Economics of Unlimited Supply of Labor and Asymmetric Power

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Working Paper No: 2015-01

May 2015

(second version)

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Abstract

Since around 2000 the education premium and the level of employment in high-skill occupations has stagnated, if not actually begun to shrink. This brings into question the generally held view that in advanced countries globalization and technological change benefit those who work with their minds, however potentially harmful they might be for those who work with their hands. The paper argues that these recent labor market trends might be better explained by the power asymmetry between capital and labor that developed in the last few decades than by autonomous changes in technology. The global oversupply of labor appears to have revived a pattern of skill replacing technological change that is reminiscent of 19^{th} century capitalism. The relative abundance of cheap labor creates an incentive to chip away whatever component can be routinized from complex tasks that are performed by expensive skilled workers so that they can be offshored and automated. The paper develops a game theoretical definition of asymmetric power and shows why in labor markets characterized by a structural imbalance between supply and demand, market exchange ceases to be a positive-sum game, and how that can favor skill replacing technological change over one that augments skills. It is possible that many "autonomous" innovations that enable non-routine task to be transformed into routine ones are induced by labor market conditions.

Keywords: power in exchange, asymmetric power, institutional economics, skill-biased technological change, deskilling, globalization
JEL Classification: F60; J60;; 033; D74; C72; B14; B25

Introduction

Globalization and technological change might have precipitated an oversupply of labor around the globe, giving rise to conditions reminiscent of Arthur Lewis's "unlimited supply of labor"[1] in advanced countries, where no positive market clearing real wage might exist for certain grades of labor; or, if it does, it falls significantly short of covering the cost of living associated with the bare minimum socially accepted standard of living. In a world where the ongoing threat posed to employment by offshoring has reached proportions hitherto unimagined (Blinder 2006, 2007), the gap between supply and demand is impervious to any price adjustments that remain within the bounds of what is socially and politically viable. A global revival of growth could potentially soak up the excess labor, but that does not appear very likely. The recovery from the Great Recession remains globally anemic, and more importantly we might be at the threshold of a new wave of labor displacing innovations as the pace of automation accelerates (Brynjolfsson & McAfee 2011,2014; Ford 2009,2015). Economists are generally known for their skepticism with respect to the possibility of technological unemployment. They believe that just as technological change destroys some jobs it also creates others that over time more than compensate its initial negative impact. An increasing number of prominent economists, however, fear that this time around it might be different and foresee an employment crisis (Summers 2013, Spence 2014, Sachs & Kotlikoff 2012).

Economists' explanations of the effect of innovations on the labor market have been noteworthy for their technological determinism. It is generally agreed that the return on education has risen steadily throughout much of the 20th century and that is taken as *prima facie* evidence that technological change complements skills, augmenting worker productivity (Acemoglu 2002, Goldin & Katz 2010, Hamermesh 1993). According to this view, the education premium on skilled workers' wages is the result of a race between education and technological change (Tinbergen 1975, Goldin & Katz 2010), determined by the balance between the demand for skilled workers, increasing with technological change which enhances their productivity, and their supply, rising with education. Revised to account for recent disparate labor market trends (Acemoglu & Autor 2011, 2012), it still informs the way many economists conceptualize the labor market effect of technological change.

Throughout the 1990s, employment growth remained robust in the US in the face of rapid diffusion of information technologies (Krueger & Solow 2002). Technology replaced mainly mid-wage, mid-skill level routine jobs, and employment growth centered on non-routine jobs hard to computerize, both low and high skill, polarizing employment growth between 'good' and 'bad' occupations (Autor 2014; Autor, Katz & Kearney 2006). Increased investment in education and improvements in human capital appeared to be the ticket to 'good' jobs, and became the main focus of recommended economic policy. Since around 2000, however, employment growth slowed markedly (Moffitt 2012) and manufacturing job losses accelerated (Charles et al 2012, Pierce & Schott 2014). At the same time, the (college) education premium and the level of employment in high-skill occupations has stagnated, if not actually begun to shrink. The skill profile of jobs replaced in the middle spectrum in the meantime kept rising, while low-

[1] The term originates from Arthur Lewis's (1954) seminal work. For a broad discussion of global conditions that led to the oversupply of labor, Alpert (2013).

skill, mostly manual, non-routine jobs accounted for virtually all new employment (Beaudry, Green & Sand 2013, 2014; Autor 2014; Mishel, Shierholz & Schmitt 2013).

These labor market trends raise the possibility that the effect of technological change on skills might be time variant. During the 19th and early 20th centuries technological change was predominantly skill replacing (Cain & Paterson 1986, James & Skinner 1985), and it is suggested that that might had been related to oversupply of labor (Acemoglu 2002). The reemergence of similar labor market conditions in advanced market economies might have revived this earlier pattern. In support of this view, this paper argues that conditions of unlimited supply of labor cause asymmetric power between capital and labor which in turn can alter the very nature of labor exchange. It shows that under such conditions market exchange ceases to be a positive-sum game and that in turn can favor skill replacing technological change over one that augments skills.

The paper is organized in four sections and a brief conclusion. Section I defines *asymmetric power* and discusses why in its presence the potential mutual benefits of private exchange cannot be realized in full. Section II discusses the *enforcement rent* that can induce workers to stay on the job under conditions of oversupply of labor. Workers' ability to *walk away* and how costly job termination is to employers given their technology and its commensurate labor process determine their pay. Section III briefly revisits a couple of themes from Marx's analysis of the nexus between technological change and the labor market that seem to have relevance in our era. One of these is the notion that reorganization of work is often what makes it possible to substitute low for high skill labor and mechanize production, while the other ties the incentive to do so to shifts in labor market conditions. Section IV draws on this discussion to show how in an economy where both types of technological change (skill replacing and augmenting) coexist the increasing power asymmetry between capital and labor can favor one modality over the other. The paper concludes that many recent employment trends such as the increasing paucity of high skill jobs are likely to be tied to the increased asymmetry of power between capital and labor as well.

I. Role of Power in Exchange

Economists have paid scant attention to non-market power differences in voluntary exchange as economic theorizing traditionally focused on prices that cleared markets and satisfied certain balancing input-output relations in competitive equilibrium. However, that might be changing. With the growing recent interest in institutions the focus of economic theory has been shifting away from the Walrasian depiction of markets and issues thereof towards strategic behavior in *complex* transactions and how markets are governed.[2] In every market that does not clear, the old Walrasian insight holds that a potential exists for mutually beneficial trades. However, the failure to exploit them might have more to do with the intricacies of strategic behavior and difficulties of collective action rather than market interference.

Think of market exchange between two agents as a Prisoner's Dilemma (PD) game. Both sides are better off when they trade than when they do not. But, for the seller it would be better yet if she could receive payment without having to part with her goods, though of course that would be the worst outcome

[2] See Bowles and Gintis (1999) for a broader discussion.

possible for the buyer. Likewise, for the buyer getting the goods without paying for them would be much better than having to pay to have them, which of course would be worse than not trading at all for the seller. In the familiar PD payoff matrix these are the off-diagonal transactions that are thought irrelevant in market exchange (Hardin 1982). When potential for a mutually beneficial exchange exists, we generally assume that the trade either takes place or not. The diagonal transactions, win-win or lose-lose, are considered the only relevant possibilities. When traders are price takers, they have no influence on how the surplus from exchange is distributed. But, whenever "price" is determined by some *bargaining game* the surplus exchange creates is up for grabs, and the off-diagonal transactions become relevant making the parties' ability to bargain important.

For instance, when the delivery of goods and payment are not simultaneous - say, because credit is used - the potential for an off-diagonal transaction emerges because the buyer can renege on his promise to pay after having received the goods. Greif (2000) calls this the "fundamental problem of exchange," for unless some *institutional framework* enables the buyer on credit to commit *ex-ante* to not renege *ex-post*, the credit is unlikely to be extended. Williamson's (2005) problem of *asset specificity* is yet another example which is in principle the same. Making a *specific investment*, similar to extending credit, is also an intertemporal transaction that will only pay off if the other side sticks to the terms agreed on prior to exchange. Reneging by the other can be tempting because the agent who extends credit or makes a specific investment is vulnerable the way a cooperating player makes herself vulnerable in PD. Once she enters into such an exchange a wedge emerges between the expected payoff from the transaction and her second best option at the sub-game stage. If the other side chooses to opportunistically renegotiate at this point she either walks away making a loss or is forced to accept a smaller share of the surplus.

In both examples the players' ability to adversely influence the other is asymmetric during exchange. One side can lower the other players' payoff through its actions much more than the other can that of the first. This results from the discrepancy in how good a second best option to trading each player has. The idea can be generalized beyond sub-game situations such that when one side's second best option is almost as attractive as her first while the other side's is much inferior (for whatever reason) the players can be said to have power asymmetry.[3] Equilibrium under conditions of such bilateral monopoly (e.g., duopoly) is indeterminant (Blair et al. 1989). A determinate solution however can emerge when the effect of power asymmetry on the bargaining process is made explicit, yet the result is not independent of how the *game* is specified (Section III provides and example).

It is well known that in repeated PD games cooperation might emerge as the better option to opportunistic defection. This can for instance happen when reputation matters (Tullock 1985), i.e., when agents have information about each other's past behavior and can choose their trading partners accordingly, or more generally whenever defection reduces one's expected future payoff in repeated play in one way or another.[4] At the simplest level, one can successfully deter the other from defection if she is perceived by the other as capable of retaliation. But, while repeated encounters might be necessary for retaliation they need not be sufficient. If withholding cooperation by one player has (or

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[3] This is similar to Emerson's (1962) classic, dyadic relational definition of power. In the modern *network exchange theory*, based in part on his work, power differences among agents originate from how exchange opportunities are distributed (Cook et al 1983; Cook & Yamagishi 1992).

[4] There are also other ways in which cooperation can emerge, which are here ignored. For a broader discussion with an emphasis on group selection, see Nowak (2006) and Bowles (2013). Also, I am ignoring here the institutional mechanisms of commitment.

perceived to have) little or no impact on the other's payoff, the other player can safely defect getting the *temptation* payoff not only in their first initial encounter but perpetually since the other, *weak* player cannot by assumption punish defection. This of course requires that the weaker player' second best option is even worse than the *sucker* payoff so that she chooses not to *walk away*. In repeated encounters cooperation would then only emerge if the powerful player prefers it to unequal exchange, which in turn requires that the *reward* to cooperation is higher than the *temptation* payoff.

I apply this framework to conceptualize asymmetric power between capital and labor under conditions of structural oversupply of labor, ignoring the potential power balancing effect *institutions* might have. Methodologically this seems fruitful for two reasons. First, as suggested in the Introduction, if indeed no positive (or socially/politically relevant) full employment equilibrium wage exists because of the global oversupply of labor, the wage determination and the distribution of surplus must be based on some *bargaining game*.[5] Two, in such a lopsided labor market asymmetric power would be a defining characteristic. When what is in offer for exchange falls short of the quantity demanded there is a long and a short side of the market (Bowles and Gintis 1993). Clearly, those on the long side of the market (workers) would have a second-best option much inferior to trading (employment) than those on short-side (capitalists).

A representative worker and a capitalist interact in the following dyadic PD game that is thought to be repeated indefinitely. Their exchange yields a fixed return for each, and involves some collective costs that can be shifted onto the other to the extent power asymmetry allows.[6] Cooperation can raise their respective payoff in two ways; one, by reducing collective costs (which are assumed exogenously given); and, two, by making them individually more productive. The game shows that when the powerful player maximizes her payoff the players' joint payoff might not be maximized depending on the level of power asymmetry.

In what is to follow, I first ignore collective costs to reproduce briefly the condition for cooperation (under the so-called 'grim trigger strategy') when power is symmetric, and then go onto introduce collective costs to show how the condition for cooperation is altered when players with asymmetric power have the ability to shift them onto the other:

Consider the familiar payoff matrix for two players who are assumed to represent agents with symmetric power:

	Cooperate	Defect
Cooperate	λ, λ	k, e
Defect	e, k	Θ, Θ

[5] In other words, the wage is determined not by conditions of equilibrium based on labor productivity but rather takes the form of enforcement rent. In more general terms this is consistent with efficiency wage models and Keynes' view of labor exchange.

[6] This is in part inspired by Flood's (1952, 1958) original formulation of PD where the focus is on the sharing of the surplus exchange creates when players cooperate to lower transaction (collective) costs. It can be recalled Flood's version involves two friends transacting on an old used car and splitting the difference between the car dealer's buying and selling price. For a history of PD in the literature, see Poundstone (1993, Chp. 6).

Where first entry in each cell gives Row's payoff and the second the Column's, and where

λ – reward for cooperation
e – temptation payoff
k - suckers' payoff
Θ – punishment payoff

When the game is repeated indefinitely, the return to cooperation is given by:

$$\lambda + \lambda\delta + \lambda\delta^2 + \lambda\delta^3 + \ldots + \lambda\delta^n = \sum\lambda\delta^t = \frac{\lambda}{1-\delta}$$

where δ is the discount factor that takes a value between 0 and 1, where a lower value implies that the future is discounted more heavily. For instance, a value of 0.9 would mean that the individual would be willing to take 90 cents on the dollar today rather than wait till the next period to receive the dollar, while .8 would mean she would accept 80 cents implying that the future values count for less.

When both players have the ability to punish defection by the other, the payoff of a player who defects against a non-defecting player who thereafter defects in retaliation (in, so-called, the *grim* strategy) is equal to:

$$e + \Theta\delta + \Theta\delta^2 + \Theta\delta^3 + \ldots + \Theta\delta^n = e + \frac{\Theta\delta}{(1-\delta)}$$

That means that the return to cooperation over time exceeds the payoff for defection when:

$$\lambda > e(1-\delta) + \Theta\delta \qquad (1)$$

In other words, under symmetric power the likelihood of cooperation rises with the *reward to cooperation* and lower discounting of the future, and falls with the *temptation* and *punishment* payoffs.

Next, collective costs are introduced to show how the condition for cooperation is altered under asymmetric power. The payoff matrix now takes the form:

	Cooperate	Defect
Cooperate	$\lambda - a\gamma, \lambda - a\gamma$	k, e
Defect	e, k	$\Theta - \gamma, \Theta - \gamma$

where γ is collective costs per player. In the absence of cost shifting, the players respective payoff is lowered by γ in the absence of cooperation ($\Theta - \gamma$). When they cooperate collective costs are reduced by the fraction $1 - a$ per player, where ($0 < a < 1$). In other words, a gives the fraction of collective costs cooperation cannot eradicate.

The Pareto improvement caused by cooperation (m) has two sources; one, the economy on collective costs (z), and the other the increment in private return caused by cooperation (r).

$$m = \lambda - a\gamma - (\Theta - \gamma) = (\lambda - \Theta) + (1 - a)\gamma = r + z$$

$$r = \lambda - \Theta > 0$$

and,

$$z = (1 - a)\gamma$$

When power is asymmetric the powerful player can shift collective costs onto the less powerful player. In the limit when the *weak* player bears all collective costs, she (Row) faces a one-dimensional PD since her defection has no influence on Column's payoff and the second row of the payoff matrix drops out. In this limiting case, the *temptation* and *sucker* payoffs are respectively:

$$e = \Theta$$
$$k = \Theta - 2\gamma$$

Cost shifting involves a zero-sum change - with a constant total sum of payoffs whatever the powerful player gains the powerless loses:

$$\Theta - \gamma = (e + k)/2$$

We can also introduce a coefficient of asymmetric power (b) in the respective payoffs, $0 < b < 1$. The total collective costs that are shifted on to the powerless player are then given by $b\gamma$, hereafter termed the level of "exploitation" and denoted by x $(= b\gamma)$. The level of exploitation is at its maximum when b is equal to unity and nonexistent when it is zero. The *temptation* and *sucker* payoffs then take the form:

$$e = \Theta - (1 - b)\gamma = \varphi + x$$
$$k = \Theta - (1 + b)\gamma = \varphi - x$$

where, $\varphi = \Theta - \gamma$, and the first row of the above payoff matrix can equivalently be written equivalently as[7]:

$$(\varphi + m), (\varphi + m) \qquad\qquad (\varphi - x), (\varphi + x)$$

Provided that unequal exchange remains viable (Section II), the powerful player will not prefer cooperation unless its return exceeds the *temptation* payoff, i.e.,

$m > x$ or $r > x - z.$

All else being the same, the greater the level of asymmetric power, the lower is the likelihood of cooperation. And, with a given level of asymmetric power, cooperation's attractiveness for the powerful

[7] This will become relevant in Section IV.

player is lower the lower the ability to reduce collective costs. This means that, for a given value of z, a threshold level of asymmetric power exists beyond which the players' joint payoff will fall short of its maximum when the powerful agent maximizes her own payoff. This can be expressed more clearly.[8]

Setting γ equal to unity and re-writing the condition for cooperation, gives:

$$b + a < 1 + r$$

When the powerful player maximizes her payoff the players' joint payoff is also maximized for values of a and b that are inside the triangle in Figure 1. However, at any point outside the maximizing decision of the powerful player produces a joint payoff that is suboptimal.

For instance, entertain the possibility that the three variables, asymmetric power, effectiveness of cooperation in reducing collective costs and its incremental impact on private return, might dynamically interact. Especially, z might be negatively related to the level of asymmetric power, b, given that parties' level of contention, the higher one would expect the greater the power asymmetry, can reduce cooperation's effectiveness in reducing collective costs. The ray from the origin, $a = f(b)$, captures this possible functional relationship. It might also steepen over time to the extent greater power asymmetry entrenches a culture of conflict which agents gradually begin to take as a given in their decision making process. If so, policies that initially raise players' joint payoff by increasing asymmetric power might eventually fail to do so if with a steepening of the slope of $f(b)$ an initial point (a, b) that was inside falls outside the triangle that bounds the solution set for the condition for cooperation. However, the outcome also depends on whether in the meantime r rises or falls, which could be shown by shifting the outer boundary of the triangle in Fig 1 up or down.

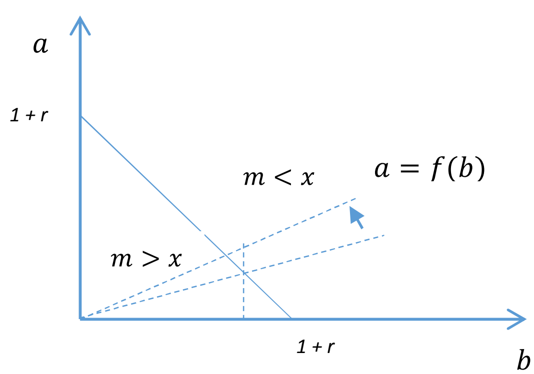

Figure 1

II. Why do not wages fall to zero?

If no positive market clearing wage exists because of oversupply of labor the question is what prevents wages from falling down to zero? Most *efficiency wage* arguments contend that *enforcement rents* are

[8] I thank Eric Sjoberg for the suggestion to provide a graphical presentation.

resistant to market pressure from unemployed workers because their claims that they can do as good a job as the employed for less are not credible. If a an efficiency rent is needed to keep workers from shirking, the unemployed workers once employed for less would also shirk and thus require a higher wage not to. Thus, the level of the enforcement rent is determined competitively by the maximizing decisions of employers to reduce shirking or labor turnover (Yellen 1984, Akerlof & Yellen 1990). While shirking might be more relevant in the case of skilled workers with high monitoring costs, labor turnover is likely to matter more with low-skill workers (Stiglitz 1974). This section extends the PD game introduced above showing that workers' ability to *walk away* and engage in on the job resistance, on the one hand, and the cost of job termination to the employer on the other can put a floor below which it is not profitable for employers to try to drive down workers' pay. Even though the powerful has the power to *exploit*, the powerless still has at least some control over her job performance and the duration of employment. As in any unequal relationship the party that is getting the short end of the stick is incentivized to look harder for a better alternative, and is expected to terminate trading as soon as a better opportunity is found.[9]

Three changes are made in the *temptation* and *sucker* payoffs, which here take the form:

$e(t) = \varphi t + c[x, t(x)]xt$ - the *temptation* payoff

$k(t) = (\varphi - x)t - s(t)$ – the *sucker* payoff

First change accounts for the variable length of employment, or trading time t, which is defined as the number of times the game is played. In the absence of cost shifting both players draw a benefit equal to $\varphi = \Theta - \gamma$ per play as assumed above, and φt over the length of their encounter (period of employment); and, when power is asymmetric, x is again the level of exploitation corresponding to the costs shifted in one play, and thus xt is the total costs shifted over the length of trading.

The second change introduces the idea that the level of exploitation might be constrained by workers' ability to resist or *walk away*, and how costly that is to employers. That turns cost shifting into a *negative-sum* game as what the powerful player can gain from cost shifting might be less than the powerless player's loss. This amount is given by cxt, where c is the benefit the powerful player draws per unit cost shifted onto the powerless. In other words, the coefficient c captures to the ability of the powerful player to exploit the weakness of the *weak*, which is assumed to be an increasing function of length of trading t, $(c_t > 0)$, and a decreasing function of the level of exploitation because workers tend to *walk away* sooner, $t_x < 0$, and increase their on the job resistance $(c_x < 0)$ when the level of exploitation is higher. Thus, an increase in the level of exploitation need not result in a proportional increase in the *temptation* payoff to the extent the average length of employment is reduced and workers become recalcitrant. The cost of a lower length of employment (i.e., higher labor turnover) to the employer in turn depends on technology and its commensurate labor process. For instance, as discussed in detail in the next section, c_t is likely to be high in craft or artisan production compared to what it would be under mass production. Given these assumptions, the marginal benefit from increased exploitation diminishes at higher levels of exploitation and vanishes at some maximum level. The

[9] The *enforcement rent* thus determined might not however cover the 'living wage'. Though important this possibility will have to be pursued in another paper.

powerful player can be assumed to choose the level of exploitation that maximizes her payoff, satisfying the condition, $\frac{de}{dx} = 0$, which gives:

$$c_{max} = -(c_x + c_t t_x)x$$

where c_{max} is equal to unity or some exogenously given constant that defines the maximum benefit the powerful player can draw per unit cost shifted onto the powerless.

Figure 2 depicts the 'optimal' level of exploitation for some arbitrary set of values for c_x and c_t, and t_x. The first two coefficients are assumed exogenously given, while t_x is derived from the maximizing decisions of workers, discussed next.[10]

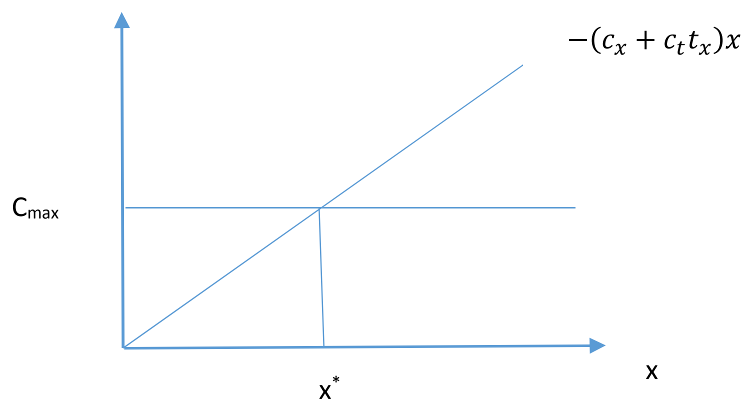

Figure 2

The third change involves modeling workers' ability to *walk away* by introducing an opportunity cost of employment function in the *sucker* payoff. Economists think axiomatically (and arguably tautologically) that when someone walks away from a job it is because the marginal cost of staying on the job exceeds its marginal benefit when termination occurs. This also suggests that before the worker quit her marginal cost of employment remained lower than the marginal benefit she drew from the job, with the implication that during the period she was employed the former had been rising faster than the latter. The simplest way to model this would be to assume that employment's marginal opportunity cost is a monotonically increasing function of time, $s'(t) > 0$, and it exceeds the marginal benefit of staying on the job at the point of job termination.

All else being the same, a higher level of exploitation reduces the marginal benefit of employment, pushing down $\varphi - x$, reducing the length of time the representative worker wants to stay on the job.

[10] A linear relationship is assumed for simplicity.

Figure 2a depicts what happens to the duration of employment when the level of exploitation increases from *x₀* to *x₁*, while Figure 2b gives the $\frac{dk}{dt} = 0$ isocline in the t – x space that is derived from it. The slope of t_x in Figure 1 is thus given by the slope of this isocline.

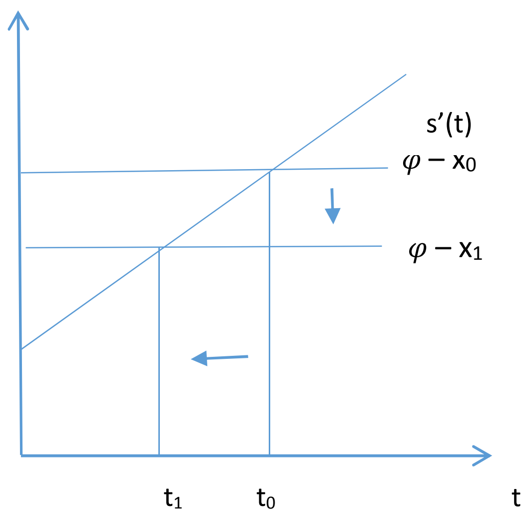

Figure 2a

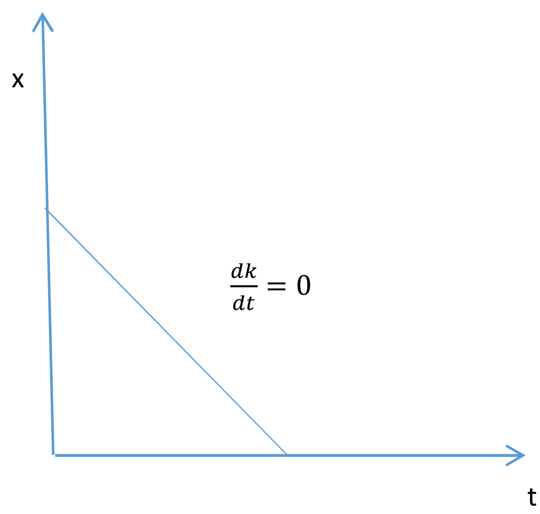

Figure 2b

Putting these diagrams together it is relatively straight forward to see how the oversupply of labor brought about by secular changes in market conditions of the type experienced in recent decades can lower workers' ability to walk away from a job, resulting in a lower payoff for labor.[11] When jobs are harder to find, the marginal cost of employment rises more slowly than before, causing the s'(t) schedule to tilt down (Graph 3a) flattening the $\frac{dk}{dt} = 0$ isocline (3b). It follows that for a given increase in the level exploitation the fall in the length of employment is now less (t_x ↓). Moreover, adverse labor market conditions might also have the effect of lowering workers' on the job resistance (c_x ↓), while changes in technology can make labor turnover less costly to employers (c_t ↓). The combined effect of all of these forces would be to tilt down the *effective exploitation* line, $-(c_x + c_t t_x)x$, in Figure 3c, making exploitation possible at a higher level.

[11] Note that when c < ½, the marginal benefit from increasing exploitation falls below its marginal cost, which makes *side-payments* possible. For ease of exposition I leave out this possibility as it can easily be introduced without changing the generality of the argument.

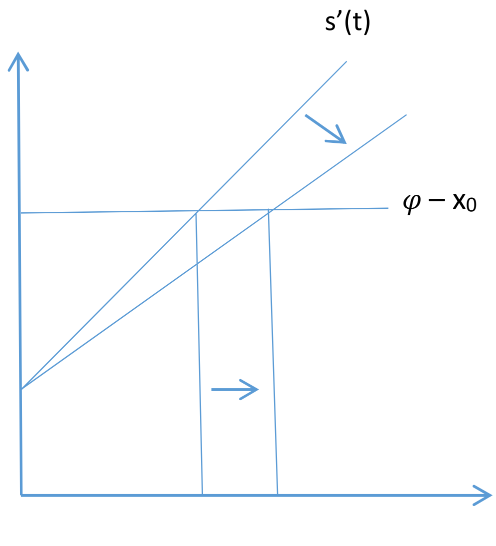

Figure 3a

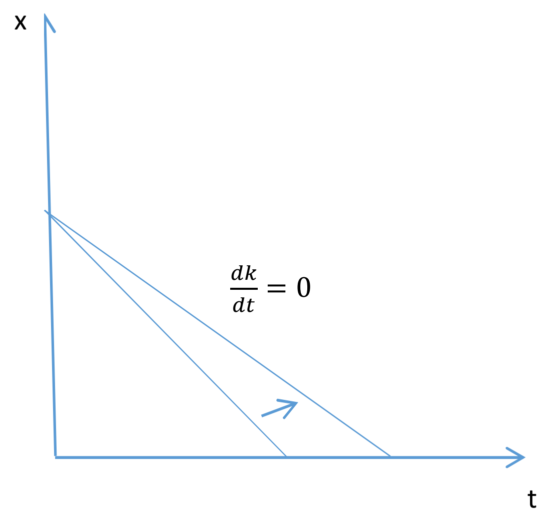

Figure 3b

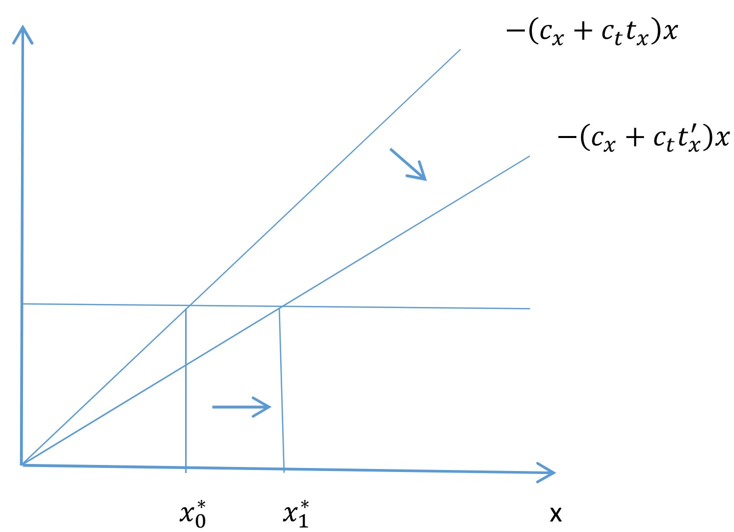

Figure 3c

III. Skill Replacing Technological Change and Organization of Work

It is reasonable to think that the nature of technology and its commensurate labor process determine how costly labor turnover is for employers. For instance, when organization of work consists mainly of non-routine tasks performed by skilled craftsmen using non-standard technology, job termination is likely to be relatively costly because the cost of both finding new workers and training them will be high. By contrast, if work involves mainly a series of routine tasks that can be performed by low skill workers with the aid of standardized technology that is easy to operate, replacement and pre-training costs following job termination will be low. Which organization of work is more profitable depends on a host of conditions that might not be easy to change in the short run. However, major shifts in labor market conditions can induce innovations that make it possible to alter the nature of labor process.

When work is organized along craft lines, any technological change that improves the skills of workers raises their relative value to their employers, and thus has the effect of lowering the level of exploitation and pushing wages higher, all else being the same. But, if high skill workers become too expensive relative to low skill workers (either because they are scarce or because the latter are abundant) it can become profitable for capitalists to search for ways to transform how work is organized so that they are no longer needed. Marx's account of the transformation of the labor process under conditions of an oversupply of low skill workers provides an example of this. The lopsided labor markets, resulting from the flood of workers from the countryside in search of employment as pre-capitalist property claims on workers and restrictions on their mobility weakened, were an important characteristic of the 19th century capitalism he observed and studied. He held that the conditions of excess labor induced capitalists to transform the labor process to overcome their dependence on skilled craftsmen whose relatively inelastic supply posed a potential bottleneck.

The craft organization of labor lent itself well to the production of non-standard and customized goods as it could flexibly adjust to changes in demand and shifts in relative prices. Craftmen took a long time to acquire the prerequisite level of skills, but once they did they also gained an ability to flexibly assign their skills to a multiplicity of tasks that often varied from one job to another and apply them to new ones as required. The labor exchange was relatively equal as capitalists faced competition among themselves for these skilled workers. That meant power symmetric labor exchange (as defined in Section I above) as each side's ability to adversely influence the other's payoff was not drastically dissimilar (Figure 4a).[12] Given the nature of the labor process mutual cooperation was in the interest of both the worker and the employer.

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[12] A bigger number indicates a higher payoff.

Capitalists

		Cooperate	Defect
Skilled Workers	C	3,3	1,4
	D	4,1	2,2

Figure 4a: Labor Exchange with Skilled Craftsman

The relative inelasticity of the supply of high-skill workers, however, was a serious drawback. Given the complexity of the required skills and the time it took to acquire them, any sustained increase in demand for labor when growth picked up risked rapidly rising wages and thus a squeeze on profits. Output expansion was self-constrained in yet another important way. Expanding employment involved significant diminishing returns because the organization of work depended on a crew of workers whose individual tasks were coordinated by a master craftsman. Thus, adding on new workers involved significant adjustment costs, and effective coordination began to suffer and marginal costs increased rapidly once an optimal crew and firm size was exceeded.

These drawbacks appear to have created incentives to switch to producing standardized goods which were cheaper, though often inferior, substitutes for custom crafted goods. The cost advantage was achieved by scale economies made possible by breaking down each complex task performed by skilled workers to a series of routine tasks that could be performed by low skill workers (Sokoloff 1984). This also paved the way for the introduction of machinery since a mechanical arm could replace an organic one relatively easily when the latter performed a simple, routine task. The relationship between skills and tasks, fluid and complex in the craft system, was thereby transformed into a rigid pairing of low level skills with a fixed number of routine tasks. Once the organizing principle and unifying thread of production became a fixed set of well-defined routine tasks, the need for skilled craftsmen dissipated. The inelastic supply of skilled workers and the inflexible crew size ceased to be constraints on production with the progressive transformation of the labor process that eventually culminated in the rise of *mass production* and the modern *assembly line*.[13]

[13] Edward J. Nell characterizes the craft production as a 'fixed employment – variable productivity' system, and standardized or mass production economy one that is defined by 'fixed productivity and variable employment' given that employment can be increased without a fall in productivity. See Nell (2005), for an extended discussion of the craft production and its affinity to the type of economy the traditional neoclassical model depicts.

This was in a nutshell Marx's account of skill replacing technological change. In his view, reorganization of work was a prelude and often the precondition of mechanizing production. At least initially, its very objective was to make the substitution of (abundant) unskilled workers for (scarce) skilled workers possible. The relative ease with which the average worker could be dispensed with altered the nature of labor exchange as asymmetric power imprisoned her in a one-dimensional PD (Figure 4b). That in turn could raise the level of exploitation (as depicted in Figure 3c), stylistically, for reasons emanating from: (i) the reduction in employers' vulnerability to labor turnover (c_t) given the reduced pre-training costs of workers; and, (ii) the fall in workers' ability to engage in on the job resistance (c_x) because of the increased competition from the unemployed workers.

Capitalists

		Cooperate	Defect
Unskilled Workers	C	3,3	1,4
	D	4,1	2,2

Figure 4b: Labor Exchange with Unskilled Workers

However, the overall process was not one of *de-skilling* alone. As Golding and Katz (1998) point out the rise of *mass production* also had the effect of raising the demand for a new breed of skilled workers such as engineers, designers and managers who were the latter-day craftsmen.[14] So, what we rather have is one of bifurcation of jobs and their respective organization of labor, with technological change having disparate effects on skills in each case. Whenever the goods and services produced are non-standard it is a safe generalization to say that the organization of work tends to remain along *craft* lines. These are often the 'good' jobs, where high-skill workers perform non-routine tasks using non-standard

[14] In part to emphasize the explosive growth of the *mass production* economy and the rise of mega companies at the turn of the 20th century, some writers seem to have argued that the craft system was replaced by standardized methods of production (or mass production) once for all (Braverman 1974; Marglin 1974; Aglietta 1979). However, as Piori and Sable (1984) remark, even at the height of so-called *Fordism*, the product specific, dedicated machinery that comprised the backbone of *assembly line* production had to be produced by skilled *craftsmen* for the simple reason that it itself could not be produced by standardized techniques *en masse* given its specialized nature. Also, see Adler (1990) who among others takes issue with the view that Marx considered only skill replacing technological change.

technology.[15] With an equal and cooperative labor exchange, this is also the world of high monitoring costs, Y-management and efficiency wages. It contrasts rather starkly with the way standardized goods and services are produced by low-skill workers who perform easy to monitor routine tasks. Despite their decreasing numbers, these workers continue to occupy an important part of the secondary sector jobs.[16]

The nature of technology and the effect technological change has on skills is also very different in both cases. In (routine) secondary sector jobs, a machine used in production is designed with a view to minimize workers' pre-training costs. It thus tends to be product-specific and single-purpose so that low skill workers can operate it easily. It is not unusual for better machines to replace older machines in rapid succession so that they can be operated by fewer and fewer operators with even lower skills. By contrast, a machine used by the skilled primary sector workers is designed to perform an ever changing multitude of non-routine tasks that varies from job to job. It thus tends to be multi-purpose, requiring specialized knowledge and skills to use (Nell 2005). Thus, technological change (at least when it is embodied in a new machine) will tend to enhance worker skills in primary sector jobs, while downgrading and replacing them in standardized jobs.[17] At the same time, however, labor market conditions can also incentivize search for the type of innovations that enable the transformation of non-routine tasks into a subset of routine ones, which can then be offshored to lower skill workers or automated. Thus, induced changes in technology can be skill replacing in primary sector jobs as well.

This line of analysis can provide a novel way of looking at the technology – skill nexus, which might be helpful in understanding recent labor market trends, especially the increasing paucity of good jobs. In the standard analysis, labor market conditions affect the choice of technique through their influence on the relative factor prices, but what goes into the menu of techniques available for adoption (and their level of productivity) is solely the domain of technology. The same appears to be true for the menu of routine and non-routine tasks at a given point in time as well. For instance, during the 1990s' 'job polarization', the demand for mid-skill jobs was decreasing despite falling wages, which suggested strong technological displacement. Introducing a separation between skills and tasks, Acemoglu and Autor (2011, 2012) argued that job polarization was the result of technological change replacing routine tasks while leaving non-routine tasks, both low and high skill, relatively untouched. In their view, technological change could still be broadly skill enhancing, while replacing skills only to the extent they were rigidly tied to the displaced routine tasks. Yet, their analysis did not address why some skills were rigidly tied to routine tasks while others were not.

IV. Labor Market Conditions and the Effect of Technological Change on Skills

The search for technological innovations that make it possible to transform non-routine task into routine ones is not independent of labor market conditions. The relative abundance of cheap labor can induce

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[15] Not until long ago skill differences between primary and secondary sector workers did not seem to matter (Bulow & Summers 1985) With the 1990s job polarization the nature of labor market segmentation appears to have been altered as well.

[16] Their ratio to other secondary sector workers who perform manual non-routine tasks such as personal services has been steadily decreasing within the last couple of decades. For the purposes of the discussion here when I use the term 'secondary sector' I will be referring to the former group only.

[17] Also, investing in human capital poses a problem because improvements in workers' skills are unlikely to be firm-specific. Skill replacing machinery also has the advantage of solving this problem. Acemoglu & Pischke (1998) argue that information asymmetries might explain why firms invest in human capital at all.

innovations that make it easier to chip away whatever component can be routinized from complex tasks that are performed by expensive skilled workers. As Krugman (2011) remarks while "robot janitors are a long way off; computerized legal research and computer-aided medical diagnosis are already here." Technological change it appears does not blindly target all non-routine tasks but mainly those performed by skilled labor when it is relatively expensive.

The negative effect of cheap labor on craft production that rely on a complex skill set on the part of workers (and thus 'good' jobs) can be captured by a simple n-person extension of the game from Section I. Keeping in mind our discussion in Section III, assume an economy where *craft* and *standardized* methods coexist, producing respectively goods that are imperfect substitutes,[18] and where individual capitalists decide between the two methods. For simplicity, I ignore explicit production functions and the cost of switching from one method to another.

Based on the discussion in Section III, it is assumed that the return on skilled workers is higher but diminishes with higher employment because of their inelastic supply and craft organization. By contrast, the return to unskilled workers, though lower, remains constant as their employment expands. This is because their supply is assumed perfectly elastic and because their productivity does not diminish with increased employment given the standardized technology they work with.

With n capitalists who have already employed skilled workers, the $n+1^{st}$ capitalist makes a decision between employing skilled or unskilled workers by comparing their respective return: $P(n+1)$ for skilled workers, and $S(n)$ for unskilled workers:

$$P(n+1) = \varphi + m(n)$$

$$S(n) = \varphi + x$$

The difference between the two payoffs can be conceptualized as the difference between positive sum labor exchange that is power symmetric and one that is power asymmetric and zero-sum. As can be recalled from Section I, this difference is equal to: $m = r + z$, and cooperation is preferred by the powerful when: $m > x$. Thus, $P(n+1) > S(n)$ - the positive sum nature of the labor exchange and the higher productivity of skilled workers secures a payoff better than the return of low skill workers - when $m(n) > x$.

The return on skilled workers diminishes at the rate m_n with more capitalists employing them:

$$m(n) = z - m_n n$$

The point where $P(n+1)$ and $S(n)$ intersects the advantage of positive-sum labor exchange dissipates relative to *exploitation*, $m(n) = x$, and yields a stable Nash equilibrium (Figure 5a). When the number of capitalists who hire skilled workers exceed n^* the return on them falls below the return on unskilled workers. As some capitalists switch from craft production to hiring unskilled workers the respective returns are equalized. Likewise, when the number of capitalists who hire skilled workers is less than n^* the return to craft production is higher, and when that attracts other employers the return is lowered into equality with the return on unskilled workers.

[18] Further assume for simplicity that in each method no possibility of substitution exists between capital and labor, or between different skill grades of labor.

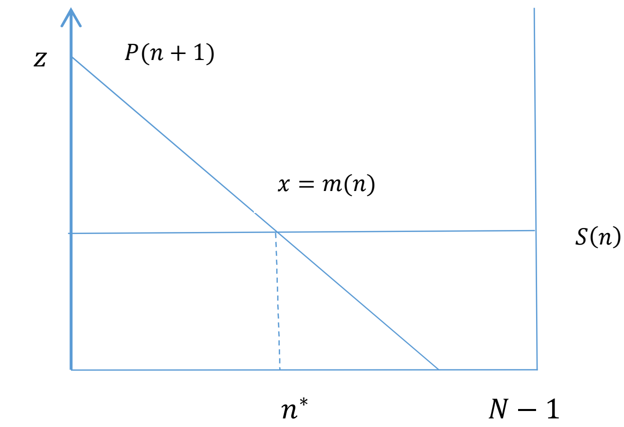

Figure 5a

The relative size of craft production (and demand for skilled workers) is thus given by:

$$n^* = \frac{z - x}{m_n}$$

showing that at equilibrium (with a given z and m_n) the level of exploitation and employment of skilled workers are inversely related. An increase in the level of exploitation for any of the reasons discussed in Section II (Figure 3c), reduces the relative attractiveness of craft production and thus the employment of skilled workers at the new equilibrium, all else being the same.

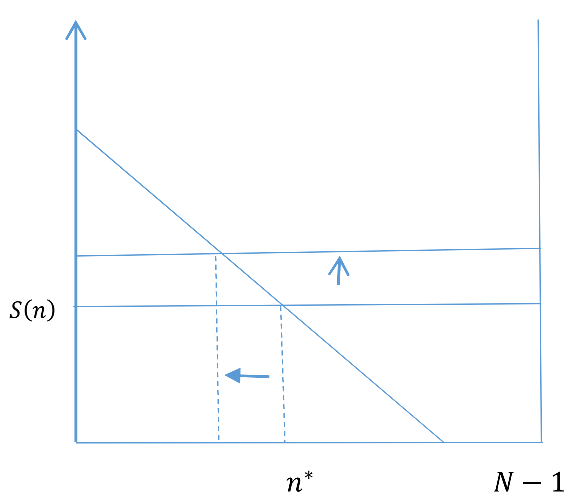

Figure 5b

The higher level of exploitation can potentially also reduce the employment of skilled workers indirectly in two other ways: on the one hand, by lowering the potential effectiveness of cooperation in eradicating collective costs (z) as higher power asymmetry raises the level of contention and enforcement costs, (i.e., giving rise to a higher a in Figure 1 above), and, on the other, by reducing m_n to the extent the shrinking size of craft production generates negative network externalities and skill mismatches that cause its return to diminish faster.

It is possible that over the longer run the new equilibrium might not be stationary. The very distributional shift towards profits associated with the higher level of exploitation can stimulate economic growth which can eventually soak up the cheap excess labor. This is what Marx considers when he argues that economic growth can reduce the size of the *reserve army of labor*, causing wages eventually to rise.[19] Rising demand for labor makes the process depicted in Figures 3(a-c) work in reverse. Higher employment makes power-balancing collective action easier and gives workers the power to influence the payoff of capitalists. The nature of labor exchange gets transformed and the average worker ceases to be locked in a one-dimensional PD (Figure 4c). This would cause the return on unskilled workers, $S(n)$, to shift down in Figure 5b, expanding the size of craft employment in the new equilibrium.

Capitalists

		Cooperate	Defect
Industrial Workers	C	3,3	1,4
	D	4,1	2,2

Figure 4c: Labor Exchange with Organized Labor

A simple way to capture this potential growth effect of higher profits would be by making N a function of x. A higher level of exploitation can then be shown to have three disparate effects:

[19] When the rise in wages overshoots and depresses profits, it checks growth lowering the demand for labor. The reserve army of labor increases again, giving rise to a cycle that repeats itself. Goodwin's (1967) eloquent formulation of Marx's argument has since spawned a voluminous literature which generally ignores how organization of work is transformed in the process.

The capitalists' total payoff (T) at equilibrium is equal to:

$$T = n^*(m - x) + N(\varphi + x)$$

and, its change with respect to x is given by:

$$T_x = [n_x^*(m - x) + n^*(m - x)_x] + N_x(\varphi + x) + N(\varphi + x)_x]$$

which comprises three parts:

$$\Delta A = n_x^*(m - x) + n^*(m - x)_x$$
$$\Delta B = N(\varphi + x)_x$$
$$\Delta C = N_x(\varphi + x)$$

Figure 5c depicts these effects when exploitation is rising. The first (ΔA) shows the reduced income (employment) of skilled craft workers, the second (ΔB) the transfer of income from unskilled workers to capitalists; and, the third (ΔC) shows the increased employment of unskilled workers.[20]

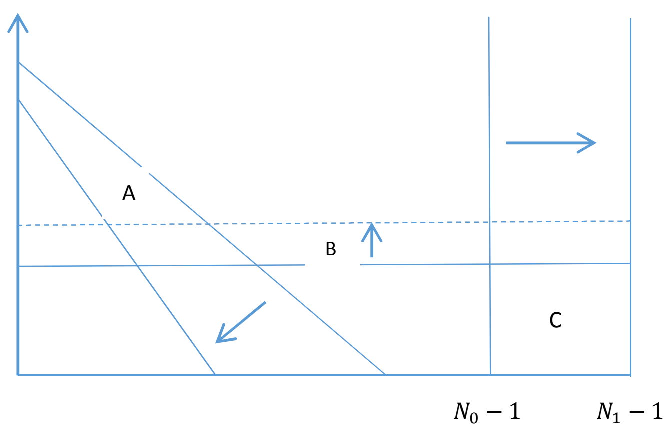

Figure 5c

When the growth effect of higher profitability, depicted by ΔC, transforms the nature of the labor exchange, the process depicted in Figure 5c works in reverse, making power-balancing by workers easier. As power-symmetry is restored, the employment of skilled workers (ΔA) begins to expand and the growth dynamic is spearheaded by improvements in human capital where skill augmenting effects

[20] For workers the payoff calculus is however different. While the loss in primary markets (ΔA) is symmetrical, capitalists' gain is equal to their loss in ΔB, and workers' gain falls short of capitalists' in ΔC the higher the value of x.

$$\Delta A_w = n_x^*(m - x) + n^*(m - x)_x$$
$$\Delta B_w - N\Delta x$$
$$\Delta C_w = \Delta N(\varphi - x)$$

of technological change predominate. The positive sum nature of the capital labor interaction and the higher labor productivity can obviate (at least for a time) the potential squeeze on profits. The observed skill enhancing pattern of technological change during much of the 20th century US might in fact be explained by sustained high economic growth that kept the overall demand for labor strong, maintaining a relative symmetry of power between capital and labor.

Conclusion

Economist often overlook that the long post war growth upswing in advanced capitalist economies had an important institutional dimension. Forming power balancing coalitions, workers successfully sought institutional labor market barriers (within their respective nation-states) that restricted competition from unemployed workers *elsewhere* to safeguard against an easy slide into lopsided labor markets at the first sign of slack labor demand. While many of these political barriers on labor mobility by and large remain intact, global integration of markets (and production) has made it increasingly difficult for workers in advanced countries to shield themselves from competition from *elsewhere*. Globalization, a backlash that has circumvented and weakened these barriers, appears to have robbed the system of its built-in mechanism to correct lopsided labor markets. All new employment expansion (ΔC in Figure 5c) has increasingly taken place *elsewhere* since the 1990s, and the offshoring of jobs gone up the skill ladder faster than anyone had ever anticipated possible. The result has not just been increasing inequality and falling living standards for workers in advanced countries but also the stagnation of high value added employment, which appears to have stopped expanding even before the financial crisis. These negative effects on low skill workers in advanced economies have long been recognized, but the stagnation of ‘good’ jobs comes as a surprise. Globalization and technological change has generally been thought to benefit high skill workers and that made better education in the minds of many the panacea in this new economy. However, neither proposition might be true any longer. The culprit is not so much the robots and offshoring *per se* but the large power asymmetry between capital and labor that seem to have made skill replacing innovations more attractive than those that enhanced skills.

References:

Aglietta, M. (1979). *A Theory of Capitalist Regulation: The US Experience*. London. New Left Books.

Acemoglu, D. (2002). "Technical Change, Inequality, and the Labor Market," *Journal of Economic Literature*, 40(1): 7-72.

Acemoglu, D. (2012). "What Does Human Capital Do? A Review of Goldin and Katz's The Race Between Education and Technology," *Journal of Economic Literature* 50(2).

Acemoglu, D. & D. Autor (2011). "Skills, Tasks and Technologies: Implications for Employment and Earnings," in O. Ashenfelter & D. Card (eds.) *Handbook of Labor Economics*, vol 4, Part B, pp. 1043-1171. Elsevier.

Acemoglu, D. & J. Pischke (1998). "Why Do Firms Train?: Theory and Evidence," *Quarterly Journal of Economics*, 113(1).

Adler, P. (1990). "Marx, Machines and Skill," *Technology and Culture*, 31(4).

Akerlof, G. & J. Yellin (1990). "The Fair-Wage Effort Hypothesis and Unemployment," *Quarterly Journal of Economics*, 105(2).

Alpert, D. (2013). *The Age of Oversupply. Overcoming the Greatest Challenge to the Global Economy*. Penguin.

Autor, D. (2014). "Polanyi's Paradox and the Shape of Employment Growth," NBER Working Paper No. 20485.

Autor, D., Katz, L. & M. Kearney (2006). "The Polarization of the US Labor Market," *American Economic Review*, 96(2), pp. 189-194.

Beaudry, P. Green, D. & B. Sand (2013). "The Great Reversal in the Demand for Skill and Cognitive Tasks," NBER Working Paper, No. 18901, December.

Beaudry, P. Green, D. & B. Sand (2014). "The Declining Fortunes of the Young Since 2000," *American Economic Review* 104(5), 381-86.

Blair, R., Kaserman, D. & R. Romano (1989). "A Pedagogical Treatment of Bilateral Monopoly," *Southern Economic Journal* 55(4).

Blinder, A. (2006). "Offshoring: The Next Industrial Revolution," *Foreign Affairs*, March/April.

Bowles, S. (2013). *Cooperative Species, Human Reciprocity and Its Evolution*. Princeton University Press.

Bowles, S. (1985). "The Production Process in a Competitive Economy: Walrasian, Neo-Hobbesian, and Marxian Models," *American Economic Review*, 75(1).

Bowles, S., & H. Gintis (1999). "Power in Competitive Exchange," in S. Bowles, M. Franzini & U. Pagano (eds.) *The Politics and Economics of Power*. Routledge.

Bowles, S. & H. Gintis (1983). The Revenge of Homo Economicus: Contested Exchange and the Revival of Political Economy," *Journal of Economic Perspectives*, 7(1).

Braverman, H. (1974). *Labor and Monopoly Capital*. New York: Monthly Review Press.

Brynjolfsson, E. & M. McAfee (2011). *Race Against the Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy*. Digital Frontier Press.

Brynjolfsson, E. & A. McAfee (2014). *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. W.W.Norton.

Bulow, J. & L. Summers (1985). "A Theory of Dual Labor Markets With Application to Industrial Policy, Discrimination and Keynesian Unemployment," NBER Working Paper, 1666.

Cain, L. & D. Paterson (1986). "Biased Technical Change, Scale, and Factor Substitution in American Industry, 1850-1919," *Journal of Economic History*, 46:153-64.

Cook, K., Emerson, R., Gillmore & T. Yamagishi (1983). "The Distribution of Power in Exchange Networks: Theory and Experimental Results," *American Journal of Sociology* 89: 275-305.

Cook, K. & T. Yamagishi (1992). "Power in Exchange Networks: A Power-Dependence Formulation," *Social Networks* 14: 245-265.

Emerson, R. (1962). "Power-Dependence Relations," *American Sociological Review* 27: 31-40.

Flood, M. (1958). "Some Experimental Games," *Management Science* 5 (October), pp. 5-26.

Flood, M. (1952). "Some Experimental Games," *Rand Corporation Research Memorandum RM-789*-1, 20 June 1952.

Ford, M. (2009). *The Lights in the Tunnel: Automation, Accelerating Technology and Economy of the Future*. Create Space Independent Publ Platform.

Ford, M. (2015). *The Rise of Robots: Technology and the Threat of a Jobless Future*. Basic Books.

Goldin, C. & L. Katz (2010). *The Race Between Education and Technology*. Belknap Press.

Goldin, C. & L. Katz (1998). "The Origin of Technology-Skill Complementarity," *Quarterly Journal of Economics* 113(3).

Goodwin, R. (1967). "A Growth Cycle," in C. Feinstein (ed.) *Socialism, Capitalism and Economic Growth*. Cambridge University Press.

Greif, A. (2000). "The Fundamental Problem of Exchange: A Research Agenda in Historical Institution Analysis," *European Review of Economic History* 4(3).

Hamermesh, D. (1993). *Labor Demand*. Princeton University Press.

Hardin, R. (1982). "Exchange Theory on Strategic Bases," *Social Science Information* 21(2).

Hudson, K. (2007). "The New Market Segmentation: Labor Market Dualism in the New Economy," *Social Science Research* 36(1).

James, J. & J. Skinner (985)., "The Resolution of the Labor-Scarcity Paradox," *Journal of Economic History*, 45: 513-540.

Krueger, A. & R. Solow (eds.) (2002). *Roaring 1990s: Can Full Employment Be Sustained?* New York: Russell Sage Foundation.

Lewis, A. (1954). “Economic Development with Unlimited Supply of Labor,” *Manchester School of Economic and Social Studies*, 22, pp. 139-91.

Marglin, S. (1974). “What Do Bosses Do?” *Review of Radical Political Economy* 6, pp. 60-112.

Mishel, L., Shierholz, H. & J. Schmitt (2013). “Don’t Blame the Robots. Assessing the Job Polarization Explanation of Growing Wage Inequality,” Economic Policy Institute and Center for Economic Policy and Research Institute Working Paper.

Moffitt, R. (2012). “The Reversal of the Employment-Population Ratio in the 2000s: Facts and Explanations,” *Brookings Papers on Economic Activity*, 1, pp. 201-264.

Nell, E.J. (2005). *The General Theory of Transformational Growth: Keynes After Sraffa*. Cambridge University Press.

Nowak, M. (2006). “Five Rules for the Evolution of Cooperation,” *Science* 314(5805).

Piori, M. & C. Sabel (1984). *The Second Industrial Divide*. Basic Books.

Piore, M. & P. Doeringer (1971). *Internal Labor Markets and Manpower Adjustment*. New York: D.C. Heath and Company.

Poundstone, W. (1993). *Prisoner’s Dilemma*. New York, Anchor Books.

Pierce, J. & P. Schott (2014). “The Surprisingly Swift Decline of US Manufacturing Employment,” Finance and Economics Discussion Series, Federal Reserve Board, Washington DC.

Pryor, F. & D. Schaffer (2000). *Who’s Not Working and Why: Employment, Cognitive Skills, Wages and the Changing US Labor Market*. Cambridge Un Press.

Rifkin, J. (2014). *The Zero Marginal Cost Society: the Internet of Things, the Collaborative Commons, and Eclipse of Capitalism*. Palgrave Macmillan.

Sachs, J. & L. Kotlikoff (2012). “Smart Machines and Long-Term Misery,” NBER Working Paper No. 18629, December.

Sokoloff, K. (1984). “Was the Transition from the Artisan Shop to Non-Mechanized Factory Associated Gains in Efficiency. Evidence from the US Manufacturing Consensus of 1820 and 1850,” *Explorations in Economic History* 21: 351-382.

Spence, M. (2011). “The Impact of Globalization on Income and Employment. The Downside of Integrating Markets,” *Foreign Affairs*. 90(4).

Spence, M. & S. Hlatshwayo (2012). “The Evolving Structure of the American Economy and the Employment Challenge,” Comparative Economic Studies, doi:10.1057/ces.2012.32.

Spence, M. (2014). “Labor’s Digital Replacement,” *Project Syndicate*, May 22.

Stiglitz, J. (1974). “Wage Determination and Unemployment in L.D.C’s: The Labor Turnover Model,” *Quarterly Journal of Economics*, 88: 194-227.

Summers, L. (2013). “Economic Possibilities for Our Grandchildren,” The 2013 Martin Feldstein Lecture. *NBER Reporter*, 4.

Tinbergen, J. (1975). *Income Differences: Recent Research*. North-Holland.

Tullock, G. (1985). “Adam Smith and the Prisoner’s Dilemma,” *Quarterly Journal of Economics* 100(4).

Yellen, J. (1984). “Efficiency Wage Models of Unemployment,” *American Economic Review*, 75(2).