The Neural Basis of Financial Risk-Taking*

Supplementary Material

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Optimal Portfolio Selection Strategy

During trial τ in each block, a rational risk-neutral agent should pick stock *i* if he/she expects to receive a dividend D^i_τ at least as large as the bond earnings, that is, if:

$E[D^i_\tau|I_{\tau 1}] >= E[D^B_\tau|I_{\tau-1}] = 1$, where $I_{\tau-1}$ is the information set up to trial τ-1.

That is: $I_{\tau-1}=\{D^i_t | \forall t \leq \tau-1, \forall i \in \{Stock\ T, Stock\ R, Bond\ C\}\}$.

Let x^i_τ = Pr{ Stock *i* = Good $|I_{\tau-1}\}$. Then:

$E[D^i_\tau|I_{\tau-1}] = x^i_\tau$ [0.5 * 10 + 0.25 * (-10) + 0.25 * 0] + (1 - x^i_τ) [0.5 * (-10) + 0.25 * 10 + 0.25 * 0] = 2.5 * ($2x^i_\tau$ - 1)

Hence, a risk-neutral agent will pick stock *i* only when his belief x^i_τ is such that:

2.5 * ($2x^i_\tau$ - 1)>=1 $\Leftrightarrow$ x^i_τ >= 0.7

If the agent's beliefs are weak, that is: x^i_τ<0.7, $\forall i \in \{Stock\ T, Stock\ R\}$, then the optimal strategy for the risk-neutral agent is to pick the bond in trial τ.

A rational agent should update his or her beliefs x_τ^i according to Bayes' rule.

In this paper, we refer to the *uncertainty* of a trial τ, defined as $min(x_\tau^i, x_\tau^j)$, where $i,j \in \{StockT, StockR\}$ and $i \neq j$. Hence, the uncertainty is highest (and equal to 0.5) at the beginning of a block, because at that point the probability of either one of the stocks being the good one is 50%. The uncertainty decreases as more information about dividends is revealed and it becomes clearer which stock dominates.

Tables

Table S1: Determinants of left NAcc, anterior insula and MPFC activation during the OUTCOME period, for trials where a STOCK was chosen. $CumEarnings_t$ is wealth accumulated during the task up to and including trial *t*. $Uncertainty_t$ is defined as min(Pr{Stock T = Good | History}, Pr{Stock R = Good | History}). $+10.00_t$ is an indicator variable equal to 1 if the dividend paid by the stock on trial *t* was +10. -10.00_t is an indicator variable equal to 1 if the dividend paid by the stock on trial *t* was -10. Subject fixed effects included.

Dependent variable	$lNAcc_t^{OUT}$	$linsul_t^{OUT}$	$lMPFC_t^{OUT}$
	Coef.	Coef.	Coef.
-10.00_t	-0.0138	0.0224	-0.0076
	(0.56)	(1.21)	(0.26)
$+10.00_t$	0.0838	0.0013	0.1408
	(3.85)***	(0.08)	(5.23)***
$Uncertainty_t$	-0.0322	0.0063	-0.1090
	(0.49)	(0.14)	(1.59)
$CumEarnings_{t-1}$	-0.0000	0.0001	0.0001
	(0.16)	(1.07)	(1.30)
Constant	0.1083	0.0992	-0.0219
	(2.27)**	(2.57)**	(0.27)
Observations	2036	2036	2036
R-sq	0.0581	0.0518	0.0434

Robust t statistics in parentheses. Robust standard errors. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table S2: Determinants of left NAcc, anterior insula and MPFC activation during the MARKET period, for trials where a STOCK was chosen. $CumEarnings_t$ is wealth accumulated during the task up to and including trial *t*. $Outcome_t$ are earnings made on trial *t*. $Uncertainty_t$ is defined as min(Pr{Stock T = Good | History}, Pr{Stock R = Good | History}). $+20_t$ is an indicator variable equal to 1 if the difference between the dividend paid by the chosen stock and that paid by the not chosen stock is equal to +20. -20_t is an indicator variable equal to 1 if the difference between the dividend paid by the chosen stock and that paid by the not chosen stock is equal to -20. $+10_t$ and -10_t are defined similarly. Subject fixed effects included.

Dependent variable	$lNAcc_t^{MKT}$	$linsul_t^{MKT}$	$lMPFC_t^{MKT}$
	Coef.	Coef.	Coef.
-20.00_t	-0.0159	0.0551	0.0295
	(0.46)	(1.87)*	(0.64)
-10.00_t	0.0227	0.0388	-0.0519
	(0.80)	(1.75)*	(1.63)
$+10.00_t$	0.0525	-0.0174	0.0732
	(2.23)**	(0.83)	(2.43)**
$+20.00_t$	0.0531	-0.0619	0.0918
	(2.10)**	(2.78)***	(2.83)***
$Outcome_t$	0.0015	0.0021	-0.0009
	(1.08)	(1.80)*	(0.51)
$Uncertainty_t$	0.0619	-0.0898	0.0513
	(1.04)	(1.70)*	(0.71)
$CumEarnings_{t-1}$	0.0001	0.0001	0.0000

	(0.85)	(1.76)*	(0.15)
Constant	-0.1496	-0.1505	-0.2006
	(3.94)***	(3.82)***	(2.42)**
Observations	2036	2036	2036
R-sq	0.0237	0.0314	0.0347

Robust t statistics in parentheses. Robust standard errors. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table S3: Determinants of left NAcc, anterior insula and MPFC activation during the MARKET period, for trials where the BOND was chosen. $CumEarnings_t$ is wealth accumulated during the task up to and including trial *t*. $Uncertainty_t$ is defined as min(Pr{Stock T = Good | History}, Pr{Stock R = Good | History}). Since subjects chose the bond, which yielded +1, we define $+11_t$ as an indicator variable equal to 1 if the maximum dividend paid by either stock was -10 (1-(-10)). -9_t is an indicator variable equal to 1 if the maximum dividend paid by either stock was +10 (1-10). Subject fixed effects included.

Dependent variable	$lNAcc_t^{MKT}$	$linsul_t^{MKT}$	$lMPFC_t^{MKT}$
-9.00_t	-0.0280	0.0062	-0.0153
	(1.23)	(0.32)	(0.63)
$+11.00_t$	-0.0318	0.0352	0.1199
	(0.96)	(1.24)	(3.26)***
$Uncertainty_t$	-0.0788	-0.1976	-0.1531
	(1.16)	(3.40)***	(2.04)**
$CumEarnings_{t-1}$	-0.0000	0.0001	-0.0001
	(0.06)	(0.62)	(0.68)
Constant	0.0615	0.0928	0.1307
	(1.22)	(1.96)**	(1.58)
Observations	1708	1708	1708
R-sq	0.0161	0.0387	0.0548

Robust t statistics in parentheses. Robust standard errors. * significant at 10%, ** significant at 5%, *** significant at 1%.