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Effects of the Third Party Errors

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Type-I and type-II errors effects do matter both from the rules enforcement perspective and vertically upward to rules enactment. The paper support conventional idea about detrimental influence on deterrence of both types of errors. At the same time special role of type-I errors is demonstrated based on strategic interaction between economic exchange participants supported by third-party enforcement with opportunities to discriminate players. The paper highlights the issue that errors in enforcement is not whole story: the simple classification of cases is suggested from the perspective of type-I and type-II errors in rules enforcement and rules enactment.

Key words: types-I&II errors, institutions, rules enforcement, rules enactment, discrimination, Nash equilibrium

Jel-codes: D02, K10, K42, P48

Contents

Introduction

1. Type I and Type II Errors: the conceptual frame of analysis
2. Zero Probability of Type-I and Type-II Errors in Law Enforcement
3. At Least One Error Type Probability is Greater than Zero
4. Types of Relationships between the Law Enactment and Enforcement in Respect to Type-I and Type-II Errors

Discussion and Conclusions

References

Introduction

Explaining of cooperation and its effects based on rules enactment and enforcement are among key issues for contemporary economics¹. Concepts of type-I and type-II errors included in economic analysis due to seminal works by Becker (1968, 1974) and developed and applied in different areas by Posner (1998), Joskow (2002), Manne and Wright (2009), Rill and Dillickrath (2009), Rizolli and Saraceno (2011), Garoupa and Rizolli (2012), Immordino and Polo (2013) became pillars of economic analysis of imperfect (by definition) institutions.

The results of transactions (both institutional and economic) based on rules and enforcing mechanisms are specified through coordination and distribution effects (Knight, 1992). Distribution effects can be analysed from the point of view of each player's absolute gain (loss) and their ratio. Developing insights of authors mentioned the present paper demonstrates type-I and type-II errors effects – not only in terms of total cost of enforcement, but also in terms of coordination and distribution consequences of economic exchanges; changing threshold conditions for improving equilibrium properties under enforcer's errors. Discrimination in terms of sanctions, compensations, and type-I and type-II errors probability as compared with no-enforcer situation are also considered along with outline of the relationships between the enactment and enforcement of rules from the point of view of type-I and type-II errors probability.

The paper is organized in a following way. First part is devoted to fixing of conceptual frame of analysis including types of errors in legal sense and in economics, clarifying basic assumptions for modeling and specification of the main types of type-I and type-II errors cases. Second part describes issues of rules enforcement under error-free but not costless third-party enforcement with discrimination opportunities. Third part contains analysis of cases when probability of at least one type of error is above zero (without and with discrimination). Fourth part combines issues of rules enforcement with rules enactment presenting both thesaurus of two types errors in rules enactment and enforcement interconnection and integrated vision of two types of errors. The last part contains discussion and conclusions.

¹ Especially for Law & Economics and the New Institutional Economics.

1. Type I and Type II Errors: the conceptual frame of analysis

As far as legal errors is concerned these errors qualified as wrongful conviction (type-I) and wrongful acquittal (type-II). This is strong version of definition. The weak one is related to quantitative aspect: too hard conviction and too weak conviction, correspondingly. Further we discuss issues related only to strong versions.

Unlike conventional legal perspective of two types of errors presentation economics also provide the frame for analysis of errors in rules enactment although much less elaborated theoretically. If, for simplicity, rules are considered as a set of constraints/prohibitions type-I errors mean excessive prohibitions while type-II – lack of constraints. Conceptually, it means that even if there is no errors in rules enforcement outcomes achieved might be insufficient due to wrongful restriction (type-I errors) or wrongful release (type-II errors).

Finally, issue of ties between errors of both types is conventional in econometrics. The basic idea is presented in the table 1. If estimates based on analysis of ties of variables wrongfully refute the hypothesis it is the in case of type-II (false negative) or not refute it in case of type-I error (false positive).

Table 1

		Null hypothesis	
		<i>Proven</i>	<i>Declined (alternative hypothesis)</i>
Verity	<i>Conforms with the null hypothesis</i>	Correctly proven hypothesis	Type I error
	<i>Doesn't conform with the null hypothesis</i>	Type II error	Correctly declined hypothesis

Unlike the conventional econometric approach to the evaluation of the correlations between type-I and type-II errors, the approach to such errors in terms of the system of economic exchanges is much less clear and conventional, much less operational and not well-developed although there are very insightful studies on the issue. Besides above mentioned papers there is a wide set of studies providing us with economic analysis of the consequences of particular laws (norms) enforcement and recommendations regarding remedies (particularly, in terms of law enacting). Basically, these studies suggest the set of tools for the reduction of the negative effects of type-I and type-II errors.

From this perspective, it is particularly important to draw attention on the adjustment of the methodological status of errors for positive analysis of economic exchanges. What is solved in case of econometric evaluations is the issue of finding optima in the balance between type-I and type-II errors, while when speaking of the emergence of type-I and type-II errors in law enforcement and especially in the law enactment, a more important question is that of reflection interests balance among groups involved in the economic exchanges under consideration. This is exactly what has determined the originally ‘not by default’ separation of type-I and type-II errors. Furthermore, while the econometric approach focuses rather on the substitution effect between type-I and type-II errors, complementarity effects are also considered in the context of the law enactment and enforcement due to employed standards considerations.

There are following basic assumptions in the paper. Firstly, the game theory models are used mainly as an illustration and doesn’t imply a need to develop new elements of game theory analysis. Nevertheless, it is crucially important that strategic interaction between economic exchanges participants is at the center of attention unlike cases with relation «enforcer – economic exchange participant». Secondly, one shot ‘prisoners’ dilemma’ is taken as an example game model, which allows to display both distribution and cooperation effects for impersonal exchanges.

We will further look into several type- I and type-II errors combinations with respect to the cases of rules enforcement, assuming that: (1) the total direct cost of the enforcer’s services is known and fixed, (2) the absolute value of anti-violation fines is known and fixed, (3) the absolute value of compensations for the adversely affected party is also known and fixed, (4) exchanges (transactions) are separable in the sense there is no spill-over effects (nor “in” neither “out”) in terms of such issues as mistakes of identity².

Let’s take the payoff matrix structure of a one-shot bilateral ‘prisoners’ dilemma’ game as a benchmark. This game is more known in Industrial Organization literature as an instrument for Bertrand competition explanation which is socially appropriate unlike results we consider here. This is so because Bertrand competition outcome might be considered as a benchmark for antimonopoly tools implementation directed to restore if not competition process but (at least imitate) results of it. However, very antitrust rules are in fact exemptions of property rights exclusivity and contract freedom principle. At the same time, it is the fundamentals of contemporary market economies – protected property rights and contract freedom is starting point for analysis (what is especially important to remember for emerging market economies). At

² There is one more assumption taking into account discussion on effects of mistakes of act and mistakes of identity in Lando (2006), Garoupa, Rizolli (2012).

the same time there is some symmetry with studies of legal errors in antitrust especially as compared with deterrence effects of errors³.

In each case of errors combinations we will look into the situations of a symmetric and asymmetric enforcement cost-sharing caused by the necessity to pay for the enforcer's services (in accordance with Douglas North's idea of the state being a discriminating monopolist (North, 1990)), which are based on the state's comparative advantages in the use of violence (North, 1981, p. 21) and the establishment of a credible commitment (threat) to use it.

It is also assumed that the enforcer who follow his own interests, uses only part of the resources available to provide the services on enforcement of the rules established, while the rest of the payments received from the participants of economic exchanges are spent on private consumption and ensuring fee collection (similar to tax administration costs on the side of the state). This issue is addressed in detail in the McGuire-Olson model (McGuire, Olson, 1996), which shows how to determine the income of an autocratic enforcer of economic exchanges between households.

We will analyse five situations corresponding to different combinations of type-I and type-II errors (table 2).

Table 2

Nº	p_1	p_1
1	0	0
2	0	1
3	1	0
4	1	1
5	$\in]0; 1[$	$\in]0; 1[$

³ See as an example [Ghebrihiwet, Motchenkova, 2010] and with insight of proof standards and per se vs. effect-based rules [Katsoulacos, Ulph, 2009, 2011]. But unlike Katsoulacos and Ulph approach we don't analyze issues of legal uncertainty.

2. Zero Probability of Type-I and Type-II Errors in Law Enforcement

Let's take the following matrix as the point of departure:

		Actor B	
		Abide	Violate
Actor A	Abide	$A_1; B_1$	$A_2; B_2$
	Violate	$A_3; B_3$	$A_4; B_4$

The payoff matrix structure has the following properties: $A_3 > A_1 > A_4 > A_2$; $B_2 > B_1 > B_4 > B_3$. Let us remind once again: it is not the case for competition on the market (or for the market to indicate its contestability); it is relations prototype of depersonalized exchanges (following North's approach in earlier mentioned publications) with property rights - absolute or relative (Furubotn, Richter, 2000) - enforcement.

There are grounds for the emergence of a third party (which might be the state) as a remedy for inefficiency of exchanges outcomes taking into account two points: (i) relocation to square one is preferable from Pareto-optimum perspective; (ii) such a relocation is not feasible just by the players themselves because of the improbability of the development of evolutionarily stable strategies (assumed), such as TIT-FOR-TAT, in the context of multi (but finite)-shot games with a fixed number of participants. Is, however, the existence of the above mentioned ratios sufficient to draw a conclusion that the state as an enforcer is necessary and sufficient to find first-best solution in one-shot games between particular players?

Third-party enforcer causes changes to the payoff matrix assuming equal distribution of tax burden in absolute terms:

		Actor B	
		Abide	Violate
Actor A	Abide	$A_1 - 0,5T ; B_1 - 0,5T$	$A_2 - 0,5T + Z ; B_2 - 0,5T - Y$
	Violate	$A_3 - 0,5T - Z ; B_3 - 0,5T - Y$	$A_4 - 0,5T - Y + Z ; B_4 - 0,5T - Y + Z$

A violator's pay-off resulting from sanctions Y and a non-breaching party's advancement caused by compensations Z (as a result of civil process) are prerequisite for such a change of the

payoff matrix structure that would relocate the Pareto-optimal Nash equilibrium to square one. Relocation of the equilibrium to square one depends on the size of the sanctions. In other words, the size of the sanctions should fulfill the following condition: $Y > A_3 - A_1$ (if $A_4 - A_2 \leq A_3 - A_1$) and $Y > B_2 - B_1$ (if $B_4 - B_3 \leq B_2 - B_1$). More detailed analysis of the situation implies also considering the issue of different ratios between the size of the sanctions and the differences between the players' payoffs with probable coordination issues emergence.

In this case, we do not discuss the size of the sanctions as a special issue despite this being one of the key issues in the economics of crime and punishment (Becker, 1968, 1974; Buccirosi, Ciari, Duso, Spagnolo, Vitale, 2009; Gravelle, Garoupa, 2002; Sunstein, Schkade, Kahnemann, 2000; Tabbach, 2009) alongside with the issue of who exactly has a right to apply such sanctions (Polinsky, Shavell, 2000, 2007). We stress attention on the issue which have been missed so far: *effects of sanctions* (and further – errors by third-party enforcer) *through the lens of strategic interaction of regular economic exchanges participants*.

Both the issue of the size of the sanctions (minimum and maximum) and that of the actor applying such sanctions should be considered with due account for this important fact: a sanction is a double-edged tool, which can turn from a weapon of defense into a weapon of attack and become crucial element in rights abuse⁴. That is why it is important to take into account the size of compensations as a source for selective incentives for private rules enforcement (which don't necessarily have to be positive due to the risk of abuse of rights).

Even if the sanctions and compensations effects are not taken into account, the price of the services does matter following question: whether we have Pareto—improvement as compared with initial Pareto-inefficient equilibrium without third party enforcement.

From this point of view, it is still unclear which strategy is better: 'bellum omnium contra omnes' or 'Leviathan'. *Protection of rights can be efficient in terms of punishing the violator and, correspondingly, incentives alignment, but not necessarily from the point of view of the restoration of the rights already violated, which have a quantitative evaluation in the form of the compensation received*⁵. Moreover — and this is crucial — saving on the law-enforcement related costs only seems to enable a painless transition to such a combination of strategies that implies law abidance by all the participants of economic exchanges what is one more illustration of idea by Pagano (2012, p.189): no institutions is free lunch.

Let's note that in such a case, the enforcer's rent income can generically be described as: $R = T - G$, while in regard to the case in question it can be described as $R_1^{ND} = T - G_1^{ND}$, where $G_1^{ND} = G_{1E}^{ND} + G_{1C}^{ND}$ means the expenditures of the enforcer as a non-discriminating monopolist,

⁴ Obvious examples are greenmail, abuse of rights to protect competition, abuse of consumers rights.

⁵ Strictly speaking, a mediated compensation is possible, if the size of the sanctions weakens a player's bargaining power irreversible, yet this is a different game altogether.

including the expenditures on policing, G_{1E}^{ND} and on service-related fee collection, G_{1C}^{ND} . From this perspective, the question of ongoing or even potential competition among enforcers is left out. The price for the enforcer's services is treated as an exogenous factor. Moreover, under conditions of dominating democratic institutions $R > 0$ means unlawful diversion of funds unless the constituency decided otherwise. This issue can be taken into account when discussing comparative advantages of different ways of enforcing the rights of the participants of economic exchanges.

Does severity of the punishment matter from the point of view of Pareto-efficient outcome in a one-shot game? It does since it affects the players' payoffs ratio when comparing the 'abidance' and 'violation' strategies. This ratio, however, also points out that punishment should be proportionate, especially since it is also supposedly linked to such a variable as compensation size $Z = kY$ (without considering the timing when the compensation is awarded against the violation, i.e. discount factor), where $0 \leq k \leq 1$, and k can serve as an indicator of the efficacy of rights restoration in case the sanctions the degree of violation are proportionate. It should be mentioned that if $k > 1$, such a system, even having a direct deterring effect, creates incentives for a potential victim to provoke or imitate a violation and, consequently, abuse its right to defense. Such a situation is commonly known since it is related to the widely discussed issue of establishing credible commitments in contractual relations with transaction-specific assets (Williamson 1985, 2002).

Also there is another side of the issue. Economically, sanctions are composed at least of three elements – fines (F), compensations (Z) and litigation expenses (LE⁶):

$$Y = F + Z + LE \tag{1}$$

Now we go to the issue of discrimination. Let's assume that n is a share of the enforcer's services cost paid for by A, while $1 - n$ is paid by B. At first, we do not take into account the issue of discrimination in terms of the differences between compensations due to A and B or other aspects of discrimination. If $n > 0,5$, *ceteris paribus* the enforcer discriminates in favor of B and vice versa. It is important *that discrimination causes income effect for the players but the set of dominant strategies towards a non-discriminatory case remains the same due to the uniqueness of payoff matrix structure with a precision to monotone transformation.*

The outcome might change if discrimination also concerns punishment and compensations paid out with the assistance of the enforcer. Assume a_2 and b_2 respectively are

⁶ Here I don't consider how rules for LE allocation might influence incentives and outcomes for dispute solutions.

adjusting factors for the size of compensations , and $0 < a_2 < 1$, $0 < b_2 < m$, where m is the coefficient that links compensation size and the extent of damage done to a player⁷

Since

$$Y > A_3 - A_1 = B_2 - B_1 \quad (2)$$

become an insufficient condition for B, their strategy might change. However, a new strategy will make A adjust their strategy too, which, in the end, will result (past certain threshold) in the restoration of Pareto-inefficient Nash equilibrium, when sanctions-related and compensations-related discrimination makes the ‘violation’ strategy dominant for player B. A closer analysis shows relocating to the initial set of strategies requires that certain conditions are met. Further we assume, if there is discrimination on sanctions as a whole there is the discrimination on sanctions component with the same sign (not necessarily proportionally).

If we assume $n < 0,5$, i.e. there is discrimination in favor of A, the next assumption is that complementarity principle (rather than compensational principle) enters into force, i.e. the above-mentioned coefficient are applied. Therefore, if $a_1 < \frac{A_3 - A_1}{Y}$ or $a_1 < \frac{A_4 - A_2}{Y}$ strategy ‘violate’ might become dominant for A as well. As for B, the choice whether to abide by the rules or to violate them depends largely on discriminating coefficient level. If $b_1 < \frac{A_4 - A_3}{Y}$, the equilibrium can relocate to square three... Isn’t such a condition a degenerate case with limitations for the potential abuse of rights? Is such a type of situations stable in case they actually exist?

There is a specific case to be considered here: $n = 0$; $a_1 = 0$, where $b_1 = 1$. Basically, it corresponds with a well-known principle: ‘Freinds get all, the rest get the law’.

		<i>Actor B</i>	
		Abide	Violate
<i>Actor A</i>	Abide	$A_1; B_1 - T$	$A_2 + Z; B_2 - T - Y$
	Violate	$A_3; B_3 - T$	$A_4 + Z; B_4 - T - Y$

⁷ Strictly speaking, this is based on assumptions that can be removed in further research. Such an assumption is made to avoid studying the cases when the enforcer is used as a tool for payoff redistribution to the benefit of the adversely affected side (this is the case of enforcer capture), thus creating incentives for the direct abuse of rights, which was mentioned earlier.

Remarkably, A's dominating strategy is Violate. However, there is opportunity to get different solutions depending of sanctions volume.

1. Return to all sides rules (rights) violation, where sanctions are not so high (Violate; Violate)
2. Law violation by friends (A) and abiding by rest (B) due to sanctions $Y > B_4 - B_3$

Discrimination effects for the enforcers is a completely separate issue. If such discrimination is the enforcer's choice, his or her rent should be at least the same size as under an equally distributed burden of fees, severity of sanctions, as compensation size. What are the sources of extra gains? First of all, it's the resources saved on fee collection costs when the main burden is laid upon those easy to collect payments from and easy to prosecute for rules violation. Secondly, it's the resources saved on the costs related to the restoration of rights. It is therefore assumed that if total fees for all players are equal, the enforcer's expenditure will be $G_1^D = G_{1E}^D + G_{1C}^D$, where $G_1^D < G_1^{ND}$. Thus, ceteris paribus, $G_1^D < G_1^{ND}$.

This assumption can be relaxed on the grounds that: (1) determination of the violation causes certain costs; (2) and so does identification of the violator (or, generally speaking, all related actors involve in rules infringement); (3) determination of the degree of violation; (4) determination of the sanctions (severity of punishment); (5) application of the sanctions to the violator (execution of the enforcer's decision). First two point are directly related to issues of mistakes of acts and identity identification used by Lando to explain whether wrongful conviction lower deterrence (Lando, 2006)

It is important to note that enforcer-entailed discrimination complicates the study of type-I and type-II errors because they imply not only wrongful conviction and punishment or wrongful acquittal thereof but also an exceedingly soft (severe) punishment (it is addressed to weak form of both types errors). As a result, when studying discrimination, one can identify type-I errors with reference to one group of the participants of economic exchanges, and type-II errors with reference to the others.

That is why we use oversimplifying assumption about prosecution of innocent and non-prosecution at all of violator and examine a non-discriminatory alternative with type I and type II errors first, in order to distinguish analytically those kinds of such situations from the distribution effects of discrimination and its consequences' interpretation in terms of such errors further.

3. At Least One Error Type Probability is Greater than Zero

If *type-I error probability is zero and type-II error probability is one*, the situation is equivalent to lack of property & contractual rights enforcement services by the third party in one respect only: in respect of no punishment for violations, while law-abiding players are also safe against any sanctions imposed by the third-party enforcer. This is a kind of a ‘title enforcer’ who only ensures income from the title right to law enforcement services, letting the players solve the issues of rights protection themselves. Moreover, in the present model (as well as in all the other cases) the problem of punishment for non-payment to the enforcer is not considered (even if the enforcer does not actually provide its services). In other words, $G_2^{ND} = G_{2C}^{ND}$, so the enforcer’s rent can increase by the sum equal to the costs of policing.

This way, if the enforcer never punishes both violators and law-abiding players, the game obviously has one inefficient equilibrium. At the same time, the necessity to pay for the state’s virtual services is an inevitable element of pay-off for all the player but is to the benefit of the enforcer. If the fee collection costs are unsubstantial and there is no competition with any other third-party enforcer or any actor providing similar services: $G_2^{ND} < G_1^{ND}$; $R_2^{ND} > R_1^{ND}$ ⁸.

If we assume that there is discrimination both in terms of fees for (virtual) services and in terms of sanctions & compensations, Nash equilibrium is Pareto-inefficient once again. What is even more important, in this case, discrimination in terms of sanctions (that includes compensations) does not matter in terms of dominant strategy choice and even payoff matrix structure adjustment from the point of view of the players’ payoff ratio.

Speaking of distribution effects, what can matter is resources saved on discriminatory fee, i.e. $G_2^D < G_2^{ND}$. Therefore, $R_2^D > R_2^{ND}$.

If *type-I error probability is one and type II-error probability is zero*, it looks as if there is an ‘intimidating enforcer’ who is merciless to violators (error-free) but also makes systemic ‘errors’ by punishing law-abiding players. In this case, the enforcer behaves like a roving bandit because law enforcement service fees aren’t set ex ante. Strictly speaking, compensations can vary too. Such a variant is probably the worst one in terms of equilibrium properties because then the equilibrium is Pareto-inefficient and actually results in a terminal payoff that is even

⁸ Such a situation can be considered through the prism of McGuire and Olson (1996) article. Here is one possibility: despite having advantages in control over the territory against other participants of the exchange and other bandits, stationary bandits is still short-sighted in its behavior, so total payments from both counterparts make up the enforcer’s rent. Nash equilibrium is once again Pareto-inefficient, and actually causes backset for both players if compared with the situation with no third-party enforcer. Such case also proves that there is no universal economic justification for a third-party enforcer that would be based only on an inefficient game outcome in the absence of an enforcer.

smaller than in case of ‘title enforcer’ due to the fact that $Y > Z$. In this respect, it is particularly important that it is erroneous to mix up the enforcers’ verifiable activities and the actual results (outcomes) of such enforcement (Manne, Wright, 2009), especially in terms of equilibrium properties. *These results reflect destroying of coordination which might result of third-party enforcer involvement in exchanges among players.*

If the enforcer punishes all the players, no matter what their behavior is, the result is nearly equivalent to the situation that would occur when errors of type-I probability is zero and errors of type-II probability is one. It is difference in the sense that now agents have to pay both the fees of T and fines, which basically means an additional fee of $2(Y - Z)$ to the enforcer. Another difference is that the enforcer’s costs are higher because punishment is always more expensive in terms of direct costs than lack thereof. So, if $2(Y - Z) > G_3^{ND} - G_2^{ND}$, an ‘intimidating enforcer’s’ rent is even higher than that of a ‘title enforcer’.

Will anything change if we assume once again that there is discrimination?

		Actor B	
		Abide	Violate
Actor A	Abide	$A_1 - nT - a_1Y + a_2Z;$ $B_1 - (1 - n)T - b_1Y + b_2Z$	$A_2 - nT - a_1Y + a_2Z;$ $B_2 - (1 - n)T - b_1Y + b_2Z$
	Violate	$A_3 - nT - a_1Y + a_2Z;$ $B_3 - (1 - n)T - b_1Y + b_2Z$	$A_4 - nT - a_1Y + a_2Z;$ $B_4 - (1 - n)T - b_1Y + b_2Z$

Enforcer-entailed discrimination also (as it was above) doesn’t directly affect equilibrium conditions but causes payoff redistribution among all the players (sometimes in favor of the enforcer⁹).

The case when *both type-I and type-II errors probability is one* is, perhaps, the most ‘exotic’ one. It is not just that Nash equilibrium is Pareto-inefficient but it also causes backset for all the players against the situation with no enforcer to the same extent as in the situation when type- I error probability is zero and type II-error probability is one¹⁰. The formulae in the matrix prove that if law-abiding players only get punished, it becomes actually more profitable to violate the rules. Despite the enforcer’s activity (unlike the ‘title enforcer’ case), such a situation is similar to the ‘title enforcer’ situation in terms of coordination aspect of outcome. In terms of the equilibrium, however, the enforcer’s behavior is less reasonable (rational) because law-

⁹ The answer to the question depends on the discriminatory factors ratio.

¹⁰ There are differences in terms of absolute payoffs only.

abiding players get punished, while the violators don't, and that can cause a decrease of the enforcer's rent, which partially consists of service fees paid by the players ($G_4^{ND} > G_2^{ND}$). In the discriminatory case:

		<i>Actor B</i>	
		Abide	Violate
<i>Actor A</i>	Abide	$A_1 - nT - a_1Y + a_2Z$ $B_1 - (1 - n)T - b_1Y + b_2Z$	$A_2 - nT - a_1Y$ $B_2 - (1 - n)T + a_2Z$
	Violate	$A_3 - nT + a_2Z$ $B_3 - (1 - n)T - b_1Y$	$A_4 - nT$ $B_3 - (1 - n)T$

It is important to note that just like in all the other cases, fee-related discrimination result in payoff redistribution among the participants, sometimes in favor of the enforcer, but do not cause any change of strategies, while punishment-related discrimination can cause adjustment of strategies. In this case, A's strategy adjustment conditions are exactly the same as when both type-I and-type II errors probability is zero; B's situation, however, is different. Taking into account the initial payoff matrix structure, 'violation' becomes dominant strategy but square four equilibrium emerges only if $a_1 > \frac{A_4 - A_2}{Y}$.

More general and realistic is a case *when type-I and type-II errors probabilities are greater than zero but less than one*. The first assumption is that these probabilities are the same for all players.

		<i>Actor B</i>	
		Abide	Violate
<i>Actor A</i>	Abide	$A_1 - 0,5T - p_1(Y - Z)$ $B_1 - 0,5T - p_1(Y - Z)$	$A_2 - 0,5T - (1 - p_2)Z - p_1Y$ $B_2 - 0,5T - (1 - p_2)Y - p_1Z$
	Violate	$A_3 - 0,5T - (1 - p_2)Y - p_1Z$ $B_3 - 0,5T - (1 - p_2)Z - p_1Y$	$A_4 - 0,5T - (1 - p_2)(Y - Z)$ $B_4 - 0,5T - (1 - p_2)(Y - Z)$

$p_1(Y - Z) > 0$, which corresponds to assumptions above: the victim's compensation is smaller than the total value of the resources withdrawn from the player who is found guilty, and

$0 < p_1 < 1$. Similarly, $(1 - p_2)(Y - Z) > 0$. Intuitively, the higher the probabilities of type-I and type-II errors, the more reason to claim that the strategy ‘violate’ might become dominant for each of the players, even if *direct costs* related to the third-party (state’s) law enforcement services aren’t too high. If there is discrimination by the probability of wrongful decision (either administrative or judicial), other things being equal, it leads to the fact that it becomes more attractive for a subset of players to violate rules.

In case type-I and type-II probabilities are zero, threshold value of the third party services (enforcement) of the difference between the agents’ payoffs is:

$$T^* = (A_1 + B_1) - (A_4 + B_4) \quad (3)$$

The equation above means constraints for Pareto-improvement for third-party enforcement as compared with self-enforcement. Otherwise, it is:

$$T^{**} = (A_1 + B_1) - (A_4 + B_4) - 2p_1(Y - Z) \quad (4)$$

which is more powerful constraints on conditions for the players to choose the ‘abiding’ strategy, thus also choosing to respect absolute and relative (contractual) property rights. The results indicate: *type- I errors are more important from the point of view of worsening equilibrium properties and its worsening (destroying) coordination effects (mechanisms) and least not less than type-II errors evidently influencing on the level of deterrence.*

So, if compared with no-enforcer exchanges, threshold conditions under discrimination become as follows:

$$T^{***} = (A_1 + B_1) - (A_4 + B_4) - 2p_1[(a_1 + b_1)Y - (a_2 + b_2)Z] \quad (5)$$

In this case, three situations are possible:

1) discrimination in favor of one player is fully compensated by discrimination against another player:

$$2(Y - Z) = (a_1 + b_1)Y - (a_2 + b_2)Z \quad (6)$$

2) discrimination in favor of one player is less intense as regards to the outcome when compared to discrimination against another player:

$$2(Y - Z) < (a_1 + b_1)Y - (a_2 + b_2)Z \quad (7)$$

3) discrimination in favor of is more intense when compared to discrimination against another player:

$$2(Y - Z) > (a_1 + b_1)Y - (a_2 + b_2)Z \quad (8)$$

Considering the third party as a discriminating monopolist we might remove assumption of equal probabilities of the type- I and type-II errors with respect to different groups of players. In reality, this might indicate ‘double’ or even ‘triple standards’ in law enforcement (and, consequently, lack of rule of law). So, the enforcer can discriminate not only in terms of service fees, fines (sanctions) and compensations, but also in terms of varying type-I and type-II probabilities by type of the player.

Discrimination might mean in this case that the player in the worst-off position will experience both a higher probability of type-I error (unless it also affects another agent) and a lower probability of type-II error in respect of his behavior. In other words, if there is discrimination, one of its key features is an asymmetric distribution of type-I and type-II errors probabilities across discriminated actors.

So, weakening of assumption on equal levels of probability for type-I and type-II errors for different players can result in a new payoff matrix structure:

		<i>Actor B</i>	
		Abide	Violate
<i>Actor A</i>	Abide	$A_1 - nT - p_1^A a_1 Y + p_1^B a_2 Z$ $B_1 - (1 - n)T - p_1^B b_1 Y + p_1^A b_2 Z$	$A_2 - nT - p_1^A a_1 Y + (1 - p_2^B) a_2 Z$ $B_2 - (1 - n)T - p_1^A b_2 Z + (1 - p_2^B) b_1 Y$
	Violate	$A_3 - nT - (1 - p_2^A) a_1 Y + p_1^B a_2 Z$ $B_3 - (1 - n)T + (1 - p_2^A) b_2 Z - p_1^B b_1 Y$	$A_4 - nT - (1 - p_2^A) a_1 Y + (1 - p_2^B) a_2 Z$ $B_4 - (1 - n)T + (1 - p_2^A) b_2 Z - (1 - p_2^B) b_1 Y$

Moreover, if $p_1^A > p_1^B$, then $p_2^A < p_2^B$, and $a_1 > b_1$; $a_2 < b_2$.

Distortion effects can increase as a result of discrimination related to type-I and type-II errors probabilities because, as assumed, a high probability of type- II error as to player B means

a higher probability of compensation for player A and, vice versa, a low probability of punishment for player B mean a lower probability of compensation for player A. A's incentive to breach B's rights actually intensifies in comparison to the non-discriminatory case, while B's incentive to abide by the rules (and observe the rights) weaken in view of decreasing compensations and increasing sanctions.

The matrix above might be used to show selectiveness in law enforcement in terms of sanctions and compensations based on discrimination rather than on the enforcer's limited resources challenged, for example, by mass violations and by the fact that it is difficult to identify such violations (due to exceedingly strict rules) – acts and persons (Lando, 2006).

4. Types of Relationships between the Law Enactment and Enforcement in Respect to Type-I and Type-II Errors

The content of the norms themselves matters because this is precisely what fixes what is forbidden and what is allowed. Depending on the set of prohibitions, one can make assumptions about potential probabilities of type-I and type-II errors in the law enforcement, taking into account the pre-existing standards of proof (including how to determine (i) the violation - identify the very act of violation, (ii) the violator – to resolve the issue of identity; (iii) degree of fault and (iv) penalties performance¹¹).

This is why errors in the law enactment can also influence the coordination and distribution effects of economic exchanges. So, the relationships between the law enactment and law enforcement are important for any legal system's evolution and for the development of any reform or law as a component of institutional environment for business.

If we assume that law enforcement errors do not depend on the law establishment errors (both of them having an effect on the outcomes of economic exchanges), we can see nine types of interconnections between such errors (see Table 3).

Table 3

		Law Enforcement		
		Error-free	Type-I errors	Type-II errors
Law Enactment	Error-free	1.1	1.2.	1.3.
	Type-I errors	2.1.	2.2.	2.3.
	Type-II errors	3.1.	3.2.	3.3.

Before explaining these situations, let's remind ourselves that:

- (1) Errors in law enforcement can aggravate the consequences of errors in the establishment of law (strengthening effects);
- (2) In some cases, errors in law enforcement can soften the consequences of errors in the establishment of law (compensation effects);

¹¹ In fact all of these four points are not technical and automatically realized. From this point of view mistakes of act and identity is not whole story since, even if rules enforcer identifies violation and violator(s) correctly it doesn't mean there will be nor mistake in other two point. Moreover, some judicial decisions on points 1-3 might simply not applied.

(3) Different combinations of errors can influence both coordination effects of the exchanges (in terms of potential Pareto-improvement) and payoff (costs or risks) distribution among the participants of such exchanges;

(4) If errors in the law enactment are qualified in terms of missed opportunities for ultimate Pareto-improvement (i.e. for the improvement of the coordination effects of economic exchanges), errors in law enforcement are only qualified in terms of whether the sanctions applied correspond with the ‘rule — actions under regulation’ framework;

(5) And last but not least: the degree of legal uncertainty does matter for explaining outcomes and particular interrelations between errors in rules enactment and enforcement, although after Katsoulakos and Ulph (2009, 2011) we assume there is difference between legal uncertainty and legal errors. If the rules are sufficiently common to recognize in particular case appropriability of person’s behavior, it is standards of enforcement directly define exchanges outcomes. If rules are specific and does not allow socially beneficial behavior (at least with high probability as, for example, under hostile tradition in antitrust) we might identify type-I error in rules enactment (and vice versa – for type-II error).

1.1. No errors in the law enactment and enforcement. In this situation, the best available rule is chosen with a view to reaching the so-called institutional frontiers of economic exchanges¹² and having an error-free mechanism to determine and punish the violator. Such a situation would be possible if we assume zero transaction costs (a) in the quest for compromises in the establishment of rules regulating economic exchanges, and (b) in the enforcement of rules upon the participants of economic exchanges. Nevertheless, it is this point is a matter of approximation (not necessary final destination to achieve as an ultimate task).

1.2. Error-free rules combined with type-I errors in law enforcement. This is basically the situation analysed above except for the fact that the enforcer’s service fee was not determined there. The situation results in a ‘bad’ institution.

1.3. Error-free rules enactment combined with type-II errors in law enforcement. Such situation was also analysed in the previous chapter with the same exception. It also results in a ‘bad’ institution. One possible explanation is closely related to the side-effect of legal nihilism.

It is particularly cases 1.2. and 1.3. where we can say that the rules are good but they are enforced badly what is not equivalent for institutions quality qualification.

2.1. The situation of erroneous rules applied error-free can be described in the following manner. For example, there is a rule that basically equates the impairment of the counterpart’s

¹² Institutional frontiers of economic exchanges demonstrates the limits of possible with the best structural alternatives exploitation relevant for particular economic exchange according to the weal selection principle (Williamson, 1985).

interests and restriction of competition, which is clearly erroneous, but if a player's interests were impaired, the violator would be punished in such a law enforcement system.

2.2. A combination of type-I errors in both the law enactment and enforcement provides an example of an oppressive enforcer, who sets erroneous prohibitions on certain actions (non-action) and, despite such exceeding prohibitions, practices very strict law enforcement and even punishes law-abiding agents.

2.3. A combination of type-I and type-II errors, correspondingly, in law enactment and enforcement helps alleviate negative effects but this does not necessarily result in a 'good' institution.

3.1. Type-II errors in the law enactment and error-free law enforcement lead to a situation when a number of actions that should be prohibited (and a number of violators that should be punished) remain legal. This resembles a reproduction of a bilateral 'prisoners' dilemma' with third-party enforcer who is unable to change payoff matrix structure properly even if it acts error-free.

3.2. A combination of type-II errors in the law enactment and type-I errors in law enforcement. This looks like 2.3., in a way, yet it is an opposite situation. The rules don't classify actions as legal or illegal but law enforcement is such that even law-abiding players can be qualified as violators. In other words, exceedingly soft rules are corrected by rather strict law enforcement.

3.3. A combination of type-I errors in both of the law enactment and enforcement creates a situation similar to 3.1., with some exceptions. In particular, the enforcer's expenditure can be higher in 3.1. than in 3.3.

Even from this fleeting comparison of potential situations it is quite clear that, other things being equal, it is much easier to get a 'bad' institution than to create a 'good' one. This is why the specially developed mechanisms for the creation of formal institutions matter (but aren't always reachable), even though it is not a universal solution to the problems. Such a conclusion is closely related to Douglas North's remark on the institutional approach to economic exchanges (North, 1997): 'Institutional analysis in this study provides no guarantee of a happy ending'.

Analyzing the enactment of law requires an extension of the enforcer's functions for it to engage into a strategic cooperation on rules-setting with the participants of the game. Strictly speaking, analysing this law-enactment function implies that it should be considered both in relation to the law enforcement function and to the institutions mediating the development of norms, models explaining the behavior of decision-makers (in this case — of that actors who

develop and adopt formal rules), and agents they cooperate with concerning such rules¹³. In this paper, however, we focus on the grounds and limits of the so-called regulatory reform, which implies that the ‘fundamentalist’ approach is replaced with ‘functionalism’ based on the comparative analysis of discrete structural alternatives — one of the key methodological features of the new institutional economics.

The mere fact of formal rules enactment means that the enforcer, usually the state, can demonstrate different levels of activity. Variations in the level of state activity might be interpreted in terms of eliminating market failures or in terms of compensating for such failures (for example, property rights rule as compared to taxation – means of externalities internalisation).

If there is understanding among all the agents that the state has to attend to the elimination of market failures first instead of compensating for them (presumption of non-interference) when possible, the contradictions-inspired polemics will focus on whether some particular failures are removable or not (at least for now) and what is the more adequate way to handle them. In particular, should one try and provide competition by lowering the (unreasonable!) market entry barriers or by using antimonopoly control measures (stopping abuse of a dominant position)¹⁴.

In this respect, it is necessary to look into ‘functionalism’ and the ‘fundamentalist’ approaches to choosing a regulatory regime and, therefore, the level of activities by third-party enforcer. The fundamentalist approach is based on two absolute advantages.

The fundamentalist approach is based on absolute supremacy of one type of actions coordination between the participants of economic exchanges. For example, in neo-Austrian economics the market is the most advantageous means to ensure competition, which, in its turn, helps determine alternative ways of using the resources at hand and finding new resources. In fact, according to this type of fundamentalism very concept of the market failure is erroneous. Another form of the fundamentalist approach is based on the assumption (either explicit or implicit) that active state interference is preferable. This might be exemplified in the ‘Pigovian’ approach to the internalization of externalities, i.e. regulatory fundamentalism.

What makes the fundamentalist approach interesting is potential cost saving on positive research and, therefore, further cost saving on the reconciliation of research results and opportunities that derive from the balance of interest groups consolidated around certain issues of economic policy. Indeed, there is no need to develop specific institutional tools for the

¹³ From this point of view, the key question is how to ensure that legislative powers are independent from executive powers and vice versa; it is widely known as the concept of separation of powers but we do not look into it in this paper.

¹⁴ Reminder: while the first variant means active competition policy, the other one means protective, or antimonopoly policy.

evaluation of decision-making and its consequences (effects) in such a situation. Moreover, decision-makers don't even need to go deep into reasoning then because it is easier to follow the 'simplified routine' principle, which presumes non-falsifiable supremacy of some alternative, and to apply comparative analysis of discrete structural alternatives for form's sake only.

So, there is a risk that people will only try to compensate for the defects that can be cured with the help of existing tools or organizational forms if this benefits pressure groups, which make the decisive coalition in policy-making (rules enactment). (What is worse, people might think they are working in their own — yet misapprehended — interests, and such a situation is analyzed in behavioral political economics). Such situations are actually studied by Rajan and Zingales, who view political support for the free market system as always tenuous (Rajan, Zingales, 2003).

Another situation is possible too: people will try to remove some of the currently ineradicable market failures for the benefit of certain pressure groups. In this respect, the issue of business on deregulation is important: it suggests such decision that would be unprofitable to the public both in the short- and long-term but would benefit specific interest groups (at least in the short- and mid-term). This was described by Stiglitz (Stiglitz, 2003).

Actually, the concept of regulation is used in a broader sense here than in Williamson's extended contract scheme (Williamson, 2002). It implies that the state has a right to determine substantial transaction properties and also to prohibit certain actions (inaction) or the substitution of private actors (suppliers of goods and services).

Regulatory fundamentalism mostly causes type I errors, while market fundamentalism — type-II errors (see Table 4). The confrontation of the two approaches is softer on the issue of error consequences and systematic drifts in the evaluation of the consequences of law enforcement. However, distribution effects come first in both situations, while coordination effects come as a by-product (and, probably, unintended) of distribution conflicts managing (Knight, 1992).

Table 4

		Policy	
		<i>Deregulation</i>	<i>Regulation</i>
Market failures	<i>Remediable</i>	Removing defects through deregulation (improving the market as a mechanism of the coordination of actions between economic agents)	Regulation remains (e.g. excessive administrative barriers, price control, prohibitions on certain types of activities) — <i>type-I error</i>
	<i>Non-remediable</i>	Deregulation and ineradicable defects (provoking higher level of market imperfection, e.g. refusing to audit economic agents) — type- II error	Regulation and ineradicable defects (e.g., such competition-restraining horizontal agreements as cartels with fixed pricing, division of markets, etc.)

Reproduced systemically, errors in the law enactment can lead to a paradox of ‘correcting’ one error through another in the cumulative process of institutional changes. In particular, this is applied to type I errors in the establishment of law that can be compensated for by type-II errors in law enforcement, just like type-II errors in the establishment of law that can be compensated for by type-I errors in law enforcement (see situations 2.3 and 3.2 in Table 3).

This question can actually be generalized. If the total set of transactions (economic exchanges) E is divided into two subsets: A , where agents abide the rules, and V , where the rules are violated, then, at a first approximation, each subset’s share might indicate the probability the rules being violated (or abided) in each specific economic exchange. Introducing an enforcer to the game implies also introducing an additional procedure: the evaluation whether the players’ actions (non-action) are done in accordance with the rules. If the enforcer does not intrude, or intrudes without sanctions when no- violation is confirmed, then it means that the enforcer classifies the players’ actions as legitimate (A^*) and without violation. When the enforcers confirms violations caused by the players’ actions (inaction), they compose a set of all the violations detected (V^*)¹⁵. These assumptions lead us to a simple matrix that enhances the ideas in Table 5.

¹⁵ Strictly speaking, one can also distinguish between the set of economic exchanges that have been evaluated by the enforcer (E^*) and the total set of economic exchanges (E). If fictitious evaluations are not taken into account (i.e.,

evaluations in the absence of the object itself), then E^* is always smaller than E , and $\frac{E^*}{E}$ is in direct relationship to the enforcer’s ‘bandwidth capacity’.

Table 5

		Actions (inaction) compared to the rules	
		<i>A (abidance)</i>	<i>V (violation)</i>
Evaluation of the players' actions (inaction) by the enforcer	A^* (no violation confirmed)	Action is recognized by the rules and does comply with them / Action is found to comply with the rules	Action is recognized by the rules and does not comply with them / Action does not comply with the rules but is found legitimate (type II error)
	V^* (violation confirmed)	Action is classified as a violation according to the rules (type I error) / Action complies with the rules but is classified as a violation (type I error)	Action is prohibited by the rules and does not comply with them / Action is recognized as a violation

Thus, type I error probability in a set of economic exchanges can present itself in the following equation:

$$p_1 = \frac{p(A)p(V^*/A)}{p(V)p(V^*/V)+p(A)p(V^*/A)} \quad (9)$$

where $p(A)$ is the probability that the rules (rights) are observed, $p(V^*/V)$ is the probability that an illegitimate action (inaction) is recognized as a violation, and $p(V^*/A)$ is the probability that a legitimate action (inaction) is still recognized as a violation. Consequently, type-II error probability in the same set of economic exchanges can present itself in the following equation:

$$p_2 = \frac{p(V)p(A^*/V)}{p(A)p(A^*/A)+p(V)p(A^*/V)} \quad (10)$$

where $p(V) = 1 - p(A)$ is the probability that the rules (rights) are violated; $p(A^*/A)$ is the probability that an illegitimate action (inaction) is not recognized as such, and $p(A^*/V)$ is the probability that a illegitimate action (inaction) is indeed recognized as such.

These correlations and the figure show that the line between A and V can be seen as a conventional borderline between what's legal and illegal, legitimate and illegitimate. The stricter the prohibitions, the more to the left the borderline should be because the actions that used to be legitimate become illegitimate. However, a possibility that the agents' actions will be considered legitimate remains. If the borderline moves more to the right, a bigger number of actions become legal, so the probability that they will be considered legitimate is also higher.

However, type-I error probability decreases and type-II error probability increases in case the norms become stricter (all other things being equal), and the liberalization of norms causes a reverse process: type-I error probability increases while type-II error probability decreases. Yet such a compromise only depicts part of the complex situation, which can also be shown through the changes in the standards of proof. In this case, the line between rows A* and V* can become a conventional borderline. If the standards of proof improve, the borderline shifts down within column one, while the other part of the borderline (within column two) shifts up. If the standards of proof degrade, the effect is reverse. In such a situation, potentially discriminatory law enforcement and external effects (i.e. the players' strategic actions and adjustment according to the rules) are left out of sight.

The 'functionalist' approach premises on the idea that choosing an organizational form of economic exchanges can be presumption-based but requires arguments that do not refute the presumption. Such functionalist approach was partially implemented in several developed countries, where state interference was considered inadvisable. In other words, different forms of state interference (ranked by strength and impact) were compared in order to find the most acceptable one.

Before answering the question whether state regulation should remain / be introduced / be removed, it is crucial to realize that none of the variants (or even the best one possible) can ensure such an outcome (efficient use of resources) that would be better than the one caused by an alternative to state regulation.

The solution based on the functionalist approach sets very high requirements to the applicable standards of proof using the tools of social sciences, primarily economics.

Discussion and Conclusions

Nash equilibrium deviation from Pareto-efficiency is an essential logical reason for the emergence of a third-party enforcer especially for one-shot games (as well as for other finite games due to the issue of backward induction) with two options: non-discriminating and discriminating by the enforcer. Third-party services enable such a change of the payoff matrix structure against original payoff distribution corresponding to one-shot (finite) ‘prisoners’ dilemma’ that Nash equilibrium conditions will be met in case all the players abide the rules (other players’ rights). Third party efficacy might (but not necessary) ensure a Pareto-improving in the new game structure context. Third-party services costs might matter from the point of view of comparing equilibrium conditions in one-shot game with Pareto-inefficient Nash equilibria¹⁶.

In this regard, it is important to take into account that such enforcement is a compound service which includes both the punishment of violators and the restoration of the right in question through the compensation. Type-I and type-II errors on the side of third-party enforcer affect both payoff distribution between the players and the third-party enforcer and coordination properties of equilibrium. Type-I errors causing higher enforcer-related full costs of players become especially important in this context weakening or even destroying cooperation among players (in non-antitrust cases). The result received support ideas by Rizolli and Stanca (2012): type-I errors have a stronger effect on deterrence than type-II errors but without any special assumptions on type-I errors aversion, risk or loss aversion.

There are different ways of discrimination by the enforcer against the participants of economic exchanges, including: a) differentiation in terms of the price of the services, b) differentiation of sanctions for the same violation (including false-positive cases), c) differentiation of the size of compensation, d) differentiation of the probability of sanctions use. Third-party enforcer discrimination in terms of the price of the services provided to the participants of economic exchanges doesn’t itself directly cause strategy adjustments and, therefore, a change in equilibrium conditions, while other kinds of discrimination can influence equilibrium properties. It is reflected in effects of type- I and type-II errors for discrimination cases too.

Quality of institution evaluation is related to limiting factor within relation “rule enforcement – rule enactment”. It reflects complementarity rather than substitutability of institutions elements whereas substitutability is a secondary aspect in institutions influencing

¹⁶ Nevertheless, it doesn’t allow to make definite conclusions considering case compatibility (with and without third-party enforcer due to the subjectivity of gains evaluation by the participants of economic exchanges).

exchanges results. Under assumption of complementarity issues of type-I and type-II errors are reconfigured both on side of opportunities set and effects to be analyzed.

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