REGULATION IN PURE AND HYBRID FORMS: SCHEME OF POSSIBILITIES

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This note is an elaboration on a calculation (footnote 46) made in: M.A. Heldeweg, Hybrid Regulation as a Legal Design Challenge, In: A.L.B. Colombi Ciacchi, B.M.J. van der Meulen, M.A. Heldeweg, A.R. Neerhof, *Law and Governance: Beyond the Public-Private Divide*, The Hague, Eleven 2014.

Introductory remarks

Assume that there are 4 pure options as types of regulation: a, b, c, d.

Single pure options can be applied as combinations of options:

1. Remaining pure: a^n, or b^n, or c^n, or d^n (^{n} = the number of positions – see below).
2. Mixed, making hybrid combinations, such as abcd.

In theory such combinations of options, whether pure or hybrid, may extend over many 'positions'.[2]
Here we will demonstrate possible combinations to the maximum of as many positions (i.e. 4) as there are options (i.e. 4) – as in abcd (i.e. not extending to abcdabcdabc etc.).
In doing so, not only do we yield (N^n) 4^4=256 combinations of four positions, but also 4^3 (=64) and 4^2 (=16) combinations of three and two positions, so together: 256+64+16=336.
If we also include the four single pure positions/options, then our total of (4) singles plus all combinations to a maximum four positions amounts to ($4^1+4^2+4^3+4^4$=) 340
Furthermore, given that options come with three aspects (standard setting, monitoring, enforcing – say N^x, N^y and N^z), but that one or two of these may (certainly theoretically) become hybrid (e.g. single, $a(x^a, y^a, z^b)$ or dual, $b(x^b, y^c, z^d)$), the afore maximum of 340 can rise to 238.343.500 (including pure combinations of options (e.g. aa, bbb and cccc) and including combinations of which not all included options come with single or dual aspect-hybridity). In doing so we assume that at least one (dominant) aspect has to be consistent with the nature of the option.[3]

Elaboration

In the below we show options (N) and positions (n).
First (A), we show pure forms, 16 in all.
Second (B), we show full hybrids, 16 in all, or 60 when the order (of options in positions) is not randomly interchangeable (e.g. abcd ≠ bcda).[4]

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[2] Regardless of their type of configuration – sequential/serial, parallel, iterative etc.

[3] Clearly, here we face the theoretical question if and when aspect hybridity, certainly of a dual nature (given a maximum of three aspects), will turn one pure option (e.g. b) into another (e.g. c). Should, or when should we conclude that $b(x^b, y^c, z^c)$ is in fact more adequately presented as $c(x^b, y^c, z^c)$? For sure an option such as $a(x^b, y^c, z^d)$ does not make sense, even if the nature of an option also depends on its external recognition as a (regulatory) function(ality) within a particular institutional context – e.g. of markets, civil networks or government hierarchy. We assume that purity of nature is necessarily (also) determined by the specific nature of the dominant one or more/most aspects (e.g. 'enforcement/sanction determines nature of control and consequently the nature of the regulatory option) if not by all aspects being of an alike nature. In the latter case, purity is a strict quality and as a label, 'purity' should be used with care – but even then we can think of instances of aspect hybridity, which we would not label as intrinsically pure, that distinguish options and combinations, as in (extrinsic hybrids such as): $a(x^a, y^a, z^a)$- $b(x^b, y^b, z^b)$ versus $a(x^a, y^b, z^a)$- $b(x^b, y^b, z^b)$. (Note intrinsic purity/hybridity refers to the single option; extrinsic purity/hybridity to the combination of options).

[4] A combination is non-random if the ordering of options (e.g. abcd) is expressive of a certain sequence or (other) functional configuration of options. E.g. sequence would mean that the first option should be applied/deployed before (as a necessary prerequisite to) one or more others, which in turn should be… etc. In those cases, the order of options matters as it fine-tunes our understanding of possible variety amongst randomly ordered combinations.

Next (C), partial hybrids are listed, 24 in all, or 228 in non-random order.
Finally (D), all 238.343.500 possibilities are calculated (as there are simply too many), when varying options in case of single or dual aspect hybridity (N^x, N^y, N^z).

A – PURE FORMS

Options a, b, c and d may present themselves as single, pairs, threesomes and foursomes ***- 16*** *pure forms in all (N*n=4*4=16)*

a	aa	aaa	aaaa
b	bb	bbb	bbbb
c	cc	ccc	cccc
d	dd	ddd	dddd

B – FULL HYBRIDS (only one of each option across positions)

Options a, b, c and d may present themselves as ***random full hybrid*** *pairs (B1), threesomes (B2) and a foursome (B3) –* ***11*** *in all.*
In case of ***non-random full hybrid*** *combinations, we yield* ***60*** *combinations.*
These numbers follow from applying factorial mathematics (N!/(N-n)!) in each type of combination (pairs, threesome, foursome).
The total no. of full hybrids is a summation of the number of combinations for pairs, threesomes and foursomes respectively.

B1 Full hybrid pairs

- Non Random: **12** (4!/2!=4*3*2*1/2.1=24/2=12)
- Random: **6** (12/2!=12/(2*1=)2=6)

Full Hybrid pairs						
Random	ab	ac	ad	bc	bd	cd
Non random	ab	ac	ad	bc	bd	cd
	ba	ca	da	cb	db	dc

B2 Full hybrid threesomes

- Non Random: **24** (4!/1!=4*3*2*1/1=24/1=24)
- Random: **4** (24/3!=24/(3*2*1=)6=4)

Full hybrid threesomes						
Random **4**	Non-random **24**					
abc	abc	acb	bca	bac	cab	cba
bcd	bcd	bdc	cdb	cbd	dbc	dcb
cda	cda	cad	dac	dca	acd	adc
dab	dab	dba	abd	adb	bad	bda

B3 Full hybrid foursome(s)

- Non Random: **24** (4!=4*3*2*1=24)
- Random: **1** (24/4!=24/(4*3*2*1=)24=1)

Full hybrid foursome(s)						
Random **1**	Non-random **24**					
abcd	abcd	abdc	acdb	acbd	adbc	adcb

We could, in theory distinguish between kinds of combinations (sequential, parallel, iterative), but haven't for reason of not wanting to overcomplicate here (similar to not discussion combinations with more than 4 positions).

-	bcda	bcad	bdac	bdca	bacd	badc
-	cdab	cdba	cabd	cadb	cbad	cbda
-	dabc	dacb	dbac	dbca	dcab	dcba

C – PARTIAL HYBRIDS

Options a, b, c and d may present themselves as ***random partial hybrids****, threesomes (C1) and a foursome (C2) – 42 in all (of course, not including hybrid pairs, inescapably full hybrids).*
In case of ***non-random partial hybrid*** *combinations, we yield* ***264*** *combinations.*
These numbers follows from applying factorial mathematics (N!/(N-n)!) in each type of combination (pairs, threesome, foursome).

C1 Partially hybrid threesomes

- Non Random: **36** (N*1*(N-1)) = (4*1*3).3=36)
- Random: **12** (4*3*1)

Partially hybrid threesomes – two of a single kind (as in: xxy)			
Random **12**	Non-random **36**		
aab	aab	Aba	baa
aac	aac	aca	caa
aad	aad	ada	daa
bba	bba	bab	aba
bbc	bbc	bcb	cbb
bbd	bbd	bdb	dbb
cca	cca	cac	acc
ccb	ccb	cbc	bcc
ccd	ccd	cdc	dcc
dda	dda	dad	add
ddb	ddb	dbd	bdd
ddc	ddc	dcd	cdd

C2 Partially hybrid foursomes

- Non Random: **228** {[(4*1*1*3)*4]+[(4*1*3*1)*6]+[(4*1*3*2)*12]=48+36+144=228}
- Random: **30** (12+6+12=24)

We split possibilities according to types of ordering (three of single kind; two doubles; one double and two singles – three tables:

Partially hybrid foursomes – three of a single kind (as in: xxxy)				
Random **12**	non-random **48** [(4*1*1*3)*4=48]			
aaab	aaab	aaba	abaa	baaa
aaac	aaac	aaca	acaa	caaa
aaad	aaad	aada	adaa	daaa
bbba	bbba	bbab	babb	abbb
bbbc	bbbc	bbcb	bcbb	cbbb
bbbd	bbbd	bbdb	bdbb	dbbb
ccca	ccca	ccac	cacc	accc
cccb	cccb	ccbc	cbcc	bccc
cccd	cccd	ccdc	cdcc	dccc
ddda	ddda	ddad	dadd	addd
dddb	dddb	ddbd	dbdd	bddd
dddc	dddc	ddcd	dcdd	cddd

Partially hybrid foursomes – two doubles (as in: xxyy)						
Random **6**	Non-random **36** [{(4*1*3*1)*6}:2=36]					
aabb	aabb	abba	abab	bbaa	baba	baab
aacc	aacc	acca	acac	ccaa	caca	caac
aadd	aadd	adda	adad	ddaa	dada	daad
bbcc	bbcc	bccb	bcbc	ccbb	cbcb	cbbc
bbdd	bbdd	bddb	bdbd	ddbb	dbdb	dbbd
ccdd	ccdd	cddc	cdcd	ddcc	dcdc	dccd

Partially hybrid foursomes – one double and two singles (as in: xxyz)												
Random **12**	Non-random **144** [{(4*1*3*2)*12}:2=144]											
aabc	aabc	aacb	abac	abca	acab	acba	baac	baca	bcaa	caab	caba	cbaa
aabd	aabd	aadb	abad	abda	adab	adba	baad	bada	bdaa	daab	daba	dbaa
aacd	aacd	aadc	acad	acda	adac	adca	caad	cada	cdaa	daac	daca	dcaa
bbac	bbac	bbca	babc	bacb	bcba	bcab	abbc	abcb	acbb	cbba	cbab	cabb
bbad	bbad	bbda	babd	badb	bdba	bdab	abbd	abdb	adbb	dbba	dbab	dabb
bbcd	bbcd	bbdc	bcbd	bcdb	bdbc	bdcb	cbbd	cbdb	cdbb	dbbc	dbcb	dcbb
ccab	ccab	ccba	cacb	cabc	cbca	cbac	accb	acbc	abcc	bcca	bcac	bacc
ccad	ccad	ccbd	cacd	cadc	cdca	cdac	accd	acdc	adcc	dcca	dcac	dacc
ccbd	ccbd	ccdb	cbcd	cbdc	cdcb	cdbc	bccd	bcdc	bdcc	dccb	dcbc	dbcc
ddab	ddab	ddba	dadb	dabd	dbda	dbad	addb	adbd	abdd	bdda	bdad	badd
ddac	ddac	ddca	dadc	dacd	dcda	dcad	addc	adcd	acdd	cdda	cdad	cadd
ddbc	ddbc	ddcb	dbdc	dbcd	dcdb	dcbd	bddc	bdcd	bcdd	cddb	cdbd	cbdd

D – PURE AND HYBRIDS COMBINATIONS WITH VARYING ASPECTS (x, y, z)

Given all 340 possibilities, from pure singles to partially hybrid foursomes, we may yet add one more layer, by also taking regard of the three basic aspects (i.e. x, y, and z) connected to each option (i.e. a, b, c and d). Effectively with each position (single or as part of a pair, threesome or foursome) the option concerned (i.e. a, b, c or d) may be intrinsically pure (i.e. not be intrinsically hybrid on any aspect), it may be singularly intrinsically hybrid (one out of aspects x, y, z is of another nature) or dually intrinsically hybrid (two out of aspects x, y, z is of another nature).[5] *Furthermore, there is in fact a fifth option, that of an aspect being absent, say '-'.*

To calculate, we divide al combinations of three aspects across four positions. Consequently, we first need to determine the total number of combinations of three aspects. Each aspect has five options (i.e. a, b, c, d and -). Thus we have five variables (V) across 3 positions (p). Using the formula V^p, we yield 5^3 combinations. One of these combinations, however, that is '- - -', is impossible (as it would signify an absent instrument), so actually we yield 5^3-1 combinations. Next we need to divide all of these (5^3-1) combinations across four positions (P=4). This produces a total of $(5^3-1)^4$ = 236.421.376 combinations.
The same method will produce the additional number of combinations for (only) three, (only) two and (only) one position(s).

In all this leads to the following final and total addition:
- 4 positions only: $(5^3-1)^4$ = 236.421.376
- 3 positions only: $(5^3-1)^3$ = 1.906.624
- 2 positions only: $(5^3-1)^2$ = 15.376
- 1 position only: $(5^3-1)^1$ = 124
- all = **238.343.500**

[5] See footnote 3.