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The rational economist in research: A model

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# **The rational economist in research: A model**

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Abstract: Econ is an economist who behaves as predicted by economic theory. His research for a paper reporting the ‘best’ estimate of an important parameter is modeled. The size of his search is determined from the costs and benefits of running regressions. The size determines the relevant supply side as the production possibility frontier. The demand side is the indifference curves generated where Econ’s preferences meet the market in the form of sponsors, referees and editors. The optimal selection appears as usual. It is shown that it is better than the true one, and that the bias has substantial inertia.

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## 1. Introducing Econ

A small literature compares us economists to other people.<sup>2</sup> It concludes that we behave more in accordance with economic theory than others. We use our theory to understand others, and we know that it often helps us to predict the behavior of the representative person. Thus, it should predict the behavior of the representative economist, *Econ*, even better.

This paper models Econ when he is in the academic career and works on a paper finding the best estimate of a parameter  $\beta$ . It is taken to be the effect of  $x$  on  $y$  ( $\partial y/\partial x$ ). It is assumed that  $\beta$  has a true value, and that its perceived size is important for some users – hence, the research project, which is an addition to the literature about  $\beta$ . In a crude analogy I say that Econ enters the ‘market’ for  $\beta$ -papers.

Econ has to solve two problems of research strategy: (p1) He has to find out how many regressions to run, and (p2) he has to choose the ‘best’ one for publication. Both problems have a solution that is evident from economic theory: (p1) is where the benefits for the researcher of one more estimate equal the cost of that estimate. (p2) is where Econ’s utmost *IC*, indifference curve, for estimates touches the *PPF*, production possibility frontier, for estimates. It will be shown that the optimal estimate resulting is too good; i.e., Econ will make *publication bias*, defined as a difference between the published estimates and the true value.

It is widely believed that if enough independent researchers with different priors and sponsors research the same subject, such as the size of  $\beta$ , truth will be revealed. This paper concentrates on the bias caused by the rational behavior of *one* researcher. But it also shows that a couple of mechanisms work to coordinate the preferences of all researchers in a field. Therefore, the average paper in the  $\beta$ -literature may be biased.

The estimates produced by Econ – and all other researchers in the field – are presented as  $(b, t)$ , where  $b$  gives the *size* and  $t$  the *fit* of the estimate. They are both the output of Econ’s production function and the arguments in his utility function. Thus, the *PPF* and the indifference curves are expressed in the two dimensions of fit and size. This allows the analysis to be done by well-known diagrams from elementary micro textbooks.

The *ICs* are discussed in section 3. It notes that Econ will try to form rational expectations on agents in the market such as sponsors, editors and referees. These agents are the same all resear-

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2. It is done by polls and experiments comparing students of economics and other students. See Marwell and Ames (1981), Carter and Iron (1991), and Kirchgässner (2005), who gives a fine survey of the literature.

chers in the field face. This is the first coordinating mechanism for the preferences of researchers.

It is assumed that economics has a basic theory about  $\beta$ . It is abstract, but it typically predicts the sign on  $\beta$ . For ease of presentation I assume that the predicted sign on  $\beta$  is plus. The trust in economic theory by economists is the second mechanism coordinating preferences of researchers. It follows that Econ's research gives a bias in the direction confirming the theory.

The *PPF* is discussed in section 4. The basic theory is consistent with a range of estimating models. They can be applied to different data sets, and a range of estimators may be used. Thus, a rather large *PPS*, production possibility set, exists for estimates  $(b, t)$  of  $\beta$ . A part of the rim is efficient, so that any increase in  $b$  causes  $t$  to fall and vice versa. This is the *PPF*, production possibility frontier. Econ only searches some of the *PPS*. The size of his search follows from the number of regressions he makes.

I have simulated this in Paldam (2015b and c). In simulations everything has to be operationalized, so that functional forms and parameters are chosen. This can be done in many ways, and I have run many millions of simulated regressions covering different combinations of the parameters, but there are still more possibilities to examine. This paper is an attempt to see how much I can derive from core theory alone. An important result from the simulations is that the estimates chosen are rather robust to the size of the trade-off. As long as the researchers are rational their choice is much the same, and always biased. This result will be referred to as *choice robustness*; see the end of section 4.2, which presents some theoretical support for this finding.

Section 6 deals with the ethos of research, which is that it looks for truth only. It will be shown that a pure search for truth is altruistic, so that it is costly for Econ. However, empirical economics normally has a sufficiently large *PPS* to allow Econ to claim that he looks for truth only, while he actually pursues his own interests. This paper is *not* about fraud, it is about leeway.

## **2. The choice of $J$ , the number of estimates made**

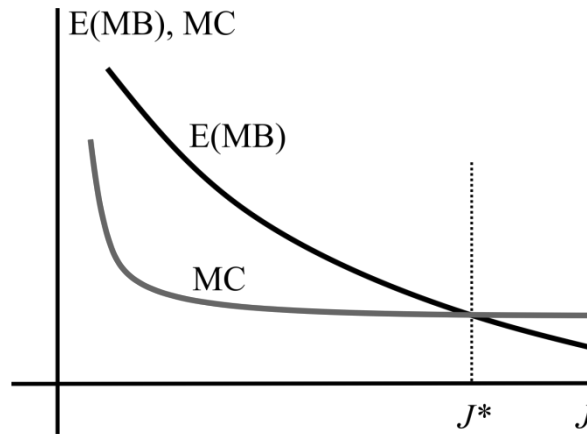
This section looks at three issues: Section 2.1 considers the relation between the marginal costs and benefits of a regression search (building on Paldam, 2013). Section 2.2 gives some crude numbers showing that a nice publication has a substantial private value for Econ, while section 2.3 looks at the cost and the solution.

### 2.1 The conditions for one and only one unique solution

Equations (1) to (3) are the conditions for finding one and only one solution where the benefits of the marginal regression equal the marginal costs. There are often surprises when you run regressions, so the benefits have a random element. Thus, the expectation operator  $E()$  is used on the benefits. As Econ starts with the most promising regressions the expected benefits are a falling function of  $J$ . Section 2.2 argues that  $E(MB)$  is much higher than  $MC$  for small values of  $J$ . Thus, we can be sure that (2) is fulfilled. However,  $E(MB)$  must fall to zero at some high value of  $J$ . Thus, it is clear that (3) holds too. The situation is very much as drawn on Figure 1.

- (1)  $E(MB(J^*)) = MC(J^*)$
- (2)  $E(MB(J^*)) > MC(J^*)$  for all  $J < J^*$ , we assume that  $E(MB(J))$  is falling
- (3)  $E(MB(J^*)) < MC(J^*)$  for all  $J > J^*$ , we assume that  $E(MB(J))$  is constant<sup>3</sup>

Figure 1. The determination of  $J^*$ , the optimal number of regressions



Note: The  $MC$ -curve starts with the high costs of finding the data and organizing them as a set of potential regressors in the computer. The figure is developed in Paldam (2013), where it is used to analyze the big downward shift over time in the  $MC$ -curve due to the great improvement in computers and econometric packages. Also, it discusses the effect of new estimators that give a temporary upward shift in the  $MC$ -curve until the new estimator becomes another command in the next version of the econometric package.

### 2.2 The $E(MB)$ curve: The value of publication: Some orders of magnitude

Econ's academic career depends upon his *publication record*, which is the number of papers weighted with their impact factors. The success of the career may be measured as the present value of his remaining life income,  $W$ . Let  $\sigma$  be his time preference,  $R$  his expected remaining life, and  $y_t$

3. We only need that  $MC$  is falling less than  $E(MB)$ . In practice  $MC$  is almost constant from  $J > 1$ .

his future annual earnings. Let  $y_t$  be constant except for career steps. One such step is  $\Delta y_t$ :<sup>4</sup>

$$(4) \quad W_t = y_t C(\sigma, R), \text{ where } C(\sigma, R) = \sum_{i=0}^R (1 + \sigma)^{-i} \approx 20, \text{ for } R = 50 \text{ and } \sigma = 0.05.$$

$$(5) \quad \text{A career step gives the gain: } \Delta W_t \approx \Delta y_t \cdot 20$$

If one step is worth, e.g.,  $\Delta y_t = \text{€ } 10,000$  per year, then  $\Delta W_t = \text{€ } 200,000$ . Let us further imagine that app. 10 papers extra are needed to make the step,<sup>5</sup> then the expected income gain from a paper is  $\Delta W_t/10 = \text{€ } 20,000$ .<sup>6</sup> This is surely a crude estimate, but it is fairly robust to polishing.

Researchers also derive *pure* utility from the work and the publication of a paper. The money-equivalent value of that utility should be added. If the paper goes nowhere, this utility is small. Thus, the pure utility is roughly proportional to the expected income gain. The key point is that Econ expects a substantial personal gain if he makes a paper that does well on the market.

Fine empirical results may add 50% to the publication chance. Thus, the regression search is worth about  $\text{€ } 10,000$  for Econ. If he runs  $J = 100$  regressions to find a fine result, the average regression has the benefit of  $\text{€ } 100$ . Even if Econ needs to run 400 regressions, the average value is still  $\text{€ } 25$ . In both cases the marginal benefits are higher at the start, but then they fall gradually.

### 2.3 The MC-curve: The size of $J$ , the number of estimates per published one

The marginal benefits should be compared to the marginal costs of running regressions. Once the data is in the computer, it probably takes less than three minutes to choose the variables, run the regression and look at the result. Econ can easily run twenty regressions and consider their merits per hour. If his hourly salary is  $\text{€ } 35$ , the average cost per regression is less than  $\text{€ } 2$ . It pays to go on regressing until the marginal benefits become equally low (see Paldam 2013).

There is, as mentioned, some stochastics involved. Researchers with a strong intuition may find a good result quicker; researchers with a large risk aversion may go on longer, etc. But basically, there is a solution, and it is likely that  $J^*$  is quite large.

Searches with large values of  $J$  have a problem known as *data mining*. When the search is done on one data set  $J$  reduces the degrees of freedom and hence the  $t$ -ratios. However, the amount of mining done is a private matter for the researcher. To demand that he reveals precisely what he has done invites an unfair burden of moral hazard. Therefore, it is a convention to disregard the

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4. This calculation excludes non-monetary benefits such as the 'gloire' of academic titles, invitations to conferences, etc. The time preference includes the effect of wage rises over time and the downward jump at retirement. I should add that this analysis does not apply to me as I am emeritus. Hopefully this will increase the credibility of my analysis.

5. The researcher needs some scientific production to keep his job. The 10 papers are in excess of that.

6. Some research institutes even give researchers a premium for a well published paper. It should be added to  $\Delta W$ .

reduction in the degrees of freedom. The point about  $t$ -ratios means that data mining decreases the probability of making Type I errors (rejecting the true model), while it increases the probability of making Type II errors (accepting false models). This is another way of saying that when  $J$  is large it is likely that results are found that are too good. If Econ chooses these results, he produces a bias.

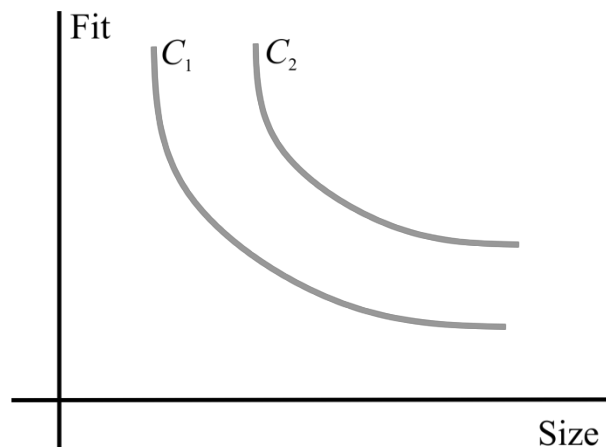
### 3 Econ's preferences – his own and that of the market

This section first looks at Econ's indifference curves for size and fit. Then it turns to a problem. Econ knows that he has to deal with sponsors, editors and referees. He obviously tries to form rational expectations about these agents and build them into his preferences.

#### 3.1 Indifference curves

The introduction stated that Econ has preferences for both the fit and the size of the estimates. Thus, reasonable indifference curves look as Figure 2. As usual indifference curve  $C_2$  gives Econ more utility than  $C_1$ . The two curves are drawn to be roughly homothetic as regards origo of the coordinate system, i.e., to  $(0, 0)$ . This is often taken as a good approximation.

Figure 2. The indifference curves of Econ, the rational researcher



Maybe the user of  $\beta$  wants to know its true value. But, the user may also be a company selling  $x$ , or a public bureau that administrates a policy  $x$ . In these cases it is likely that the revenue/budget of the user depends upon  $\beta^R$ , the perceived size of  $\beta$ . Such users have an interest in getting  $\beta^R$  as large as

possible. They may even sponsor research with that aim.<sup>7</sup>

Sometimes it is alleged that many economists look at the  $t$ -ratio only, see Ziliak and McCloskey (2008). In this case the indifference curves are horizontal. However, as already suggested, many researchers are more interested in size. If they prefer size only, their indifference curves are vertical. Both horizontal and vertical indifference curves are extreme and thus unreasonable. Figure 2 shows that Econ has a trade-off between size and fit.

### 3.2 *Rational researchers take external pressures into consideration*

Econ is subjected to two sorts of external pressures.

The first is that research needs to be financed, so many projects have sponsors who normally have interests. Sometimes the sponsor is the employer of Econ. In this case he will surely know when he is expected to find certain results. In other cases Econ is employed by a research institute, e.g., at a university, which derives income from ‘taxes’ on research grants from sponsors. Thus, it wants its researchers to be accommodating to sponsors in the interest of future grants.

Most western countries have ministries that are in charge of science and higher education. As will be discussed in section 6, such ministries and many universities have stated policies of ‘research integrity’. The interest of research institutes is thus at odds with the official policy of research integrity. It is arguable that the policy of research integrity is needed precisely to keep the interests of sponsors and research bureaucrats at bay. I think that most researchers know of stories where some pressures have been applied. Normally it is done discretely, so stories are difficult to document. But from time they erupt into the public domain. Then they become a ‘scandal’ that is harmful for everybody involved. Researchers who understand the game are thus popular with sponsors and administrators.

The second is from referees and editors, who want clear results within a certain accepted range around  $\beta^R$ . The range is defined by the ‘reservation’ mechanics discussed in section 6 below. Here it is important that most referees are chosen among authors of the previous papers in the  $\beta$ -literature. The fact that Econ has large interests at stake, as argued in section 2.1, makes him pliable to pressures from referees and editors; see Frey (2003).

Econ is rational and thus he tries to form *rational expectations* about all such pressures. That is, he tries to include them in his indifference curves. As the ‘market’ for the papers of

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7. Sometimes exaggerated results may have a positive real effect. In discussions of policy effectiveness, *credibility* is often taken to be an important factor. Perhaps studies that exaggerate the effectiveness may in fact increase effectiveness. In medicine, studies that find exaggerated effects may increase placebo effects.



different researchers is roughly the same, and the relevant sponsors are known to all researchers in the market, it is likely that the external influences on all researchers are much the same. This will act as a coordination device on the preferences of all researchers.

### 3.3 *The search and the reservation estimate, $\beta^R$*

A similar argument follows from search theory: A key concept in search theory is the one of a reservation outcome that the searcher seeks to reach. The  $\beta$ -knowledge is likely to contain a ‘state-of-the-art’ estimate  $\beta^R = (b^R, t^R)$ .<sup>8</sup> From the argument till now it is likely that  $\beta^R > \beta$ . We like to believe that the estimates in this literature converge to the true value  $\beta$ . That is, hopefully  $\beta^R \rightarrow \beta$ . But at any point in time researchers may consider  $\beta^R$  as the reservation estimate they have to reach.

When Econ sends his paper to a journal the editor will assign referees. They are likely to be authors of the  $\beta$ -literature. They have helped making the estimates that have made the profession believe that  $\beta^R$  is ‘reasonable’. Econ will know that most referees belong to that group. They will surely like that he gets a reasonable result that is close to  $\beta^R$ .

In the search process at the labor market there is a realistic market price that the search process will converge to. That is, if the searcher sets his reservation wage too high, he will be disappointed and lower his goal. However, in the estimate search discussed it is quite clear that it is doable to find estimates that are too high. Thus, the adjustment process of  $\beta^R$  down to  $\beta$  due to disappointment is not strong at all.

## 4. **The *PPS*, production possibility set, and the *PPF*, its frontier**

First the technology is briefly outlined and then it is discussed how the *PPS* looks. Finally, it is argued that the true value is an interior point in the *PPS*.

### 4.1 *A complex production technology*

To produce estimates  $(b_i, t_i)$  of  $\beta$  requires much human, but little physical capital.

Econ’s research is for paper  $M$  on the size of  $\beta$ . First step in the research process is that Econ tries to acquire the  $\beta$ -knowledge. The previous  $M - 1$  papers on  $\beta$  are the  $\beta$ -literature, which contains most of the knowledge, but there are often some casual observations as well. The  $\beta$ -knowledge already contains a *standard theory* about  $\beta$ . It gives a qualitative prediction about  $\beta$ ,

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8. Sometimes two or more schools fight for different  $\beta^R$ s, but then the researcher is likely to refer to one school.

which typically is the sign on  $\beta$ , as mentioned. Econ's claim for publication is that his paper gives the standard theory a new twist and his fine estimates.

The theoretical model is abstract and complex. It has to be operationalized to be estimated on available data. The *estimating model* contains the term of interest,  $\beta x$ , which is typically the same as in the previous models, plus some new variables which follow from the twist, and a handful of control variables to establish *ceteris paribus*. The cp-controls are typically a combination of variables that have been used before. Econ's choice of controls requires a great deal of judgment, which may be a rationalization of variables that 'work' as they should.<sup>9</sup>

Then a *data set* is required. How it is limited is another matter for Econ's judgment. Then the *right estimator* has to be chosen. The choice should follow from the problem, but apparently it rarely does. When two-stage instrument estimators are used it is a problem to choose the instruments. These choices involve judgment as well.

Thus, when the estimation search starts the set of potential controls and instruments is often quite large – and certainly larger than what can possibly be included in the final paper.

Then everything is entered into an econometric package on Econ's computer and the regression search starts, as discussed in section 2. It makes it possible to test if the judgment made under the previous steps works, and to make revisions, to get a better estimate. If something works, it will cause an iteration of the process. Finally, the last iteration has to be written to a paper, reporting the result and how it can be justified. The experiments and assessments made on the way to the published results are Econ's private knowledge, which does not need to be revealed.

#### 4.2 How does the PPS and the PPF look?

It is assumed that the theory used about  $\beta$  is true, but the many choices made during the research process are judgmental so that the *J*-set of estimates scatters a great deal. Recall that each experiment made decreases the probability of Type I errors, while it increases the likelihood of making Type II errors. With, e.g., 200 regressions run, some false models may be found. Due to luck they work in the said data sample, but not in general.

Since the theory is basically sound, it is likely that the true value is within the set. The fit and size are positively correlated, so the production possibility set is an eight-shaped object where the long axis has a positive slope as drawn on Figure 3.<sup>10</sup> It is expressed in the same fit-size diagram

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9. I think that most academic economists have been to seminars where the presenter (proudly) declares that all signs in the estimate of his model are right!

10. The form of the curve looks as found in Paldam (2015a).

as Figure 2. The eight-shaped curve is the expected area for the estimates as a function of  $J$ . If  $J$  increases from  $J_1$  to  $J_2$ , the eight-shape increases as shown.<sup>11</sup>

Figure 3. The production possibility set of estimates

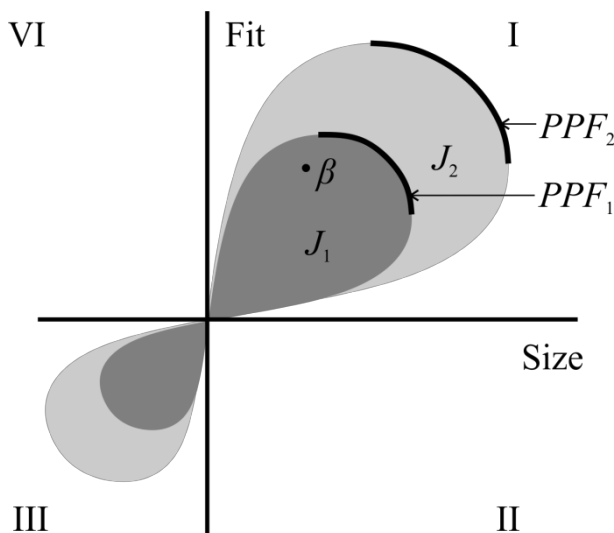


Figure 3 is drawn so that some negative estimates appear too. As the  $t$ -ratio has the same sign as the estimate, quadrants II and IV are empty by definition. Also, it is difficult to get close to the axes; i.e., large estimates rarely have a fit that is close to zero, and vice versa. This gives the form shown. The theory says that the sign on  $\beta$  is positive, so the estimates in quadrant III are ‘wrong’. Only the segment in quadrant I makes sense. The true value,  $\beta$ , is actually in this set.

The rim of the  $PPS$  from its horizontal tangent at the top to its vertical tangent at the right hand side is the production possibility frontier,  $PPF$ . It will be further discussed in section 5. The two  $PPFs$  drawn are for two values of  $J$  as mentioned, and they are drawn to be roughly homothetic with respect to the origo of the coordinate system.

While the eight-shaped production possibility sets look somewhat special, the two  $PPF$ -curves look as the standard textbook case, just as the indifference curves did.

Given that the curves look as drawn, it is clear that the indifference curves have to be very different to produce choices that are really different. And with some little noise added, it is likely that the ends of the  $PPF$  will be chosen rarely. Thus, the choice robustness result referred to in the introduction appears reasonable.

11. As  $J$  is finite, the points in the gray area are a point scatter, and the rim consists of straight lines, but for ease of presentation I shall stick to the continuous ‘expectation’ presentation as drawn.

### 4.3 Why $\beta$ must be an inside point in the PPS

The true value  $\beta$  is a point in the possibility set of estimates, which is an area. Hence, it has infinitely more internal points than rim-points. Thus, the probability of hitting the rim by chance is zero. If there is no strong reason for  $\beta$  to be on the rim, it is thus extremely unlikely to happen.

This formal point also applies for a finite set of estimates when the behavior of researchers is considered. Imagine that:

- (6)  $y = F(x)$  is the true model. It contains the true controls.
- (7)  $Z = (z_1, \dots, z_n)$  is a set of  $n$  false controls that sometimes ‘work’.

The false controls should not be in the model, but as the  $z$ 's are correlated with  $x$  in some data samples, but not in others, some researchers have used one or the other of these controls. From reading up the literature the  $Z$ -set becomes part of the  $\beta$ -knowledge of the researcher. But, of course, he does not know if they are false or true. Thus, he will experiment with such variables.

They give results that vary from one data sample to the next. However, for the sample considered some of the  $z$ 's in the  $Z$ -set are positively correlated with  $x$ . Hence, when they are included in the model they ‘take’ some of the effect of  $x$ , so that the estimate of  $\beta$  becomes too small. Conversely, some of the  $z$ 's in the  $Z$ -set are negatively correlated with  $x$ . Hence, when they are included in the model  $x$  obtains an extra effect, so that the estimate of  $\beta$  becomes too large.

As the reservation estimate  $\beta^R$  is too large, Econ will need some of the latter controls when they work in order to reach  $\beta^R$ . Thus,  $\beta$  will be an inside point in the production possibility set. This is especially true in a literature that has been going on for some time.

The finding that  $\beta$  is an inside point is important for the argument below. It causes the optimal choice of Econ to have an upward bias.

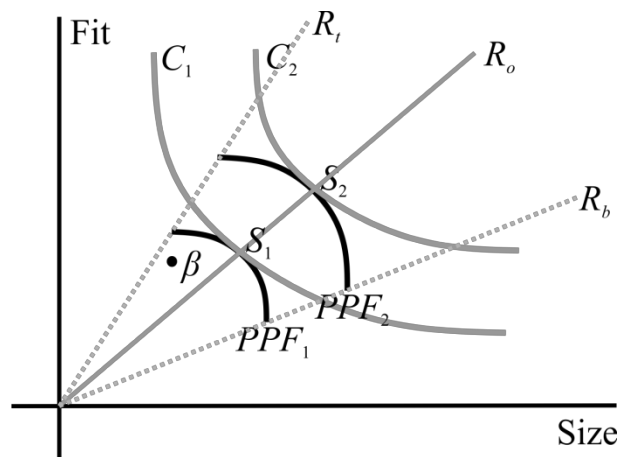
## 5. The optimal solution

Sections 3 and 4 depicted the preferences for estimates and the production of estimates as in the textbook of elementary microeconomics. Section 5.1 gives the well-known solution. Section 5.2 shows that the solution is robust to differences in Econ's preferences. Section 5.3 turns to the macro level by looking at the whole  $\beta$ -literature.

### 5.1 The usual solution

As both Figure 2 and 3 are drawn in the same diagram, they can be merged as done on Figure 4. It shows two *PPF*-curves –  $PPF_1$  is for a lower  $J$  and  $PPF_2$  is for a higher  $J$  – and the two indifference curves  $C_1$  and  $C_2$  that touch the two *PPFs*. As  $C_2$  is better for Econ than  $C_1$ , it follows once again that it pays to make a good many regressions.

Figure 4. The optimal solution: The solutions  $S_1$  and  $S_2$



If both the indifference curves and the *PPFs* are homothetic as regards the origo of the coordinate system, the expansion path for the optimal solution as a function of  $J$  becomes a ray, i.e., a straight line from origo (0,0), as drawn. It is likely that the two sets of curves deviate a little from the strict homothetic forms so that the expansion path bends a little, but it is not clear if they bend upwards or downwards, so I take the case drawn as the middle case.

As all readers will recall, the only relevant part of the production possibility set is the convex part of the rim as drawn. It is the production possibility frontier, *PPF*. The optimal solution is thus where the *PPF* is tangent to the utmost indifference curve as usual. It is shown on Figure 4 that solution  $S_1$  for  $PPF_1$  is  $(b_{o1}, t_{o1})$  and solution  $S_2$  for  $PPF_2$  is  $(b_{o2}, t_{o2})$ .

Econ's optimization can only reach the true value of  $\beta$  if it is on the *PPF*. Section 4.3 argued that  $\beta$  is an internal point. Once  $\beta$  is an internal point, two key results follow: (i) Econ produce a bias due to his *rationality*. (ii) The rationality bias is in the *direction of his priors*. If he prefers big significant estimates, he chooses estimates that are systematically too *big and too significant*.

## 5.2 *Three rays and the gap of reason*

The three rays drawn are the following:

$R_t$  is the extreme expansion curve for horizontal indifference curves, where Econ looks for the highest t-ratio only. The chosen solution is  $(b_t, t_t)$  as a function of  $J$ .

$R_b$  is the extreme expansion path for vertical indifference curves, where Econ looks at the size of  $b$  only. The chosen solution is  $(b_b, t_b)$  as a function of  $J$ .

$R_o$  is the expansion path for the ‘nice’ rounded indifference curves from Figure 2. This ray represents Econ’s reasonable solutions. The chosen solution is  $(b_o, t_o)$  as a function of  $J$ . It is the gap between the extreme rays. This gap will consequently be termed *the gap of reason*.

The three curves must have approximately the form shown, but maybe they bend a little either way.

The gap between  $R_t$  and  $R_b$  can be assessed as two gaps: The b-gap:

$$(8) \quad \text{The b-gap:} \quad G_b = G_b(J) = (b_b(J) - b_t(J))/b_b(J)$$

$$(9) \quad \text{The t-gap:} \quad G_t = G_t(J) = (t_t(J) - t_b(J))/t_t(J)$$

$$(10) \quad \text{With symmetry:} \quad G_b \approx G_t$$

If the expansion paths are rays, the gaps are likely to be constant from  $J = 2$  and up. Paldam (2015b and c) simulate this situation and find that the two gaps are normally less than 10%. This means that the  $R_o$  is robust. In other words: It does not matter very much for the bias if the preferences of Econ are mostly for the size or mostly for the fit of the estimate.

## 5.3 *The size of the publication bias – the macro perspective and some empirics*

Till now I have developed the micro theory for Econ only. It has been shown that he is likely to make a publication bias by selecting a result that is too good.

I now turn to the macro theory of the whole of the  $\beta$ -literature. The bias produced by Econ generalizes if a mechanism exists that coordinates the preferences of enough authors of the literature. Two coordinating mechanisms have been mentioned: (i) The attempts of the researchers in the field to form rational expectations about the market. (ii) Relevant economic theory known and believed by all researchers in the field.

It is difficult to detect publication bias in one study, but technique of meta-analysis has been developed to do so in a literature. It studies the distribution of the results, which is displayed as a ‘funnel’ that gives the precision of the estimate over its size. The funnel should be symmetric, so

asymmetries indicate a problem. In many cases the asymmetry can be interpreted as a publication bias. Economics has seen a wave of meta-studies since Stanley (2008) proposed a remarkably simple and robust tool that detects the asymmetry and corrects it.<sup>12</sup> An introduction to meta-analysis in economics is found in Paldam (2015a). Readers who want to dig deeper should consult the textbook Stanley and Doucouliagos (2012).

Publication biases are discussed in a large literature. In August 2015 Google scholar gave 3,070,000 hits for ‘publication bias’ and 149,000 hits for ‘sponsor bias’. While many of these hits are irrelevant, a good many are to studies that show such biases using meta-techniques.<sup>13</sup> Most of these are in medicine where an old tradition exists for meta-studies.

Meta-studies in economics find biases in about 2/3 of the literatures analyzed. The biases are quite variable, but a crude assessment is that the typical bias found is two. That is, the mean of the published result is twice as big as the average estimated meta-average.

Several simulation projects have been under-taken to see how the behavior of researchers makes biases and if the methods of meta-analysis manage to detect and correct these biases. The two main reasons for such biases studied till now are:

(1) Stanley (2008) considers *censoring* of ‘bad’ estimates.<sup>14</sup> Censoring is typically to one side only. A typical case deals with estimates of the price elasticity. Except in rare cases it should be negative, but it is difficult to sort out demand from supply so estimates scatter a great deal, especially at low precision. As researchers know that positive estimates are wrong, they are often suppressed. It is clearly rational – seen in the perspective of one study – to suppress unreasonable results. However, it means that the average of published estimates will be exaggerated, i.e., numerically too large.<sup>15</sup> The meta-techniques work rather well to remove such biases.

(2) Paldam (2015b and c) looks at *rationality* in a broader sense, as discussed in the present paper. It appears that it is doable to mimic the typical biases found, and surprisingly it also appears that the meta-techniques work rather well to greatly reduce these biases. One result keeps coming up in the simulations: It is, as already mentioned, the *robustness of the rationality bias* (for a given  $J$ ) to the selection rule. As long as the selection is rational much the same bias results. It matters

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12. The tool is the FAT-PET MRA, where the FAT is the funnel asymmetry test and the PET is the precision estimate test that corrects the mean for the asymmetry. MRA is meta regression analysis, which is a regression on regression coefficients.

13. The term publication bias is sometimes used loosely. The reader should recall that I use it as a systematic difference between the published and the true estimate.

14. They may be unreasonable according to economic theory (i.e. have wrong signs), or they may be undesired for political/moral reasons. Or perhaps they are disliked by sponsors.

15. Nelson (2014) shows that the average paper on the demand for beer exaggerates the price elasticity by a factor two.

little if Econ has a higher preference for the fit or the size of the estimate. Thus, I have returned to the micro theory dealing with Econ.

## 6 An altruistic researcher

The official policy of the typical ministry dealing with research and many universities is to demand that researchers have a high level of research integrity.<sup>16</sup> This is in accordance with the ethos of research that sees the researcher as a pure seeker of truth. Section 6.1 explains why truth seeking is altruistic, and section 6.2 shows how Econ can mimic truth seeking.

### 6.1 *Truth seeking is altruism*

Imagine a researcher who seeks truth only. This means that her results will be below  $\beta^R$  in both dimensions. Thus, she will be an underachiever. It is likely that neither referees nor editors will like her paper(s). It will also cause sponsors to disregard her.

The university administrators will soon note that she does not deliver the goods: Neither publications that attract public research funds nor other sponsors that bring in funds to tax. Consequently, this preference will harm her career. Thus, pure truth seeking is altruistic in the sense of giving away personal gain for the greater good of truth.<sup>17</sup>

In contrast Econ finds an estimate that is a little ‘better’ than  $\beta^R$ . Thus, he will add to the  $\beta$ -knowledge that the ‘state-of-the-art’ estimate is  $\beta^R$ , or maybe even a bit higher. Econ’s research gives a small divergence from the truth, not convergence to the truth.

It is nice to believe that truth will prevail in the long run. If it does, truth may pay in that perspective. From the argument above it follows that the long run may be rather long. The career of the economist takes place in the short to medium run. This is surely a problem. The pure truth seeking strategy has two more problems. The second is that it is difficult for the researcher herself to know if she has found truth or confirmed her priors and the ones of the market.<sup>18</sup>

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16. The official Danish report on the *Code of Conduct for Research Integrity* (2014) is typical of such reports. It was made by a committee of 12 leading administrators of academic institutions citing 24 similar reports and declarations from other countries and international organizations. From these reports it is clear that researchers, who declare that they are rational, may be submitted to a great deal of bureaucratic hassle, which is likely to harm their career.

17. Economists recognize altruism as a fact of life, and empirical studies regularly find altruism, but it is also a main finding that it plays a limited role. A famous quote by Gordon Tullock is that ‘people are 5% altruistic’.

18. A simple device to get close to the truth is to make the  $J$  estimates you think are the best ones and publish the average and the distribution around that average. Unfortunately this method is not rationality proof.



## 6.2 *Mimicking truth seeking*

The third follows from the fact that everybody else pretends that they seek truth only, and has great ‘research integrity’ as demanded by official policy. In relation to these ideals Econ is a ‘rotten’ researcher, but he does not want to appear so, as it would harm the publication chances of his paper and his career in general. Thus, Econ will mimic the altruistic as much as he can, and he will, of course, be terribly offended if anyone suggests that he accommodates sponsors, referees etc. Thus, for the reader it is difficult to know if the researcher is rational or altruistic.<sup>19</sup>

It follows that both rational and altruistic authors do their best to create credibility by the same devices. One method is to present *robustness* experiments. The average paper publishes about ten estimates in order to show the robustness of the main result. The main problem with robustness experiments is that what matters for the bias is the number of experiments per published one, not the number published (see Paldam 2015c).

A second method is *out-of-sample projections*. It is not as common as robustness experiments, but it is not rare either. Obviously, the rational researcher may mine both the sample and the out of sample data. This is likely to be a stepwise process, but it can surely be done.

The main characteristic of a true estimate is that it survives *independent replication*.<sup>20</sup> What is needed is another researcher who tries to replicate *exactly* the same model on another data set. If it survives, it increases the probability that it is the true model. After repeated independent replications it is likely that the true model has been sorted out.

Finally, it is also possible to get close to the true value by making meta-studies of the literature. Here the distribution of the results may indicate that the published results are systematically skewed and should be corrected by the appropriate methods.

## 7. **Conclusion: A rationality bias that sticks**

The analysis has considered the choices of Econ, who investigates  $\beta$ . Given that he is rational his choices can be modeled by economic theory. The paper models the research process as a choice problem with two steps: Step one is choice of  $J$ , the number of regressions produced. It is found where the marginal benefits of a regression equal the marginal costs. It is likely that  $J$  is substantial. Step two is the choice of the optimal estimate. It is found where Econ’s outmost indifference curve

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19. The reader has probably already thought of the obvious parallel to the ‘rotten kid theorem’ from Becker (1974).

20. See also, Dewald *et al.* (1986), McCullough *et al.* (2008) and Duvendack *et al.* (2015)

touches the production possibility frontier. It is shown that these choices lead to exaggerated results.

The priors of the individual researcher are his own, but they also internalize the priors of the market. This greatly homogenizes the priors of all rational researchers, making them similar, as do commonly accepted economic theory. Thus, if most researchers are rational, it is likely that the whole  $\beta$ -literature comes to suffer from a bias in the same direction. The bias is robust to the weights researchers put on the fit and size of the estimates. Through the reservation estimate mechanism it is likely that the bias can survive for some time – maybe several decades.

The reader may look inward and reject this theory as a description of his own behavior – economic theory is not made to describe any particular individual, but the representative individual. Consequently, it is a problem if it is rejected for the representative economist. Can it be rejected without a rejection of core theory?

If the reader goes through everything, it is possible to identify cases where no bias is produced. This may happen, e.g., when economic theory does not predict the sign on  $\beta$ , or in cases where the interests of sponsors differ. And, in fact, about one third of meta-studies find no publication bias. All I want to claim is that it is for good reasons that two thirds of meta-studies in economics detect biases.

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