Exploitation without Subsumption:
The Scope and Limits of
Proto–Industrial Exploitation

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PREFACE

This working paper is one of a collection of papers, most of which were prepared for and presented at a festschrift conference to honor the life's work of Professor Thomas Weisskopf of the University of Michigan, Ann Arbor. The conference took place on September 30 - October 1, 2011 at the Political Economy Research Institute, University of Massachusetts, Amherst. The full collection of papers will be published by Elgar Edward Publishing in February 2013 as a festschrift volume titled, *Capitalism on Trial: Explorations in the Tradition of Thomas E. Weisskopf.* The volume's editors are Jeannette Wicks-Lim and Robert Pollin of PERI.

Since the early 1970s, Tom Weisskopf has been challenging the foundations of mainstream economics and, still more fundamentally, the nature and logic of capitalism. That is, Weisskopf began putting capitalism on trial over 40 years ago. He rapidly established himself as a major contributor within the newly emerging field of radical economics and has remained a giant in the field ever since. The hallmarks of his work are his powerful commitments to both egalitarianism as a moral imperative and rigorous research standards as a means.

We chose the themes and contributors for this working paper series, and the upcoming festschrift, to reflect the main areas of work on which Tom Weisskopf has focused, with the aim of extending research in these areas in productive new directions. The series is divided into eight sections, including closing reflections by our honoree himself, Professor Weisskopf. Each section except for the last includes comments by discussants as well as the papers themselves.

The eight sections are as follows:

1. Reflections on Thomas Weisskopf's Contributions to Political Economy
2. Issues in Developing Economies
3. Power Dynamics in Capitalism
4. Trends in U.S. Labor Markets
5. Discrimination and the Role of Affirmative Action Policies
6. Macroeconomic Issues in the United States
7. Applications of Marxist Economic Theory
8. Reflections by Thomas Weisskopf

This working paper is 2 of 4 included in Section 7.

- Jeannette Wicks-Lim and Robert Pollin

Exploitation without Subsumption:
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Gilbert L. Skillman[1]

My purpose in this paper is to begin an investigation of the microeconomic logic underlying the Marxian concept of *subsumption of labor under capital* (SLC), understood as the imposition of capitalist control over the process of commodity production. Although Marx did not extensively analyze SLC as such until the second draft of *Capital* (the sprawling Economic Manuscript of 1861-63[2]), the notion that capitalists exercise direct and historically progressive control over the labor process is fundamental to the Marxian critique of capitalism, and informs other core aspects of Marxian theory such as the respective distinctions between labor and labor power and absolute and relative surplus value. Marx omitted most of his discussion of the concept from the published editions of *Capital*, Volume I, despite having carried over the core elements of his theory of SLC to the penultimate draft in a chapter called "Results of the Immediate Process of Production" that he also dropped from the published version. Since Marx's pre-publication drafts of *Capital* were not widely available until the last third of the 20th century, Marx's definition and analysis of this concept has consequently not received as much attention as other aspects of his economic theory.

There is, of course, a large and growing literature that analyzes capitalist production within a Marxian framework, broadly conceived. Beginning with the seminal contribution of Marglin (1974) (see also Gintis (1976) and Reich and Devine (1981)), there have been a number of efforts within the heterodox literature inspired by Marx's critique to account for the specifically economic logic of capitalist control of commodity production, perhaps the most developed of these being Bowles and Gintis's (1990) analysis of capital-labor relations as "contested exchange." While this literature has contributed greatly to our understanding of the economic consequences of SLC at a relatively advanced stage of capitalist development, contributions in this area have tended to take the fact of capitalist ownership and control of commercial enterprises as given, and thus do not seek to establish the systemic pre-conditions for SLC or the basis for its progressive historical development. This latter-day approach is consistent with Marx's narrative in the published version of *Capital* Volume I, which focuses solely on capitalist production employing wage labor as the vehicle for exploitation in private ownership economies.

But in his historical discussion of capitalist exploitation in the three drafts of *Capital* prior to the 1867 publication of Volume I, Marx consistently acknowledged cases in which capitalists exploited labor and appropriated surplus value without directly controlling the production process, subject to the caveat that these "antediluvian" forms of the circuit of capital (in which usury or merchant capital was used to finance commodity production) faced limitations that are surmounted by capital-labor relations premised on SLC. This possibility of capitalist exploitation via purely contractual means of control is also affirmed in another strand of the Marxian literature originated by John Roemer's *General Theory of Exploitation and Class* (1982) and based on an analysis of exchange relations under conditions of perfect competition, and in particular, perfect or frictionless contracting. Under these conditions, Roemer derives a quantitative isomorphism between exploitation based on loan capital (in which "labor hires capital" rather than vice-versa) and that based on capitalist-owned pro-

duction processes. Ironically, much of the criticism of Roemer's analysis and conclusions in the Marxian literature starts from the premise, contradicted by Marx's historical analysis, that capitalist control of production is categorically necessary for the existence of capitalist exploitation (see, for example, Anderson and Thompson [1988]).

The present paper explores this theoretical clash on the basis of an analytical middle ground in which neither direct capitalist control of production nor the scenario of ideal contracting is assumed in exploring how capital suppliers attempt to secure surplus value in exchange relationships with suppliers of labor. More specifically, a core assumption of the analysis presented here is that capitalists undertake this pursuit under conditions of imperfect information in which key aspects of the relationship (such as the worker's effort level) are either known only to the labor supplier or unknown by both parties at the time the contract governing the transaction is established. The paper then considers the extent to which the capital supplier can extract a surplus—and in so doing, exploit labor—via purely contractual means in exchange relations, on the presumption that any limitations in this regard suggest a concomitant economic motivation for SLC. Conversely, scenarios in which maximum feasible exploitation is achieved despite such informational imperfections extend the scope of Roemer's conclusions about the economic basis of exploitation derived on the basis of ideal contracting conditions.

The general economic problem of transacting under conditions of imperfect information is explored in depth in the mainstream literature on the "principal-agent problem" (see, e.g., Holmstrom (1979) and Holmstrom and Milgrom (1991) for important contributions), and the analytical approach taken here makes significant use of this framework. The approach taken in the present line of research, however, is to customize the general principal-agent framework so as to address the specific concerns and variables of Marxian theory, which focuses, as does Roemer's more recent work, on the implications of wealth inequalities along class lines for the manner and extent to which capital exploits labor.

Primarily for illustrative purposes, the analysis on this paper also draws on the historical literature concerning *proto-industrial* forms of production that preceded capitalist industrialization. In particular, the theoretical cases considered below are framed in terms of the so-called *Kauf* and *Verlag* modes of capital-financed production that preceded the factory system and in many instances persisted alongside it (Ogilvie and Cerman (1996), p. 4). The analysis developed here provides tentative answers to certain important and enduring questions in the historical literature on proto-industrialization; for example, the argument identifies conditions informing the relative viability of these proto-industrial forms, and offers an explanation for why they were able to continue into the era of capitalist production.

CAPITALIST EXPLOITATION WITHOUT CAPITALIST PRODUCTION

Marx's Historical Account of Capitalist Exploitation

Marx first introduced the notion of subsumption of labor "into the process of capital" in *Grundrisse* (1993), the first draft of the analysis that would eventually be published as *Capital*. He did so, however, in the context of noting historical cases in which usury and merchant capital exploited labor without directly controlling the

labor process and thus constituted "exploitation by capital without the mode of production of capital" (p. 853). Marx reasserts this assessment in the second and third drafts, the latter providing the material Engel edited for publication as Volume III of *Capital* after Marx's death. For example, treating the case of usury capital in the latter work, Marx discusses cases in which it financed commodity production and appropriated "*all* surplus-value save that which accrues to the state" (1991, p.730) and thus constituted "capital's mode of exploitation without its mode of production" (p. 732). Marx repeats this conclusion in a chapter entitled "Results of the Immediate Process of Production" intended for Volume I of *Capital* but excluded from the published version (1976 (Appendix), p. 1023).

Having acknowledged the capacity of "antediluvian" forms of the circuit of capital to appropriate surplus value and exploit labor in cases when they financed commodity production, Marx stipulates that there are important limitations in this capacity: first, they are not sufficient to develop the forces of production in the manner associated with the capitalist mode of production based on SLC (1991, pp. 730-31); and second, the power of usury capital to exploit labor "comes to an end" once workers are completely expropriated of the means of production (p. 730). On the other hand, he allows that exploitation via these pre-industrial forms can persist into the era of capitalist production, albeit in restricted form and extent (1993, p. 853, 1991, pp. 730-31).

In sum, Marx's historical account of capitalist exploitation suggests that the connection between capitalist exploitation and direct capitalist control of production (SLC) is contingent rather than categorical, and is in any case a matter of degree than necessity.

Proto-industrial production and exchange conditions

The conclusions of Marx's account are mirrored in the more recent historical literature on proto-industrialization, which discusses the economic viability and persistence of commercial production arrangements predating the capitalist factory system. This literature has distinguished two forms of proto-industrial production which correspond to Marx's representation of the "antediluvian" forms of usury and merchant capital that financed commodity production. In the *Kauf* system, corresponding to Marx's representation of usury capital, loan capitalists financed commodity production via labor processes "in which rural producers retained autonomy over production and selling," purchasing their own inputs and selling their output directly in product markets. In contrast, merchant capitalists in the *Verlag* or "putting-out" system of production provided raw materials to the producers and paid them by the piece for their output, which the merchants then retailed themselves. According to the original statement of the proto-industrialization hypotheses, these two forms, along with the subsequently emerging factory system, represented successive stages of industrial organization (Ogilvie and Cerman, p. 4).

Further historical investigations of the proto-industrialization hypothesis challenged this stadial conception of industrial development. In particular, subsequent research on this hypothesis established that in many cases the *Kauf* system did not wither away upon the advent of the *Verlag* system in given regions (see, for example, Hudson (1996), p. 57), and furthermore that both proto-industrial forms often persisted well into the era of capitalist production (e.g. Berg (1986), p. 19)). These historical findings, then, mirror Marx's account in rejecting the categorical superiority (from the capitalists' viewpoint) of industrial over pre-industrial forms of

commercial production, and extend this more nuanced assessment to the comparative viability and persistence of alternative proto-industrial forms.

A Formal Analysis of Capitalist Exploitation without Subsumption

In this section, I analyze a scenario in which capitalists appropriate surplus value in the absence of SLC. In this context, capitalist control over productive outcomes is exerted solely via contractual means such as the form of payment (more specifically, the combination of interest charges and piece rates).

As noted earlier, the analysis developed here is based on the framework of principal-agent theory, but differs from standard principal-agent analysis in three key ways, informed in part by Marx's particular theoretical concerns. First, and primarily, whereas the standard principal-agent model focuses on differences in risk preferences (and the corresponding problem of Pareto-optimal risk sharing given asymmetric information and the need to provide effort incentives), the model developed here investigates the implications of systematic differentials in productive wealth between otherwise risk-neutral capital suppliers and commodity producers. As such, it provides a natural extension to Roemer's analysis of the systemic basis of exploitation under perfect contracting conditions. Second, the analysis is *historical* in the sense of focusing successively on alternative historical forms of capitalist response to the problem of exploiting labor under imperfect contracting conditions, starting with the case of no SLC.

The third departure from standard principal-agent analysis is that the analysis limits attention *a priori* to *linear* payment schemes involving piece rates and interest payments. However, this limitation is not as restrictive as it might appear, given the first assumption of risk neutrality. In this case, the functional form of the payment scheme becomes less relevant than the information on which it is based. While the linear form is not uniquely optimal under such conditions, it is often among the set of optimal compensation schemes.

The Basic Model

Consider the relationship between a representative worker or commodity producer L and a capital supplier K who, in anticipation of a profitable return, finances production beyond the level that L could produce using her own means of production. This return can only be realized after production is completed and the product is sold. *Ex ante*, however, output is stochastic, so that gross returns are uncertain. Taking x to denote the market value of the worker's output and ($e \geq 0, \theta \geq 0, k > 0$) to denote, respectively, the worker's effort level and realized productivity level (understood to be a random state variable), and the quantity of capital borrowed from the capitalist. For simplicity, I'll take the required level of capital as fixed, and not represent it explicitly hereafter.

Endowments. The worker has an exogenously given, nondepreciating asset valued at $W > 0$ that can be used in production or sold at value to finance the worker's consumption or (as discussed below) or to satisfy the terms of the contract with the capitalist. The capitalist is endowed with an asset $A \geq k$ that can be lent to the producer to enable additional production via the function described next.

Payoffs. Let $y(x)$ be the net income received by the producer given output x. Then her payoff conditional on x is indicated by the function $v = W + y(x) - c(e)$, where $c(e)$ denotes the monetary value of the disutility

or discomfort incurred by the worker in producing the output financed by the capitalist. Let $c(\square)$ be a twice continuously differentiable function that is strictly increasing and strictly convex in its argument with $c(0) = c'(0) = 0$, where the prime denotes the first derivative. The capitalist's payoff is simply the return yielded by the transaction with the worker net of the capital advanced, denoted $\pi = A + x - y(x) - k$. Note that both actors are risk-neutral with regard to variations in income.

Production. Let the worker's production possibilities be expressed by the twice continuously differentiable function $x = x(e, \theta)$, assumed to be strictly increasing and strictly concave in its arguments such that $0 = x(0, \theta) = x(e, 0) < x_{e\theta}(e, \theta)$ for all admissible values of (e, θ), and assume that $[x_e(e, 0) / x_\theta(e, 0)] > 0$ for all positive levels of effort. The random productivity state variable θ is distributed according to the continuously differentiable density function $f(\theta)$ defined on the support $[\underline{\theta}, \bar{\theta}]$, where $\bar{\theta}$ is finite and strictly greater than zero. Let $\underline{\theta}$ be normalized to 0. It is convenient to let f be strictly positive everywhere on the support of the distribution. The production technology is said to yield a surplus if it is possible to generate an expected output value which exceeds the sum of capital and effort costs incurred in producing it. This definition is embodied in the following assumption.

Assumption A1 (Potential surplus). There exists a value of $\tilde{e} > 0$ such that

$$E\{x(\tilde{e}, \theta)\} - c(\tilde{e}) - k = \int_0^{\bar{\theta}} x(\tilde{e}, \theta) f(\theta) d\theta - c(\tilde{e}) - k > 0$$

In addition, let there be a value of effort $\bar{e} > \tilde{e}$ such that $E\{x(\bar{e}, \theta)\} - c(\bar{e}) = 0$. The latter assumption justifies restricting attention to effort choices drawn from the compact set $[0, \bar{e}]$.

Information. The informational conditions of the problem are such that the capitalist cannot directly observe the worker's effort choice e or output x, and neither actor observes the realization of the random variable θ when making his or her economic choices. Below I'll consider alternative scenarios affecting the worker's willingness to report output truthfully (and then deliver it) to the capitalist.

Contracted payments and net returns. Since the capitalist cannot observe labor effort or the random productivity parameter, the net payment contractually demanded of the worker (and thus, the net return contractually assured to the worker) can at most be conditioned on the worker's reported output. The modeling strategy pursued here is to allow the endogenous realization of either pure "lender-borrower" contracts consistent with Marx's scenario of usury capital or "piece-rate" contracts consistent with the putting-out form of merchant's capital. Thus, let the net return to the worker be given by the affine function $px - R$, where p can be interpreted as a piece rate and R can be interpreted as an interest payment to the capitalist or a (possibly negative) fixed component of the net return to the worker in a piece rate scheme.

This net return is negative for low values of x if R is positive. Thus, to define the exchange terms between capital supplier and worker completely, it is necessary to specify the transfer that occurs if, given observed or reported x, $px - R < 0$. Toward this end, suppose that the worker's endowment that can be used as security for the capital advance, so that the capitalist can appropriate W whenever given contractual terms are not fulfilled. The role of W as collateral or security on contracted terms in the determination of contingent and expected net returns will discussed further in sections 2.2 and 2.3 below, which address the respective informational scenarios introduced above.

Class conditions. Assume that the balance of class power in this economy is such that the worker is on the "long side" of the market and thus receives no economic rent under perfect contracting conditions. Let the worker's reservation payoff, corresponding to the situation in which she does not transact with the capitalist, be given by her exogenously determined endowment W, and refer to the requirement that the worker receives at least her reservation utility the *participation constraint* on the capitalist's contracting choices. The capitalist, being on the "short" side of the market, receives all of the economic rents under perfect contracting conditions. This corresponds to the condition of *capital scarcity* identified by Roemer (1982) as a necessary condition (along with differential ownership of productive assets) for the existence of exploitation in private ownership market economies. Of course, this condition does not necessarily dictate that the worker receives only her reservation utility in a scenario with imperfect contracting conditions, and one issue in the analysis to follow concerns the possibility that certain forms of informational imperfections allow workers to accrue rents in the absence of some form of labor subsumption.

The capitalist's optimization problem. In light of the foregoing considerations, the capitalist's problem is to choose the piece rate p, the interest rate or fixed component R, and the worker's effort level e to maximize expected profit $\Pi(e,p,R) = E\pi = E\{x(e,\theta) - y(x(e,\theta))\}$ subject to the following constraints:

(1a) (*Participation constraint*) $V = Ev(y(x),e) = W + pE\{x(e,\theta))\} - R - c(e) \geq W$;

(1b) (*Securitization constraint*) $y(x) = \max\{px - R, -W\}$ for all $\theta \in [0, \overline{\theta}]$;

(1c) (*Revelation constraint*) For any realization of (e,θ), $v(y(x(e,\theta),e) \geq v(y(x(\tilde{e},\tilde{\theta}),e)$ for all

$\tilde{e} \in (0,\overline{e})$, $\tilde{\theta} \in [0,\overline{\theta}]$ such that $x(\tilde{e},\tilde{\theta}) \leq x(e,\theta)$; and

(1d) (*Incentive compatibility constraint*) For given p, R, $e \in \arg\max_{\hat{e}} W + E\{y(x(\hat{e},\theta))\} - c(\hat{e})$

Maximal Exploitation and Surplus Maximization

To establish a reference case for the analysis to follow, first consider the maximum surplus that can be induced and appropriated by the capitalist, given capital scarcity, if it were possible for him to observe or verify the worker's effort and output levels and thus to stipulate these levels as part of the transaction. In this scenario, in other words, the capitalist maximizes expected profit subject only to the worker's participation constraint. Simply put, since the capital scarcity condition ensures that the capital supplier receives the entire economic surplus, the level of effort is that which maximizes that surplus. Thus, maximum feasible exploitation corresponds to the surplus that results from the solution to the following optimization problem:

$$\underset{e \in [0,\overline{e}]}{Max}\ S(e) = E\{x(e,\theta)\} - c(e).$$

Assumption A1 ensures an interior solution for this problem. The first-order necessary condition for an interior optimum at e^* is given by

(2) $\qquad S'(e^*) = E\{x_e(e^*,\theta)\} - c'(e^*) = 0.$

Given the curvature conditions on the production and payoff functions assumed above, the surplus function $S(e)$ is strictly concave in effort, implying $S''(e^*) = E\{x_{ee}(e^*, \theta)\} - c''(e^*) < 0$ and guaranteeing that $S(e)$ attains a unique global maximum at e^*.

The capitalist could hypothetically appropriate this maximal surplus under perfect contracting conditions through the use of a *forcing contract* in which the worker is guaranteed a net return just sufficient to attain her reservation utility of W so long as she chooses the surplus-maximizing effort level e^*, but otherwise incurs an unpleasantly harsh penalty (debtor's prison, say, or a monetary penalty that drives net income below subsistence) enforced by a judicial system.

In anticipation of the analysis to follow, it is useful to note here that if the capitalist could accurately monitor output (so that the revelation constraint is irrelevant), then he can always induce the worker to choose the surplus-maximizing effort level e^* via a linear compensation scheme by setting $p = 1$ and setting R so that it does not exceed the lower of the boundaries established by the participation or the securitization constraint. In this case, the worker chooses labor effort e to maximize $W - R + E\{x(e, \theta)\} - c(e)$, which is readily seen to yield the same first- and second-order conditions as for the surplus maximization problem noted above. However, the participation and securitization constraints may preclude the capitalist from appropriating the entire resulting surplus from the worker, and the capitalist may be further restricted in this regard if output levels can be known or verified only by the producer. The latter case is considered next.

Exploitation Without Output Monitoring: Unrestricted Outside Sales

In the absence of capitalist subsumption, the production process is under the control of the worker and the capitalist is merely the outside financier, although it may be possible for the latter to provide production incentives through contractual means such as piece rates. This is subject to an important caveat, however. Since the worker controls the production process, realized output level is her private information, and the presumptive case is that the capitalist can only infer the output level from information reported by the worker. This case corresponds descriptively to the historical stage of proto-industrialization known as the *Kauf* system.

More specifically, it is assumed in this section that the worker can always choose to sell her output directly (and report correspondingly less output) rather than delivering it to the capitalist for the contractually stipulated return $y(x)$, subject only to the penalty of losing R up to the value of the worker's endowment W. Given the realization of x, the worker always chooses the option that yields her the highest *ex post* payment. Consequently, to induce the worker to report and deliver the true output, the payment scheme must satisfy

(3) $\quad y(x) = \max\{px - R, -W\} \geq y(\tilde{x}) + x - \tilde{x} = \max\{x + (p-1)\tilde{x} - R, x - \tilde{x} - W\}$

for all $\tilde{x} \leq x$. Satisfying this constraint is easily seen to require that $p \geq 1$ and $R \leq W$.

These constraints on the terms of the payment scheme have the following implications for the capitalist's optimization problem. First, since $R \leq W$, the default constraint on the minimum net payment to the worker is never binding for any value of x. Consequently, the capitalist's expected profit is given by

(4) $$\Pi(e, p, R) = E\pi = R + (1-p)E\{x(e,\theta)\},$$

which he maximizes subject to the worker's participation and incentive compatibility constraints as well as the conditions $p \geq 1$ and $R \leq W$ implied by the revelation constraint in the scenario of unrestricted outside sales. The solution to the capitalist's problem is characterized in the following proposition.[3]

Proposition 1. The capitalist's optimal contract entails $p^* = 1$ and $R^* = \min\{W, S(e^*)\}$, which induces the worker to choose effort level e^*. The capitalist's expected payoff is $\min\{W, S(e^*)\}$, and the worker receives economic rent if $W < S(e^*)$.

The message of Proposition 1 is that the capitalist pays a price for the inability to monitor or directly infer the producer's output levels, once the interest payment is limited by the worker's wealth level. Furthermore, this cost increases as the worker's wealth level falls. Applied to the historical context, the corresponding hypothesis is that *Kaufsystem* transactional arrangements became less attractive over time as workers' collateralizable wealth levels fell relative to the surplus achievable by proto-industrial production, either because producers were becoming progressively expropriated or increasingly productive in the latter processes. The corollary is that the relative benefit of alternative arrangements in which capitalists can either observe output levels or else induce commodity producers to report these levels accurately at less cost increases with either of the noted changes. The next section considers the scope for exploitation when the latter conditions hold, but still in the absence of capital's subsumption of the labor process.

Exploitation without Output Monitoring: Restricted Outside Sales

As noted above, the *Verlag* system is distinguished from the *Kauf* system in that the former, rather than simply involving the loan of financial capital at interest, has capitalists supplying the inputs to be used in production and paying by the piece for the producer's output, which the capitalist then sells. In light of the analysis of the preceding section, it must then be explained how the capitalist can induce truthful revelation of output while retaining the flexibility of setting piece rates at values other than one (in other words, letting the worker keep the value of all output produced). In this section, it is ultimately assumed that the worker can only sell her output independently after incurring a fixed cost $C > 0$. In the historical context of the *Verlag* system, this cost might be associated with difficulties small domestic producers face in supplying products to foreign markets, or with expected legal costs of selling outputs commissioned by capital suppliers.

To analyze the effects of restrictions on outside sales on the capitalist's problem, I first consider the extreme case in which the cost to the worker of accessing external markets is prohibitive, so that it is always in her interest to report and deliver her true output level to the capitalist; that is, I first assume that $x \leq C$ for all attainable levels of output, and characterize the optimal contract for the capitalist under these conditions. I then contrast the case in which the cost to the worker of directly accessing markets is not so prohibitive as to automatically preclude outside sales.

In the former case, since the worker always prefers to report and deliver actual output to the capitalist, the worker's payment is given by $y(x) = \max\{px - R, -W\}$, with a corresponding expected payoff, given the compensation terms set by the capitalist, the worker's endowment *W*, and effort level *e*, of

(5) $\qquad V(e,p,R,W)=E\{\max[0,W-R+px(e,\theta)]\}-c(e)$.

The capitalist's expected payoff, given the compensation scheme and the worker's effort level, is

(6) $\qquad \Pi(e,p,R,W)=E\{\min[W+x,(1-p)x+R]\}$.

In the problem under study, the capitalist can by assumption infer the worker's true output level, but cannot observe and therefore cannot contractually stipulate the worker's effort level. Rather, taking the values of p, R, and W as given, the worker chooses e to maximize $V(e,p,R,W)$. Denote the optimal value of effort for the worker by $\hat{e}$.

Unless the piece rate is set at 0, the commodity producer's compensation will depend on output level, and will thus be a random variable depending on the realization of the parameter θ. Note further that, whatever the value of R, the worker has no incentive to expend positive effort if the piece rate is zero, since there is no gross marginal payoff to increasing effort. Note further that the capitalist has no incentive to reduce R below the minimum of W and $S(e^{*})$, since raising R has no disincentive effects on the worker's effort choice so long as it remains the case that $R \leq \min\{S(e^{*}),W\}$, since the worker then always receives the marginal value of output weighted by the piece rate. Assuming, therefore, a strictly positive value of p, and given $R \geq \min\{S(e^{*}),W\}$, let $\hat{\theta}=\theta(e,z)$ denote the continuously differentiable implicit function that ensures

(7) $\qquad\qquad x(e,\hat{\theta})-z=0$

for all $e \in \{0,\bar{e}\}$ and $z=(R-W)/p \geq 0$, noting that for any positive level of effort, $\hat{\theta}_{e}=-x_{e}/x_{\theta}<0$, $\hat{\theta}_{z}=1/x_{\theta}>0$, and $\theta(e,0)=0$. If $\hat{\theta}<\bar{\theta}$, the worker receives a net income of zero in those states of the world in which $\theta \leq \hat{\theta}$, and $W-R+px(e,\theta)$ otherwise. Thus the worker's expected payoff defined in (5) can be rewritten

(5a) $\qquad V(e,p,R,W)=(1-F(\hat{\theta}))(W-R)+\int_{\hat{\theta}}^{\bar{\theta}}px(e,\theta)f(\theta)d\theta-c(e)$,

and similarly the expected payoff of the capitalist defined in (6) can be expressed as

(6a) $\qquad \Pi(e,p,R,W)=\int_{0}^{\hat{\theta}}[W+x(e,\theta)]f(\theta)d\theta+\int_{\hat{\theta}}^{\bar{\theta}}[R+(1-p)x(e,\theta)]f(\theta)d\theta=$

$\qquad\qquad F(\hat{\theta})W+(1-F(\hat{\theta}))R+\int_{0}^{\bar{\theta}}x(e,\theta)f(\theta)d\theta-\int_{\hat{\theta}}^{\bar{\theta}}px(e,\theta)f(\theta)d\theta$.

Assuming an interior solution for the worker's optimization problem, and utilizing condition (7), the associated first-order condition for an interior maximum reduces to

(8) $\qquad V_{e}=\int_{\hat{\theta}}^{\bar{\theta}}\{px_{e}(e,\theta)\}f(\theta)d\theta-c'(e)=0$,

Assuming that the second-order condition is satisfied with strict inequality, there is a uniquely optimal value of effort for the worker's problem, and the capitalist's problem is to choose R, p, and the unique value of e consistent with these magnitudes so as to maximize expected profit (6) subject to the worker's transformed incentive constraint (8), the securitization constraint (1b), and the participation constraint (1a) requiring that the worker's expected payoff (5) is at least as great as the reservation level of utility W. To facilitate the statement and proof of the next proposition, it will be useful to characterize, for a given effort level, the loci in (R, p) space corresponding respectively to the worker's incentive compatibility condition (8), and given iso-payoff contours for the capitalist and worker. These contours completely overlap, having identical slopes and curvature at any given combination of R and p.

For a given level of worker effort $e > 0$, one can invoke the implicit function theorem to establish the unique existence of a continuously differentiable function, denoted $\rho^{V_e}(R,e)$, representing the locus of (R, p) combinations satisfying the incentive compatibility condition (8). Substituting this function into equation (8) and totally differentiating with respect to R yields the slope of the function, given by

$$(9) \qquad \rho_R^{V_e}(R,e) = \alpha(e,\hat{\theta}) / [\alpha(e,\hat{\theta}) \cdot z + \int_{\hat{\theta}}^{\bar{\theta}} x_e(e,\theta) f(\theta) d\theta],$$

where $\alpha(e,\hat{\theta}) = x_e(e,\hat{\theta}) f(\hat{\theta}) / x_\theta(e,\hat{\theta}) > 0$ and z is defined as in (7). Differentiating again with respect to R yields $\rho_{RR}^{V_e}(R,e) = [\int_{\hat{\theta}}^{\bar{\theta}} x_e(e,\theta) f(\theta) d\theta] \cdot \alpha_\theta(e,\hat{\theta}) \theta_z z_R$, which has the same sign as $\alpha_\theta(e,\hat{\theta})$. I'll assume in what follows that $\alpha_\theta(e,\hat{\theta}) > 0$, implying that $\rho^{V_e}(R,e)$ is strictly convex in R for any given positive level of effort.

Parallel reasoning is used to establish the unique existence of a continuously differentiable function $\rho^{\bar{V}}(R,e)$ representing a given iso-payoff contour for the worker selecting a given positive effort level, using expression (6a), and then using definition (7) in deriving the slope of the contour:

$$(10) \qquad \rho_R^{\bar{V}}(R,e) = (1 - F(\hat{\theta})) / \int_{\hat{\theta}}^{\bar{\theta}} x(e,\theta) f(\theta) d\theta > 0,$$

and can be applied again to show

$$\rho_{RR}^{\bar{V}}(R,e) = [(1 - F(\hat{\theta})) \cdot x(e,\hat{\theta}) - \int_{\hat{\theta}}^{\bar{\theta}} x(e,\theta) f(\theta) d\theta] \cdot f(\hat{\theta}) \hat{\theta}_z z_R / (\int_{\hat{\theta}}^{\bar{\theta}} x(e,\theta) f(\theta) d\theta)^2 < 0 \text{, indicating}$$

that this function is strictly concave in R for any given positive value of e. Furthermore, expression (10) and its corresponding second derivative also represent the slope and curvature, respectively, of a given iso-payoff curve for the capitalist, indicating that the respective curves coincide (although representing different payoff levels for the two actors). With these results in mind, now consider the following proposition.

Proposition 2: In the optimal contract ($\hat{e}, \hat{R}, \hat{p}$), the capitalist's expected payoff is non-decreasing in W. In addition,

(*i*) If $W \geq S(e^*)$, the capitalist achieves the surplus- and exploitation-maximizing solution with $p^* = 1$ and $R^* = S(e^*)$, resulting in $\hat{e} = e^*$.

(*ii*) If instead $W < S(e^*)$, there are two possible outcomes, determined by the level of W and the form of the production function. In one scenario, there is at least one value of the duple (R, p) that satisfies the incentive compatibility constraint for the efficient effort level e^*, and at the same time satisfies the participation constraint with equality. In this case, the participation constraint is binding, the incentive compatibility constraint is not binding, and the solution is such that $\hat{e}_1 = e^*$, $\hat{p}_1 > 1$, and $\hat{R}_1 > W$. The worker receives an expected payoff equal to her reservation utility and the capitalist receives an expected payoff equal to $S(e^*)$. In the alternative scenario, there is no value of the duple (R, p) that simultaneously satisfies the two constraints with equality for effort level e^*. In this case, the incentive compatibility constraint is binding, and the solution entails $\hat{e} < e^*$, $\hat{p}_2 \leq \hat{p}_1$, and $\hat{R}_2 \geq \hat{R}_1$.

The proposition can be interpreted to have the following implications for capitalists' efforts to appropriate surplus value in the historical era preceding SLC (and potentially, for contemporary efforts to appropriate surplus value from, say, worker-owned firms on the basis of interest capital or payment by the piece). The first case considered by the proposition, such that $W \geq S(e^*)$, can be thought of as an instance of Roemer's "mixed borrower" or "small peasant" class. Workers in this class have sufficient wealth to finance independent production, but not so much that they are completely independent of borrowing from capitalists in order to finance their production and consumption plans. Given sufficient wealth, capitalists are in effect able to demand collateral for their production loans without thereby infringing on the incentives to maximize the available surplus. If competitive conditions are such that workers in this class have no bargaining power to gain more than their reservation payoffs, the capitalists appropriate the entire surplus, as indicated. This suggests that production arrangements corresponding to the *Kauf* system would be optimal for capitalists under the stated condition. However, a consequence of the probabilistic forfeiture of collateral over time is the progressive proletarianization of this class, with implications considered in the second part of the proposition.

In the second case considered, workers are more proletarianized in the sense that they depend on borrowing for a relatively larger share of their production and income streams. In this case, capitalists may still be able to extract maximal surplus even though workers are unable to provide collateral for the full amount of this surplus. This is the case if the worker's wealth constraint is not so severe as to preclude providing the worker full incentives even though limiting the worker to his or her reservation utility. If this does not obtain, capitalists seeking to exploit labor face a tradeoff, as appropriating a surplus in excess of the value of the worker's (smaller) endowment requires curtailing incentives and thus reducing the potential surplus to be appropriated. Nevertheless, as demonstrated by the optimization analysis, the capitalist always gains more at the margin by increasing appropriation, even at the cost of reducing the surplus to be appropriated. The latter two solution cases are illustrated in Figures 1 and 2 below.

Now with Proposition 2 in mind, return to the capitalist's optimization problem in the case that the worker's fixed cost of accessing markets directly is not prohibitive; in particular, assume for what follows that $C < x(\hat{e}, \overline{\theta})$, where $\hat{e}$ is the second-best level of output corresponding to the second scenario in case (*ii*) of Proposition 2. In this case, the condition for truthful revelation and delivery of output is that for any feasible x to be achieved in the transaction between the capitalist and the worker,

(11) $\quad y(x) = \max\{px - R, -W\} \geq y(\tilde{x}) + x - \tilde{x} - C = \max\{x + (p-1)\tilde{x} - R - C, x - \tilde{x} - W - C\}$

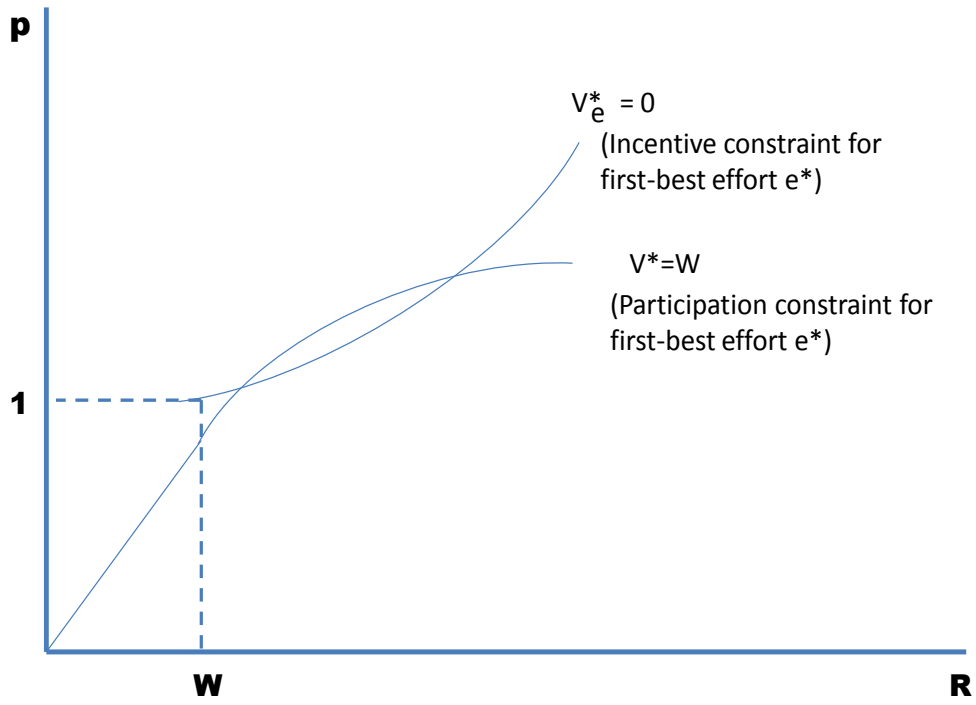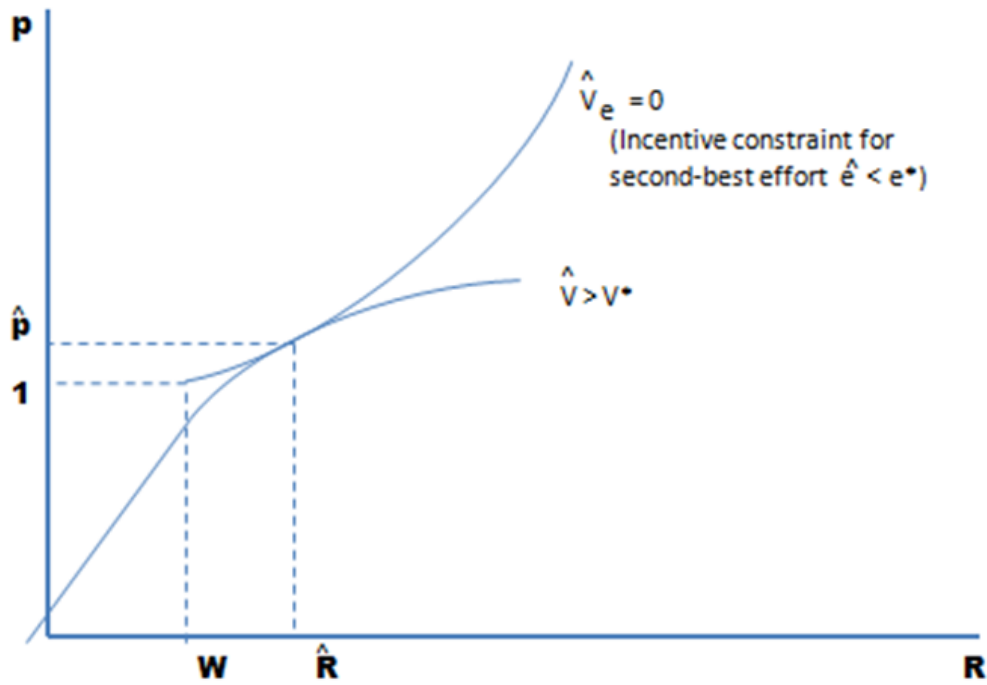*Figure 1. Solution Case 1: Participation Constraint Binding*

p

$V^*_e = 0$
(Incentive constraint for
first-best effort e*)

$V^* = W$
(Participation constraint for
first-best effort e*)

1

W

R

Figure 2. Solution Case 2: Participation Constraint Non-Binding

p

$\hat{V}_e = 0$
(Incentive constraint for
second-best effort $\hat{e} < e^\bullet$)

$\hat{V} > V^\bullet$

$\hat{p}$

1

W $\hat{R}$

R

for all values of $\tilde{x} \leq x$. The presence of the positive fixed cost implies that this constraint is less restrictive than that implied by condition (3) for the case of unrestricted outside sales. In this new case, condition (11) implies the following constraints on the capitalist's contract choices:

(12a) $p \geq 1 - C / x(e, \bar{\theta})$

and

(12b) $R \leq W + pC$.

The implications for the capitalist's optimized payoffs are recorded in the final proposition.

Proposition 3: In the presence of fixed cost C for the worker's outside sales, optimal contract $(\hat{e}, \hat{R}, \hat{p})$ is identical to the contract described in Proposition 2 if $W \geq S(e^*)$. If instead $W < S(e^*)$, constraint (12b) is binding for sufficiently small values of C. In that case, the capitalist selects $\hat{e} < e^*$, $\hat{R} = W + \hat{p}C$, and sets $\hat{p}$ lower than would obtain under the conditions of Proposition (2) for the selected level of effort. In addition, the shadow price to the capitalist of the agent's endowment is higher when the constraint is binding.

When it is costly, yet not prohibitively so, for small commodity producers to gain access to outside markets, the power of proto-industrial capital to extract surplus value is further restricted relative to the case that outside sales are economically unviable. However, it is under some conditions still possible for capitalists to extract the maximum possible surplus, and this is the case even if collateralizable worker endowments fall short of the optimal surplus to be realized.

These results provide foundations for Marx's key claim, mirrored by the historical record discussed in the literature on proto-industrialization, that the connection between direct capitalist control of production and capitalist exploitation is contingent and a matter of degree rather than categorical and a matter of necessity.

CONCLUSION

This paper has framed Marx's historical account of exploitation in terms of the problem of extracting profit-maximizing levels of labor effort in the face of imperfect information and limited worker wealth. Viewed from this perspective, capitalist control of production is a potential strategic substitute for arranging the terms of labor exchange by purely contractual means. Given imperfections in the latter option due to imperfect information or other transactional barriers, capitalists might wish to resort to (possibly costly) forms of direct control in order to ensure the desired production conditions. This stage of the formal analysis demonstrates conditions under which capitalists can extract maximal surplus without SLC. The analysis presented here bears extending in the following directions. First, given that the use of collateral raises questions regarding intertemporal allocation, it would be useful to embed the analysis in an intertemporal optimization framework. Similarly, endogenizing the worker's income parameter W by linking it to underlying wealth endowments and the prospects for pursuing income-generating production activities would facilitate making a more immediate connection of this analysis to Roemer's treatment of the systemic basis of exploitation.

The next major step in the argument would be to analyze the considerations informing capitalists' choice to subsume the labor process under direct capitalist control, in the sense of at least *formal* SLC. At least two key questions arise in contemplating the latter scenario. The first concerns the new transactional and informational issues arising from the possibility that capitalists might monitor worker effort in the production process. On one hand, monitoring may provide capitalists with informative signals about worker effort, making it easier to direct that effort and thus appropriate surplus without curtailing effort incentives. On the other hand, capitalists' use of monitoring signals introduces the prospect of a new form of moral hazard, since there might be an incentive for production overseers to misrepresent what they observe.

The second issue concerns the connection of monitoring to the allocation of ownership or control rights in the firm. In principle, for example, capitalists might insist on monitoring provisions in otherwise arms-length contracts with worker cooperatives, and thus accrue the informational advantage of monitoring. The transactional question is thus why capitalist ownership rights—and thus, in Marxian terms, commodification of labor power—might serve as a strategic complement to the use of monitoring. These are issues to be pursued in subsequent work.

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[2] The notebooks comprising this manuscript are reproduced in the International Publishers' edition of Marx and Engels *Collected Works*, volumes 30-34.

[3] Proofs of propositions are available upon request from the author.