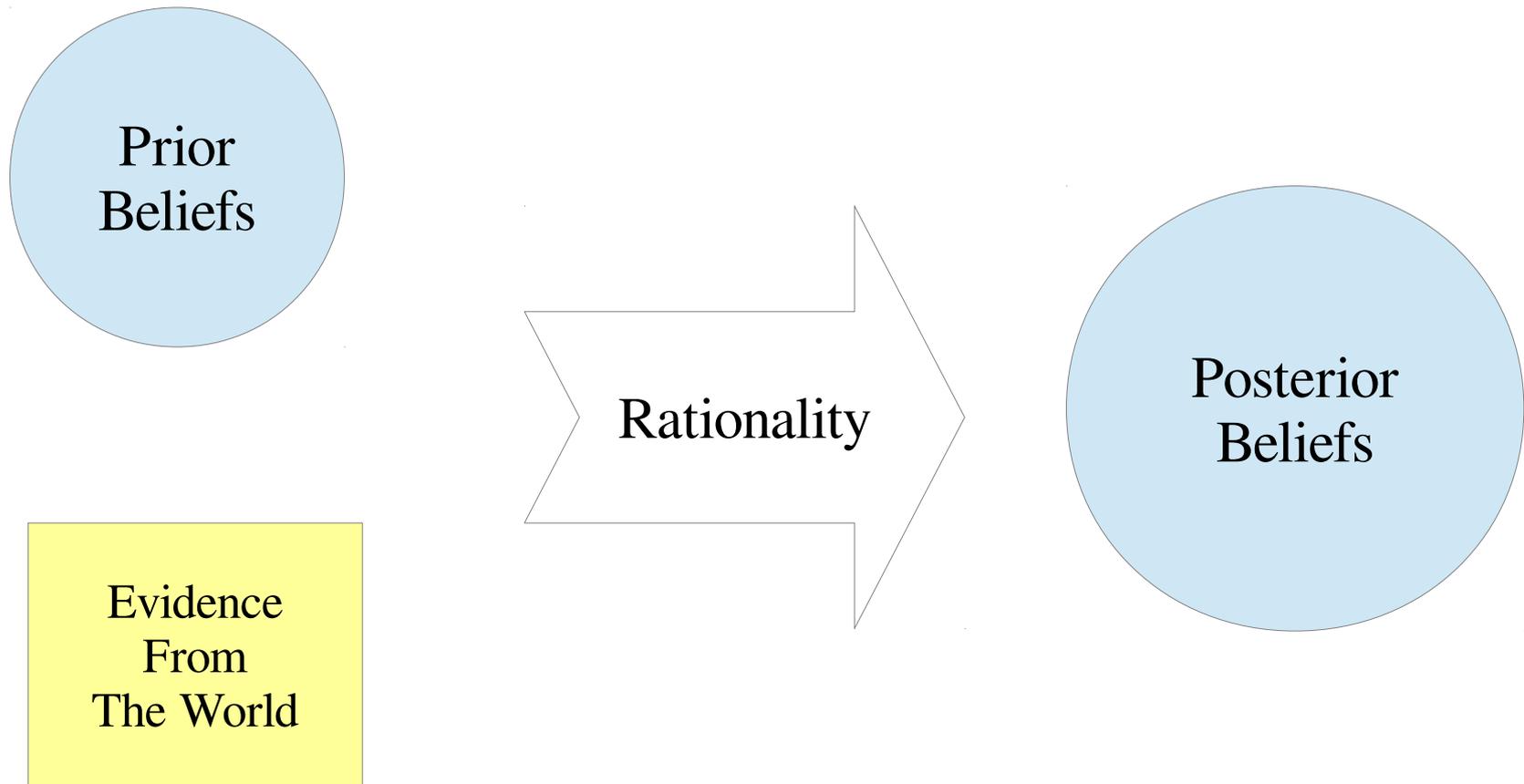


The credit economy and the economic rationality of science

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Philosophy of science



Standards

- Convergence in the limit (statistical consistency)
- Conservatism
- Accuracy

Arational choices?

- How much time should I dedicate to science?
- What experiments should I perform?
- What project should I work on?
- Should I publish now or later?
- Where should I publish?

Etc.

Epistemic vs. instrumental rationality

- Some have suggested there are two senses of rationality
- The progress of science depends critically on both epistemic and instrumental choices

Economic rationality

- “Rationality” in economics is about means (not ends)
- Are all scientist's ends equally “rational”?

Ends of scientists

- Truth or useful theories
- Publications, credit for their discoveries, acclaim, fame, respect, invitation to conferences, appointment to government panels,
- Revenge, furthering political agenda, promotion to university administration

Only truth

Students must be careful to insist that science as such— be it physics, chemistry, psychology, or sociology— has but one simple aim: the discovery of truth. Its results lie open for the use of all ... but the aim of science itself is simple truth. Any attempt to give it a double aim, to make social reform the immediate instead of the mediate object of a search for truth, will inevitably tend to defeat both objects.

W.E.B. Dubois, 1898

Credit

Credit

Solves a public goods problem

Dasgupta, P., & David, P. A. (1994). Toward a New Economics of Science. *Research Policy*, 23(5), 487–521.

Stephan, P. E. (1996). The Economics of Science. *Journal of Economic Literature*, 34(3), 1199–1235.

Credit

Solves a public goods problem

Solves a labor allocation problem

Kitcher, P. (1990). The Division of Cognitive Labor. *The Journal of Philosophy*, 87(1), 5–22.

Strevens, M. (2003). The Role of the Priority Rule in Science. *Journal of Philosophy*, 100(2), 55–79..

Credit

Solves a public goods problem

Solves a labor allocation problem

Effects the “communist norm”

Michael Strevens (forthcoming) Scientific sharing: Communism and the social contract. In Thomas Boyer-Kassem, Conor Mayo-Wilson, and Michael Weisberg, editors, *Scientific Collaboration and Collective Knowledge*. Oxford University Press, Oxford.

Heesen, Remco (manuscript) Communism and the incentive structure of science

Credit

Solves a public goods problem

Solves a labor allocation problem

Effects the “communist norm”

Causes errors or fraud

Ionnidis, J.P. (2005) Why most published research findings are false. PLoS Medicine 2: e124

Heesen, R. (manuscript) Expediting the flow of knowledge versus rushing into print

Bright, L. (manuscript) On fraud

Features of particular credit systems

File drawer problem

Significance chasing

Low risk versus high risk science

Gender and racial disparities

Credit

Solves a public goods problem

Solves a labor allocation problem

Effects the “communist norm”

Causes fraud

Credit

Solves a public goods problem

Solves a labor allocation problem

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Causes fraud

Prof. Crusoe

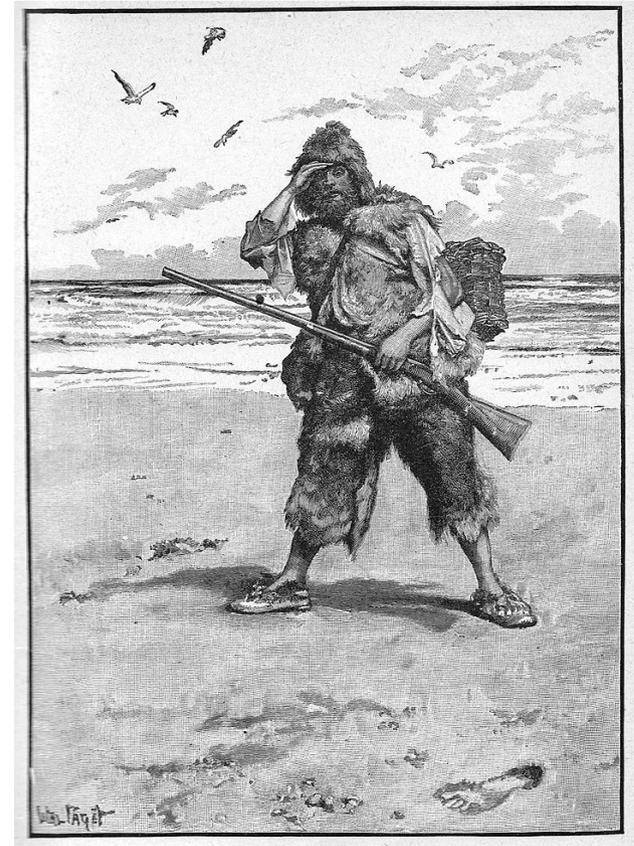
Utility of science

$$u(x) = \sqrt{x} + a\sqrt{1-x}$$

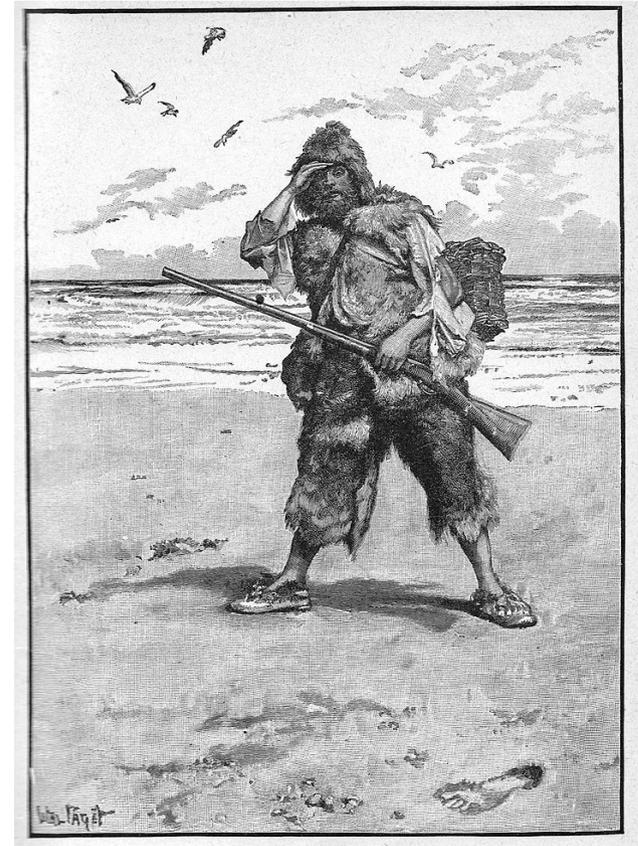
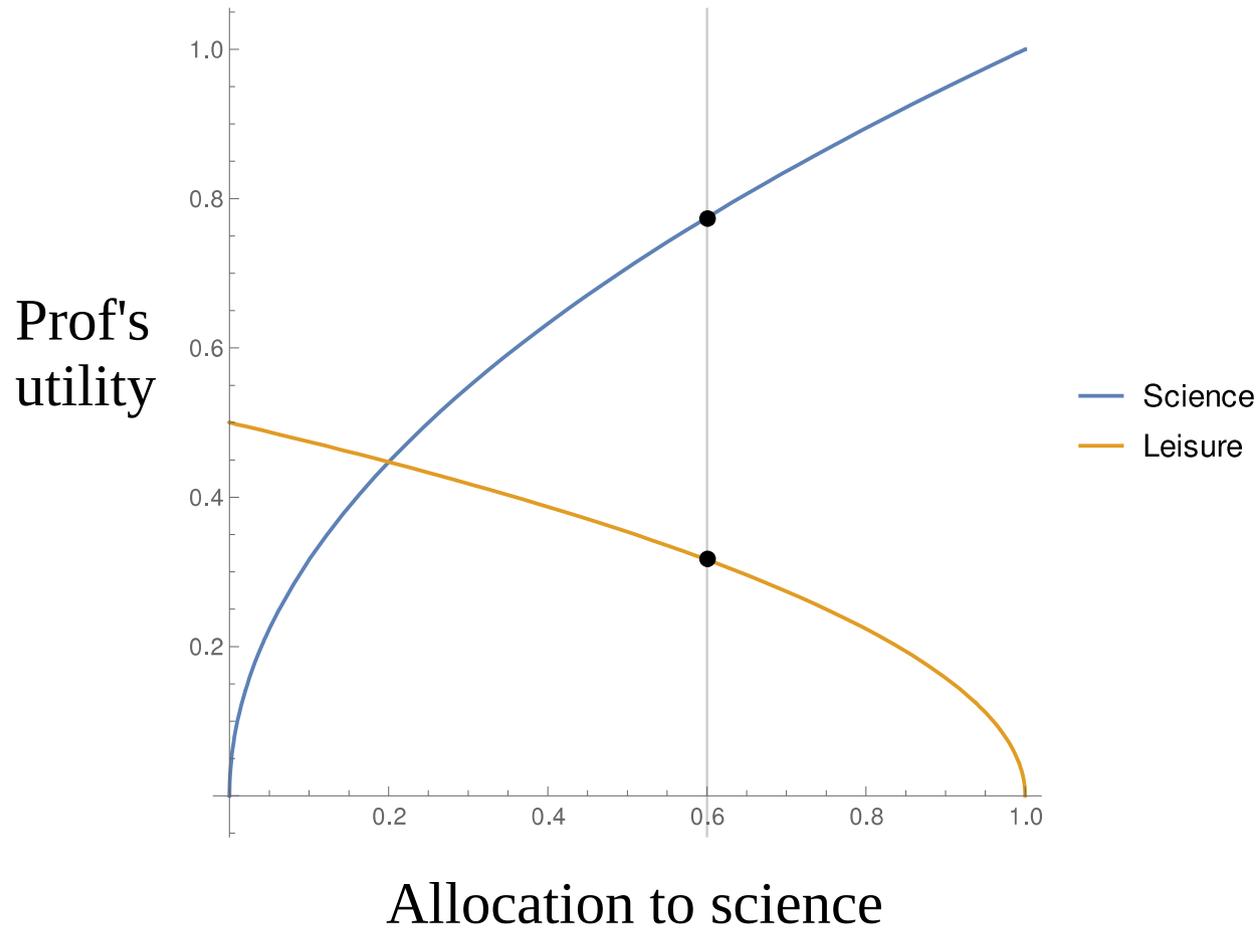
Relative Value of Leisure and Science

Utility of leisure

The diagram illustrates the utility function $u(x) = \sqrt{x} + a\sqrt{1-x}$. The term \sqrt{x} is highlighted in a blue box and labeled "Utility of science". The term $a\sqrt{1-x}$ is highlighted in an orange box and labeled "Utility of leisure". The parameter a is labeled "Relative Value of Leisure and Science". Arrows indicate the flow of information from the labels to the corresponding parts of the equation.



Prof. Crusoe



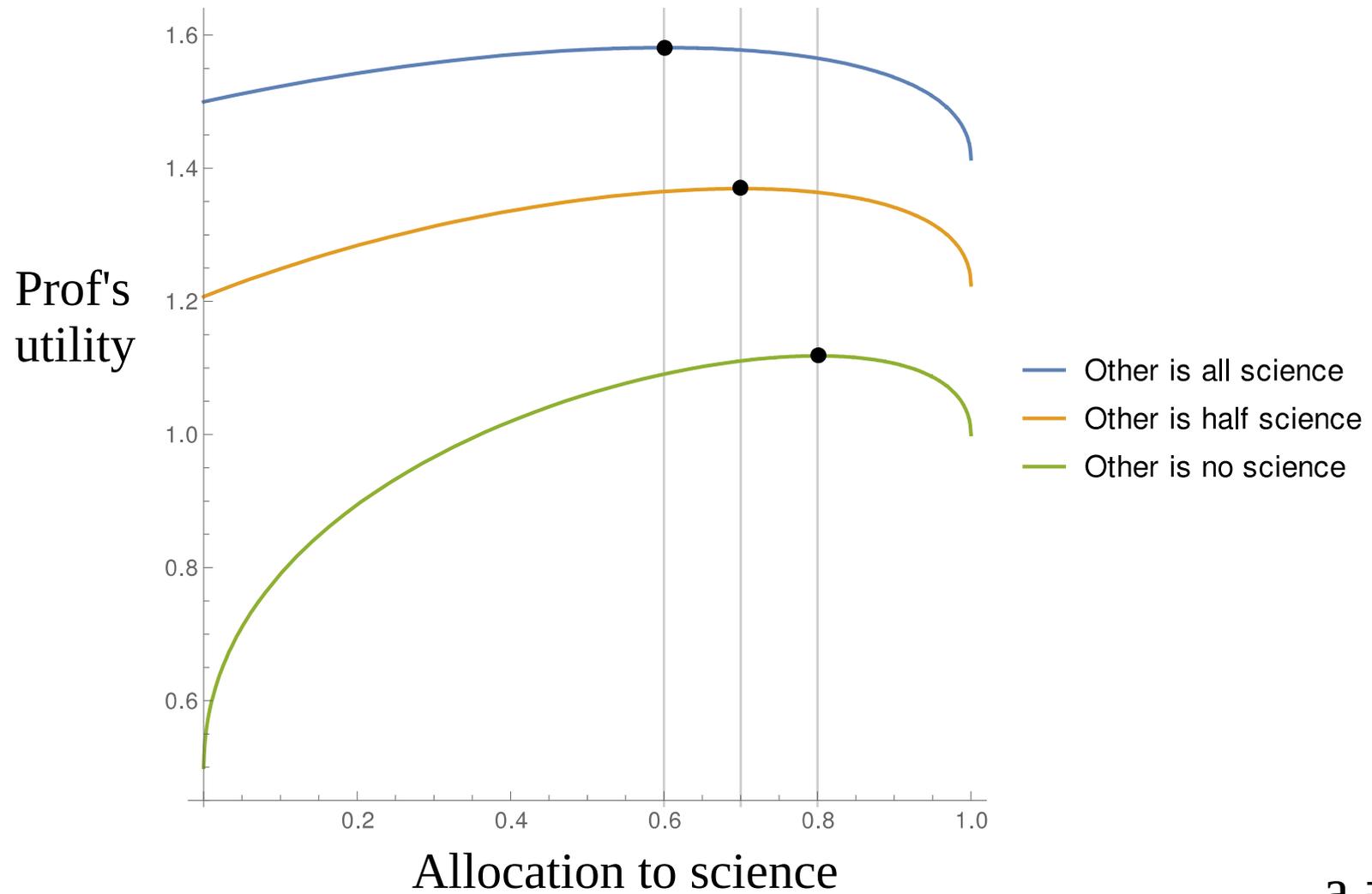
Two Scientists

$$u_1(x, y) = \sqrt{x + y} + a\sqrt{1 - x}$$

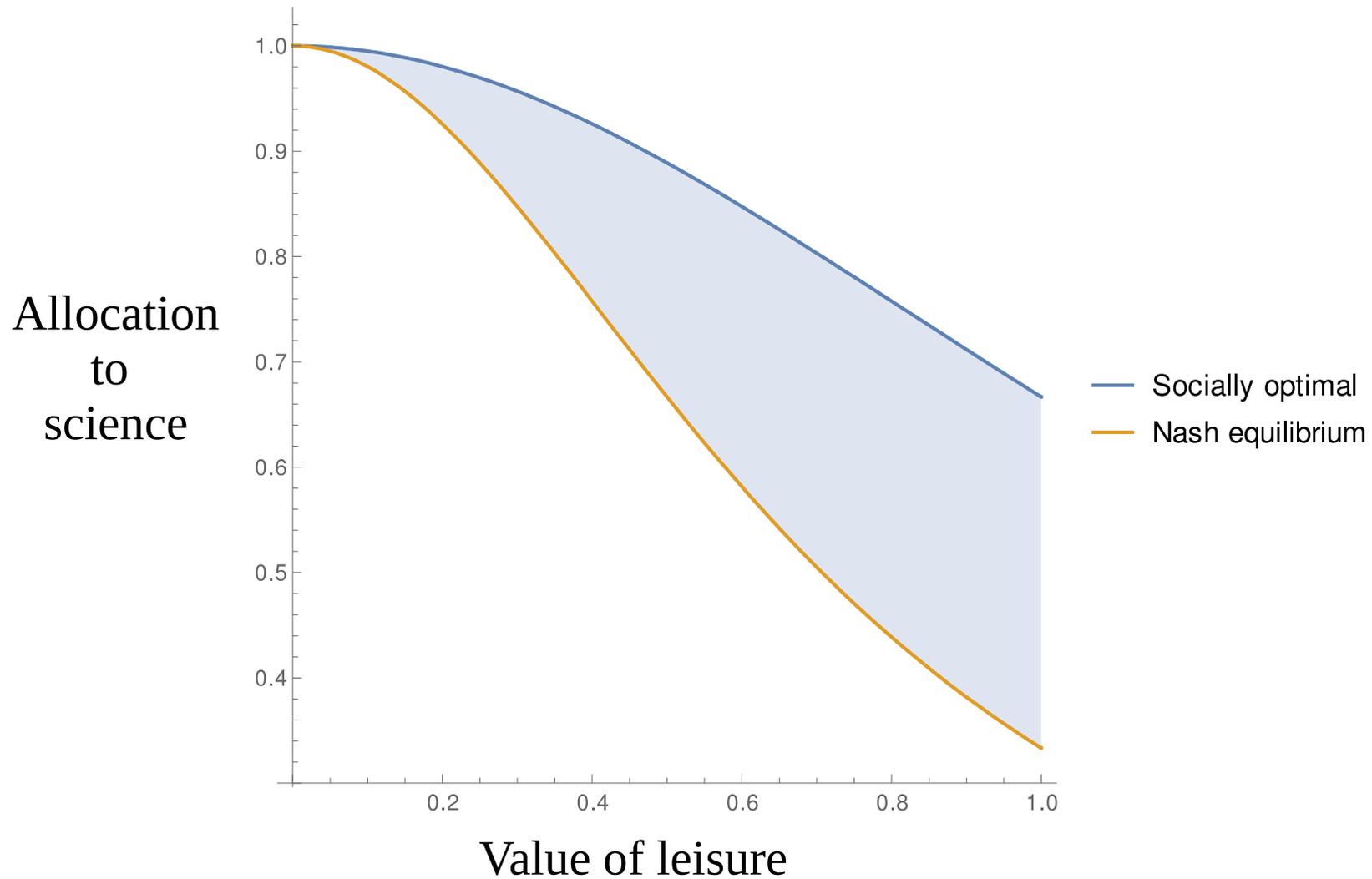
Utility of science

Utility of leisure

Two scientists



Two Scientists

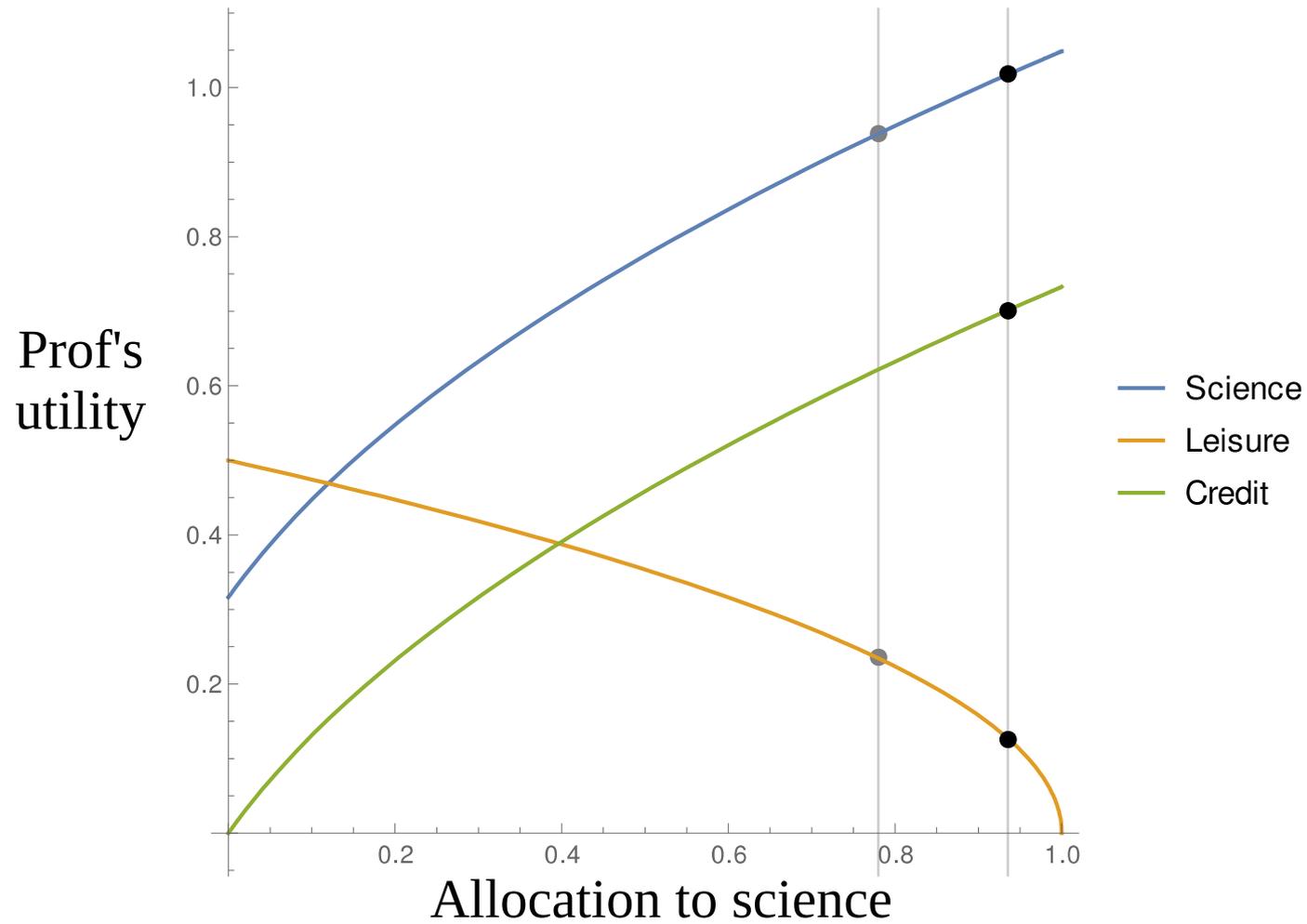


Adding credit

$$u_1(x, y) = \underbrace{\sqrt{x + y} + a\sqrt{1 - x}}_{\text{Non-credit utility}} + \underbrace{b}_{\text{Relative value of credit}} \underbrace{\left(\sqrt{x + y} - \sqrt{y}\right)}_{\text{Marginal contribution to science}}$$

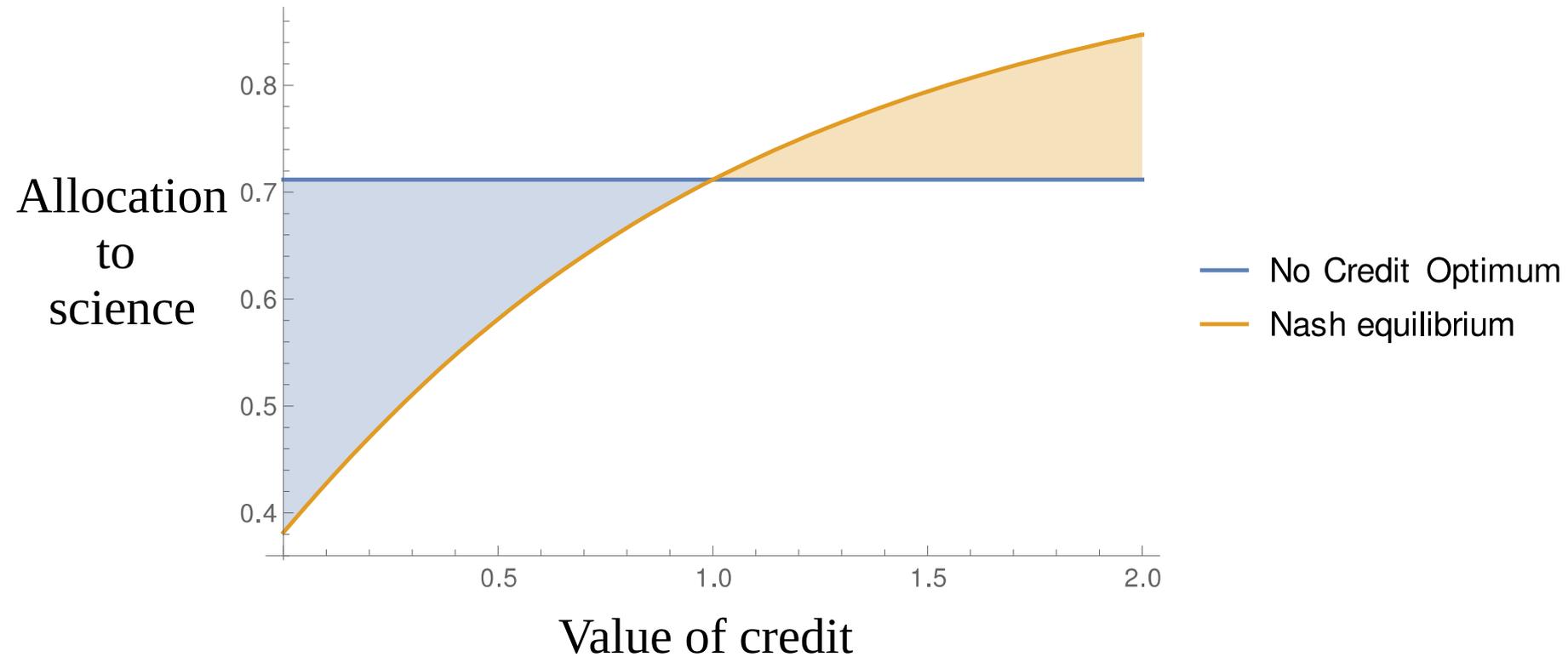
The diagram illustrates the utility function $u_1(x, y)$ as the sum of two components. The first component, $\sqrt{x + y} + a\sqrt{1 - x}$, is highlighted in a light blue box and labeled "Non-credit utility". The second component, $b(\sqrt{x + y} - \sqrt{y})$, is highlighted in a light green box and labeled "Marginal contribution to science". The coefficient b is highlighted in a light purple box and labeled "Relative value of credit". Arrows point from the labels to their respective parts in the equation.

Adding credit



$$a = 0.5$$
$$b = 1$$
$$y = 0.1$$

Solves the social dilemma



$a = 0.5$

Generality

- Any number of scientists
- Many science “production” functions
- Many leisure functions
- Many forms of credit functions
- Heterogeneity in all of the above

Credit

Solves a public goods problem

Solves a labor allocation problem

Effects the “communist norm”

Causes fraud

Credit

Solves a public goods problem

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Prof. Crusoe redux

Utility of project one

$$u(x) = \sqrt{x} + a\sqrt{1-x}$$

Relative “quality” of project two

Utility of project two

The diagram shows the utility function $u(x) = \sqrt{x} + a\sqrt{1-x}$. The term \sqrt{x} is highlighted in a blue box, and the term $a\sqrt{1-x}$ is highlighted in an orange box. An arrow points from the text 'Utility of project one' to the blue box. An arrow points from the text 'Relative “quality” of project two' to the orange box. Another arrow points from the text 'Utility of project two' to the orange box.



Society of scientists

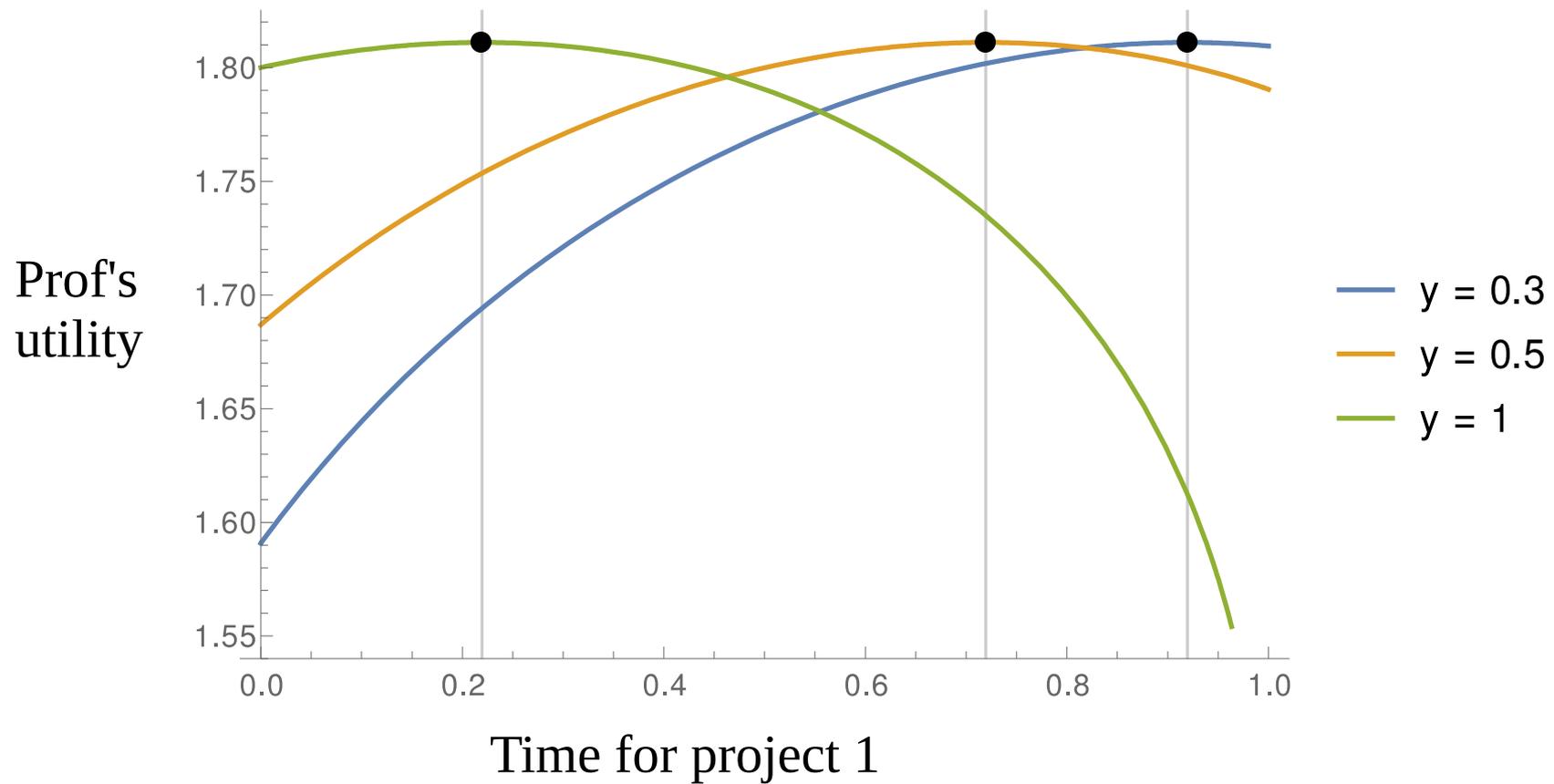
Utility of project one

$$u_1(x, y) = \sqrt{x + y} + a\sqrt{(1 - x) + (1 - y)}$$

Relative "quality" of project two

Utility of project two

Society of scientists



$a = 0.8$

Social optimality

- With these utility functions social optimality and individual choice will never come apart
- This generalizes to any utility function where all scientists are aiming for the same ends

Adding credit

Option 1: Credit follows marginal contributions to both projects

- Credit has no additional effect

Option 2: One project wins and takes all the credit

Adding credit

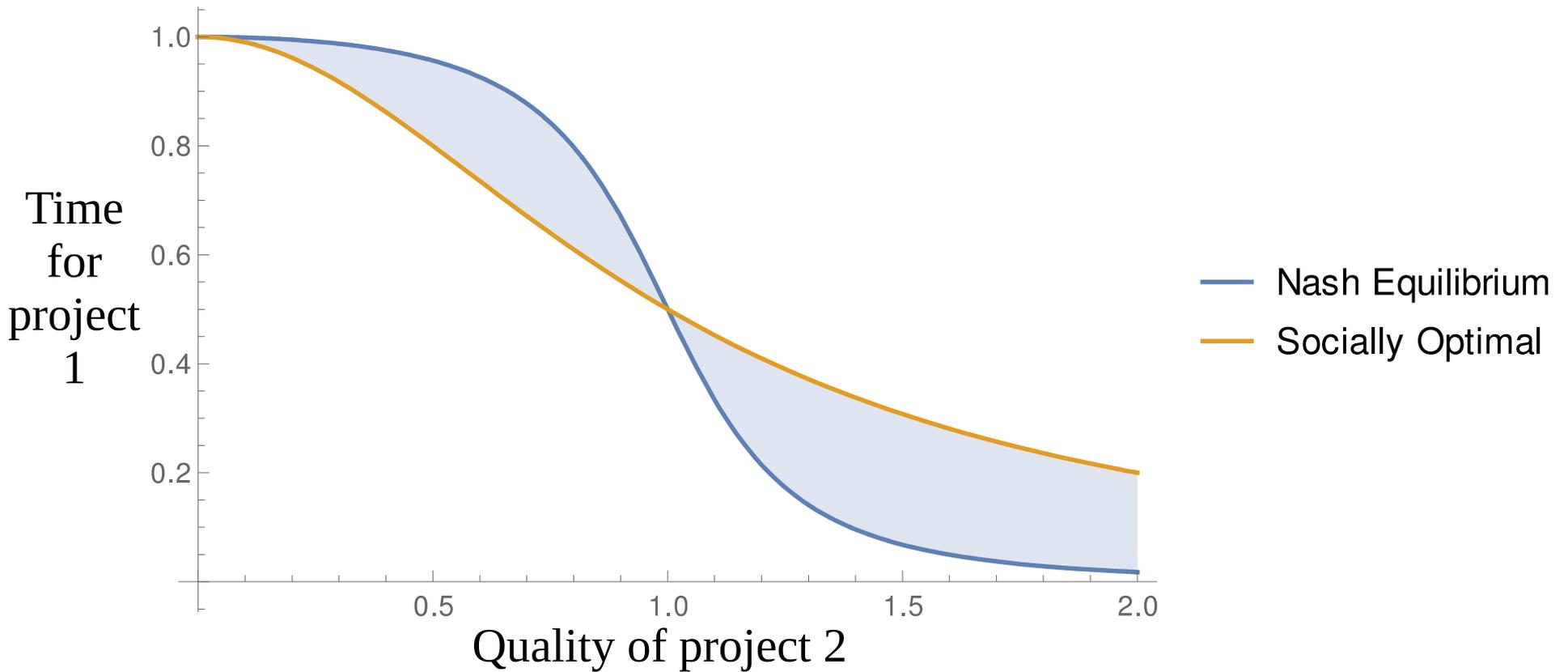
Marginal contribution
to project

Relative value
of credit

$$c(x, y) = b \left(\sqrt{x+y} (\sqrt{x+y} - \sqrt{y}) + a\sqrt{2-x-y} (a\sqrt{2-x-y} - a\sqrt{1-y}) \right)$$

Probability project
succeeds

Relative value of two projects



$b = 1$

Moral

The desire for credit over-allocates labor to the more promising project.

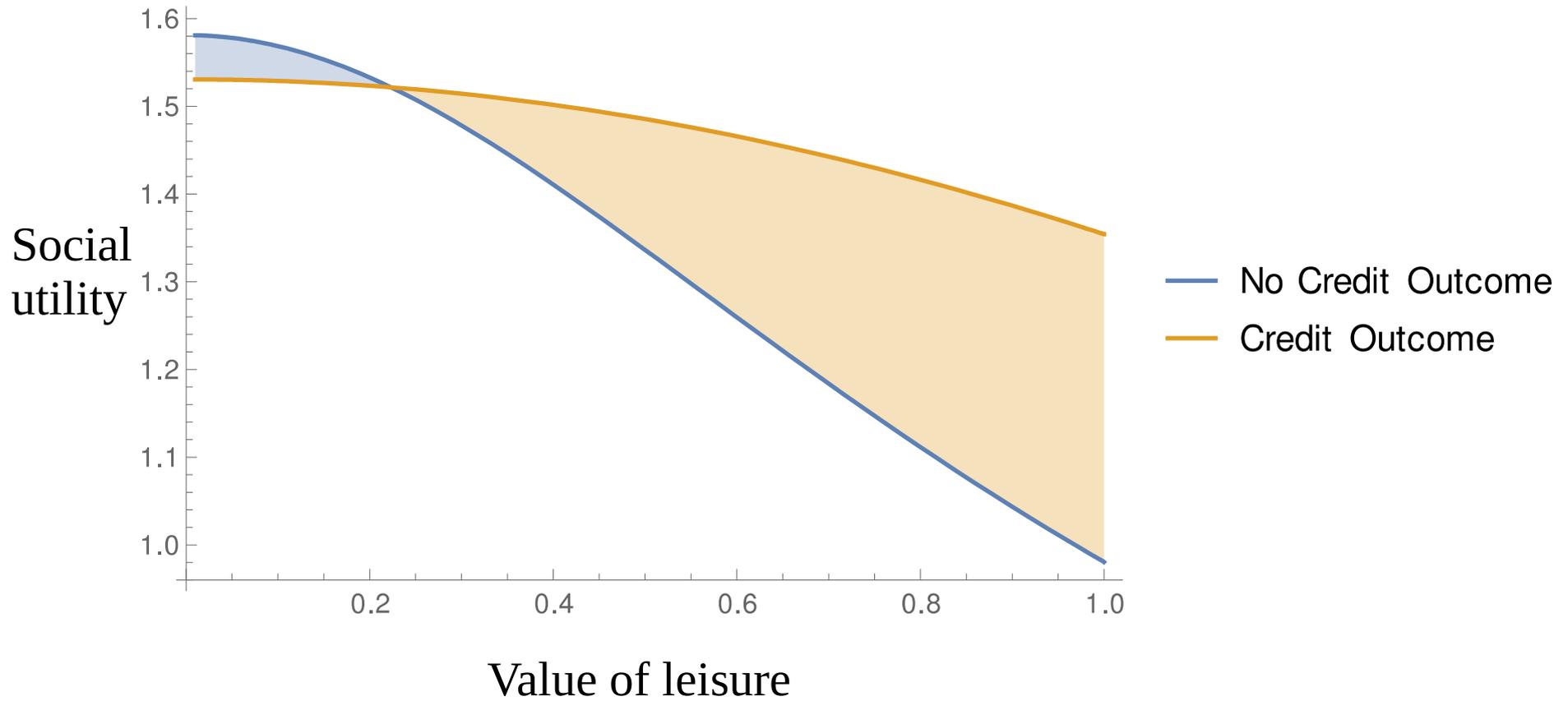
Contra Kitcher and Strevens

- Kitcher and Strevens don't consider a reasonable “base case”
- The truth motive leads to a natural division of labor

Generality

- More scientists, projects
- For all “truth oriented” science production functions, non-credit seekers will optimally allocate
- Credit can (at best) have no effect

With leisure



$a = 0.5$

Idealizations

- Additively separable utilities
- Scientists cannot fake effort
 - Expected credit is a function of effort
 - All effort is valuable
- Single shot decisions

The credit economy

- The credit economy helps to solve the public goods problem.
- The credit economy will make labor allocation decisions worse.
- The trade-off is worth taking when leisure is valuable.
- As a motivation it seems to both serve and hinder scientific progress.