Gary Becker’s Neglected Early Research on Training on the Job

by

Timothy Perri†

September 19, 2022

Abstract

Gary Becker’s first published paper on training on the job was in the *Journal of Political Economy* in 1962. However, an earlier unpublished and neglected paper by Becker analyzed training in the military (Becker, 1957*a*). In his 1957 paper, Becker began to develop ideas on who would and how to pay for training. I consider the analysis in Becker (1957*a*), and examine the evolution of Becker’s ideas on training on the job.

† Department of Economics, Appalachian State University, Boone, NC 28608. E-mail: perritj@gmail.com. Home page: https://perritj.wordpress.com. I thank Kyung Baik, Isaac Ehrlich, Mike Gibbs, Don Parsons, and Fred Wallace for comments on earlier versions of this paper. I thank Diana Sykes at the Hoover Institution Library and Archives for scanning and sending me the correspondence between Gary Becker and Milton Friedman for the period 1953 to 1983. I thank Megan Ó Connell and Kate Collins from the David M. Rubenstein Rare Book and Manuscript Library at Duke University for duplicating and sending me correspondence between H. Gregg Lewis and Gary Becker. I thank Cara McCormick from the Rand Corporation archives for information on Gary Becker’s consultancy at Rand, and Beth Asch for pointing me to Ms. McCormick.

1. Introduction

"Gary Becker's most noteworthy contribution is perhaps to be found in the area of human capital ...first presented in some articles in the early 1960s and...in his book, *Human Capital*, written in 1964."[1]

In his seminal 1962 paper in the *Journal of Political Economy*, referred to as JPE_{62} herein, Gary Becker introduced a theory of investment in human capital that has been called "...the workhorse of all labor economics..."[2] His analysis "...introduced the henceforth classic distinction between specific and general human capital."[3] That paper was the product of Becker's work at the National Bureau of Economic Research (NBER) on human capital begun while he was at Columbia and the NBER in 1957.[4]

It is generally believed that JPE_{62} was Becker's first paper on training on the job.[5] However, an earlier unpublished and neglected paper by Becker analyzed training in the military

---

[1] The Sveriges Riksbank Prize in Economic Sciences press release, October 13, 1992.

[2] Heckman *et al*. (2018, p. S5).

[3] Teixeira (2014, p. 8). Becker's paper in the *Journal of Political Economy* (*JPE*) was published in a supplement to the October 1962 issue. Walter Oi published his paper on labor as a quasi-fixed factor of production in the December 1962 issue of the *JPE*. Oi's paper was based on his 1961 dissertation at the University of Chicago. In his *JPE* article, Oi mentioned specific and general training (Oi, 1962, p. 540). Although Oi's dissertation predates Becker's 1962 *JPE* article, it is likely that Oi learned of the terms specific and general training from Becker. In a letter from H. Gregg Lewis---dissertation supervisor for both Becker and Oi---dated August 1, 1957 (Lewis, 1957), Lewis told Becker that Oi would try to see Becker before Becker left the Rand Corporation in California for Columbia University. Lewis had told Oi that Becker had some ideas on Oi's dissertation topic. In the first footnote in his *JPE* particle, Oi said "A reading of two unpublished articles by Professor Gary S. Becker led me to revise the theory substantially" (Oi, 1962, p. 538). Oi did not say what the two articles were, but presumably one of them was an early version of what became Becker's 1962 *JPE* article. In August 1959, Becker sent a draft chapter (Becker, 1959*a*) for the book *Human Capital* to members of an NBER reading committee that mentioned specific and general human capital (see the discussion in Section 5 herein). Years later, Oi said his ideas on labor as a fixed factor were introduced in a University of Chicago workshop around the time of Becker's "...development of a theory of human capital" (Oi, 1999, p. 15).

[4] Teixeira (2005, p. 139). Solomon Fabricant supported a project at the NBER on measuring returns to education (Heckman, 2011, p. 91). Becker decided that a theory of human capital was required so he expanded the scope of his work at the NBER (Becker, 1962, pp. 9-10).

[5] Weiss (2015, p. 27) suggested Becker's work on human capital began around 1960. Becker began working on rates of return to education in 1957. He had a brief discussion of his work on training on the job in Becker (1959*b*, p. 39). Although labor economists are generally aware of JPE_{62} (see Ehrlich and Murphy, 2007, p. 1), many seem to believe Becker's first published work on human capital theory was the first edition of his book *Human Capital* in 1964. Teixeira (2005, p. 139) said Becker first introduced the distinction between general and specific training in *Human Capital*. Van Overtveldt (2007, p. 122) referred to the first edition of *Human Capital* without mentioning

(Becker, 1957*a*). The important ideas in JPE_{62} on who and how one would pay for training on the job were first discussed in the earlier paper, which I will call $Rand_{57a}$. Note that $Rand_{57a}$ will soon be published in a book that includes other unpublished work of Becker's (Elias, Mulligan, and Murphy, forthcoming).

Becker spent the summer of 1957 at the Rand Corporation (Becker, 2007). While at Rand, he produced two papers, one on military conscription (Becker, 1957*b*), and the other I have denoted $Rand_{57a}$.[6] Other than in a footnote in his Rand paper on conscription, I have seen no reference to $Rand_{57a}$ by anyone. Thus, I am the first to examine Becker's earliest work on training on the job. My objective is to consider the analysis in $Rand_{57a}$, and to examine the evolution of Becker's ideas on training on the job.[7]

As noted by Elias, Mulligan, and Murphy (2019) in a preview of the book that will contain $Rand_{57a}$ and other previously unpublished work by Becker, early papers allow the reader to see the intellectual journey followed by the author. $Rand_{57a}$ is relatively short (twelve pages), but the paper appears to reflect Becker's early views on paying for on the job training.[8] The fact

---

JPE_{62}. Coleman (2017, p.3) said Becker "...solidified the conceptual framework...about human capital" in *Human Capital*. For origins of the concept of human capital, see Kiker (1966). Irving Fisher (1897*a*, 1897*b*) may have been the first economist to use the term "human capital" in a journal article (Chiswick, 2006). For early work on human capital, see Teixeira (2020).

[6] Becker was a consultant to the Economics Division at Rand beginning June 1 and ending September 30, 1957. He was in residence there at least part of that time. He wrote two internal papers dated August of that year (Becker, 1957*a*, and 1957*b*), the first on training, and the second on conscription. He later was a consultant to Rand for over twelve years (from March 15, 1968 through September 30, 1980). An inquiry to Rand yielded this information, but no details about his responsibilities are available. Thus, I do not know why Becker worked on training and conscription in 1957. I thank Cara McCormick at Rand for this information.

[7] Sanderson and Siegfried (2006) discuss Rottenberg's 1956 paper on the baseball players' labor market. Rottenberg, then a faculty member in the University of Chicago Department of Economics, acknowledged Becker's comments on Rottenberg's paper. Sanderson and Siegfried say that Becker suggested to Rottenberg that wages below marginal revenue product in major league baseball were, at least in part, payment for specific training of players, including for players who did not end up as major league players. Note that Rottenberg did not mention *specific* training. Thus, it is not clear if Becker had then developed the distinction between specific and general training, which he apparently first considered in $Rand_{57a}$ (although he did not then use the terms specific and general training).

[8] Becker thanked seven individuals for helpful comments, including future eminent economists Armen Alchian and Roland McKean. McKean was then full time at Rand. Alchian was at UCLA then (Clough, 2006), but probably consulted with Rand.

Becker did not refer to *Rand*$_{57a}$ in his future work on training suggests he later had sharpened his ideas on that subject.

2. Introducing general and specific human capital, 1962

Becker's 1962 *Journal of Political Economy* paper on human capital was his second publication analyzing that topic, and his first publication that considered training on the job.[9] Before considering Becker's first unpublished work on training on the job, *Rand*$_{57a}$, it is useful to restate Becker's conclusions in *JPE*$_{62}$ regarding paying for training.[10]

The paper Becker presented at a conference in New York City in December 1961 that became *JPE*$_{62}$ contained the gist of the theory found in his book *Human Capital*.[11] Examining *JPE*$_{62}$ and the three editions of *Human Capital* (1964, 1975, and 1993), it appears that the material on training on the job is identical in all three editions of the book, and changed only slightly from *JPE*$_{62}$ to *Human Capital*. Thus, I will mainly refer to *JPE*$_{62}$, and, when referring to *Human Capital*, will not distinguish between editions of the book, and will simply call all three *Human Capital* (Table 1).[12]

To simply illustrate the relevant results on training on the job in *JPE*$_{62}$, assume two periods of identical length, periods one and two, and zero discounting. Training occurs in period

---

[9] Becker (1959*b*) is a three page outline of his ongoing work on human capital in which he briefly mentions on the job training (see Section 5 below). Becker's first publication analyzing human capital (Becker, 1960) considered whether there was underinvestment in college education.

[10] Jacob Mincer also considered training on the job (Mincer, 1962) in the issue of the *Journal of Political Economy* that contained Becker's first published analysis of job training. Mincer's focus was on the magnitude of resources devoted to training, and on the return on training. He credits Becker with developing the theory of the cost of schooling and job training. Mincer briefly mentioned that firms may pay some of training cost, but did not discuss either specific or general training.

[11] Teixeira (2014, p. 7) and Weiss (2015, p. 27).

[12] The material on training on the job is found in pp. 10-25 in *JPE*$_{62}$, and in pages 8-29, 16-37, and 30-51 in *Human Capital* editions 1-3 respectively.

one. Also, Becker referred to marginal product and not marginal revenue product, so he apparently assumed a competitive product market (price equal to marginal revenue) with product price equal to one so that marginal revenue product equaled marginal product. I do the same.

Table 1. Abbreviations Used in this paper	
Paper/Article/Book	**Abbreviation**
Becker, Gary, 1957, Rand paper on training in the military, August.	$Rand_{57a}$
Becker, Gary, 1962. *Journal of Political Economy*, on investment in human capital, October.	JPE_{62}
Becker, Gary, 1964, 1975, and 1993. Book entitled *Human Capital*.	*Human Capital*

Let training have cost equal to C, with wages and marginal products at the training firm in each period respectively denoted by W_i and MP_i, i = 1, 2. Break even for a firm that offers training requires:

$$W_1 + W_2 + C = MP_1 + MP_2. \tag{1}$$

Assume an individual has the same marginal product elsewhere in period one, MP_1, and marginal product elsewhere of MP_a in period two. With completely *general training*, marginal product rises the same elsewhere as at the training firm: $MP_a = MP_2 > MP_1$. Thus, the wage in the second period elsewhere must equal MP_2 or the individual will quit after training. Hence, in order for the training firm to break even, $W_1 = MP_1 – C$---the worker pays all of general training cost by accepting a sufficiently lower wage during training.

For completely *specific training*, marginal product does not rise elsewhere with training: $MP_a = MP_1$. Thus, a firm *could* pay for specific training, with $W_1 = MP_1$, because it could recoup training cost by paying $W_2 = MP_a = MP_1 < MP_2$ in period two.

Becker discussed the role of turnover cost in affecting the worker and firm shares of specific training cost and returns. That issue will be discussed in Section 5. Also, Becker considered the possibility lowering wages during training may not be sufficient to prevent some under-investment in training. That issue also will be considered in Section 5.

3. Rand Corporation paper on training, 1957

Becker's research on training in the military, conducted at Rand in the summer of 1957, was concerned with whether the military should pay for training that produced skilled personnel. He was particularly interested in efficiency questions, whether the military paid too much for skilled personnel given the training provided, and whether the military should train less and hire or conscript those with some of the skills desired by the military (Becker, 1957*a*, pp. 7-11).[13]

Of more interest to economists, in $Rand_{57a}$, Becker considered the issues that have become an important part of labor economics: who and how to pay for training on the job.

Becker considered a two period problem (with the periods not necessarily of equal length). In the first period, military enlistees are trained. In the second period, an individual may either re-enlist in the military or become employed in the civilian sector. All amounts are in terms of present value. If one chooses the civilian sector in the second period, marginal product

[13] As discussed in footnote six, I do not know what Becker's responsibilities were at Rand. The last half of $Rand_{57a}$ is concerned with practical applications of his analysis, including outsourcing of training. This suggests there were some particular topics that Rand wanted him to analyze.

is MP_C, the wage is P_C, and equilibrium requires $P_c = MP_c$.[14] One who re-enlists in the military in the second period has a marginal product MP_m and a wage of P_m. Civilian employers hire individuals who are either trained in the military or in civilian training schools. Later (p.10), Becker used the term "transferable" to refer to this training. In his terminology from JPE_{62}, this would be called *general training*.

Becker defined t_m as "...the value at the end of the first term of the difference between the costs and productivity of first-termers."[15] Intuitively, t_m represents the part of training cost borne by the military. For a proof, see the Appendix. If the trainee paid none of the cost of training (marginal product equaled the wage during training), t_m would equal the full training cost of an individual. Becker then argued that equilibrium requires cost equal to marginal productivity:[16]

$$P_m + t_m = MP_m \tag{2}$$

Becker's equilibrium condition is actually a break even condition. The amount by which cost (training and wage) of a first period enlistee exceeds marginal product, t_m, equals how much the second period wage of those who re-enlist is reduced below marginal product:

$P_m = MP_m - t_m$. Using the facts that the military would have to match civilian pay to retain individuals in the second period, so $P_m = P_c$, and that $P_c = MP_c$, Becker substituted into *eq*.(2) to get:

[14] As in JPE_{62}, Becker treated marginal product as marginal revenue product.
[15] Becker (1957*a*, p. 3).
[16] Equations (2) and (3) herein are also equations (2) and (3) in $Rand_{57a}$.

$$MP_m - MP_c = t_m. \tag{3}$$

Since t_m is non-negative, and is positive if the military paid for any of training cost, then, with the military paying at least some of training cost, $MP_m > MP_c$. Thus, marginal product is higher in the military than in the civilian sector. Becker argued that inefficiency exists because marginal products should be the same for these individuals. Also, he argued "...the military pays more for skilled manpower than it needs to..."[17]

To be candid, Becker analysis is inconsistent and sometimes incorrect. He argued "...there is no way for the military to capture the gain...from training."[18] He is correct that general training cost cannot be recouped, as he explained five years later in JPE_{62}. Yet his equilibrium condition, *eq*.(2), assumed training cost *is* recouped. The discrepancy is due to his focus on the supposed inefficiency of resource allocation.

In *eq*.(3), Becker found that $MP_m > MP_c$ when the military pays for any training and $t_m > 0$. This stems from his equilibrium (breakeven) condition for the military in the second period, *eq*.(2). Becker found inefficiency since trained individuals have the same skill level in the civilian and military sectors. However, he did not explain how MP_m and MP_c could differ given that he clearly is concerned with general training at this point.

There are two reasons MP_m could exceed MP_c, even with identical skills in the military and in the civilian sector. One is if second period employment in the civilian sector differed in length from that in the military (since MP_m and MP_c are present values). Becker did not make

[17] Becker (1957*a*, p. 3).
[18] Becker (1957*a*, p. 3).

that argument, and it would be difficult to do so because military careers are usually shorter than those in the civilian sector. With the same marginal product per year, but fewer years worked post-training in the military than as a civilian, $MP_m < MP_c$, the opposite of what is required for *eq.*(3) to hold. Second, diminishing marginal productivity could yield $MP_m > MP_c$ if the military employed fewer individuals than the civilian sector. However, in *Rand*$_{57a}$, just as later in *JPE*$_{62}$, Becker focused on training cost and benefits for one individual, and did not consider diminishing marginal productivity. Consequently, it should be that case that

$MP_m = MP_c$.

Since the military is not a for-profit operation, it can, did, and likely still does lose from training.[19] However, Becker treated the military as one would a private, for-profit firm in *eq.*(2). Recognizing that MP_m must equal MP_c with training that is general/transferable, then *eq.*(2) cannot hold unless $t_m = 0$: the military pays none of training cost, what Becker argued in *JPE*$_{62}$.

In *Rand*$_{57a}$ (pp. 4-5), Becker argued that inefficiency---his finding that $MP_m > MP_c$---could be reduced if some of training cost were shifted to individuals thus lowering t_m. Although, I have argued this inefficiency does not occur, at this point in his analysis, Becker presented ideas that were later more clearly considered in *JPE*$_{62}$. He offered two ways by which individuals could pay for training.

First, individuals could be paid less than their marginal product during training. This could be accomplished in two ways. A longer initial enlistment period might be used. Also, the wage could be lower per unit of time. Of course, lower earnings during training are the means by which general training cost is implicitly paid by trainees in *JPE*$_{62}$. Second, for training with large

[19] See the discussion in Section 5.

cost (such as for pilots), Becker said this method is "...apt to have too weak an effect to shift entirely the burden to the trainees..."[20] Consequently, Becker suggested charging directly for training "...just as they now charge for goods in the PX."[21] Loans would be available for those who could not afford to pay directly for training. Direct payment for training cost by trainees was not considered in *JPE₆₂*. By page ten of *Rand₅₇ₐ*, Becker concluded that transferable/general training should be paid by trainees.

In $Rand_{57a}$, Becker noted that some military training "...such as handling a jet fighter may only slightly affect...civilian productivity...although it significantly affects...military productivity."[22] Aside from the possibility private training schools might be cheaper than the military, Becker argued "...it makes no difference whether the military or the trainee directly pays the training cost..."[23]

Thus, at this point, Becker began to consider what we now call *specific training.* Except for issues of turnover (see Sections 2 and 5 herein), Becker first came to the same conclusion about paying for specific/non-transferable training that he did in JPE_{62}, except that, as he discussed earlier in $Rand_{57a}$ with general/transferable training (p. 5), he considered the possibility of a trainee *directly* paying for specific training.

After first saying it did not matter who paid for the cost of specific/non-transferable training cost (p. 10), Becker concluded such cost should be paid for by the employer, and argued that "...the equilibrium wage rate would simply equal the marginal product..."[24] It is not clear which marginal product he meant. If the military paid for completely specific training, then the

---

[20] Becker (1957*a*, p. 5).
[21] Becker (1957*a*, p. 5).
[22] Becker (1957*a*, p.1 0).
[23] Becker (1957*a*, p. 10).
[24] Becker (1957*a*, p. 10).

military could break even paying a wage equal to the individual's marginal product elsewhere, which would be less than the individual's marginal product in the military. Although somewhat similar to the arguments in JPE_{62}, the analysis in this part of $Rand_{57a}$, as with the earlier analysis on transferable training, is inconsistent and unclear.

4. Training in the military as a theme

In Becker's first example of *general training* in JPE_{62}, he said "...a machinist trained in the army finds his skills of value in steel and aircraft firms..."[25] He then discussed how the military "...offers training in a wide variety of skills and many---such as piloting and machine repair---are very useful in the civilian sector."[26] Becker (JPE_{62}) discussed why for-profit firms will not pay for general training, but noted that "...the military...is not a commercial organization judged by profits and losses."[27] As discussed in Section 3 herein, in $Rand_{57a}$, Becker was not clear about whether the military was subject to a break even constraint.

Becker's first examples on *specific training* in JPE_{62} involved the military. He noted that military training is "...offered that is only of minor use to civilians: astronauts, fighter pilots, and missile men..."[28] In JPE_{62}, Becker mentioned neither his summer at Rand in 1957 nor $Rand_{57a}$. However, one who reads either JPE_{62} or *Human Capital* realizes that the issue of training in the military was important to Becker.

---

[25] Becker (1962, p. 12).
[26] Becker (1962, p. 16). In *Human Capital*, the phrase "such as piloting and machine repair" is omitted.
[27] Becker (1962, p. 16).
[28] Becker (1962, p. 17).

5. The evolution of Becker's analysis of training on the job from 1957

A. Who pays for training?

How did Becker get from *Rand*$_{57a}$ to *JPE*$_{62}$? There are several bits of information on this question. In 1959, Becker published a brief note (Becker, 1959*b*) in a publication that described ongoing research at the NBER. Becker said his work then underway at the NBER included analysis of training on the job, and that he had concluded the cost of such training was "...*usually paid by the trainee*..."[29] (emphasis added). In this short piece, Becker did not mention either general/transferable training or specific/non-transferable training, whether trainees would pay for training cost directly or via lower wages during training, or under what circumstances an employer would pay for training.

Also in 1959, Becker sent part of a preliminary chapter (Becker, 1959*a*) of what would become *Human Capital* (1964) to members of the reading committee of the book for the NBER.[30] This document contained the first reference I have found by Becker to what he called specific and general capital. Here Becker mentioned a firm's share of the cost of specific training. However, if Becker explained the factors that determined the firm and worker shares of specific training cost, he did so in an earlier part of his manuscript which apparently was not included in his memorandum to the reading committee.[31]

---

[29] Becker (1959*b*, p.3 9).

[30] The individuals to whom the memo was addressed are Milton Friedman, George Stigler, and Richard Easterlin. I found this information in the Milton Friedman papers, Box 20, Folder 30, Hoover Institution Archives, provided to me by Diana Sykes at the Hoover Institution.

[31] Becker may have sent more than part of a chapter, but it was not in the correspondence between him and Milton Friedman found in the Hoover Archives.

I do not know whether what I have called Becker 1959*b* was written before or after what I have called Becker 1959*a*. The former is in a book published in 1959, and the latter is dated August 31, 1959. There does appear to be a difference between the documents in that Becker 1959*b* says, with no distinction between general and specific training, that training cost is usually paid by the trainee, and Becker 1959*a* talks about the share of specific training cost paid by a firm.

Additionally, in his December 1960 Presidential Address to the American Economic Association 73rd annual meeting, Theodore Schultz discussed human capital research. In the references to the published paper of this talk,[32] Schultz referred to Becker's work on human capital at the NBER as "G.S. Becker, preliminary draft of study undertaken for Nat. Bur. Eco. Research, New York 1960."[33] Schultz said that Becker "...advances the theorem that in competitive markets *employees pay all the costs of their training* and none of these costs are ultimately borne by the firm"[34] (emphasis added).

Schultz was one of the pioneers in the analysis of human capital, was the chair of the economics department at the University of Chicago when Becker was a graduate student there, wrote a glowing letter of recommendation for Becker for a job at Harvard in 1956,[35] and organized the conference in which Becker presented the paper that became JPE_{62}. Thus, Schultz was well aware of Becker's work. Schultz claimed that, in 1960, Becker had concluded that an employee would *always* pay for training, which differs from Becker's statement in Becker 1959*b*

[32] Schultz (1961).
[33] Schultz (1961, p. 16).
[34] Schultz (1961, p. 10).
[35] Heckman (2014, pp. 70-73).

that an employee would *usually* pay for training, and from his statement in Becker 1959*a* that suggests firms pay some of the cost of specific training.

Recall that Becker considered non-transferable/specific training in $Rand_{57a}$, where he first argued that it did not matter who paid for non-transferable/specific training cost, but, in the same paragraph, concluded that the employer should pay such cost. Thus, prior to JPE_{62}, we have three statements by Becker (the first in $Rand_{57a}$) and one by Schultz about Becker's work, covering approximately three years, and none completely agrees with the other on who pays for specific training.

What Becker finally concluded in JPE_{62} is either a firm or a worker *could* pay for specific training, but that turnover dictates that the cost and return to specific training would generally be shared. A firm fears paying for specific training when a worker may quit. A worker fears paying for specific training when the worker may be fired or laid off. The shares of training cost and returns for a worker and a firm "...depend on the relation between quit rates and wages, layoff rates and profits and on other factors..."[36]

Ehrlich (2018) notes that Becker considered possible underinvestment in general and specific training due to the inability to capture full returns to training as the result of turnover. Underinvestment in training is considered in sub-Section 4B below. Other researchers developed Becker's ideas on sharing specific training cost and returns. Parsons (1972) separated specific training into worker and firm financed shares, and examined the implications for quits, layoffs, and wages. Hashimoto (1981) considered how costs of evaluating an individual's marginal

[36] Becker (1962, p. 20).

product at the training firm and elsewhere affect the decision of what share the worker and the firm pay for specific training cost.

For general training, as discussed in Section 3, Becker was ambiguous about whether the military would pay for training in *Rand*$_{57a}$, but ultimately appeared to conclude the individual would pay for such training. In *JPE*$_{62}$, Becker noted that the military pays some of general training because it is not subject to a profit constraint.[37] However, Becker concluded that for-profit firms would not pay for general training. As shown in Section 2 herein, workers pay for such training by accepting lower wages during training.

B. Underinvestment in training?

As discussed in Section 3 above, in *Rand*$_{57a}$, Becker said there might be some cases when lowering wages to pay for training in the military might not be sufficient to shift training cost to individuals. He suggested charging individuals directly for training, with the possibility of loans by the military to trainees who could not pay for training up front. Since the military can prevent an individual from quitting before the end of one's enlistment period (and could conscript individuals in 1957), and federal law enforcement could be used to pursue delinquent borrowers, the problem of too little investment in training was not an issue in *Rand*$_{57a}$.

When private firms are concerned, the possibility of underinvestment in training exists. In 1947, Chicago eminence Aaron Director claimed a private enterprise system would underinvest in humans (Caldwell, 2022). In his early draft of *Human Capital* (Becker, 1959*a*), Becker discussed how a firm's share of specific capital was intangible capital that could be used as

[37] Becker (1962, p. 16).

collateral for a loan. He argued the "...capital market functions almost as well for specific capital as for tangible capital, and much better than for general human capital."[38]

In his 1960 *AER* paper, Becker was specifically interested in the possibility of underinvestment in college education, noting that economists have long stressed how capital market imperfections limit the amount invested in education and other training. Ehrlich (2018) notes that underinvestment in education due to borrowing constraints was well recognized. However, Becker found little difference in rates of return to college education and to business capital, which implies that underinvestment in college education might not have been a problem.

Becker continued his analysis of possible underinvestment in training in JPE_{62} and in *Human Capital*. He repeated his argument (discussed above) that it is easier to finance specific training than it is for general training. He also cast doubt on the old argument that firms have no incentive to train workers---since workers would then quit---by showing that lower wages during training may cover training cost. He noted that specific training produces external effects, external diseconomies to workers and firms providing training, but does not produce external economies to other firms, the traditional Pigovian argument for too little training by firms. [39]

6. Summary

Gary Becker's seminal work on training on the job was first published in the *Journal of Political Economy* in 1962, and later was included in his book *Human Capital* (1964). In an

---

[38] Becker (1959*a*, p. 31).
[39] Van Overtfeldt (2007, pp. 122-123) said Becker showed how the Pigovian argument that training is an externality, so under-investment in training occurs, is not a problem if individuals can accept lower wages during training. White (2016, pp. 3-4) noted that Becker showed that any under-investment in general training is due to the same problem with other worker investments in training---the inalienability of human capital.

unpublished 1957 Rand paper on training in the military (Becker, 1957*a*), Becker first considered issues involving *general training* and *specific training*, although he did not use those terms. In his 1957 paper, Becker appeared to struggle to deal with issues of how to pay for training, and whether the employer or the trainee should pay the cost of training. The analysis was somewhat confused and contradictory in his 1957 paper, and he suggested trainees might *directly* pay for training, an idea he no longer considered in his 1962 *Journal of Political Economy* article.

Earlier, I referred to Becker's 1962 *Journal of Political Economy* paper as "seminal," given its originality and the influence it had on the economics profession.[40] Clearly Becker's 1957 Rand paper on training contained the seeds of his later development regarding who and how one would pay for training on the job. The 1957 paper is apparently unknown to the economics profession,[41] but its forthcoming publication (Elias, Mulligan, and Murphy, forthcoming) will allow for easier access by scholars to this important early work by Gary Becker.

[40] Becker (1957*a*) refers to ideas that later were of great interest in labor economics: sorting, self-selection, and signaling. I owe this point to Mike Gibbs. See Chiappori and Levitt (2003) for Becker's influence on empirical research in microeconomics.
[41] For example, Teixeira's paper (2014) on Becker's early work on human capital did not mention Becker's 1957 paper. Neither Teixeira nor anyone else who has written about Becker likely knew about the paper.

Appendix

Proof that t_m is the part of training cost borne by the military

Let w_0, MP_0, and c_0 represent the present value of the wage, marginal product and training cost respectively during the initial period in Becker (1957*a*). Becker defined t_m as the present value at the end of the first term of the difference between the costs and productivity of a first term enlistee. Thus:

$$w_0 + c_0 - MP_0 = t_m. \quad \text{(A1)}$$

Presumably, the minimum value of w_0 equals $MP_0 – c_0$---the military pays for none of training---and the maximum value of w_0 equals MP_0---the military pays for all of training. This implies:

$$w_0 = MP_0 – (1-\alpha)c_0, \quad \text{(A2)}$$

with $0 \leq \alpha \leq 1$. Thus, α is the share of training cost borne by the military. Substituting in *eq*.(A1) for w_0 from *eq*.(A2) yields $t_m = \alpha c_0$.

References

Becker, Gary S., 1957*a*. “Should the Military Pay for Training of Skilled Personnel?” Working paper number D-4508, Rand Corporation, August. Forthcoming in *The Power of the Economic Approach: Unpublished Manuscripts of Gary Becker*. Ed. by Elias, Julio J., Mulligan, Casey B., and Murphy, Kevin M. Chicago: University of Chicago Press.

______, 1957*b*. “The Case Against Conscription.” Working paper number D-4514, Rand Corporation, August.

______, 1959*a*. “Memorandum to Milton Friedman, George Stigler, and Richard Easterlin.” *Collected Works of Milton Friedman*. Milton Friedman papers, Box 20, Folder 30, Hoover Institution Archives.

______, 1959*b*. “Investment in Education.” In *The Study of Economic Growth*, edited by Solomon Fabricant. New York: National Bureau of Economic Research: 38-40.

______, 1960. “Underinvestment in College Education?” *American Economic Review* 50 (May): 346-354.

______, 1962. “Investment in Human Capital: a Theoretical Analysis.” *Journal of Political Economy* 70 (October, part 2): 9-49.

______, 1964. *Human Capital: a Theoretical and Empirical Analysis, with Special Reference to Education*. New York: Columbia University Press.

______, 1975. *Human Capital: a Theoretical and Empirical Analysis, with Special Reference to Education*. 2nd edition. New York: Columbia University Press.

______, 1993. *Human Capital: a Theoretical and Empirical Analysis, with Special Reference to Education*. 3rd edition. Chicago: University of Chicago Press.

Caldwell, Bruce, ed., 2022. *Mont Pèlerin 1947,* Stanford: Hoover Institution Press.

Chiappori, Pierre-André, and Levitt, Steven D., 2003. "An Examination of the Influence of Theory and Individual Theorists on Empirical Research in Microeconomics." *American Economic Review Papers and Proceedings* 93 (May): 151-155.

Chiswick, Barry, 2006. “Jacob Mincer, Experience and the Distribution of Earnings.” In *Jacob Mincer*: *A Pioneer of Modern Labor Economics*, edited by Shoshanna Grossbard. New York City: Springer, 109-126.

Clough, Richard, 2006. “An Economic Tradition.” *UCLA Daily Bruin*, May 8. On line at:

https://web.archive.org/web/20060515212412/htttp://www.dailybruin.ucla.edu/news/articles.asp?id=37051.

Coleman, Thomas S., 2017. “Human Capital.” Working paper, Harris School, University of Chicago, March.

Ehrlich, Isaac, 2018. “Celebrating the Life and Work of Gary Becker.” *Journal of Human Capital* 12 (Summer): 173-181.

Ehrlich, Isaac, and Murphy, Kevin M., 2007. "Why Does Human Capital Need a Journal?" *Journal of Human Capital* 1 (Winter): 1-7.

Elias, Julio J., Mulligan, Casey B., and Murphy, Kevin M., 2019. "Sample of *The Power of the Economic Approach: Unpublished Manuscripts of Gary Becker*." *Journal of Human Capital* 13 (Summer): 140-141.

_____, forthcoming. *The Power of the Economic Approach: Unpublished Manuscripts of Gary Becker*. Chicago: University of Chicago Press.

Fisher, Irving, 1897*a*. "Senses of 'Capital'." *Economic Journal* 7 (June): 199-213.

_____, 1897*b*. "The Role of Capital in Economic Theory." *Economic Journal* 7 (December): 511-537.

Hashimoto, Masanori, 1981. "Firm-Specific Human Capital as a Shared Investment." *American Economic Review* 71 (June): 475-482.

Heckman, James J., 2014. "Private Notes on Gary Becker." IZA working paper number 8200, May.

Heckman, James J., Lazear, Edward P., and Murphy, Kevin M., 2018. "Gary Becker Remembered." *Journal of Political Economy* 126 (October, S1): S1-S6.

Kiker, B.F., 1966. "The Historical Roots of the Concept of Human Capital." *Journal of Political Economy* 74 (October): 481-499.

Lewis, H. Gregg, 1957. "Letter to Gary Becker". *The H. Gregg Lewis Papers, 1939-1990*. Correspondence Series. Becker, Gary, 1957-1979. Box 10. David M. Rubenstein Rare Book and Manuscript Library, Duke University.

Mincer, Jacob, 1962. "On-the-Job Training: Costs, Returns, and Some Implications." *Journal of Political Economy* 70 (October, part 2): 50-79.

Oi, Walter Y., 1962. "Labor as a Quasi-Fixed Factor." *Journal of Political Economy* 70 (December): 538-555.

______, 1999. "A View from the Midway." *American Economist* 43 (Fall): 13-18.

Parsons, Donald O., 1972. "Specific Human Capital: an Application to Quit Rates and Layoff Rates." *Journal of Political Economy* 80 (November-December): 1120-1143.

Rottenberg, Simon, 1956. "The Baseball Players' Labor Market." *Journal of Political Economy* 64 (June): 242-258.

Sanderson, Alan R., and Siegfried, John J., 2006. "Simon Rottenberg and Baseball, Then and Now: A Fiftieth Anniversary Retrospective." *Journal of Political Economy* 114 (June): 594-605.

Schultz, Theodore W., 1961. "Investment in Human Capital." *American Economic Review* 51 (March): 1-17.

Sveriges Riksbank Prize in Economic Sciences press release, 1992. October 13. On line at: https://www.nobelprize.org/prizes/economic-sciences/1992/press-release/

Teixeira, Pedro Nuno, 2005. “The ‘Human Capital Revolution’ in Economics.” *History of Economic Ideas* 12 (Number 2): 129-148.

______, 2014. “Gary Becker’s Early Work on Human Capital---Collaborations and Distinctiveness.” *IZA Journal of Labor Economics* 3 (Number 12): 1-20.

______, 2020. "Loose Ends? Discussing Human Capital and the Economic Value of Education in the First Half of the Twentieth Century." *The European Journal of the History of Economic Thought* 27 (Number 6): 1011-1032.

Van Overtfeldt, Johan, 2007. *The Chicago School*. Agate: Chicago.

Weiss, Yoram, 2015. “Gary Becker on Human Capital. *Journal of Demographic Economics* 81 (March): 27-31.

White, Lawrence H., 2016. “Human Capital and its Critics: Gary Becker, Institutionalism, and Anti-Neoliberalism.” Working paper, Department of Economics, George Mason University, December.