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Effort Standards and the Velocity of Production: A Theory of Labor, Time, and Wage Funds

by

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Abstract

A model of dual measures is proposed to explain the economic relevance of time for labor services. The paper investigates two significant temporal decisions of the firm with respect to wages and employment: the investment in labor-time and the use of a circulating wage fund to finance this investment. The use-efficiency of a firm's investment in labor-time and the cost of wage funds employed are shown to be determined by variables, both internal and external to the firm besides effort supplied by its work force.

"Scientific management approaches the problem of remuneration for manual labor by the reflections that time-wages give no direct stimulus towards efficiency; and that piece-rate wages err by yielding the same payment to two men, using similar plant for the same job; though one of them has occupied his plant with it for a day and a half, and the other only for a day. It insists...(on) **the importance of setting up a direct connection between an operative's remuneration for a job and the shortness of time during which he keeps his plant occupied on it...**" (Marshall, 1919: 385)(emphasis added)

INTRODUCTION

Should firms be interested in the level of effort put forward by their workers? How should firms value the effort supplied by their workers? The textbook answer provided by the marginal productivity theory of wages to the second question has led to conclusions which seem odd when held up against the mirror of real world concerns: As long as the firm is presumed to pay its workers their true contribution, **in product terms**, it should be indifferent as to the actual effort decision on the part of the worker. Both worker A and B "produce" a hundred pins each, with A, the hard worker, using two-thirds the time used by B, the shirker. Assuming zero monitoring costs, the use of identical techniques by both workers and a single, competitive price or piece-rate, their respective total earnings at the end of a working day, from the point of view of the employer, should reflect their differential productivities. Does it? It does not, if we are to believe Marshall's statement quoted above. However, a clear link between remuneration and effort is not obtainable from the marginal productivity apparatus. In our example, should the two workers be paid the same competitive piece-rate? If not, who should be paid a lower wage? An obvious response would be that a single piece rate does not take into account the differential use of firm capital by each worker. Yet, the "cost" of this differential use is not readily identifiable through the conventional production function, $Q = f(k,l)$--where k and l are **units** of labor and capital services. The faster work pace of A does not imply a lower real input/output ratio. On the other hand, if it is suggested that, A, by working at a faster pace effects a higher rate of depreciation or equipment wear, his compensation would have to be lowered to reflect a greater, i.e. a more intense use of capital. But this results in a piece rate differential in favor of worker B--i.e. just the opposite of what is implied by Marshall.

A significant paradox is perceivable here: The product or "real" measure of effort fails to signal the differential worth to a firm of varying effort levels. The paradox results from a problem of **dual measures**--attested by the quote from Marshall--that to my knowledge has not been adequately addressed in the literature. While for non-labor commodities their contribution in the production process is defined in units of measure which at the same time serve as units of market or price measure, for labor this is not true. The relevant unit of price or market measure for labor is a conventional **time unit**--an hour, day, week, etc. On the other hand, the effort supplied within the production process is allocated using a **product** measure--Q/t. Q/t measures the velocity of production or goods turnover per unit of time, where Q is product quantity and t, a discrete time unit. The time specification is important here, since, as a measure of velocity, Q/t cannot be equated with a stock measure, Q/t_n--i.e. Q, where t_n is now an instant of time. I shall argue that while the measure, Q/t, serves the purpose of both setting effort standards[1] and monitoring worker performance, it **cannot** serve as the basis of an ex-post compensation of effort. Q/t is not a measure of actual effort supplied by the worker[2]. Effort is not susceptible to cardinal, and therefore, economic measurement.

To identify the differential cost of labor services (or effort levels), one needs to move beyond the limits of the exclusively "physical or real" marginal productivity apparatus and consider two significant temporal decisions of the firm with respect to wages and employment: the investment in labor-time and the use of a circulating wage fund to finance this investment. The relevant implications of the problem of dual measures for the internal allocation of the labor input are contained in the following set of propositions:

> **Proposition** 1. Without a spatial, i.e. product, measure of effort, price functions as an allocative mechanism for time units, while effort provided within such time is not susceptible to price allocation.

Two significant corollaries follow from this proposition:

> **Corollary 1.1** The firm invests in labor time which is not representable by a stock measure of so-called "effort units."

> **Corollary 1.2** The use efficiency of invested labor-time is determined by both sustainable, i.e. legitimate, effort standards and the velocity of production.

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[1] The question of quality is kept aside here, since it is properly interpreted on an ordinal scale. It therefore functions as a minimum requirement. The worker provides standard, or at most, "better" quality work, he does not supply "more" quality.

[2] Though the effort standard is defined in terms of Q/t, assuming heterogenous workers and denying inter-personal utility comparisons, the same Q/t could imply varying effort disutility or "pain costs" for different workers.

Proposition 2. The firm's investment in labor time is financed by a circulating wage fund, with the following cost function:

$$C^F = f(w \cdot h \cdot N \text{ (or } W), r, T^f, Q/t)$$

where: C^F--Net Cost of Wage Fund.
w--Wage rate per unit of labor time.
h--Unit of labor time.
N--Number of workers employed.
W--Total wage outlay.
r--Short term rate of interest or opportunity cost of short term capital.
T^f--Number of times the wage fund is turned over.
Q/t--Velocity of production.

The mechanics of this cost function is described and explained in Section 3.

In the framework proposed here, the firm is not indifferent to the actual effort level provided by the workers. The effect of effort, for the employer, is captured by the velocity of production, Q/t. Unlike variable commodity inputs, whose unit cost or implicit price to the firm remains unaffected by the intensity of their use in the firm--i.e. by the velocity of production[3], the opposite characterizes the use of labor. A higher Q/t not only implies a more efficient or intensive use of invested labor-time, but it also, as will be shown, reduces the cost of labor employed. A richer set of factors--both internal and external to the firm--can be incorporated in the proposed framework as being relevant to wages and production. Though obviously beyond the scope of the present paper, some issues are worth mentioning: the use efficiency of a firm's investment in labor-time is affected by, besides effort supplied, the velocity of production sustainable by the firm which,

[3] Assuming that the material inputs or raw materials supplied to the firm are produced under conditions of constant returns to scale.

in turn, is a function of variables, both internal and external to the firm--for example, the "absorption capacity" of its markets, its inventory and marketing strategies, its internal "division of labor," etc.; the availability and cost of liquid or short term funds serve as constraints for the employment decision of the firm. Thus, the structure of and conditions in both capital and product markets affect the relative costs of the two sources of wage funds--internal cash generation and external financing; the effect of popular labor legislation, such as minimum wages, on employment will be sensitive to both the differential use efficiency of invested labor-time across industries and the cost of wage funds.

Section I delineates three distinct problematics associated with economic measure in order to introduce the concept of dual measures. Though problems of measurability have been essential ingredients in economic models that concern themselves with various micro-institutional and macro-implications of the labor phenomenon, the measurement problem identified with labor has been mis-specified. The discussion in Section 2 provides support to the Proposition 1 and its corollaries. The nature of labor's participation in the production process is analyzed and the dichotomy for the labor commodity between its "external" or market value and its "internal" measure is explained. Section 3 elaborates on Proposition 2, that is, the employment and cost of a circulating wage fund within a firm. Summary and conclusions are provided in the last section.

1. The Issue of Economic Measure

What is the significance of measurability in economic theory? The answer is quite simple: measurability is essential to the co-operative functioning of two key market institutions--the price system and the production system. The allocation of resources by the price system as well as the transformation of resources by the production system require well defined units of resource measure. More importantly, for the application of the broader test of market or allocative efficiency to the production system, economic theory presumes identical units of resource or product measure for both systems. Three separate problematic relevancies of resource measure may arise here with corresponding implications for the functioning of price allocation.

(1) Though identical units of resource measure may apply in both market transactions and production activity, maintaining complete or accurate measures could in each case involve positive economic costs. For example, the purchase of flour, its transformation into bread, and the sale of bread use homogeneous units of measure--volume or weight. However, for each of these activities there could be costs associated with the maintenance of accurate measures and the accounting of all possible "leakages": future prices may be uncertain, weights used may be defective, a certain percentage of flour is wasted in production, workers may embezzle for own consumption, etc. In all such cases, price adjustments and

institutional arrangements could be achieved that minimize and internalize these costs--i.e. product prices would reflect the costs of such measurements and adjustments. That the price system is sufficient here to ensure allocative efficiency has been convincingly demonstrated by the transaction costs paradigm.

(2) The production process may involve not only waste of measured products, but it may also generate outputs measured neither in the market nor in the production unit. An example would be "heat units" generated during a chemical process. Where such outputs lack economic value, the absence of a complete measure of all components in a production process would not affect the calculus of allocative and productive efficiency. Such outputs may, of course, effect positive or negative "externalities." In such a case the problem of measure would once again be relevant for the goal of allocative efficiency. Smoke from a factory chimney, though of no economic value, may impose negative externalities on members of the community. Here, the achievement of allocative efficiency would require a measure of the relevant "social costs."

(3) For certain inputs in the production process, a strict dichotomy may exist between its market measure and its measure in the production process. Valuing the services provided by a machine is one example of this dichotomy,

the other being the value of labor services. The purchase or market price for a piece of new machinery bought today does not provide a firm basis for valuing its use in the production process the day after, at which point in time the machine is already a "used" one, and in all probability there exists no "market" for such used machines. The valuation problem within the production unit is solved firm-wide by employing rules for depreciation determined by both internal objectives and external, including accounting, conventions.

Though the dichotomy between the "external" and "internal" measures of capital has received authoritative treatment[4], the significance of dual measures for the labor commodity has been neglected. Instead, the participation of the labor commodity in the production process has characteristically been defined, in both neoclassical and marxian models, in terms of homogeneous measures of type(1) above. This interpretation reflects a one-sided perspective on the labor commodity--an outcome perspective. The equally, if not more, important aspect of labor--its process significance has been incompletely developed [5],[6].

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[4] See Robinson (1954), Hicks (1973), and Georgescu-Roegen (1971, 1976).

[5] A notable exception exists in the writings of Professor Georgescu-Roegen (1971, 1976), who clearly delineated the process aspects of production in his concept of "fund factors." However, to the best of my knowledge, he has not explored the issue in the direction pursued in this paper.

[6] The Marxian contributions to the theory of the firm [See Bowles (1985)] recognize the process aspect of labor--in their distinction between "labor" and "labor power." However, they fail to maintain the process-outcome distinction in their modelling of "labor." In fact, their specification of "labor" is no different from that of neoclassical production theory:

"Let the output of a firm be a function of the level of inputs.

2. The Outcome Versus Process Measure of Labor

The neoclassical production function,

$$Q = f(L, X) \quad \text{L--Labor, X--Other Inputs.}$$

represents labor as a flow of homogeneous "commodity" units that are transformed into a corresponding measure of output units. Such a "commodity" interpretation is correct when considering the **outcome** aspect of labor, but is misleading when used to represent its **process** form. The dichotomy between outcome and process is best illustrated by the following stylized representation of two institutionally distinct production systems: **specialization of work** (Figure 1) as in craft production and **division of labor** as in the factory system (Figure 2).

Under craft production, the worker supplies "units" of labor embodied in commodities. Each of the spatial vectors in Figure 1 represents a specialized craftsman performing a distinct operation and supplying **n** number of finished components-- straightened wires, cut wires, pointed wires, ground wires and so on. Each artisan is paid according to the number of components supplied.

Under division of labor, the significance of the laborer shifts from result or product to process. The laborer now commits his labor or effort to the production process per se, not to the product. This shift from outcome to process is illustrated in Figure 2.

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(1) $Q = f(X, L)$,
where Q is the number of units of output over some period of time, X is the vector of material inputs and services, and L is the input of labor over this time period. **All inputs and output are measured in physical terms. Labor is thus counted in effective work done, or effort units.... As is quite evident,..., the physical input-output aspects of production in the model is similar to its neoclassical--or Walrasian--analogue."** (Bowles, 1985:20)(emphasis added)

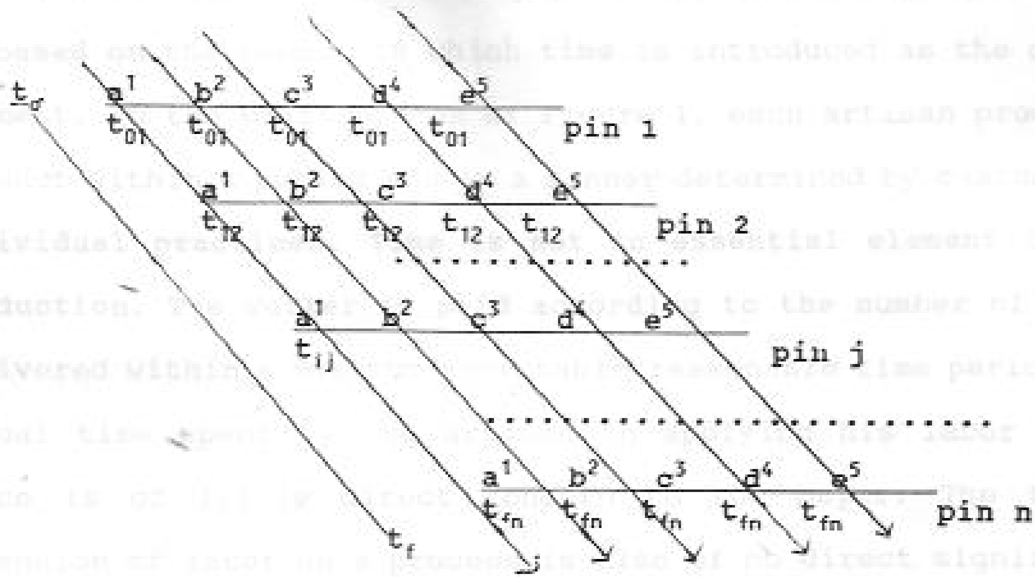
$$\begin{bmatrix} a_{11} \\ a_{12} \\ a_{13} \\ \vdots \\ a_{ij} \\ \vdots \\ a_{1n} \end{bmatrix} \quad \begin{bmatrix} b_{21} \\ b_{22} \\ b_{23} \\ \vdots \\ b_{ij} \\ \vdots \\ b_{2n} \end{bmatrix} \quad \begin{bmatrix} c_{31} \\ c_{32} \\ c_{33} \\ \vdots \\ c_{ij} \\ \vdots \\ c_{3n} \end{bmatrix} \quad \begin{bmatrix} d_{41} \\ d_{42} \\ d_{43} \\ \vdots \\ d_{ij} \\ \vdots \\ d_{4n} \end{bmatrix} \quad \begin{bmatrix} e_{51} \\ e_{52} \\ e_{53} \\ \\ e_{ij} \\ \vdots \\ e_{5n} \end{bmatrix}$$

Where, a, b, c, d, and e are independent artisans.

i=1,...,5 is the distinct operation each artisan performs, 1=straightening wires, 2=cutting wires, etc.

j=1,...,n is the indicator of units supplied.
$Y_{artisan} = P_i \times j$, Y--income, P_i--price of i.

Figure 1



Where, a^1, b^2, c^3, d^4, e^5 are the laborers, performing operations 1 to 5 respectively.

t_{ij} is the ith point of time at which an operation is performed on the jth pin: i=0 to f; and j=1 to n.

each operation is assumed to be of equal intensity and require an equal amount of time.

the diagonal vector, t_0--t_f, is a time vector that measures the passage of time during a single factory work-day.

the horizontal vectors represents the spatial flow of products at every instant of time.

Figure 2

The distinction between specialization and division of labor is based on the manner in which time is introduced as the defining element. In the craft system of Figure 1, each artisan produces a product within a period and in a manner determined by customary and individual practices. **Time is not an essential element in craft production. The worker is paid according to the number of pieces** delivered within a maximum acceptable/reasonable time period[7]. The actual time spent by the artisan in applying his labor to each piece is of little direct concern to the buyer. The temporal dimension of labor as a process is also of no direct significance to the artisan himself (i.e. the seller). Given the customary technological possibilities, the focus of exchange is on the decision of how many units to supply and purchase at given prices. Once that is decided, the appropriate technique will be employed by the craftsman to obtain the output at minimum cost. The main concern of the artisan is to manufacture a superior quality of goods with minimum use of raw materials[8]. Therefore, a supply

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[7] Obtaining and enforcing reasonable delivery schedules was, however, an important and strongly disputed element in the exchange transaction between the artisan and the merchant. So much so that various trades saw concerted attempts by merchants to obtain more consistent delivery schedules from the "domestic workers." Marglin (1974: 50) notes the legislative attempts in eighteenth century Britain at enforcing delivery schedules in the woolen trade:

> "Parliament twice enacted laws requiring domestic woolen workers to complete and return work within specified periods of time. In 1749 the period was fixed at 21 days, and in 1777 the period was reduced to eight days."

[8] That quality and materials used, not time intensity, were the main elements in efficient market exchange is indicated by the pathologies within the craft system that developed around these two elements. Adulteration and embezzlement of raw materials employed in production was considered a serious problem in the pre-factory domestic or putting-out system. In fact, the common and widespread occurrence of the problem in textile, metals, gun, cutlery, nails, and other English manufactures of mid-nineteenth century had led the costs of such embezzlement to be included as part of expected expenses or deductions from profits (Jones, 1982: 132):

> "Given the obvious and longstanding link between embezzlement and the wage rate, one has to consider whether it is legitimate to classify embezzlement as an 'interface leakage,' or whether it is more appropriate to regard it as a labor (or raw material) cost. There are good reasons for arguing that it should be regarded as the latter, the extent and regularity of embezzlement encouraging manufacturers to make some regular provision for the loss of material in their costings."

induced change in price mainly emerges from a lower material cost, not from a more time efficient i.e. more intense use of labor. An increase in the rate or speed of labor application would mainly go to increase the total income of the craftsman--he would produce more and sell more[9]. This could, of course, cause a secondary effect on price depending on the demand elasticity for the artisan's product.

In Figure 2, the task of each laborer is defined along two temporal dimensions: instants of time and the passage of time. Each worker is required to work at a pace that is coordinated with the pace of the other workers in both dimensions of time. Thus, workers **a** to **e** start and complete their respective operations at the same instants of time--t_0, t_1,...,t_i, etc.--as shown along the horizontal spatial vectors. In addition, their activity is coordinated in time--from t_0 to t_f--as shown along the diagonal time vector. **Time comes to define the contribution of each laborer.** This fact is overlooked in the outcome perspective on labor which identifies the contribution of each worker with the flow of components along the horizontal spatial vector. Instead, what each laborer supplies is effort, which is regulated in terms of, **but is not equal to**, the number of components, n, "worked upon" by the worker within a given time period. Unlike commodity inputs whose contribution to the production process is identified along the horizontal spatial vectors, for the worker, his effort is defined by the diagonal time

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[9] For the artisan-supplier, given production techniques and his subjective preferences with respect to the allocation of time between market and non-market activities, his use of working or "market" time will be guided by a straightforward profit-maximizing calculus.

vector.

Division of labor removes the craft focus on outcome by creating a demand for mere effort or process. Within the factory employing division of labor, the primary requirement is not the production of commodities, but the production of commodities within a minimum amount of time. Unlike the buyer in the craft system, the purchaser of "labor" has a direct interest in the temporal intensity of labor. That is, what the laborer supplies is not a set of goods for which he is paid per unit, but a certain intensity of effort, monitored in terms of the rate of goods turnover per unit of time, i.e. the **velocity of production**.

With the emphasis on effort intensity, of which, the turnover rate of goods per time unit is only an indicator, not a measure, the worker can no longer be compensated with respect to quantity of goods supplied or worked upon. Though the employer uses spatial, i.e product, units to establish an effort standard for the laborer, spatial categories cannot provide a measure for effort intensity that, as seen in Figure 2, exists only in the temporal dimension. The non-spatial essence of effort can be overlooked if its provision by labor is wrongly identified with a commodity flow measurement--the quantity of units "worked upon." The services of labor cannot even be mapped with some infinitesimal part of a unit of output worked upon. **Unlike commodity units, services do not have a spatial dimension and therefore, cannot be mapped with flow elements existing in spatial forms.** The textbook marginal productivity theory of wages that posits a determinate mapping between labor and output with both represented in commodity space overlooks this non-commodity or temporal dimension of effort. Effort provided by the worker is not susceptible to cardinal, and therefore, economic measurement. As a result, with time as the nearest economic surrogate for effort, the principle of compensation is fundamentally altered. **The firm purchases labor-time, while effort supplied within such time is not susceptible to price exchange.** The fact that piece and time wages have been found to be used in varying combinations in both craft and industrial systems of production should not conceal the essential distinction being stressed here. The identity between the two forms of payment exists only under the craft system. For example, the artisan **a** in Figure 1 that produces forty straightened wires in an hour and works five ten-hour days a week is indifferent between a piece rate payment of one cent a wire and a weekly payment of twenty dollars. The payment is based on the number of wires produced, period. However, with division of labor, the emphasis is on the intensity of effort, i.e. number of wires straightened per hour.[10]

The factory laborer is expected to supply a minimum intensity of effort--a standard that is not prone to simple price calculus. In the above example, one cent is the market determined price for a defined unit of exchange--the wire. There is no similar market measure for effort intensity--a subjective, non-commodity

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[10] The turn-of-the century historian of North American industrialization, Norman Ware expressed this change in the basis of labor compensation as thus:

> "This transition from the earlier (i.e. craft) to the later (i.e. industrial labor) was reflected in terms of the labor contract. The old term for the remuneration of the mechanic was 'price.' It referred to his product rather than to his labor, for it was his product that he sold. When the producer, whether master or journeyman, sold his product, he retained his person. But when he came to sell his labor, he sold himself." (Ware, 1990[1924]:

See also Weber (1923:118).

phenomenon. For the purposes of the employer, the measure of product velocity, Q/t, suffices for both, setting effort standards and monitoring worker performance. However, it does not serve as the basis of an ex post compensation of effort. The use efficiency of a firm's investment in labor-time cannot be an object of exchange, but only one of production and control. The question of how much time is required for production of wire is, for the artisan, a matter of unquestioned customary technology[11]. But for the laborer, the standard of effort intensity is as much a matter of personal motivation and work ethics as a target of organizational incentives and control. The purchase of labor time leaves unresolved the broader issue of legitimate effort standards[12]. Thus, the primary transaction between the firm and

11 At the U.S. arsenal at Harpers Ferry, not only did each finished product bear the mark of the "whims, styles, and even the carelessness" of the craftsman, but productivity at the armory varied according to the ability and experience of each artisan. The standards of "working" were provided by the individual tasks. The working-day of an armorer was determined by the minimum necessary time required to "file a lock" or "forge a barrel," according to traditional standards of workmanship, as well as by individual skill and dexterity--which were often coincidental and difficult to separate. Thus,

> "Although the factory opened at sunrise and closed at sunset, artisans were free to come and go as they pleased [ ] In effect, this meant that younger apprentices and journeymen generally spent a greater amount of time at their benches than older more experienced hands. Often skilled artisans would achieve their monthly quota in two or three weeks and could devote the remainder of their time to other pursuits such as farming, operating a small business or making weapons for private customers in the armory shops [ ] For the most part, hard work prevailed at Harpers Ferry; a systematic work regimen did not." (Smith, 1991: 65)

12 Whether by piece or time, wages, in so far as they are used to motivate a higher standard of effort, function as inputs in the production process. The emergence of effort intensity--a process phenomenon--as the target of compensation fundamentally alters the essence of piece-rates as the "price" of labor. Piece-rates can no longer perform a purely allocative-role in the case of the supply of effort-intensity. Instead, piece-rates become an instrument in the establishment of effort standards. This fact is well supported by historical evidence--in particular, the use of piece-rate wages by the proponents of "scientific-management."

The task faced by the employer was twofold--obtaining maximum effort in time and adopting a payment system that would indicate this requirement:

> "Scientific management approaches the problem of remuneration for manual labor by the reflections that time-wages give no direct stimulus towards efficiency; and that piece-rate wages err by yielding the same payment to two men, using similar plant for the same job; though one of them has occupied his plant with it for a day and a half, and the other only for a day. It insists...(on) the importance of setting up a direct connection between an operative's remuneration for a job and the shortness of time during which he keeps his plant occupied on it..." (Marshall, 1919: 385)

However, in the absence of an objective or pre-given determination of effort-intensity, an alternative means to determine this element was to be found. Scientific management proved to be one such source of legitimacy:

labor is the investment in labor-time, the use-efficiency of which is determined by the velocity of production, Q/t--a function of the effort standards sustainable[13], the efficiency of the overall production process, the extent of the market, etc.

This section has explored the first of two relevant temporal

> "But scientific management claims that a change in the mode of reckoning remuneration does not suffice: there is needed in addition a 'scientific' ascertainment of the time which the job requires when performed with standard provision of accessories and by workman of fair average ability." (Marshall, 1919: 385)

Interestingly, such a "scientific" calculation of the time required to fulfill a specific task had to include in its measurements, the average "willingness" of a normally "motivated" worker. A minimum amount of work ethics was thus slipped in as a significant assumption in the time and motion studies introduced by scientific management:

> "They (management) recognize the task before them as that of inducing each workman to use his best endeavors, his hardest work, all his traditional knowledge, his skill, his ingenuity, and his <u>good will</u>--in a word, his 'initiative,' so as to yield the largest possible return to his employer. The problem before the management, then, may be briefly said to be that of obtaining the best <u>initiative</u> of every workman. And the writer uses the work 'initiative' in its broadest sense, to cover all of the <u>good qualities sought for from the men</u>." (Taylor, 1911. Quoted in Clawson (1980:214)) (emphasis added)

Piece-rates were employed as an incentive mechanism to draw higher levels of effort supply from the labor force. Bonus systems [See Burgess (1986: 226-227) for the "Rowan System" introduced in 1898 and its widespread use in the British engineering sectors by early 1900s] combined "scientific" time estimates with a structured piece-rate system that rewarded labor a proportion of time saved on well-defined tasks. See also Montgomery (1987).

As expected, determination of legitimate effort supply (per unit of time) and the role of piece-rate wages in such determination became the main basis of industrial disputes associated with length of the working day, pace of work, and labor remuneration. A major source of contention with respect to piece rates wages was the management policy of reducing piece-rates as workers met the higher standards of effort intensity:

> "The major reason why trade unions like the ASE (Amalgamated Society of Engineers) were opposed to payment by results was that it allowed employers to adjust piece-work prices without due regard to negotiated time rates, and there was also the problem of persistent cutting of piece-rates as employers sought to maximize their returns from the general intensification of work." (Burgess, 1986: 218)

See also Zuboff (1988: 45), Rodgers (1978: 51-55), Ware (1990 [1924]: 120-22), Montgomery (1987), Clawson (1980) and Braverman (1974). Workers and Unions responded to the cut in wages and the intensified pace of work in various ways: by non-cooperation with the "time-experts" (Zuboff, 1988: 46); informal time quotas and restriction of pace (Rodgers, 1978: 165-166); peer pressure (Marshall, 1919: 381, 639) (Montgomery (1987), (1979)) (Clawson, 1980: 173); formal negotiations with management, etc.

[13] Eighteenth and seventeenth century work ethics played a specially important role in obtaining worker commitment to the factory system. The spiritual roots of the work ethic in New England Puritanism along with the later secularized view of work ethics in the writings of Benjamin Franklin, Henry Ward Beecher, and Thomas Carlyle [see Glickstein (1991)] molded the work habits of industrializing America:

> "The industrial economy was in large part a creature of the intense regional faith in the worth of labor. The work ethic helped impel the restless personal energies of the Northern manufacturers, blessed their enterprises with a sense of mission, and gave them a transcendent sanction. It helped anesthetize employers to the eleven- and twelve-hour days they imposed on their workers and the pace at which the factories drove them. The work ethic provided the language of calculation, system, and diligence into which the efficiency engineers poured their new and stricter meanings, turning the new plants into matchless hives of industriousness." (Rodgers, 1978: 28)

See Robertson and Lee (1992) for the failure to apply Fordist work principles in British firms due to the inability of management in securing adequate worker commitment to the high effort levels required. See also Chandler (1990) and Piore and Sabel (1984) for persistence of craft traditions in France, Italy, and Germany that discouraged the introduction of mass production processes in these countries.

decisions of the firm--the investment in labor-time and the use of a wage fund to finance this investment. The purchase of labor-time and its use efficiency as determined by Q/t, i.e. the velocity of production, was argued to characterize the employment of labor. The conventional allocative calculus fails to incorporate the temporal value of effort by using and interpreting the ratio,

> w/q^* -- where w is the wage rate; q^* the so-called "effective labor units" supplied, measured in obvious commodity terms.

as the cost or "implicit price" of a unit of labor. It was stressed that the measure of production velocity, Q/t, used by the employer as an indicator or worker performance is not a measure of effort incurred by a worker. **For labor as a process phenomenon, wage outlays do not represent a corresponding "stock" of labor services.** The employer demands from the worker effort in time, evaluated in terms of the velocity of production, Q/t, not a stock of commodities, Q. The cost of labor services is to be obtained from an alternative standard--that provided by the circulating wage fund employed in the firm. The nature of this calculus and the use of the internal measure, Q/t, in reference to labor services is clarified in the following section.

3. Circulating Wage Fund

The "cost" of man-hours invested in by the firm is given by the following:

$$C^f = f(w \cdot h \cdot N \text{ (or } W), r, Q/t, T^f) \qquad (1)$$

where, w is the wage rate per unit of labor time; h, the unit of labor time; and N, number of workers employed. W is the total wage outlays incurred by the firm.

C^f--Net cost of Wage Fund used to employ labor.

r--Short term rate of interest or opportunity cost of short term capital.

Q/t--Velocity of production, where t is a discrete time unit.

T^f--Number of times circulating capital is turned over in its use for wage payments. T^f is determined by the distribution over time of wage outflows and the inflows of revenue. A simple formula can be used to calculate the value of T^f:

$$T^f = \frac{L^t}{\sum_{i=1}^{n} (\alpha_i p_i)} \tag{2}$$

where, L^t--Total Invested Labor-Time.

p_i--period between wage disbursements or between wage disbursements and receipts.

$\alpha_i = \dfrac{\text{total wages disbursed up to period } i}{W}$

n--number of disbursements

$$\text{Therefore, Wage Fund} = \frac{W}{T^f} \quad \text{.........}(3)$$

$$\text{and,} \qquad C^F = \frac{W}{T^f} \cdot r \quad \text{......................}(4)$$

The cost of invested labor time is jointly determined by the variables in (1). The effect of each variable on C^F, keeping others constant and allowing T^f to adjust when necessary, is described in the following propositions.

Proposition 1. $\quad dC^f/d(Q/t) < 0$, $\Delta r = \Delta W = 0$
$\Delta T^f > 0$

The left hand side of the above inequality indicates the change in cost when velocity of production is increased, without a change in total wage outlays and r, but with a higher T^f.

Proposition 2. $\quad dC^f/dr > 0$, $\Delta W = \Delta T^f = \Delta(Q/t) = 0$

Here a higher cost of money capital increases the cost of employment, other variables being fixed.

Proposition 3. $\quad dC^f/dT^f < 0$, $\Delta(Q/t) = \Delta r = \Delta W = 0$

A higher turnover of wage funds, ceteris paribus, decreases the cost of employment. Thus, external credit market conditions may effect the turnover of liquid funds to individual firms.

Proposition 4. $dC^f/dw > 0, \quad \Delta r = \Delta T^f = \Delta Q/t = 0$

Increase in market wage rates, without a change in Q/t or in the other variables, leads to higher labor costs.

Proposition 5. $dC^f/dN < 0,$ **if existing division of labor is non-optimal--i.e. $\Delta(Q/t) > 0$.**

$> 0,$ **if existing division of labor is optimal--i.e. $\Delta(Q/t) < 0$.**

The inequalities here seek to capture a potential **scale effect** that results from the employment of an additional worker. If an increased N, makes possible a more efficient division of labor, the use efficiency of invested labor-time is improved, and the cost of labor decreased. If the existing arrangement, i.e. scale, of tasks is optimal, an additional worker may in fact reduce Q/t and thus increase C^f.

Proposition 6. $dC^f/dh > 0,$
or $dC^f/dh < 0,$

Firms often hire some workers for a shorter time unit--for example, hourly or weekly. The effect on employment cost may depend here on two opposing forces: hourly workers, besides possibly being paid a lower wage rate, imply a shorter commitment of wage funds, i.e. a higher T^f, and therefore a lower C^F. On the other hand, hourly or temporary workers may be less motivated and thus provide lower levels of effort, lowering the use efficiency of invested labor-time, and increasing overall costs. A simple example illustrates the differential cost with respect to the value of **h**:

Two Wage Schemes for a Single Production Week

(1) \$350 for one week, paid on the first day.
(2) \$50 per day, for seven days.

r = 10% per week.

Assuming a single inflow of receipts at the end of the seventh day, wage scheme**(2)** will result in a lower C^F. This example is illustrated in graphs 4 (Scheme 1) and 5 (Scheme 2) below, which also provides a visual representation of the nature of the circulating Wage Fund. Time is measured on horizontal axis in both figures. The vertical axis measures disbursements and receipts. Using the formula for T^f, the area/s enclosed by the dotted lines represent/s the cumulative wage disbursements over time. The fraction/s in parenthesis is/are the individual product/s, $(\alpha_i p_i)$. Thus, for **Scheme (1)**, $T^f = 1$ and $C^f = \$35$, while for **Scheme (2)**, $T^f = 1.75$ and $C^f = \$20$. However, if scheme**(2)** produces a higher labor turnover and lower work ethics, the resulting drop in **Q/t** and thus, in T^f, could more than offset the mentioned cost savings.

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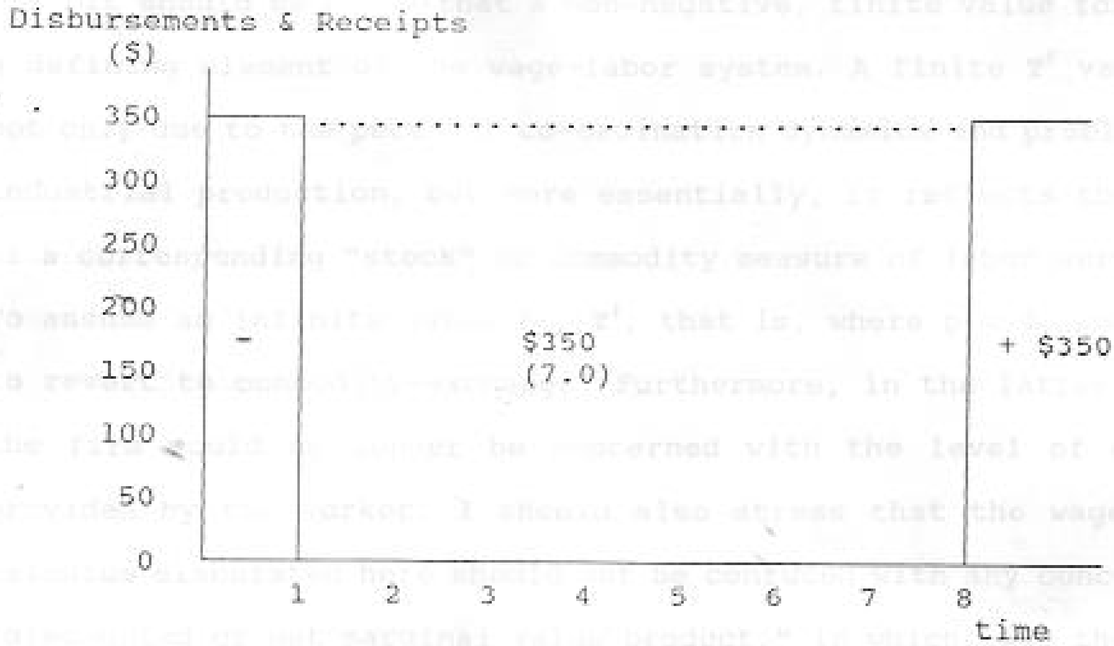

Figure 4

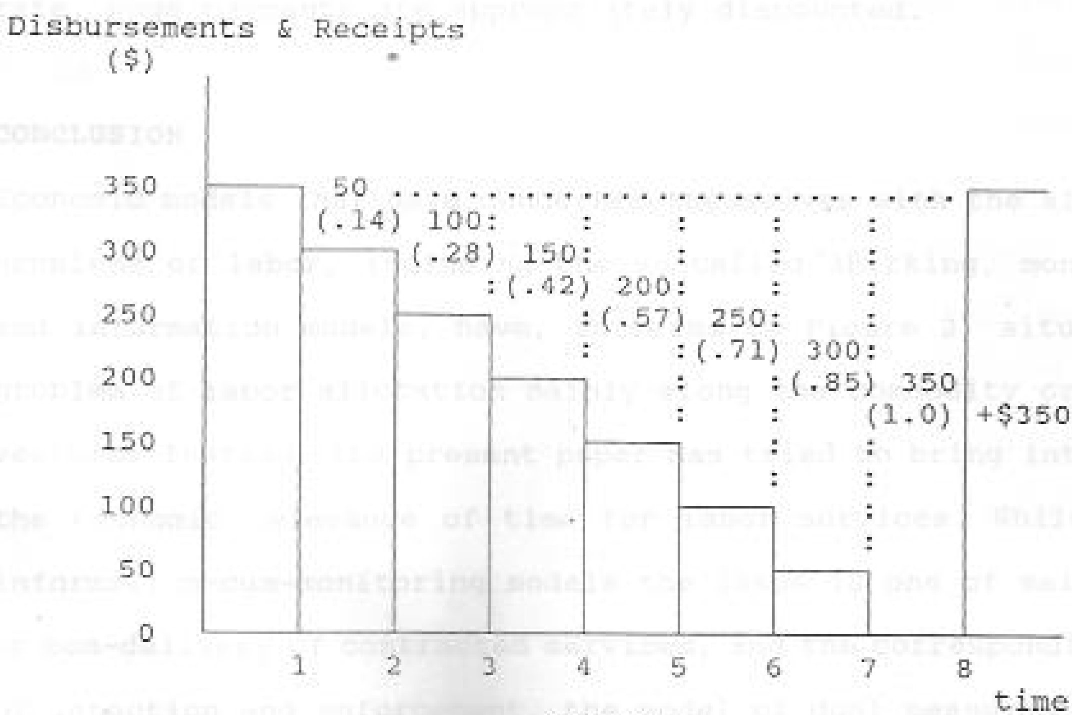

Figure 5

It should be noted that a non-negative, finite value for T^f is a defining element of the wage-labor system. A finite T^f value is not only due to the peculiar co-ordination dynamics and problems of industrial production, but more essentially, it reflects the lack of a corresponding "stock" or commodity measure of labor services. To assume an infinite value for T^f, that is, where $p = 0$, would be to revert to commodity-exchange. Furthermore, in the latter case, the firm would no longer be concerned with the level of effort provided by the worker. I should also stress that the wage fund calculus elaborated here should not be confused with any concept of "discounted or net marginal value product," in which case the firm is again indifferent to internal shirking on the part of its workforce if, assuming the availability of a suitable discount rate, wage payments are appropriately discounted.

CONCLUSION

Economic models that have concerned themselves with the allocative problems of labor, including the so-called shirking, monitoring, and information models, have, in terms of Figure 2, situated the problem of labor allocation mainly along the commodity or spatial vectors. Instead, the present paper has tried to bring into relief the economic relevance of time for labor services. While in the information-cum-monitoring models the issue is one of malfeasance or non-delivery of contracted services, and the corresponding costs of detection and enforcement, the model of dual measures concerns itself with the use efficiency of a firm's investment in labor-time. As should be evident in the stylized production model of

Figure 2, the firm is less concerned with individual shirking than with the effort standards sustainable for the entire work force or "team." Given the nature of the production process, individual shirking is relatively easy to locate and control. The firm, however, is not indifferent to the level of work ethics prevalent amongst its work force. Further, the use efficiency of invested labor-time is subject to variables both external and internal to the firm besides effort supplied by its work force.

The labor factor has inappropriately been seen as a pure variable factor to the production process, no different from commodity inputs or raw materials. The investment in labor time, instead, should be viewed as fixed investment in the relative short run--defined here, in terms of Figure 2, as the period for which Q/t is variable and non-zero with the existing division of labor or process scale. The flow of raw materials or pin components in Figure 2--i.e. the variable factors, determine the use efficiency of invested labor-time. In the particular case of Figure 2, the long run would be defined with respect to either the abandonment of the entire production process or a change in the scale of production, the latter being effected by either a mere duplication (or a reduced scale) of the existing division of labor, or by a more complex division of labor. For a production process employing machinery, the degree of fixity of investment in plant capital relative to invested labor time, would be measured by the fixed costs incurred for a Q/t = 0.

The potentially significant contribution of this paper is the attempted integration between traditional production theory and the

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theory of financial capital in the concept of wage funds. A much richer set of variables has been incorporated as being relevant to the theory of wages and employment. A fruitful future research area would be the effect of changing conditions in capital markets and availability of short term financial instruments on the structure of employment and production.

BIBLIOGRAPHY

Bowles, Samuel (1985) "The Production Process in a Comparative Economy: Walrasian, Neo-Hobbesian, and Marxist Models," The American Economic Review, 75:16-36.

Bowles, Samuel and Gintis, Herbert(1993) "The Revenge of Homo Economicus: Contested Exchange and the Revival of Political Economy," The Journal of Economic Perspectives, Vol. 7, No.1: 83-102.

Braverman, Harry (1974) Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century, Monthly Review Press, New York.

Burgess, Keith (1986) "Authority relations and the division of labor in British Industry, with special reference to Clydeside, c.1860-1930," Social History, Vol. II, No. 2: 211-233.

Chandler, Alfred D. Jr. (1990) Scale and Scope: The Dynamics of Industrial Capitalism. The Belknap Press of Harvard University Press, Cambridge, Massachusetts.

Clawson, Dan (1980) Bureaucracy and The Labor Process: The Transformation of U.S. Industry, 1860-1920, Monthly Review Press, New York.

Georgescu-Roegen, Nicholas (1966) Analytical Economics Harvard University Press, Cambridge, Massachusetts.

___________ (1971) The Entropy Law and the Economic Process Harvard University Press, Cambridge, Massachusetts.

___________ (1976) Energy and Economic Myths Pergamon Press Inc., New York.

Hicks, John (1973) Capital and Time: A Neo-Austrian Theory, Oxford University Press, Oxford.

Jones, S.R.H. (1982) "The Organization of Work: A Historical Dimension," Journal of Economic Behavior and Organization, 3:117-137.

Marglin, S.A. (1974) "What Do Bosses Do? The Origins and Functions of Hierarchy in Capitalist Production," Review of Radical Political Economy, 6:60-112.

Marshall, Alfred (1919) Industry and Trade, Macmillan and Co. Ltd., London.

___________ (1982[1920]) Principles of Economics, Porcupine Press, Philadelphia.

Montgomery, David (1987) The Fall of the House of Labor. Cambridge University Press, Cambridge.

Robertson, Paul and Alston, Lee (1992) "Technological Choice and the Organization of Work in Capitalist Firms," Economic History Review, XLV, No.2: 330-349.

Robinson, Joan (1954) "The Production Function and the Theory of Capital," The Review of Economic Studies, 81-106.

Rodgers, Daniel T. (1978) The Work Ethic in Industrial America: 1850-1920, University of Chicago Press, Chicago.

Piore, Michael J. and Sabel, Charles F. (1984) The Second Industrial Divide: Possibilities for Prosperity, Basic Books Inc., New York.

Smith, Merrit Roe (1991) Harpers Ferry Armory and the New Technology, Cornell University Press, Ithaca.

Ware, Norman (1990[1924]) The Industrial Worker: 1840-1860, Ivan R. Dee, Inc. Publisher, Chicago.

Weber, Max (1923) General Economic History, George Allen & Unwin Ltd., London.

Zuboff, Shoshana (1988) In the Age of the Smart Machine: The Future of Work and Power. Basic Books, New York.