argument game. For more details see [6].

2.3. Embedding the logic in a dynamic setting

In our account of burdens of proof we assume that a dispute is regulated by some legal procedure in which two parties debate an issue in front of an adjudicator. However, we abstract from its details and simply assume that a dispute consists of a sequence of stages which are characterised by different (A)LIS theories and where the parties can move from one stage to another by adding or withdrawing claims or arguments. The outcome of a dispute is determined by applying the (A)LIS argument game to the final stage. We also apply it to intermediate stages, to verify what would be the outcome of the dispute if an intermediate stage were the final stage. Note that the final stage may also contain evaluative arguments stated by the adjudicator. For instance, he could decide evidential arguments to be *internally invalid* by moving an exclusion attack, thus expressing that

the evidence is even in the absence of counterarguments too weak to support its conclusion. Or he could decide on the *dialectical validity* of an evidential argument by moving priority arguments, thus deciding whether the evidence outweighs its counterevidence according to the applicable standard of proof.

3. Summary of our logical account of burdens of proof

In this section we summarise our logical account in [6, 7] of burdens of proof. Common law systems distinguish various kinds of burdens of proofs (similar distinctions are more or less explicit in civil law systems). The *burden of persuasion* specifies which party has to prove a statement to a specified degree (the standard of proof) on the penalty of losing on the issue. Whether this burden has been met is determined on the basis of all evidence provided in the proceedings and all arguments referring to this evidence. The *burden of production* specifies which party has to offer evidence on an issue at different points in a proceeding. If the burden of production is not met, the issue will be decided as a matter of law against the burdened party, while if it is met, the issue will be decided on the basis of all available evidence according to the burden of persuasion. Both these burdens are a matter of law. By contrast, the *tactical burden of proof* is a matter of tactical evaluation in that a party must assess the risk of ultimately losing on an issue if no further evidence concerning that issue is produced. The tactical burden on an issue can shift between the parties any number of times during the proceedings, depending on who would likely win on that issue if no further evidence were provided.

In [6, 7] we formalised these notions as follows. The *burden of persuasion* for a claim can be defined as having the task to make sure that at the end of the proceeding, when all evidence and arguments have been produced, there exists a justified argument for the claim, while having proponent role for the claim in the (A)LIS argument game. This implies that if in the final stage there are arguments for and against the claim which are otherwise undefeated, at least one argument for the claim has to strictly defeat all arguments against. *Proof standards* for the burden of persuasion are captured in two ways. The first is in the criteria for the internal validity of an evidential argument, reflected in the possibility of an exclusion attack: the higher the proof standard, the easier it is to defeat the argument with an exlusion attack. The second is by a careful definition of the defeat relation between rebutting arguments: a stronger rebutting argument should strictly defeat a weaker argument only if the degree to which it is stronger satisfies the applicable proof standard; otherwise both arguments defeat each other. For example, if the standard is 'on the balance of probabilities', the fact finder can already say that A strictly defeats B if A is just a little bit stronger than B, while if the standard is 'beyond reasonable doubt', the fact finder can say this only if, when faced with only A and B, he would certainly accept A's conclusion.

To verify the *burden of production*, the adjudicator must at the appropriate stage of a proceeding examine whether an evidential argument has been produced for the claim on which the burden of production rests, and whether this argument satisfies its proof standard. The proof standard for the burden of production is usually lower than for the burden of persuasion: it has been phrased as the question whether 'reasonable minds' can disagree about whether its conclusion would hold if only its premises were known. A negative answer can be expressed as an exclusion attack on the evidential argument,

while a positive answer can be expressed by saying nothing. The strength of the proof standard is implicit in the reasons for moving or not moving the exclusion attack.

Finally, the *tactical burden of proof* is induced by the defeasible nature of the reasoning. At a given stage a party has a tactical burden of proof with regard to an issue if the evidence thus far provided would make her likely lose on that issue if no further evidence were provided (where 'likely' means 'according to the most probable decision of the adjudicator). Note that one party may have the tactical burden even if the other party has the burden of persuasion, namely if that other party is the current likely winner. Shifts in the tactical burden are accounted for by the embedding of the logic in a dynamic setting: producing new arguments may result in a new stage with a new likely winner.

4. Presumptions

In this section we discuss some logical issues concerning presumptions that we left untreated in our previous work. Recall first that in [5] we argued that the logical form of presumptions is that of a conditional default rule. As for their effect on the various burdens of proof we argued that they are a way to fulfill a burden of production and/or persuasion while their use shifts a tactical burden to the other party. These effects were modelled in our (A)LIS logic by formalising presumptions as defeasible rules. We also modelled the distinction between kinds of presumptions in terms of the backings of these default rules; to this end, the rule names proved convenient. For present purposes especially our distinction between source-based and probabilistic presumptions is relevant: source-based presumptions (which in this paper will be called *legal presumptions*) are based on some legal-authoritative source, such as statute or precedent, which declares that proof of a certain fact P is to be taken as sufficient to infer another fact Q in the absence of counterevidence, so that after proving P in a situation where no other evidence on Q is available, the tactical burden with respect to Q shifts to the other party ([8] says that it is the burden of production that shifts, but [9] argues that this confuses the burden of production with the tactical burden: if the other side fails to provide counterarguments, she runs the risk of losing on Q in the strongest possible sense, namely with certainty). Probabilistic presumptions are based on knowledge that the conditional probability of the rule consequent given the rule antecedent is high. In the present paper we will call them *empirical presumptions*, to reflect that often they are not based on precise statistics but express qualitative commonsense knowledge. Thus in our account of [5] the main difference between legal and empirical presumptions is that the adjudicator is required by law to apply the former, while s/he must form its own opinion on the latter.

We still adhere to our previous analysis of presumptions, but we now realise that we underestimated how subtle the notion of presumption in law is. In particular, we ignored the following features: firstly, only legal presumptions and not their empirical correlates are made inapplicable by counterevidence; and secondly, the use of legal presumptions can make a difference for who has the burden of persuasion and for the proof standard. We now discuss these two features in turn.

4.1. Legal vs. empirical presumptions

A main difference between legal and empirical presumptions is that when two empirical presumptions, i.e. two empirical default rules, conflict, they must be weighed to see

which one is stronger, while if an empirical presumption conflicts with a legal one, such weighing does not happen (at least not if the counterevidence is strong enough to support its conclusion in the absence of any other information). In the latter case, weighing would not make sense since a legal presumption does not express empirical knowledge, so since legal and empirical presumptions are things of different sorts there is no basis for comparing their evidential strength (for this reason we think that this issue is not a matter of legal policy but of rationality). Instead a legal presumption becomes inapplicable when concrete evidence to the contrary is provided.

Consider, for example, the Italian legal presumption that sales of real estate between spouses are for tax purposes presumed to be donations. Imagine a dispute between John and the tax office, which claims that John has donated a house to his wife Mary and so has to pay the tax on donations, which is higher than the tax on sales. The office can defend this claim by proving that John and Mary signed a sale contract, after which the presumption yields that John made a donation. Assume, however, that John can prove that Mary paid the full price of the house to him (she gave him a check, whose amount corresponds to the price of the house). Then, other things being equal, we should disregard the presumption and conclude that John sold the house to Mary. Legally, the tax office can prevent this conclusion only by providing empirical evidence for John's making a donation, for example, by showing that John returned the money to Mary. Then if the evidential arguments for and against a donation are equally strong, the issue is decided by looking at who has the burden of persuasion concerning this fact. Our challenge is to represent these situations in the correct way, reflecting their difference.

However, there is a subtlety here that is easily overlooked. As remarked by [8], many legal presumptions have an empirical correlate in that the relation between condition and consequent presumed by the legal presumption also holds as an empirical regularity. For instance, the fact that John and Mary are married can work not only as the legal ground of the presumption of donation but also as an independent evidential element supporting the conclusion that they did not really want to make a sale (as a matter of fact most married couples make gifts to each other rather than selling each other things). Now such an empirical correlate to a legal presumption is not affected if the legal presumption is made inapplicable: in our example, the empirical presumption based on the fact that John and Mary are married may need to be weighed against the counterevidence that a check was exchanged, or considered in combination with further pieces of evidence (John used the money for paying a debt, or on the contrary, he gave it back to Mary).

Clearly, not all legal presumptions have empirical correlates. For example, the presumption of innocence is clearly empirically false since most accused are as a matter of fact guilty. So another challenge for us is to make a correct difference between legal presumptions that have and that do not have an empirical correlate.

4.2. Effects of presumptions on the burden of persuasion and proof standards

Above we said that a legal presumption is made inapplicable by counterevidence, since legal and empirical presumptions, being things of different sorts cannot be weighed against each other. However, [8] remarks that in the common law of evidence this issue is very controversial, and discusses cases where jury instructions regard legal presumptions as 'evidence' to be weighed against the other available evidence. Yet it seems that such cases are compatible with the view that presumptions are made inapplicable by coun-

terevidence. Firstly, we have seen above that in many cases it is not the legal presumption but its empirical correlate that is weighed against the counterevidence. Secondly, sometimes it is meant that after a presumption has been invoked the burden of persuasion is on the other side [8, p. 464] or, to take a variant of this, that the tactical burden that is shifted by the presumption on the other side is stronger than usual in that evidential counterarguments run a higher risk to be ruled internally or dialectically invalid (this is our interpretation of [8, p. 464]). A third challenge then for our logical model of presumptions and burdens of proof is to account for these phenomena.

5. Modelling some aspects of presumptions and burdens of proof

We now discuss how the above situations can be represented in our previously proposed logical account of presumptions and burdens of proof. In fact, we will give two alternative formalisation methods. The first is directly based on our earlier proposal to regard a legal presumption that q if p as a defeasible rule $r : p \Rightarrow q$. The alternative method chooses a more refined representation $r : p \wedge \sim \neg q \Rightarrow q$, to directly express that the presumption only applies if no counterevidence is provided.

5.1. A presumption made inapplicable by applicable counterevidence

First we show how a legal presumption can be made inapplicable by counterevidence while leaving its empirical correlate (if it has one) applicable. In the first method a presumption is represented as a defeasible rule, while its counterevidence is represented by a pair of rules with the same name, one concluding for the negation of the conclusion of the presumption, and the other concluding for the presumption's inapplicability. (Our symbolic example can be mapped unto the previous legal example as follows: p means *Married*, q means *Donation*, s means *Check* and t means *RestitutionOfPrice*.)

r_1: $p \Rightarrow q$ (the legal presumption)
r_2: $s \Rightarrow \neg q$ (the counterevidence)
r_2: $s \Rightarrow \neg r_1$ (making the legal presumption inapplicable)
r_3: $t \Rightarrow q$ (additional evidence for q)

In case that the presumption for q has an empirical correlate, this is also expressed by a defeasible rule, which has the same content of the presumption but a different name:

r_3: $p \Rightarrow q$ (empirical correlate of the presumption)

So the idea is that for each rule expressing counterevidence, a second rule with the same name is made that proclaims the legal presumption inapplicable but leaves its empirical correlate r_3 (if it exists) applicable. Now note first that in all cases it has to be decided whether the counterevidence against the presumption is strong enough in itself to support its conclusion (internal validity). If not, this can be expressed as an exclusion attack with conclusion $\neg r_2$: this blocks both versions of r_2 so r_1 is applicable again and (in case of p and s), we have that q is justified on the basis of the presumption. This seems reasonable: surely a presumption cannot be made inapplicable by counterevidence that is in no circumstance good enough to support its conclusion.

Below we will in all examples assume that the counterevidence is at least internally valid so that no argument for $\neg r_2$ is moved. Now if we have both p and s, then r_1 is

inapplicable. If moreover p and s is all we have, then $\neg q$ is justified, while if we also have t, a comparison must be made between r_2 and r_3, as desired. (If there is further evidence for or against q, then the various arguments may have to be accrued in the manner formalised by [3]. Below we ignore this complication for simplicity.) If the evidence on q turns out to be balanced, then it becomes relevant who has the burden of persuasion with respect to q. Then our next issue arises.

First, however, we apply our alternative representation method. According to the second representation method a presumption is represented as a defeasible rule whose antecedent assumes that the negation of the presumption's conclusion is not established.

r_1: $p \wedge \sim \neg q \Rightarrow q$ (the legal presumption)
r_2: $s \Rightarrow \neg q$ (the counterevidence)
r_3: $t \Rightarrow q$ (additional evidence for q)

Also in this case a rule has to be included if the presumption has an empirical correlate:

r_3: $p \Rightarrow q$ (empirical correlate of the presumption)

With the new formulation of r_1 the duplication of r_2 has been avoided. If now all we have is p and s, then the argument based on r_2 strictly defeats the one based on r_1, since assumption attack prevails over rebutting attack. So we obtain that $\neg q$ is justified without having to compare the strength of the legal and empirical presumption. On the other hand, if we also have t, then the argument for q based on r_1 is still strictly defeated by the argument for $\neg q$, so the only weighing is between r_2 and r_3: then if r_2 is preferred over r_3 then q is justified, if r_3 is preferred over r_2 then $\neg q$ is justified, while if r_2 and r_3 are equally strong, then both q and $\neg q$ are defensible. Again the issue on q is then decided according to who has the burden of persuasion. Now we can turn to our next issue.

5.2. Does a presumption put the burden of persuasion on the opposite side?

The next issue is whether a presumption puts the burden of persuasion on the opposite side. For legal presumptions this is a matter of legal policy, which may point at different answers for different presumptions. Both accounts have been defended, both by legal scholars, by legislators and by courts. A 'no' answer means that the only effect of a presumption is to put a tactical burden for $\neg q$ on the other party. Logically, both answers can easily be formalised in (A)LIS. A 'no' answer corresponds to the above formalisations, while a 'yes' answer can be expressed by adding $\neg q$ to the burdens of the side who wants to argue for it.

The answer to this question is relevant for when the evidence on q is balanced, i.e., if the arguments for q and $\neg q$ are both defensible. If the burden of persuasion is on the side who claims q, then (in our first method) in the LIS argument game the proponent of q loses on q as follows (P and O denote the player's dialectical roles):

$\pi_1(P)$: $t, t \Rightarrow q$, *so* q
$\delta_1(O)$: $s, s \Rightarrow \neg q$, *so* $\neg q$

(Note that these arguments defeat each other since r_2 and r_3 are equally strong.) Now since π may not repeat his argument for q, π has no moves and δ wins. Or if π starts with his presumptive argument for q:

$\pi_1(P)$: $p, p \Rightarrow q$, *so* q
$\delta_1(O)$: $s, s \Rightarrow \neg r_1$, *so* $\neg r_1$

And π has no strictly defeating reply.

In our second method the first game is the same while the second is as follows:

$\pi_1(P)$: $p, p \wedge \sim \neg q \Rightarrow q$, *so q*
$\delta_1(O)$: $s, s \Rightarrow \neg q$, *so ¬q*

(Note that δ_1 strictly defeats π_1 by assumption-attacking it, so no comparison is made between r_1 and r_2.) Again π has no strictly defeating reply.

If, on the other hand, the burden of persuasion is on the side who claims $\neg q$, then the side who claims q wins in that any further conclusion drawn on the basis of q is justified (even though q itself is only defensible). Suppose we also have a rule

r_4: $q \Rightarrow u$ (u is some legal consequence)

Then if a game starts with

$\pi_1(P)$: $t, t \Rightarrow q, q \Rightarrow u$, *so u*

then the counterargument

$\delta_1(P)$: $s, s \Rightarrow \neg q$, *so ¬q*

must be moved in proponent role so in LIS it must strictly defeat π_1 on q, which it does not. So π can win any game on u so that u is justified. Note that this holds for both our methods, since π did not need the legal presumption.

Concluding, both our logical methods correctly capture that if the evidence on a legally presumed fact is balanced, the issue is decided according to the burden of persuasion. Moreover, our methods can distinguish between situations in which the use of a presumption does or does not place the burden of persuasion on the other party. To compare the two representation methods, it is easy to see that they are equivalent in that the logical status of the consequent of a legal presumption is the same in both methods. Basically, this is since an argument using a presumption is exclusion-attacked in the first method just in case it is assumption-attacked in the second method, and both kinds of attack prevail over rebutting attack. To formally prove equivalence some further assumptions on the representations must be formalised but a full formal analysis goes beyond the scope of this paper. Nevertheless, we can say that the choice between the two methods essentially is a matter of taste.

5.3. Does a presumption affect proof standards?

In some cases a presumption is said to imply a higher proof standard than usual for the other side, even if it does not put the burden of persuasion on that side. Clearly this is a matter of legal policy. [8, p. 464] gives some examples where legal policy rationales for presumptions have led courts to stipulate that the contradictory evidence should be "uncontradicted, clear, convincing and unimpeached". Again, if this happens, this is not a *logical* effect of the presumption but based on legal policy reasons. In terms of the burden of persuasion this means, among other things, that the criteria for internal and dialectical validity are made stronger for the counterevidence of the presumption. In our above account this means that an exclusion attack on such counterevidence will be more easily made and that a priority argument resolving a conflict will more easily favour the evidence agreeing with the presumption.

6. Conclusion

In this paper we have extended our analysis in [5] of the logic of presumptions. We have seen that presumption is a very subtle concept, and that various legal treatments are possible. We have provided two logical representation methods that we claim to capture all reasonable legal accounts and that give a precise logical characterisation of their respective differences. Among other things, we were able to formalise an often-overlooked distinction between legal presumptions and the empirical correlates that they may have. For jurisprudence and legal theory perhaps our most important insight has been that the view that counterevidence makes a presumption inapplicable can be reconciled with the view that presumptions for which there is counterevidence still have some effect.

One topic for future research is to which extent our methods can be used in other logical systems. For instance, [1] claim that the Carneades logic is suitable for modelling burdens of proof, but they do not discuss the present issues. It would be interesting to see if they can make similar distinctions as us.

Acknowledgements

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