

# Capital scarcities as a reason for high unemployment in the European Union

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## Abstract

This paper argues that scarcities for non-transferable fixed-supply goods such as land, infrastructure and social capital, may affect European unemployment in two, mutually enforcing, ways. Firstly the existence of minimum non-transferable capital requirements per worker implies that in a growing economy, workers must have ever higher productivities to obtain any wages at all. Secondly, the fact that non-transferable goods are not only production inputs, but are also indispensable consumer goods, increases the price of the non-transferable goods even higher, thereby increasing again the minimum wages one needs to survive. Furthermore, in a simple general equilibrium model I show that the presence of high-productivity workers will decrease the wages (and job-opportunities) of other workers and increase the minimum wages necessary to survive. Unemployment and minimum living costs are also increased by an increase in population, by an increase in the relative productivity of capital, by an increase in the dispersion of labour quality and by an increase in the importance of capital goods for consumption.

*keywords:* minimum-costs, non-transferable capital, general equilibrium, unemployment, wage-divergence.

## 1 Introduction

Contrary to the US, much of Europe is still troubled by high levels of unemployment, despite substantial recent reductions in welfare spending, union power, trade barriers, and real minimum wages: average employment growth in Central and Western Europe from 1983-1995 is only 0.35% compared to the 1.8% in the USA, whilst relative unit labour costs, calculated from wages, has decreased in the same period (O.E.C.D. 1996: table 1.2 and 1.4). These considerations lead one to ask whether European unemployment can be explained without assuming that markets are less competitive in Europe than in the US?

The goal of the paper is to draw attention to the double-edged sword of limited non-transferable goods, such as land, infrastructure, cultural capital, managerial talent, etc. As Western Europe is populated more densely than the US, the scarcity of these goods is greater with two important effects. Firstly, unemployment then naturally arises out of

the existence of minimum capital and labour costs per worker, such as space to work, administration overhead, entrepreneurial talent, and minimum working facilities. As these costs are per worker per period, workers need to achieve a minimum productivity to earn back these fixed costs. If some workers don't achieve this, the market for capital still clears but some labour remains unused. Secondly, it is the case that these limited non-transferable goods are not only inputs into production but are also indispensable consumer goods. Combining these effects, the low-productivity European worker will have to have a higher productivity than his American counterpart to be able to obtain any wages at all and will need more wages to be able to survive due to the higher costs of produced goods and the higher costs of non-transferable goods (more expensive housing, rents, roads).

In section 2, some existing theories of unemployment and wages are investigated and the basic arguments of the paper are developed. In section 3, a one-period open-economy general equilibrium model is constructed. By first concentrating on the production side, I show that the effect of minimum costs per worker on unemployment is greater when the capital scarcities are greater. By adding a consumption side to the model, I investigate the implications of the existence of minimum worker costs and of non-transferable goods. It turns out that when non-transferable goods are both consumption and production goods, the price of these goods will further increase, resulting in greater unemployment and higher minimum living costs. The main prediction of the entire model is that countries which possess a large amount of non-transferable capital goods, have a small population or have a very homogeneous workforce, will under *Ceteris paribus* conditions have a lower unemployment rate.

Section 4 summarises and concludes.

## 2 The basic arguments

Statistics on unemployment and wages show that the number of unemployed workers in Europe has grown relative to that of the US<sup>1</sup>. Many reasons have been suggested for this difference, including European unemployment benefits, worker's rights, European wage-rigidities, European corporatist institutions and European unions. Each suggestion however has its critics.

One explanation for high European unemployment is given by labour market segmentation or signalling theories who predict that high-skilled workers are cyclically and voluntarily unemployed as a result of waiting for job-offers in the sector where their qualities are most productive (Smith (1995), Sattinger (1995) or Gottfries and McCormick (1995)). As the unemployed in Europe and the US are mostly lowest skilled

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<sup>1</sup>Although the definition of unemployment differs between countries, the OECD's 1996 Employment outlook estimates that in 1996, 10.5% of the labour force can be counted as unemployed and searching for a job, compared to 5.9% in the US. If we include discouraged workers and half of the involuntary part-time workers as unemployed, the US still did better in 1993 with 9.4% (standard definition: 6.8%), than the UK with 12.3% (10.3%) and Sweden's 10.3% (7.8%) (OECD 1994).

workers (O.E.C.D. 1996), it seems unlikely that these theories can explain much of current European unemployment.

Woods (1994) and others argue that European unemployment is partially explained by European wage rigidities and high minimum wages. Indeed, the whole flow-approach to the labour markets assumes that more people would work if benefits were lower because they would accept lower wage-offers. Is it really the case that many jobs are to be won by allowing lower wages at the lower end of the labour markets? Blank (1995) looked at seven case-studies into the relationship between welfare policies, such as minimum wages and unemployment benefits, and European unemployment. None of the seven case-studies she reviewed was able to show that the disappearance or down-scaling of welfare policies had any significant effect upon wages or hours of work. Even in the US, the controversy created by Card and Krueger (1994, 1995) showed that US minimum wages and unemployment are at best weakly related.

Another barrier to perfectly functioning markets which has been blamed for high European unemployment is high firing costs in Europe (Saint-Paul (1995)) or excessive worker rights. How high firing costs could explain recent European unemployment rises versus the US's low unemployment is unclear because of the possibility of firms to hire workers on a part-time basis. The fact that the relative amount of part-time jobs in Western Europe has grown fast over the last decade (O.E.C.D. (1996), table 1.6) suggests that the high firing rates may alter the legal structure of jobs but not their amount. There are also theoretical arguments against the idea that restrictions on firing increase unemployment. Institutionalist economists like Heap (1994) and Hoel (1990) argue that restrictions on firing can increase employment and efficiency as it enforces mutually beneficial agreements between employers and workers. Such agreements have a bread-now-jam-tomorrow nature, whereby workers agree for wage restraint so that investments can be made now. Employers however have an incentive to break these agreements by firing employees once the investments are made and firing restrictions can thus be efficient. Such a scheme does assume that capital markets do not satisfy the demand for capital, which could be due to asymmetric information or imperfect capital markets. Hartog et al. (1996) even suggest that Europe's corporatist institutions allow nominal wages to adjust quickly to macro-economic shocks via wage-bargaining on a higher level than the firm, whereas non-corporatist countries have to stick to contract wages as they have no credible mechanism to which both workers and employers can agree for adjusting wages. Soskice (1990) indeed argues that welfare institutions could improve long-term economic performance via wage restraints. Thus there seems to be no consensus on whether we can actually explain high European unemployment by referring to voluntary unemployment, high minimum wages or excessive job-protection.

Despite their differences, the discussed explanations of European unemployment and their critiques leave unchallenged the basic premise that all potential workers have a positive marginal productivity with which to bargain for wages. Rather, I will argue that, for most jobs, the employment of a worker creates minimum capital and labour costs which have to be paid each period. Such costs come from three different sources: physical minimum requirements, administration costs and costs from capital indivisibilities.

Physical costs mainly arise out of requirements of space: a worker needs space to work, park a car, eat and to meet other physical needs. Although the amount of

space, in terms of buildings or land, varies greatly between organisations, a minimum is always indispensable. This space is usually not very productive: it is the workers with the machines who produce, whereas the toilets, the canteens and the workplace are not directly involved in production.

The second source of minimum costs is the cost that each organisation has to make in terms of administrating a workforce: these costs comprise of both minimum capital and labour costs and are part of the overhead of an organisation, consisting of general administration costs, the minimum costs of managing and socialising workers, and the costs of maintaining a certain level of workforce. As wages and careers have to be filed, managed, and handled for every employee, these costs are proportional to the size of the workforce and are not very reducible.

The third source of fixed minimum costs arises out of the impossibility or impracticability of dividing capital goods amongst more than one employee. These are machines, computers, desks and other forms of capital inputs which are difficult to split up. Although employers do have a range of mixes between capital and labour to choose from and thus face a wide choice, even a bad worker does not use half a chair or a third of a typewriter. This observation was already used by Akerlof (1981) to show in a job-assignment model that some employees are unemployable, although the survey by Sattinger (1993) of assignment models shows that his example was not widely followed.

All three sources of minimum fixed costs are interpreted as minimum costs per period. In the remainder of this paper we focus on minimum capital costs, whereas labour inputs are interpreted as net-labour inputs, adjusted for its fixed labour costs. Capital goods in this context are not restricted to physical capital, but also represents human and social capital.

Standing alone, these minimum costs could not explain regional differences in unemployment. If we however consider the fact that many forms of capital are non-transferable and in fixed supply, at least in the short-term (land, infrastructure, social capital), then minimum cost requirements will create higher unemployment in areas of relative capital scarcities. Add to this the observation that these capital goods are not only production inputs, but also consumer goods and we will see that the price of these scarce non-transferable goods will increase with the existence of a high-productivity sector in the economy.

### **3 The model**

We develop a one-period, one-good, representative firm general equilibrium model with perfect competition and instant adjustment to changes. For simplicity, we only have labour and non-transferable capital goods as inputs.

#### **3.1 Production**

When we consider the total cost function of the productive sector of the economy, we must add a term for the fixed capital cost per period per worker:

$$Cost = TC = p_k(K_1 + ANd) + w(L) \quad (1)$$

$p_k$  stands for the price of capital,  $K_1$  stands for the variable amount of non-transferable capital that is used in production,  $Nd$  denotes the amount of persons in the potential workforce times the employment rate,  $A$  denotes the minimum capital constant,  $w(L)$  denotes the total wage costs of a given level of labour. Using as much of the neo-classical armoury as possible, we take as the production function a standard Cobb-Douglas, constant returns to scale function:

$$\begin{aligned} Q &= (K_1 + vANd)^\beta L^{1-\beta} \\ 0 &< v < 1 \end{aligned} \quad (2)$$

The variable  $v$  summarises our minimum costs argument as it is used to model the fact that the fixed capital costs per worker are neither a total write-off nor as productive as the variable capital costs. If  $v=1$  this would allow for the possibility that capital which is necessary for hiring a new employee can be used by another employee. As this would defeat the idea of minimum capital per worker,  $v$  represents the loss of flexibility that employers have in matching capital and other non-labour inputs to workers. If  $v=0$ , the minimum capital costs per worker are a total write-off. A second change with the traditional model we make at this point is in the variable  $L$ . As we allow for a heterogeneous workforce,  $L$  stands for the total amount of quality employed as a function of the fraction employed persons in the labour force ( $d$ ) and the distribution of quality over the labour force ( $f$ ):

$$L = N_w \frac{\int_{F^{-1}(1-d)}^{F^{-1}(1)} qf(q) dq}{d} \quad (3)$$

$F(q)$  represents the cumulative distribution function of labour quality<sup>2</sup>. (3) asserts that the total labour quality employed equals the number of people employed in the labour force ( $N_w$ ) times the average quality employed, whereby all the persons with quality greater than  $F^{-1}(1-d)$  are employed. Some definitions:

$$d = \frac{N_w}{N}$$

$K$  = total initial capital endowment

$$K = K_Q + K_c$$

$$K_Q = \text{capital used by firm} = K_1 + ANd$$

$$K_2 = \text{capital used in production} = K_1 + vANd = K - K_c - (1-v)ANd$$

$$K_c = \text{capital used in consumption}$$

$$\text{price of output} = 1$$

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<sup>2</sup>the analysis can include minimum labour costs by interpreting the worker's quality distribution as "adjusted-quality":

$q_i = q^*_i$  - minimum labour costs

whereby  $q^*_i$  stands for unadjusted labour quality, and where the minimum labour costs are a total write-off.

The price of output has been set to unity which allows us to interpret the economy as an open economy in which consumption goods are tradable without costs, but where the capital goods which we consider in this model are in fixed supply and not tradable. In order to insure that the results are non-trivial, the initial capital endowment has to be enough to be able to employ everyone:

$$\frac{K}{A} > N$$

The total profit function now reads:

$$\pi = \text{production} - \text{costs} = (K_1 + vANd)^\beta L^{1-\beta} - p_k(K_1 + ANd) - w(L) \quad (4)$$

The first order conditions for a competitive equilibrium are:

$$\frac{\partial \pi}{\partial K_1} = \beta \left(\frac{L}{K_2}\right)^{1-\beta} - p_k \quad (5)$$

$$\begin{aligned} \frac{\partial \pi}{\partial N_w} &= \frac{\partial \pi(K_Q)}{\partial K_Q} \frac{\partial K_Q}{\partial N_w} + \frac{\partial Q}{\partial L} \frac{\partial L}{\partial N_w} + \frac{\partial \pi}{\partial w} \frac{\partial w}{\partial N_w} \\ &= (v\beta \left(\frac{L}{K_2}\right)^{1-\beta} - p_k)A + (1-\beta) \left(\frac{K_2}{L}\right)^\beta F^{-1}(1-d) - \frac{\partial w}{\partial N_w} \end{aligned} \quad (6)$$

As profits must be zero under perfect competition, we insert  $p_k$  from (5) into (4) to give:

$$w(L) = K_2^\beta L^{1-\beta} - \beta \left(\frac{L}{K_2}\right)^{1-\beta} (K_2 + (1-v)ANd) \quad (7)$$

## 3.2 Consumption

Non-transferable goods are not only wanted as a production factor, but are also consumption goods. Some non-transferable goods, such as land, are even indispensable for living. As richer consumers will want more land, it follows that the costs of the non-transferable goods will rise if workers have more to spend, thereby increasing the costs of living for everybody and increasing the minimum amount of wages necessary to survive. As the capital goods are thus both inputs in production and consumer goods, we specify the utility of the representative consumer to be:

$$U = K_c^\alpha O^\gamma$$

Whereby O denotes the bundle of goods produced by the representative firm and individuals are assumed to always want to work. Given that total incomes from all sources must equal total costs of the firm plus the value of the capital goods sold directly to consumers, we can write  $K_C$  and O as:

$$K_c = \frac{\alpha}{\alpha + \gamma} \frac{TC + p_k K_c}{p_k} = \frac{\alpha}{\gamma} \frac{TC}{p_k}$$

and

$$O = \frac{\gamma(TC + p_k K_c)}{\alpha + \gamma} = TC$$

which indeed should hold trivially. With these equations we can derive some results.

### 3.3 Outcomes

First, we will compute the amount of capital used by firms in production from its definition :

$$K_2 = K - K_c - (1 - \nu)AN_w = K - \frac{\alpha TC}{\gamma p_k} - (1 - \nu)AN_w \quad (8)$$

If we insert TC and  $p_k$  into this expression and simplify, we get:

$$K_2 = K - \frac{\alpha p_k (K_1 + ANd) + (1 - \beta)K_2^\beta L^{1-\beta}}{\gamma \left(\frac{L}{K_2}\right)^{1-\beta}} - (1 - \nu)AN_w \quad (9)$$

which leads to

$$K_2 = \frac{K - \frac{\alpha + \gamma}{\gamma} (1 - \nu)AN_w}{1 + \frac{\alpha}{\gamma} \frac{1}{\beta}} \quad (10)$$

To see how much unemployment we get, we can say that if there is unemployment, the marginal wage rate has to be zero as that signifies the point at which workers will not be willing to work. If we take  $\frac{\partial w}{\partial N_w} = 0$ , insert  $p_k$ ,  $K_2$  and L into (6), we get as the total expression:

$$d = 1 - F \left\{ \frac{A(1 - \nu)\beta L}{(1 - \beta)K_2} \right\} = 1 - F \left\{ \frac{\left(1 + \frac{\alpha}{\gamma} \frac{1}{\beta}\right) A(1 - \nu)\beta N \int_{F^{-1}(1-d)}^{F^{-1}(1)} qf(q) dq}{(1 - \beta) \left(K - \frac{\alpha + \gamma}{\gamma} (1 - \nu)AN_w\right)} \right\} \quad (11)$$

The argument of F equals the minimum quality a person must have in order to get positive wages as below that he is unemployed. As both sides depend on d, this expression does not yield an easily manipulable solution for d. We can however immediately see that if there are persons with a quality near or at zero, there will always be some unemployment. We can also see that if L increases without an increase in N, which will occur if only the most productive workers become even more productive, that, Ceteris paribus, the minimum quality requirement to earn positive wages will go up. An increase in the relative skills of the highest productivity employees could be the interpretation of the skill-biased technological change which some authors have held responsible for diverging wages in the US and Europe (Katz and Murphy (1992), Krueger et al. (1993), Bound and Johnson (1992), Burtless (1995)). Thus an increase in the quality of only the most productive workers will not only mean diverging wages,

but also increasing unemployment and lower wages at the lower end of the labour market. This prediction nicely fits the empirical fact that real incomes for the bottom 50% of the income distribution have not increased much, or have even declined, for the US and Western Europe over the last 20 years, despite big rises in average earnings (O.E.C.D. 1996).

Another prediction arising from (11) is that the minimum quality requirement increases with the size of the population as both the numerator of the argument of F increases with N, and the denominator decreases with N (as  $N_w = Nd$ ). The argument of F is thus increasing in N, making unemployment also increasing in N. An increase in population thus increases the number of unemployed if the quality distribution remains constant.

To gain some insight as to the importance of the distribution of quality, we will take f to be the uniform distribution (a,b) with the lowest quality being a and the highest being b. This makes:

$$L = dNb - d^2 \left( \frac{N(b-a)}{2} \right) = N_w b - d \frac{N_w(b-a)}{2} \quad (12)$$

$$\frac{\partial L}{\partial N_w} = b - d(b-a) > 0$$

If we insert this into (6) we get:

$$\frac{\partial w}{\partial N_w} = (v-1)A\beta \frac{(dNb - d^2 \left( \frac{N(b-a)}{2} \right)) \left( 1 + \frac{\alpha}{\gamma} \frac{1}{\beta} \right)}{K - \frac{\alpha+\gamma}{\gamma} (1-v)AdN} + (1-\beta)(b-d(b-a)) \quad (13)$$

If there is going to be unemployment, then there must hold that at  $d=1$ ,  $\frac{\delta w}{\delta N_w} < 0$  as an extra worker will have to pay to be employed. This occurs if:

$$0 > (v-1)A\beta \frac{\frac{N(b+a)}{2} \left( 1 + \frac{\alpha}{\gamma} \frac{1}{\beta} \right)}{K - \frac{\alpha+\gamma}{\gamma} (1-v)AN} + (1-\beta)a \quad (14)$$

After manipulations, we see that unemployment occurs if:

$$K < \frac{b+a}{a} \frac{\beta + \frac{\alpha}{\gamma} (1-v)AN}{1-\beta} + \frac{\alpha+\gamma}{\gamma} (1-v)AN \quad (15)$$

Thus we have hereby shown that the occurrence of unemployment due to minimum costs can be induced by:

1. an increase in the size of the population (N)
2. an increase in the capital intensity of the production process ( $\beta$ )<sup>3</sup>

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<sup>3</sup>capital in comparative statics: we can see directly from equation (11) that more capital means less unemployment. Perhaps the densely populated areas of Europe and Japan (where a large percentage of the area is too mountainous to build on, thus creating very expensive urban areas) belong to the capital scarce areas, relative to the USA or Canada.

3. an increase in the importance of non-transferable capital goods for consumption  $(\frac{\alpha}{\gamma})$
4. an increase in the minimum capital costs per worker (A)
5. an increase in the relative productivity of the most productive members of the labour force  $(\frac{b+a}{a})$

Though results 1-4 are intuitively clear and can also be seen from (11), the last one is the most insightful for policy reasons: if there is an increase in the productivity of the highest productive members of the economy, i.e., an increase in  $b$ , then it becomes optimal for firms to sack their less productive workers and combine the scarce non-transferable capital goods with these higher productivity workers. Thus an increase, or even the existence of, a high-productivity sector in an economy will increase the minimum productivity necessary to obtain positive wages. What are the policy implications?

### 3.4 Policy implications

#### 3.4.1 The costs of living

If we want to see how much one would minimally have to spend in this economy to avoid dire poverty (starvation coupled with negative externalities such as being unable to invest in future generation and human suffering), we have to calculate the minimum amount of money needed to obtain a minimum utility level. Applying standard techniques, the minimum costs to reach  $U_{\min}$  are:

$$m(p_k, U_{\min}) = \left[ \left( \frac{\alpha}{\gamma} \right)^{\frac{\gamma}{\alpha+\gamma}} + \left( \frac{\alpha}{\gamma} \right)^{\frac{-\alpha}{\alpha+\gamma}} \right] p_k U_{\min}^{\frac{1}{\alpha+\gamma}} \quad (16)$$

As this is increasing in  $p_k$ , all the factors that make non-transferable capital goods more expensive, will increase the minimum amount of income needed to avoid poverty. If we compute  $p_k$  from (5), we get:

$$p_k = \beta \left( \frac{L}{K_2} \right)^{1-\beta} = \beta \left( \frac{1 + \frac{\alpha}{\gamma} \frac{1}{\beta}}{K - \frac{\alpha+\gamma}{\gamma} (1-\nu) ANd} \right)^{1-\beta} (dNb - d^2 \left( \frac{N(b-a)}{2} \right))^{1-\beta} \quad (17)$$

Thus the minimum costs of avoiding poverty increase with population size and decrease in the stock of available non-transferable capital good, holding all else constant. Because of this increase in the price of capital, an increase in  $N$  or a decrease in  $K$  will also increase the minimum productivity needed to obtain positive wages (eq. 11), and will thus increase unemployment. Lastly, an increase in  $N$  or a decrease in  $K$  will lower wage earnings (eq.7).

For workers, an increase in the size of the population is thus a triple edged blade as they will face higher unemployment, lower wages and higher prices.

### 3.4.2 What could a government interested in lowering unemployment do?

Within this model a benevolent government can influence three variables: K, N, and the quality distribution of the labour force. Increasing K may or may not be an option, depending on the ability of a government to increase the outstanding stock of non-transferable fixed-supply capital goods by for instance reclaiming land from the sea or trying to influence the stock of social or entrepreneurial talent.

Decreasing N or decreasing the increase in N via family or migration policies may also be an option which will decrease unemployment in this model.

A government may be able to influence the quality differences between workers via education. From (15) we saw that unemployment will occur sooner if  $\frac{b+a}{a}$  increased. The policy implication of this is that a government interested in reducing unemployment should reduce the relative difference between the lowest quality workers, and the highest quality workers. This can be done in many ways. Firstly, there is the possibility of reducing the quality of the highest-productivity workers, which will decrease total output and reduce unemployment. Secondly, one can increase the quality of the lowest productivity workers. Thirdly, one can increase both the highest quality and the lowest quality whilst raising the relative productivity of the least productive workers. To illustrate this last possibility, we assume that a high level of general education for all workers will shift the quality of all workers upwards by an equal amount: both a and b increase by a fixed amount e:  $a^*=a+e$  and  $b^*=a+e$

Because  $\frac{b^*+a^*}{a^*} = \frac{b+e+a+e}{a+e} < \frac{b+a}{a}$ , equation (15) shows us that unemployment will occur later as a result of an equal increase in the quality of all workers.

## 4 Conclusions and discussion points

One of the predictions of standard general equilibrium models is that if only wage rates were perfectly flexible, the markets would clear and all those now unemployed would find jobs. The model in section 1 has tried to demonstrate that where a minimum amount of social, human, or physical capital is needed per worker per period, workers may never attain the productivity necessary to pay back for this. If, in addition, a worker finds himself in a region with relatively low amounts of non-transferable capital and with many highly productive workers around him, these two effects combine to raise the minimum productivity the worker must attain to get any income at all.

A similar mechanism will also apply for the consumption-side of the economy: non-transferable capital goods such as land and organisational talent are not only production inputs but also indispensable consumer goods. The greater the overall demand for these goods from producers *and* consumers, the higher the price of these goods will be, thereby raising the costs of hiring workers and the minimum costs of surviving (via costs of these capital-and-consumption goods). In the situation where there are a number of high-income consumers or producers, the minimum amount of money one needs to survive in an area will thus be higher than in the situation where there are less affluent consumers and productive firms. Indeed, the costs of food and shelter are higher in both the USA and Europe than, say, in rural Africa, where there are fewer productive consumers and producers to drive up the price of land, goods and services. I would thus argue that however low the wages for unskilled workers might become in Western Europe, the workers there can never expect to be able to compete for the same jobs with workers in countries with much cheaper living costs (such as, at present, Indonesia or China). In essence the low-skilled European workers are handicapped by the presence of high-skilled and high-waged European workers who not only increase the minimum productivity they must attain to get any wage at all, but also increase the amount of wages they need to survive. The policy implication would be that one should either increase the amount of capital available (e.g. by reclaiming land), decrease the size of the population or reduce the relative quality differences between workers.

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