A Microeconomic Analysis of Slavery in Comparison to Free Labor Economies

Haluk I. Ergin* and Serdar Sayan**

Department of Economics
Bilkent University, 06533 Ankara, Turkey

July 1997

* Graduate Research Assistant (**E-mail:** ergin@fen.bilkent.edu.tr)

** Assistant Professor
E-mail: sayan@bilkent.edu.tr **Fax:** +90(312)266-5140 **Phone:** +90(312)266-4040x2071

A Microeconomic Analysis of Slavery in Comparison to Free Labor Economies*

Haluk I. Ergin and Serdar Sayan

ABSTRACT

In addition to supervision costs, the labor cost of an enterprise (plantation) in the system of slavery consists of the cost of acquiring the slaves and the subsistence compensation given out to the slaves. In this paper, we leave aside the issue of supervision costs previously taken up in the theoretical literature on slavery, and focus on these two peculiar components of labor costs. We analyze the implications of this cost structure on the levels of profitability, efficiency and determination of equilibrium wages, and compare them to systems with free labor markets, along a continuum of demand side Cournotic competition. For this purpose, we first use a model characterized by a decreasing returns to scale technology, and show, parallel to the findings of Vedder, *et. al.* (1990), that the equilibrium subsistence wage in the system of slavery is strictly lower than the marginal product of labor. We then extend the model, given the same technology and preferences, to free labor markets covering possibilities ranging from monopsony to perfect competition in the limit, and obtain a second and perhaps more striking result: Differently from equilibria in imperfectly competitive free labor markets, slavery and perfect competition equilibria are Pareto optimal. Furthermore, our comparisons across labor market scenarios suggest that the resistance of slaveholders to the abolishment of slavery is directly related to the expected level of demand side competition in the free labor market which would replace slavery. Finally, we show that the conclusions derived from our analysis would remain generally valid under a constant returns to scale technology as well.

Keywords: Economics of Slavery vs. Free Labor Systems, Labor Economics, Perfect Competition vs. Oligopsony and Monopsony in Labor Markets.

---

* Comments on an earlier draft by Prof. Gavin Wright are greatly appreciated but the responsibility for any errors or omissions that might have remained belongs to the authors.

Introduction

The political economy of slavery has been a widely discussed topic in economic history literature, particularly in reference to the North American experience. Findlay (1975) characterizes slavery as one of the oldest, most complex and extensive of the institutions in economic history. Wright (1991 and 1997) identifies three distinct dimensions of the subject, each providing material for extensive historical investigation: slavery as a work organization or a system of production; slavery as a set of property rights, and slavery as a political regime. Depending upon the purpose at hand, a recognition of these distinct dimensions could help with the choice of proper level of abstraction, leading to a better understanding of the economics or politics of slavery through a confinement of analytical focus. Taken as a system of production, for example, slavery may be viewed strictly as a special type of factor market organization, and economic implications of using slave labor may be evaluated in comparison to alternative forms of labor market structures. While the wide range of labor employment practices observed under the name of slavery may limit the historical relevance of results from such an evaluation to a certain locale, period or produce,[1] there obviously are certain features and common practices essentially distinguishing slavery from others. The purpose of this paper is to present a formal comparison of slavery to free labor economies by focusing on some of the factor market characteristics that are essentially different across systems, and to discuss certain microeconomic implications of these characteristics. Such a comparison might help historical analysis aiming to explain the economic reasons behind the rise and collapse of slavery as a work organization.

While the multifarious structure of slavery as an economic institution has always attracted the attention of economists, the aspect most extensively investigated has been the profitability/efficiency issue, particularly within the US context. The empirical evidence reported in the literature, however, has failed to lead to a consensus among researchers

[1] See Wright (1997) for a discussion and a survey.

about the conclusions that could be derived. Instead, the controversy around the issue grew especially after the publication in 1974 of *Time on the Cross* by Fogel and Engerman, where the authors argued in reference to North American agriculture that the production in the South was more efficient than in the North. According to Fogel and Engerman (1974), this regional difference was due to the higher physical efficiency of slave farms located mostly in the South, relative to free farms in the North. The efficiency advantages of slave farms, in turn, could be attributed to the larger scale of plantation operations and superior managerial skills of planters. In a follow up article, Fogel and Engerman (1977) argued more specifically that efficiency differences followed from higher intensity per unit of time of slave labor relative to free workers, rather than longer hours worked by slaves or lower costs associated with slave labor. Reactions to Fogel and Engerman's work came from Wright (1976 and 1979), Haskell (1979), David and Temin (1979), Schaefer and Schmitz (1979), and Field (1988) each focusing on a different aspect of the original work. Wright (1976 and 1979) and David and Temin (1979), for example, challenged the validity of efficiency calculations presented in the 1977 article with reference to the choice of data and the crop mix considered, whereas Field (1988) proposed an alternative specification for the production function to avoid problems in the Fogel and Engerman formulation. Schaefer and Schmitz (1979), on the other hand, agreed that the suggested relationship between the use of slave labor and productivity could indeed be explained by the scale of operation, but challenged the line of reasoning behind the conclusions drawn. According to them, slaves were not the cause of higher productivity, but rather a means of achieving a larger scale of operation which, in turn, led to higher levels of profitability.

Despite such a sizable empirical literature that continues to grow, relatively few studies have been devoted to a theoretical analysis of the issue, e.g., Fleisig (1976), with most of the theoretical works focusing on pain-incentive aspects and supervision costs, e.g., Findlay (1975), Fenoaltea (1984), Chwe (1990). Others have presented formal models developed for broader comparisons of slavery to free labor economies in terms of Paretosuperiority and welfare implications, e.g., Dirickx and Sertel (1978), de Dios (1990). This paper aims to contribute to this literature by presenting a theoretical, factor market analysis of slavery in comparison to other economic systems where labor is self-owned –as opposed to being owned by others in the words of Graves, *et. al.* (1983). A salient feature of the comparative analysis here is that it does not consider the somewhat ambiguous notion of free labor as a single benchmark. Free labor economies are characterized, instead, by labor markets that are perfectly competitive on the supply side, but competitive to differing degrees on the demand side. While ignoring supervision or monitoring costs studied in the previous literature, our analysis of labor costs emphasizes the quasi-capital structure of the slaves by relating slave prices to returns on capital. The analytical results concerning the levels of profitability, efficiency and labor compensation under slavery are also contrasted with the results of previous studies evaluating the issues from a historical/empirical perspective. However, given the extensive scope of the term slavery, the empirical relevance of analytical results would be limited to the cases where the definition of slavery employed is applicable. To avoid confusion, the term slavery is used in the rest of the discussion strictly to refer to a system of production where human labor needed for production is supplied by slaves who could be purchased and sold in the market just like any other factor of production, and once purchased (or inherited), are required to perform the tasks assigned to them by their owners, without having the will to quit working.[2]

The analytical framework employed here is an extended version of the "nutshell" analysis which was developed by Dirickx and Sertel (1978) for a comparative evaluation of certain key variables in different political economies characterized by different objective functions and constraints. In comparing the political economies they consider,

[2] This definition is similar to the list of distinguishing legal features of slavery that Wright (1997) notes to be persistent during most of the era of modern slavery. While it, too, makes references to underlying elements of property rights, the analysis here does not intend to address legal considerations. Instead, the definition aims to identify essential features that distinguish slavery from other labor market structures considered in the rest of the paper.

Dirickx and Sertel (1978) assume that the societies living under each political economy are equipped with the same technology, resources and preferences. The same assumption is employed here so as to assure comparability across systems. Greater detail about the assumptions on common and differing features of each system is given in the next section. Sections 3 and 4 develop the model for the system of slavery and free labor economies, respectively. Section 5 discusses results and presents concluding remarks.

Preliminaries

The steps of model development here are similar to Dirickx and Sertel (1979) but significant variations are introduced to the model structure. Some assumptions are commonly employed throughout the analysis regardless of whether the labor force of the system under consideration is made up of slaves or free workers. The agents are assumed to be symmetric. The number of firms and the number of workers/slaves in each system are m and N ($=m\times n$), respectively, where n is the number of workers (slaves) employed by each enterprise under the symmetry assumption. A representative enterprise i is assumed to produce output Y_i (say, cotton) under a decreasing returns to scale (DRS) Cobb-Douglas technology given by

$$Y_i = K_i^{\alpha} L_i^{\beta} \quad i \in \{1,2,...,m\} \quad \alpha, \beta > 0, \alpha+\beta < 1 \qquad \textbf{(1)}$$

where K_i is the aggregate capital input composed of physical capital and land employed by the i^{th} enterprise and L_i is the total labor hours satisfying

$$L_i = \sum_{j=1}^{n} l_i^j \qquad i \in \{1,2,...,m\} \qquad \textbf{(2)}$$

where l_i^j is the labor hours spent by the j^{th} worker/slave employed by the i^{th} entrepreneur/slave owner.[3]

[3] Since the output of the i^{th} enterprise is the same across systems, this formulation implicitly assumes that slaves and free workers are equally capable and qualified to perform the same tasks. For an alternative viewpoint, see Fenoaltea (1984).

The entrepreneurs are considered to be price takers in capital and final product markets where the price for the produced good is given by P . The cost of renting one unit of aggregate capital input is given by the market rental of capital, $r > 0$. Total rental cost of the optimal capital stock for each enterprise will then be equal to rK_i where K_i is the capital stock at which the marginal revenue from employing an additional unit of capital is equal to its marginal cost. That is,

$$K_i = \arg\max_{K_i} [PY_i - rK_i - C(L_i)] = \left(\frac{\alpha P}{r} L_i{}^{\beta} \right)^{\frac{1}{1-\alpha}} \quad i \in \{1,2,...,m\} . \quad \textbf{(3)}$$

V, the value added by labor in a system is defined as the residual income left after paying for all costs other than wages. Letting v_f denote value added per worker in a free labor economy, it follows from (3) that

$$v_f = \frac{V_i}{n} = \frac{PY_i - rK_i}{n} = \frac{1}{n}(1-\alpha)\left[\left(\frac{\alpha}{r} \right)^{\alpha} PL_i{}^{\beta} \right]^{\frac{1}{1-\alpha}} = \frac{1}{n}(1-\alpha)\left[\left(\frac{\alpha}{r} \right)^{\alpha} P(nl)^{\beta} \right]^{\frac{1}{1-\alpha}}$$

$$i \in \{1,2,...,m\} \qquad \textbf{(4a)}$$

implying that v_f can be expressed as a function of n and l for all i.

The determination of the wage rate, w, differs across systems but the utility function of each worker or slave is assumed to be of the form:

$$u_i^j = I_i^j - l_i^{j\,\gamma} \qquad \gamma > 1, \qquad \textbf{(5)}$$

$$I_i^j = wl_i^j \ , \qquad (i,j) \in \{1,2,...,m\} \times \{1,2,...,n\} \qquad \textbf{(6)}$$

where I_i^j denotes the wage income of the j^{th} worker (slave) employed at the i^{th} enterprise. The condition $\gamma > 1$ is necessary in order to assure the nonnegativity of the wage elasticity of labor supplied.[4]

---

[4] In what follows, two conventions are adopted. First, the consumption good is taken as the numeraire and I, w, r, prices, per capita profits p as well as ρ (defined in the next section) are measured in terms of the consumption good. Secondly, unless required to avoid confusion, sub/superscripts are dropped reflecting the symmetry of the agents.

The subsistence income is calculated by setting the utility in equation (5) equal to the reservation level.[5] For reservation level set equal to zero, $\bar{I}$ would represent the income that just suffices to counterbalance the worker's disutility from work (Dirickx and Sertel, 1979), i.e.,

$$\bar{I} = l^{\gamma}. \qquad \textbf{(7)}$$

In all systems, the ratio of the equilibrium wage to the value of marginal product of labor (MPL) is given by:

$$\theta = \frac{w}{P\frac{\partial Y}{\partial L}} = \frac{wl}{P\beta y} \qquad \textbf{(8)}$$

where y denotes the output per worker.

e denotes the value added per capita after compensating the workers (slaves) for their disutility of work, e=v-$\bar{I}$ (Dirickx and Sertel, 1979). In a society where resources are fully employed and the number of workers is given, e can be taken as a measure of efficiency since a higher level of e would be necessary for a Pareto improvement.

In cases where a free labor market prevails, the utility maximizing choice of labor contribution $\underline{l}$ of a worker facing a given wage rate w is

$$\underline{l} = \arg\max_{l} \quad (wl - l^{\gamma}) = \left(\frac{w}{\gamma}\right)^{\frac{1}{\gamma - 1}}, \qquad \textbf{(9)}$$

which can be used to derive a free worker’s offer curve, i.e., the income level for which a worker is willing to offer $\underline{l}$ hours of his labor:

$$\underline{I} = w\,\underline{l} \qquad \rightarrow \qquad \underline{I} = \gamma\,\bar{I}. \qquad \textbf{(10)}$$

---

5 The reservation utility is interpreted as the utility that a worker can get from his/her alternative to working. For the case of slavery, Chwe (1990) interprets the reservation utility as "the very large but not infinite disutility of death or suicide," or alternatively as "the expected utility of an escape attempt" (p. 1113).

When n is constant, the profit maximizing choice of labor hours to be demanded from each worker by the employer for a given wage rate w, is given by

$$\bar{l} = \arg\max_{l} \; (PY_i - wL_i - rK_i) = \frac{1}{n}\left[P\left(\frac{\alpha}{r}\right)^{\alpha}\left(\frac{\beta}{w}\right)^{1-\alpha}\right]^{\frac{1}{1-\alpha-\beta}} . \quad \textbf{(11)}$$

For a complete analysis, one should also consider the offer curve of the employer,[6] i.e., the maximum amount that the employer is willing to pay in order to procure $\bar{l}$ hours of labor:

$$\overline{v_f} = w\bar{l} \quad \rightarrow \quad \bar{v}_f = \frac{\beta}{1-\alpha} v_f \quad . \qquad \textbf{(12)}$$

The System of Slavery

The analysis here emphasizes the quasi-capital structure of slaves.[7] Unlike workers in other political economies, the slaves in the system of slavery are bought and sold in the market. Thus, total labor cost of an enterprise can be separated into two components: the subsistence income that should be given out to slaves, and the purchasing price of slaves themselves. Given this nature of the slavery system, a special treatment is required with respect to the assumptions of the analytical framework to be employed. In the nutshell analysis of Dirickx and Sertel (1979), for example, the systems are characterized by a fixed supply of labor. While this is a reasonable short-run assumption for other political economies, it need not be the case for slavery where slave imports may increase the supply of labor even in the short-run.[8] Should one consider the slavery in North America, for

---

[6] Both offer curves are depicted in the figure given at the end of the paper.

[7] This is the reason why Ransom and Sutch (1988) refer to slave owners as "capitalists without capital."

[8] Population in many colonies in the New World continued to increase through slave imports even when natural growth rates of population were negative, with death rates exceeding the birth rates – see Wright (1997) for evidence on this.

example, slave owners created demand for the services of the slavers (slave traders) who, in turn, supplied the slave owners to the point where the formers' marginal cost equaled his marginal revenue. This implies, differently from the case of a free working population where the number of workers in the system is given to the entrepreneurs who have no significant control over the size of the total work force, that total number of slaves in slavery is a decision variable of the slave owners. So, the feasibility of slave imports makes it possible that there *may* be large increases in the slave population even during periods of time that would be too short to allow for a significant growth of a free working population.[9] The following analysis accounts for this possibility by maintaining the assumption that the number of workers is fixed only for the cases where a free labor market prevails. For the case of slavery, on the other hand, the assumption is relaxed and the total number of slaves employed is determined endogenously.

Just like capital and land, slaves are considered to have an imputed rental ρ which represents the opportunity cost of holding one slave instead of purchasing an alternative asset which is taken here as the aggregate capital good. Under perfect foresight, the absence of arbitrage requires that ρ satisfy:

$$\frac{\rho_t + \Delta P_t^S - \lambda^S P_{t+1}^S}{P_t^S} = \frac{r_t + \Delta P_t^K - \lambda^K P_{t+1}^K}{P_t^K} \qquad \textbf{(13)}$$

where t is time, P denotes prices, l denotes the constant rates of depreciation, $DP_t = P_{t+1} - P_t$, and the superscripts S and K stand for slaves and the capital good, respectively. Since $r > 0$ and $l^K < 1$,[10] $\frac{\partial \rho_t}{\partial P_t^S} > 0$ implying that ρ is directly related to current slave prices.[11]

---

[9] Note that if there are restrictions upon slave trade, breeders are likely to replace slavers. In such a case, the effect of the growing demand for labor upon slave population growth would be limited by biological constraints. It would still be possible for slave population to grow naturally over time –as observed in North American mainland (Fogel, 1989), for example, but the analysis of such medium to long run growth in the supply of slave labor is beyond the scope of this paper.

[10] For simplicity, the rest of the discussion assumes $l^K = 0$.

Ignoring supervision costs, total labor cost of the i^{th} slave owner depends on two variables: total amount of labor and number of slaves employed. It follows naturally that the labor cost can be separated into two parts: the cost of employing *n* slaves and the total amount of subsistence income that should be given out to the slaves, i.e.,

$$C(L_i, n) = n\rho + n\left(\frac{L_i}{n}\right)^{\gamma}. \qquad \textbf{(14a)}$$

Therefore, the value added per capita in the system of slavery can be expressed as:

$$v_s = \frac{PY_i - rK_i - n\rho}{n} = v_f - \rho \qquad \textbf{(4b)}$$

Assuming that the slave owners behave rationally, a slave owner who needs to employ a total of L_i hours of labor would try to minimize his labor cost by adjusting *n*, the number of slaves. Denoting the cost minimizing level of *n* by

$$n(L_i) = \underset{n}{\operatorname{argmin}}\ C(L_i, n)$$

one obtains $$n(L_i) = L_i \left(\frac{\gamma - 1}{\rho}\right)^{1/\gamma} \qquad \textbf{(15)}$$

implying that the minimum cost of labor can be expressed as a function of the total amount of labor L_i employed by each slave owner alone. Then, equation (14a) would yield

$$C(L_i) = C[L_i, n(L_i)] = L_i\ \gamma \left(\frac{\rho}{\gamma - 1}\right)^{\frac{\gamma - 1}{\gamma}}. \qquad \textbf{(14b)}$$

The number of slaves employed is automatically adjusted to the optimal level. The profit maximizing levels of demand for labor and the aggregate capital input by the i^{th} slave owner can be found through

---

[11] Addressing population dynamics in the absence of slave trade was left out of the scope of the paper as it would require a dynamic model incorporating several channels to capture the demographic adjustment process that was rather complicated (footnote 9). But the closing of slave trade are likely to have short run implications as well: Since the speed of growth in the supply of slave labor would then be forced to stay within biological limits, the increase in slave prices would create capital gains for the original owners –captured by the $\Delta P_t^{\,S}$ term in equation (13). The first clear statement on this was in a 1960 article by Y. Yasuba, subsequently reprinted in Fogel and Engerman (1971).

$$(L_s, K_s) = \underset{(L_i, K_i)}{\arg\max} \quad [PY_i - rK_i - C(L_i)] \ .$$

When the relevant expressions for L_S and K_S are substituted into previous equations, one can easily derive the expressions for $n(L_S)$, π_S [12] and those for the per capita values of other key variables of the system as reported in the first column of the table given in the next section.

Since the income given out to the slaves is just enough to meet their subsistence needs, the utility of slaves turns out to be 0. An increase in the relative price of the output results in an increased demand for land, capital and slaves, leading to increased production and higher profits. In such a case, the increased demand for labor is met by increasing the number of slaves employed, as this is more cost efficient than increasing the number of labor hours supplied by each slave.[13] The increase in the amount of capital and land employed has a positive effect on marginal productivity of labor, but this effect is offset by the increase in the number of slaves employed. Thus, the output per slave turns out to be inversely related to the output price *P*, whereas profits per slave is independent of *P*.

θ_S, the ratio of the equilibrium subsistence wage to the value of marginal product of labor is strictly smaller than 1, and is indirectly related to the coefficient of disutility from work, γ. Following from the special labor cost structure in the system of slavery (where the equilibrium value of marginal product of labor is affected by both the marginal cost of subsistence compensation and marginal cost of employing one more slave), this

---

[12] The expressions for L_S , K_S, $n(L_S)$ and π_S are reported in the Appendix.

[13] It must be noted that had the size of the labor force been constant as in the case of free labor economies over the short-run, increasing the number of hours supplied by each worker would be the only way of satisfying increased demand for labor.

analytical result is supported by Vedder, *et. al*. (1990) where θ_S under the system of American slavery is argued to be smaller than 1/3.[14]

An increase in slave prices is reflected through an increase in ρ leading, in turn, to a decline in the overall size of the operation as reflected by declining values of n, L_S, K_S, Y_S and p_S. The increase in slave prices also affects the labor cost structure, since the slave owners tend to increase subsistence wages and make each slave work more, instead of employing a large number of slaves. Therefore, when slave prices go up, subsistence wages w, labor supplied per slave l, output per capita y, and profit per capita p tend to increase.

Free Labor Systems

This section retains the assumptions on technology and preferences but extends the foregoing discussion to free labor markets along a continuum of demand side Cournotic competition, ranging from monopsony to perfect competition in the limit.

Given L, total amount of labor employed in the system, $L_{-i}=L-L_i$ denotes the total labor employed by all enterprises other than the i^{th}. In a free labor market, each worker is free to choose the amount of labor he will supply. The workers determine this amount through the solution of their utility maximization problem. It follows from equation (9) that the wage rate in a free labor market with N symmetric workers will satisfy

$$w = \gamma\, l^{\gamma-1} = \gamma\left(\frac{L}{N}\right)^{\gamma-1}. \qquad \textbf{(16)}$$

The profit function of the i^{th} enterprise in an oligopsonistic free labor market can then be expressed as

[14] In a paper published earlier, Graves, *et. al.* (1983) argue that slaves in the US probably earned less than half the value of their marginal product, and that "[t]he end of slavery allowed newly freed blacks to earn amount close to their marginal product instead of a subsistence wage (...)" (p. 158).

$$\pi_i = PL_i^{\beta} K_i^{\alpha} - \gamma \left(\frac{L_{-i} + L_i}{N} \right)^{\gamma - 1} L_i - rK_i . \tag{17}$$

The solutions to the profit maximization problems of the individual enterprises result in *m* necessary conditions for a Cournot-Nash equilibrium in the free labor market with *m* buyers:

$$\beta P L_i^{\beta-1} \left(\frac{P\alpha}{r} L_i^{\beta} \right)^{\frac{\alpha}{1-\alpha}} - \gamma \left(\frac{L_{-i} + L_i}{N} \right)^{\gamma-1} - \gamma(\gamma - 1) L_i \frac{1}{N} \left(\frac{L_{-i} + L_i}{N} \right)^{\gamma-2} = 0$$

$$i \in \{1,2,...,m\} . \tag{18}$$

When (18) is solved for L_i, $i \in \{1,2,...,m\}$, the equilibrium values of the key variables can be derived as reported in the Appendix. When *n* is constant, perfect competition equilibrium is reached in the limit as the number of firms (*m*) tends to infinity, and for *m=1*, the expressions derived would represent the equilibrium values in a monopsonistic free labor market. Finally, when the number of enterprises is finite and strictly greater than 1, oligopsony prevails in the labor market. The results indicate that total profits of an individual enterprise in a free labor market that is perfectly competitive on the supply side, i.e., p_f in equation (A5) of the Appendix, are directly related to the size of the total work force *N*,[15] and that profits per capita is strictly decreasing in the number of enterprises, *m*.[16]

---

[15] Given *m*, $N = mn$, $\frac{\partial \pi_f}{\partial N} = \frac{1}{m} \frac{\partial \pi_f}{\partial n} > 0.$

[16] The expression for p_f is given in equation (A8) of the Appendix. Since

$1 - \alpha - \frac{\beta}{\gamma} \geq 1 - \alpha - \frac{\beta}{\phi} \geq \varepsilon > 0, \ \frac{\psi}{\delta\phi} = \frac{1}{\gamma} \frac{1 - \alpha - \frac{\beta}{\phi}}{1 - \alpha - \frac{\beta}{\gamma}} < 1$ implying that

$$\frac{\partial p_f}{\partial m} = (1 - \alpha) \frac{\gamma}{\beta} \frac{\rho}{m^2} \left(\frac{1}{\phi} \right)^{\frac{\gamma(1-\alpha)}{\delta}} \left(\frac{\psi}{\delta\phi} - 1 \right) < 0 .$$

The comparison of the values of l, y, p, w and u in free labor markets characterized by varying degrees of demand side Cournotic competition to those under slavery is only possible for comparable employment levels. This requires setting n relevant to free labor systems equal to $n(L^i_s)$, the endogenously determined level of employment under slavery. This is done by plugging the expression for $n(L^i_s)$ in equation (A3) of the Appendix into the relevant expressions for l_f , y_f , p_f , w_f and u_f –equations (A6) through (A10). The resulting (per capita) values for each of these key variables are reported in the second column of the table on the next page where the subscripts s and f stand for the system of slavery and the free labor markets, respectively. The third and the fourth columns of the table extend the results to the case of a constant returns to scale (CRS) technology with the homogeneity of the production function measured by $1-\varepsilon$ approaching to 1. Given that the agents are taken to be symmetric, it would suffice to consider the results for the i^{th} plantation alone under both technological assumptions.

Intersystematic Comparisons and Conclusions

Under the DRS technology assumption, a comparison of free labor markets to slavery in terms of l, y, p, w, u and q would yield the ranking in (19) below, where the superscripts C, O and M stand for competition, oligopsony and monopsony in the free labor

INSERT TABLE HERE !

market, respectively. Given that the level of employment was held the same at $n(L_S)$, the endogenous level of employment solved under slavery, the ranking in (19) could be interpreted as showing the directions the values of key variables would take immediately following a sudden end to slavery, depending upon the degree of demand side competition in the emerging market for free labor. Ruling out the possibility of migration of newly freed slaves out of the geographical region under consideration for the moment, this degree, in turn, would be determined by the number of slaveholding enterprises at the time of emancipation.

Labor supplied per capita:	$l_s = l_f^C > l_f^O > l_f^M$	
Output per capita:	$y_s = y_f^C > y_f^O > y_f^M$	
Profits per capita:	$p_f^M > p_f^O > p_f^C = p_S$	
Equilibrium wage rate:	$w_f^C > w_f^O > w_f^M > w_S$	**(19)**
Utility level:	$u_f^C > u_f^O > u_f^M > u_S$	
Equilibrium wage rate/MPL:	$\theta_f^C > \theta_f^O > \theta_f^M = \theta_s$	

The only modification to (19) that would be required by a change in the assumption about production technology concerns the ranking of wages. Under the assumption of a CRS technology, the fourth line would read:

Equilibrium wage rate: $w_f^C > w_f^O > w_f^M = w_S$

with the last inequality turned into an equality.[17]

[17] The ranking of other values including profits per worker/slave would remain the same. In order to see that $p_f^m > p_f^o > p_f^c = p_S$ would still hold, it is sufficient to remember that p_f is strictly decreasing in m (Footnote 16) and that p_f tends to p_S as m tends to infinity as under perfect competition. Noting that $\phi=\gamma$ when $m=1$, ϕ is decreasing in m and it tends to 1 as m tends to infinity, the other results are straightforward and can be checked in a similar fashion.

Figure

INSERT FIGURE HERE !

S: Slavery Solution

C: Competitive Solution

M: Monopsony Solution

The figure above depicts the offer curves of laborers and employers, and the respective equilibria of different systems under consideration. In the figure, $\overline{I}$ is the subsistence income necessary for a laborer to provide l hours of his labor –equation (7), and v_f is the maximum amount that an employer is willing to pay in order to procure l hours of labor –equation (4a)– without allowing for negative profits to persist. Therefore, the intersection of the areas above $\overline{I}$ and below v_f corresponds to the feasible region of any economy. Likewise, $\underline{I}$ represents the offer curve of a free worker, i.e., the income level for which he is willing to offer l hours of his labor –equation (10), whereas $\overline{v}_f$ represents the offer curve of an employer, i.e., the maximum amount that he is willing to pay in order to procure l hours of labor –equation (12). As expected, the intersection point of the two offer curves, *C*, corresponds to the competitive equilibrium, where both the employers and the laborers behave as price takers. The free labor market solutions lie on $\underline{I}$ between points *M* and *C*. Under slavery, the relevant offer curve of the slave owner-entrepreneur (planter) would be v_S in equation (4b), and would deviate from v_f by r.

It can easily be checked for given values of ρ and $n=n(L^i_S)$ that $l_s = l_f^c$ maximizes e_s and e_f. Technically speaking, this implies that the slavery and perfect competition in the labor market operate at socially efficient levels, whereas the monopsony and oligopsony in the labor market are inefficient. At first sight, this assertion may seem to contradict the inequalities $p_f^M > p_f^O > p_S$ and $u_f^O > u_f^M > u_S$ in (19) for they imply together that both slave owners and slaves are worse off in the 'efficient' system of slavery, compared to the inefficient systems of monopsony and oligopsony in the labor market.[18] The explanation for this apparent contradiction can be found through a careful examination of the figure which suggests that, in the system of slavery, the slave owners' surplus is not only p_S but $p_S + \rho$. This is a natural implication of the set of property rights in the system of slavery

[18] The slave owners are worse off as they fail to obtain per capita profits that are as high as those under monopsony or oligopsony as indicated by the first inequality. Likewise, slaves are worse off for their utility remains below the levels relevant to imperfectly competitive markets for free labor.

which entitle the slave owners to the (imputed) rental of their quasi-capital holdings, slaves.

Turning back to the static comparisons in expression (19), a good question to ask concerns the reason why the slave owners did not abolish slavery, even though they had a chance to improve their profits in the short run by adopting a free labor market.[19] The answer to this question is twofold. Firstly, in the system of slavery, the surplus of slave owners is not made up of only the operational profits but also includes the (imputed) rental of the slaves already owned. Thus, the abolishment of slavery would impose a burden on the slave owners amounting to r per slave per period.[20] Note that for all free labor economies under consideration $p_f < p_S + \rho$, implying that the profits alone would not account for total gains of the slave owners from the maintenance of slavery. In other words, the slave owners would be made worse off by a transition to a free labor economy despite the inequality $p_S < p_f^O < p_f^M$. The second reason is the risk of ending up with a smaller labor force and hence, lower profits[21] after the abolishment of slavery, due to the migration of freed slaves to other parts of the country (Mandle, 1992; Graves, *et.al.*, 1983).

The degree of demand side competition in the free labor market of a system alternative to slavery depends on the number of planters. Remembering that p_f is strictly decreasing in *m*, the change in the profits per capita after the abolishment of slavery is inversely related to the number of plantations. Along with the negative effects of emancipation on the slave owners mentioned in the previous paragraph, this would imply a stronger resistance against slavery in the regions having a large number of small planters, compared to those regions with few large planters. Similarly, on an intertemporal basis, a

---

[19] The underlying assumptions behind this statement are: (a) after the adoption of a free labor market, the slaves would become wage taking workers, i.e., labor unions are not allowed, (b) the number of planters is finite, i.e., the demand side of the free labor market is not perfectly competitive.

[20] This burden could alternatively be viewed as a lump-sum tax to the slave owners amounting to the market value of the slaves they own.

[21] An important characteristic of the model is that in the systems having free labor markets, total profits are directly related to the size of the working population (see also Footnote 16).

ceteris paribus decline (increase) in the number of planters in a region would be likely to reduce (increase) resistance against the abolishment of slavery.

The ranking in (19) also indicates that θ, the value of the equilibrium wage to the value of marginal product of labor, attains its lower bound (the inverse of the coefficient of disutility from work, $1/\gamma$) in the case of slavery and monopsony in the labor market. The upper bound for θ is 1 and this value is reached only at the limit as m tends to infinity, i.e., under perfect competition in the labor market. When the demand side competition in the labor market is characterized by oligopsony, θ will strictly increase in m and take a value that lies strictly between its lower and upper bounds. This ranking of possible values for θ implies that the labor will be paid the value of its marginal product only when there is a large number of enterprises competing to attract workers, and the ratio of labor earnings to MPL will decline as m falls. It is worth noting that the existence of a single buyer in the labor market, i.e., monopsony, is not different than slavery when compared in terms of this ratio.

Appendix

$$L_s = \left[P \left(\frac{\beta}{\gamma} \right)^{1-\alpha} \left(\frac{\alpha}{r} \right)^{\alpha} \left(\frac{\gamma - 1}{\rho} \right)^{\frac{(\gamma - 1)(1-\alpha)}{\gamma}} \right]^{1/\varepsilon} \quad \textbf{(A1)}$$

$$K_s = \left[P \left(\frac{\beta}{\gamma} \right)^{\beta} \left(\frac{\alpha}{r} \right)^{1-\beta} \left(\frac{\gamma - 1}{\rho} \right)^{\frac{(\gamma - 1)\beta}{\gamma}} \right]^{1/\varepsilon} \quad \textbf{(A2)}$$

$$n\,(L_s) = \left[P \left(\frac{\beta}{\gamma} \right)^{1-\alpha} \left(\frac{\alpha}{r} \right)^{\alpha} \left(\frac{\gamma - 1}{\rho} \right)^{\delta/\gamma} \right]^{1/\varepsilon} \quad \textbf{(A3)}$$

$$\pi_S = \left[P\,\varepsilon \left(\frac{\beta}{\gamma} \right)^{\beta} \left(\frac{\alpha}{r} \right)^{\alpha} \left(\frac{\gamma - 1}{\rho} \right)^{\frac{(\gamma - 1)\beta}{\gamma}} \right]^{1/\varepsilon} \quad \textbf{(A4)}$$

$$\pi_f = \psi \left[P^{\gamma} n^{\beta(\gamma-1)} \left(\frac{1}{\phi} \right)^{\gamma(1-\alpha)} \left(\frac{\beta}{\gamma} \right)^{\beta} \left(\frac{\alpha}{r} \right)^{\gamma\alpha} \right]^{1/\delta} \quad \textbf{(A5)}$$

$$l_f = \left[P \left(\frac{1}{n} \right)^{\varepsilon} \left(\frac{1}{\phi} \right)^{1-\alpha} \left(\frac{\beta}{\gamma} \right)^{1-\alpha} \left(\frac{\alpha}{r} \right)^{\alpha} \right]^{1/\delta} \quad \textbf{(A6)}$$

$$y_f = \left[P^{\gamma\alpha+\beta} \left(\frac{1}{n} \right)^{\gamma\varepsilon} \left(\frac{1}{\phi} \right)^{\beta} \left(\frac{\beta}{\gamma} \right)^{\beta} \left(\frac{\alpha}{r} \right)^{\gamma\alpha} \right]^{1/\delta} \quad \textbf{(A7)}$$

$$p_f = \psi \left[P^{\gamma} \left(\frac{1}{n} \right)^{\gamma\varepsilon} \left(\frac{1}{\phi} \right)^{\gamma(1-\alpha)} \left(\frac{\beta}{\gamma} \right)^{\beta} \left(\frac{\alpha}{r} \right)^{\gamma\alpha} \right]^{1/\delta} \quad \textbf{(A8)}$$

$$w_f = \gamma \left[P^{\gamma-1} \left(\frac{1}{n} \right)^{\varepsilon(\gamma-1)} \left(\frac{1}{\phi} \right)^{(\gamma-1)(1-\alpha)} \left(\frac{\beta}{\gamma} \right)^{(\gamma-1)(1-\alpha)} \left(\frac{\alpha}{r} \right)^{\alpha(\gamma-1)} \right]^{1/\delta} \quad \textbf{(A9)}$$

$$u_f = (\gamma - 1) \left[P^{\gamma} \left(\frac{1}{n} \right)^{\gamma\varepsilon} \left(\frac{1}{\phi} \right)^{\gamma(1-\alpha)} \left(\frac{\beta}{\gamma} \right)^{\gamma(1-\alpha)} \left(\frac{\alpha}{r} \right)^{\gamma\alpha} \right]^{1/\delta} \quad \textbf{(A10)}$$

$$\theta_f = \frac{1}{\phi} \quad \textbf{(A11)}$$

where $\varepsilon=1-\alpha-\beta$, $\delta=\gamma(1-\alpha)-\beta$, $\phi=1+(\gamma-1)/m$, $\psi=\phi(1-\alpha)-\beta$ and the subscripts s and f stand for the system of slavery and the oligopsonistic free labor market, respectively.

References

Chwe, Michael Suk Young (1990). Why were Workers Whipped? Pain in a Principal-Agent Model. *Economic Journal*, 100 (403): 1109-21.

David, Paul A. and Temin, Peter (1979). Explaining the Relative Efficiency of Slave Agriculture in the Antebellum South: A Comment. *American Economic Review*, 69 (1): 211-12.

de Dios, Emmanuel S. (1990). Preliminary Notes on Modes of Production. *Philippine Review of Economics and Business*, 27 (1): 8-18.

Dirickx, Yvo M.I. and Sertel, Murat R. (1979). The Comparative Political Economy of Workers' Management and Capitalism in a Nutshell. European Institute for Advanced Studies in Management Working Paper No. 79-2.

Dirickx, Yvo M.I. and Sertel, Murat R. (1978). Comparative Political Economy of Capitalism, Communism, Slavery and Colonialism in a Nutshell. *Recherches Economiques de Louvain*, 44, no. 3.

Fenoaltea, Stefano (1984). Slavery and Supervision in Comparative Perspective: A Model. *Journal of Economic History*, 44 (3): 635-68.

Field, Elisabeth B. (1988). The Relative Efficiency of Slavery Revisited: A Translog Production Function Approach. *American Economic Review*, 78 (3): 543-49.

Findlay, Ronald (1975). Slavery, Incentives and Manumission: A Theoretical Model. *Journal of Political Economy*, 83 (5): 923-33.

Fleisig, Heywood (1976). Slavery, the Supply of Agricultural Labor, and the Industrialization of the South. *Journal of Economic History*, 34 (3): 572-97.

Fogel, Robert W. (1989). *Without Consent or Contract: The Rise and Fall of American Slavery*. New York: W.W. Norton.

Fogel, Robert W. and Engerman, Stanley L. (1980). Explaining the Relative Efficiency of Slave Agriculture in the Antebellum South: Reply. *American Economic Review*, 70 (4): 672-90.

Fogel, Robert W. and Engerman, Stanley L. (1977). Explaining the Relative Efficiency of Slave Agriculture in the Antebellum South. *American Economic Review*, 67 (3): 275-96.

Fogel, Robert W. and Engerman, Stanley L. (1974). *Time on the Cross: The Economics of American Negro Slavery*. Boston: Little Brown.

Fogel, Robert W. and Engerman, Stanley L. (eds.) (1971). *The Reinterpretation of American Economic History* . New York: Harper & Row.

Graves, Philip E., Sexton, Robert L. and Vedder, Richard K. (1983). Slavery, Amenities, and Factor Price Equalization: A Note on Migration and Freedom. *Explorations in Economic History*, 20: 156-62.

Haskell, Thomas L. (1979). Explaining the Relative Efficiency of Slave Agriculture in the Antebellum South: A Reply to Fogel-Engerman. *American Economic Review*, 69 (1): 206-7.

Mandle, Jay R. (1992). *Not Slave not Free: The African American Economic Experience since the Civil War*. Durham and London: Duke University Press.

Ransom, Roger L. and Sutch, Richard (1988). Capitalists without Capital: The Burden of Slavery and the Impact of Emancipation. University of California at Berkeley Working Paper in Economics: 8867, February, 54.

Schaefer, Donald F. and Schmitz, Mark D. (1979). The Relative Efficiency of Slave Agriculture: A Comment. *American Economic Review*, 69 (1): 208-12.

Vedder, Richard K., Gallaway, L. and Klingaman, D. C. (1990). Black Exploitation and White Benefits: The Civil War Income Revolution. In R. America (ed.), *The Wealth of Races: The Present Value of Benefits from Past Injustices*. Westport and London: Greenwood.

Wright, Gavin (1997). Slavery and Commerce in the Colonial Era. Lecture Notes. Stanford University.

Wright, Gavin (1991). What was Slavery? *Social Concept*, 6: 29-51.

Wright, Gavin (1979). The Efficiency of Slavery: Another Interpretation. *American Economic Review*, 69 (1): 219-26.

Wright, Gavin (1976). Prosperity, Progress and American Slavery. In Paul A. David *et.al.* (eds.), *Reckoning with Slavery*. New York.