Are Intellectual Property Rights Unfair ?[1]

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ABSTRACT: If redistribution is distortionary, and if the income of skilled workers is due to knowledge-intensive activities and depends positively on intellectual property, a social planner which cares about income distribution may in principle want to use a reduction in Intellectual Property Rights (IPRs) rather than redistributive transfers. On the one hand, such a reduction reduces statis inefficiency. On the other hand, standard redistribution also reduces the level of R and D because it distorts occupational choice. We study this possibility in the context of a model with horizontal innovation, where the government, in addition to taxes and transfers, controls the fraction of innovations that are granted patents. The model predicts that standard redistribution always dominates limitations to IPRs.

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1 Introduction

Modern societies are gradually evolving toward a situation where knowledge is a much more important economic asset than physical capital. Accordingly, while distributive conflict in the nineteenth century was chiefly between workers and owners of physical capital, it is increasingly between unskilled workers and skilled workers who produce knowledge. The richest man in the world, Bill Gates, made a fortune out of the knowledge-intensive goods he produced, and some authors see the gap between "symbol manipulators" and other workers as critical to modern economies.[1] In the nineteenth century, defenders of the "working class" were often advocating a reconsideration of property rights on physical capital, which led to the socialist and communist doctrines. Similarly, we now witness complaints about intellectual property rights (IPRs). Given that they tend to increase the income of knowledge producers such as Bill Gates, aren't they a factor of inequality? Wouldn't it be fairer to put limitations on IPRs, which would reduce the income of very rich people while allowing poorer people to consume knowledge-intensive goods at a cheaper price? From a global perspective, this argument is compounded by the observation that poor countries do not seem to afford important goods such as drugs because their price is too high, due to the monopoly power of the patent's owner.

The economist's standard answer to these arguments would a priori look as follows: there is a dichotomy between distributive concerns and efficiency. The former are best taken into account by means of taxes and transfers. IPRs, on the other hand, make sure that innovation is remunerated. Even under infinitely-lived, perfectly enforceable patents, there are reasons to believe that the private return to innovation is too low–since part of the social return is appropriated by inframarginal consumers. Therefore, let us not touch IPRs, but instead redistribute money to the poor.

This argument seems valid provided redistribution is not distortionary.

[1] Reich (1992).

However, non distortionary redistribution only exists on paper. In practice, if the rich's income is derived from IPRs, we expect redistribution from rich to poor to affect occupational choice and reduce the overall level of innovation, just like limitations on IPRs. As long as there is a cost of acquiring human capital in order to specialize in knowledge production, a reduction in the income gap between knowledge producers and knowledge consumers will negatively affect the return to that investment.

This brings the following question: if redistribution has such distortionary effects, could we consider limitations to IPR as an alternative redistributive tool? Such limitations do not increase the poor's nominal income. But they increase their real income by making goods cheaper. In other words, they reduce the static inefficiency due to monopoly power, which benefits workers whenever their income is not indexed on IPRs. They also reduce the wages of knowledge workers, that are directly indexed on the monopoly rents associated with patents, and thus they reduce innovation, but so does redistribution, which has no effect on static efficiency.

Thus a social planner which cares about income distribution may in principle want to use a reduction in IPRs rather than redistributive transfers, which seems to vindicate the arguments of those who object to intellectual property.

In this paper, I build a simple model of horizontal innovation in the fashion of Dixit and Stiglitz (1977), Romer (1990), and Grossman and Helpman (1991) with heterogeneous workers and imperfect enforcement of IPRs, in order to analyze whether this intuition is valid. Using numerical simulations, I look at the effects of both redistribution and limits to IPR on innovation, occupational choice, income distribution, and welfare. While intellectual property is clearly inegalitarian, this is much more because it benefits the rich rather than because it harms the poor. In the model, reducing it does not increase welfare. For all relevant parameters that were tried, the model predicts that the optimal level of IPR enforcement is the maximum one. Therefore, despite the adverse effect of redistribution on innovation, the traditional economist's view is confirmed: redistribution always dominates restrictions to IPRs.

The explanation is as follows. While restricted IPRs reduce goods prices, they also reduce product variety. For monopoly pricing to reduce welfare by enough, it must be that there is enough complementarity between goods that are patented and priced at a monopoly markup, and goods that are not patented and priced at marginal cost. Otherwise, people will largely substitute the latter for the former, and monopoly pricing is not very harmful. However, complementarity between goods also means that product diversity is more valued, so that at all parameter values the effect of reduced diversity slightly dominates that of reduced monopoly power. This makes it impossible for limitations to IPR to increase welfare, while redistribution may achieve that goal if the social planner cares enough about inequality, since it directly increases the poor's purchasing power.

2 The model

The model combines a Roy (1951)-style model of occupational choice with a Dixit-Stiglitz (1977)-style model of endogenous product variety. There exists a continuum of workers of mass 1. Each worker has a skill level equal to s, which is distributed over $[0, \bar{s}]$ with density $f(s)$. Skills determine two dimensions of productivity: "productivity" stricto sensu, and "creativity". The former refers to the worker's productivity in the physical output sector, while the latter refers to his productivity in the R and D sector, which invents the goods. Both are increasing functions of skill, but with different sensitivities. Specifically we assume that a worker of skill s has a productivity equal to

$$l = \alpha_L s + \beta_L,$$

and a creativity equal to

$$h = \alpha_H s + \beta_H.$$

The economy lasts for two periods, and there are two sectors: output and R and D. In period 1 the R and D sector operates and invents N goods. In order to invent one good it needs ρ units of creativity. Denoting by H the total amount of creativity used by the R and D sector in period 1, we have

$$N = H/\rho. \tag{1}$$

The R and D sector hires workers who supply creativity and promises to pay a competitive wage equal to ω_H per unit of creativity in period 2. Workers who have worked in the R and D sector in period 1 cannot work in the output sector in period 2. Finally, working in the R and D sector involves a training cost e per worker.

In period 2, the output sector operates, employing all the workers who have not worked in period 1, and who supply productivity. Wages are paid to all workers and consumption takes place. The output sector consists of a continuum of invented goods of total mass N, indexed by i, plus a "numeraire" called m. The production function for any of these goods has constant returns to scale in labor and a unit productivity: $y_i = l_i$, $y_m = l_m$, etc. For simplicity we assume that the training cost is only paid in period 2, and is specified in terms of the numeraire.

People have the same utility function, given by

$$U = \int_0^N c_i^\gamma di + m^\gamma,$$

where c_i is consumption of good i and m is consumption of the numéraire.

An invented good has a probability q of being granted a patent, in which case it is "proprietary" and charged at monopoly price; otherwise, it is "non proprietary" and charged at marginal cost. The numéraire is non proprietary. q captures the degree of intellectual property protection. Given preferences, the markup for patented goods will be equal to $\mu = 1/\gamma$.

We normalize the price of the numéraire to 1. This implies that the wage per unit of productivity must be equal to $\omega_L = 1$. Consequently, all patented goods are charged at price μ, while non patented goods are charged at price 1. By symmetry, consumption of each patented good is the same, equal to c_P, while consumption of each non patented good is the same, equal to c_N.[2] c_P, c_N and m are therefore determined by maximization of

$$Nqc_P^\gamma + N(1-q)c_N^\gamma + m^\gamma,$$

subject to the budget constraint

$$Nq\mu c_P + N(1-q)c_N + m = y,$$

where y denotes the consumer's income (net of training costs). The solution to this problem is

$$m = c_N = \frac{y}{\psi}$$

$$c_P = \frac{y}{\psi}\mu^{1/(\gamma-1)} < c_N$$

where ψ is given by

$$\psi = 1 + N(1-q) + Nq\mu^{\frac{\gamma}{\gamma-1}} \tag{2}$$

The resulting indirect utility can be computed as

$$U(y) = y^\gamma \psi^{1-\gamma}. \tag{3}$$

The aggregator ψ captures the hedonic value of income when expressed in terms of the numéraire. In particular, one has $\partial\psi/\partial N > 0$, capturing the taste for diversity, and $\partial\psi/\partial q < 0$, which captures the utility loss of consuming goods charged at monopoly prices.

[2] See also Saint-Paul (2001a) for the growth implications of a coexistence between proprietary and non proprietary goods.

The preceding analysis implies that the value of a patent, which is equal to the monopoly profit for the corresponding proprietary good, is equal to

$$\pi = (\mu - 1)Y\mu^{1/(\gamma-1)}/\psi, \tag{4}$$

where Y is aggregate income (net of training costs). Let us denote by ω_H the wage of a unit of creativity. Under a competitive labor market, the expected profit from inventing a new good must be equal to its cost in terms of creativity, i.e.

$$q\pi = \rho\omega_H.$$

The LHS is the product of the probability that the good gets patented, times monopoly profits. The RHS is the cost of inventing one blueprint. Substituting (4), we find that this is equivalent to

$$q(\mu - 1)Y\mu^{1/(\gamma-1)}/(\psi\rho) = \omega_H. \tag{5}$$

We now describe occupational choice and the redistributive system. We assume the government levies a proportional tax τ on labor income and pays a transfer T to each worker. We also assume that training costs are not observable and cannot be deducted from taxable income (otherwise this tax system would not distort occupational choice). How does that affect occupational choice? If a worker of skill s decides to work in the knowledge sector, he gets a net income equal to

$$\omega_H(1-\tau)(\alpha_H s + \beta_H) + T - e.$$

If he decides to become a production worker, he gets

$$(1-\tau)(\alpha_L s + \beta_L) + T.$$

A worker chooses the occupation which gives him the maximum disposable income, implying that his net income will be

$$y(s) = \max(\omega_H(1-\tau)(\alpha_H s + \beta_H) + T - e, (1-\tau)(\alpha_L s + \beta_L) + T). \tag{6}$$

Consequently, occupational choice is as follows: if $\omega_H > \alpha_L/\alpha_H$, which is the case of interest, then the worker elects to work in the R and D sector if and only if his skill is greater than

$$s^* = \frac{\beta_L - \omega_H\beta_H}{\omega_H\alpha_H - \alpha_L} + \frac{e}{(1-\tau)(\omega_H\alpha_H - \omega_L)} \tag{7}$$

Figure 1 illustrates the determinants of occupational choice and income distribution, by plotting income against the skill level. Knowledge workers have a greater return to skill; inequality is greater, the greater the wage of creativity ω_H. Controlling for Y and N, an increase in intellectiual property rights q raises inequality by raising the return to creativity (since q/ψ is increasing in q), as illustrated on figure 2. This triggers an increase in the number of creative workers as s^* falls. Conversely, an increase in redistributive taxes τ reduces the net return to creativity and the number of knowledge workers, as illustrated on figure 3.

Given s^*, the total supply of productivity and creativity is determined by

$$H = H(\omega_H, \tau) = \int_{s^*}^{\bar{s}} (\alpha_H s + \beta_H) f(s) ds \tag{8}$$

$$L = L(\omega_H, \tau) = \int_0^{s^*} (\alpha_L s + \beta_L) f(s) ds. \tag{9}$$

If $\omega_H < \alpha_L/\alpha_H$, then the workers with skills lower than s^* will typically specialize in knowledge. Note that s^* will then often be negative, implying that all workers will specialize in production. In any case, we rule out this regime in the simulations presented below–if skilled workers could costlessly work as unskilled, this regime would actually disappear.

Net output Y is determined by writing down that it is equal to total factor income minus training costs:

$$Y = \omega_H H + L - e(1 - F(s^*)), \tag{10}$$

or equivalently by using the equilibrium condition for the raw labor market:

$$L = e(1 - F(s^*)) + \frac{(1 + N(1-q))Y}{\psi} + \frac{NqY\mu^{1/(\gamma-1)}}{\psi}. \tag{11}$$

The first term in the RHS is labor demand coming from the numeraire dissipated in training costs; the second term comes from the consumer demand for the numéraire and non proprietary goods; the third term comes from the consumer demand for proprietary goods. Using (1) (which is nothing but the equilibrium condition in the market for creativity), one can show that if two equations in (5)-(11) are satisfied, so is the third one.

The model is then solved by using (2),(1),(5),(7),(8),(9),(10/11), which jointly determine the endogenous variables $N, H, L, Y, \omega_H, s^*, \psi$. The level of transfer T is then residually computed using the government's budget constraint, given by

$$\begin{aligned} T &= \tau \int_0^{s^*} (\alpha_L s + \beta_L) f(s) ds + \tau \omega_H \int_{s^*}^{\bar{s}} (\alpha_H s + \beta_H) f(s) ds \\ &= \tau(\omega_H H + L) = \tau(Y + e(1 - F(s^*))). \end{aligned}$$

3 Welfare

We now introduce the social planner's welfare function. We assume that it cares about output and inequality, and we allow for it to care more about inequality than a purely utilitarian planner, which would care about it entirely through the concavity in the agents' own utility. Thus we assume that the social planner maximizes a CES aggregate of each individual agent's utility, renormalized in order to be linear in income. Specifically, if $U(s)$ is the utility of an agent of skill s, as defined by (3), then social welfare is given by

$$SW = \left[\int U(s)^{\varepsilon/\gamma} \right]^{1/\varepsilon}.$$

If $\varepsilon = \gamma$, then the social planner is utilitarian; if $\varepsilon < \gamma$, then the social planner displays more inequality aversion than the utilitarian social planner– in fact, (3) implies that $SW = (1 - ATK).Y\psi^{(1-\gamma)/\gamma}$, where ATK is the Atkinson (1970) measure of inequality with an inequality aversion equal to ε. Consequently, for $\varepsilon = 1$ social welfare is just equal to output, adjusted by a factor $\psi^{(1-\gamma)/\gamma}$ to express it in hedonic terms. The utilitarian case obtains when inequality aversion is just equal to individual risk aversion.

Substituting (3) and (6), we get that

$$SW = \psi^{\frac{1-\gamma}{\gamma}} \left[\begin{array}{c} \int_0^{s^*} ((1-\tau)(\alpha_L s + \beta_L) + T)^{\varepsilon} f(s) ds \\ + \int_{s^*}^{\bar{s}} (\omega_H (1-\tau)(\alpha_H s + \beta_H) + T - e)^{\varepsilon} f(s) ds \end{array} \right]^{1/\varepsilon}$$

For clarity, it is useful to keep in mind a certain number of thought experiments. First, an increase in N, holding all else constant, raises social welfare by increasing the hedonic index ψ : one unit of numéraire buys more happiness because it can be spread over a greater variety of goods. Second, a reduction in q, holding all else constant, also increases social welfare through ψ : one unit of numéraire buys more goods, as more of them are nonproprietary and thus cheaper. Third, income redistribution from rich to poor, holding Y, and ψ constant, also increases social welfare because of inequality aversion.

Consequently, an increase in τ has a direct positive effect on social welfare because of that redistribution. However, it typically reduces N and thus ψ. The poor benefit from a greater income but can spend it on fewer goods. Consider now a reduction in q, the degree of IPRs. It typically reduces ω_H, the income of knowledge workers, while leaving the income of production workers (in terms of the numéraire) unchanged. At the same time, ψ may either go up or down depending upon whether or not the effect of price reductions dominates the effect of having fewer varieties. If ψ goes down, then there is no way a reduction in q can increase social welfare. On the other hand, if it goes up, then it benefits the poorest, and likely harms the richest (as long as the increase in ψ is not enough to compensate them for the fall in ω_H). In this case it is more likely to increase welfare, the more the social planner cares about inequality, i.e. the lower ε. Thus a necessary condition for reduction in IPRs to increase social welfare is that the hedonic value of one unit of the numéraire, ψ, goes up.

4 Numerical simulation results

We now report the numerical simulation results from the model. We start from a benchmark simulation with the following parameters: $\gamma = 0.8, \rho = 0.02, q = 1, e = 0.2, \alpha_L = 0, \alpha_H = 3, \beta_L = 0.3, \beta_H = 0, \tau = 0$, and s uniformly distributed over $[0, \bar{s}]$, with $\bar{s} = 10$. This benchmark simulation implies $s^* = 8.91$, i.e. a 10 % share of intellectual workers, and an "inequality index", defined by the ratio between the highest and the lowest wage, equal to 1.94.

We first ask the question: can a reduction in IPRs be desirable? As we have seen, in order to be so it must be that ψ rises. Thus we start by looking at the effect of q on ψ. As Table 1 makes clear, lower IPRs reduce ψ, and this is robust to changes in γ. While these reductions reduce the number of goods by a substantial amount (Table 2), they turn out to have only moderate effects on inequality (Table 3).

$\gamma \backslash q$	1	0.9	0.8	0.5
0.8	64.0	61.3	54.8	31.4
0.5	177.2	166.9	150.9	107.1
0.3	279.2	259.7	239.7	160.4

Table 1 – Impact of intellectual property on the hedonic index ψ for various values of γ

$\gamma \backslash q$	1	0.9	0.8	0.5
0.8	10.8	9.0	7.0	2.9
0.5	27.1	22.7	18.3	9.9
0.3	38.5	32.3	27.2	14.3

Table 2 – Share of researchers (%)

$\gamma \backslash q$	1	0.9	0.8	0.5
0.8	1.94	1.9	1.86	1.78
0.5	2.36	2.22	2.11	1.91
0.3	2.77	2.53	2.36	2.01

Table 3 – Inequality index

Thus, the prospects for reductions in IPR to be beneficial seem quite bleak. Is that robust across a wide range of parameter values? To check that, I have run a large number of computer simulations, with 9 values of γ ranging from 0.1 to 0.9, 20 values of ρ ranging from 0.01 to 0.2, 10 values of e ranging from 0.02 to 0.2, 10 values for each of the α and β parameters ranging from 0.1 to 1, four values of τ, and 5 values of q from 0.6 to 1. Simulations yielding near-zero innovation were eliminated. Of the remaining 880,000 simulations, a reduction in q increased ψ in only 29 cases, and they seem to be numerical problems in zones where $\omega_H \alpha_H \approx \alpha_L$, i.e. one is close to switching from the normal regime to the "reverse" one where the poorest would like to specialize in knowledge.

To conclude, the model quite clearly conveys the message that reductions in IPR are unlikely to be an appropriate redistributive tool.

Finally, Table 4 looks at the effects of fiscal redistribution on the number of goods, pre- and post-tax inequality, and welfare. It does not seem to go very far either: The simulation predicts that an increase in τ increases welfare over some zone, but its optimal value remains equal to zero even at a high level of inequality aversion. This is due to the fact that researchers are a relatively small share of the population, and while taxing them reduces their income and the number of goods, it does not achieve much in terms of redistribution. It is easy to get a greater impact of fiscal redistribution by assuming a positive value of α_L, but then most of its welfare effects come from redistribution *among* production workers, rather than between them and knowledge workers. Another possibility is to assume a larger fraction of researchers, as is the case for γ smaller. One obtains positive effects of τ on welfare for a high enough level of inequality aversion. For example for $\gamma = 0.3$ and $\varepsilon = -5$, the optimal value of τ is 0.5. However, the associated share of knowledge workers sounds large.

To conclude, it is virtually never optimal to reduce IPRs. Standard redistribution is optimal for a wide range of parameter values, but for many parameters its cost in terms of reduced innovation is actually greater than its benefits.

τ	N	I_0	I_1	$SW_{0.5}$	$SW_{-1.2}$	SW_{-5}
0	332	1.96	1.96	1.072	1.07	1.067
0.1	299	2.01	1.9	1.052	1.05	1.048
0.2	290	2.11	1.86	1.052	1.05	1.049
0.3	291	2.24	1.83	1.066	1.065	1.064
0.4	265	2.39	1.79	1.053	1.05	1.051

Table 4–Effect of redistributive taxation on the number of goods, pre-tax ratio between highest and lowest wage (I_0), post-tax ratio, post-transfer ratio between highest and lowest income (I_1), and social welfare for $\varepsilon = 0.5, -1.2, -5$.

5 The inelastic case

An objection to the preceding analysis is that it rests on the assumption of a uniform distribution of skills. Clearly, by changing that distribution in such a way that the marginal density of workers around the critical threshold s^* is small enough, one can construct examples where the cost of a reduction in IPRs in terms of innovation is arbitrarily small. One may, for example, consider the extreme case where there are only two skill levels. As long as the most skilled strictly prefer to work as knowledge workers, a reduction in IPRs does not affect innovation and clearly benefits the least skilled, whose purchasing power is enhanced by the associated reduction in the aggregate price level. However, this does not settle the case for lowering IPRs as a redistributive tool: One has to prove that reduced IPRs are preferable to fiscal transfers; and it is also true that the lower the density of marginal workers, the lower the distortionary impact of redistribution on occupational choice.

To analyze that, note that it is straightforward to solve the model recursively in the case of two skill levels, denoted by $i = 1, 2$. Let f be the proportion of group 1, l_i be the labor endowment of an individual in group i and h_i his creativity endowment. Let us assume $h_1 = 0$; one must also have

$l_2 \geq l_1$. Total population remains normalized to one. In the regime where all skilled workers are specialized in knowledge production, one has

$$N = (1-f)h_2/\rho;$$

$$\psi = 1 + (1-f)h_2(1-q)/\rho + (1-f)h_2 q \mu^{\frac{\gamma}{\gamma-1}}/\rho.$$

Equations (5) and (10) allow to compute total GDP and the wage of creativity:

$$Y = \frac{\psi\rho\left(fl_1 - e(1-f)\right)}{\rho + qh_2(1-f)\mu^{1/(\gamma-1)} + (1-q)h_2(1-f)}$$

$$\omega_H = \frac{q(\mu-1)\mu^{1/(\gamma-1)}\left(fl_1 - e(1-f)\right)}{\rho + qh_2(1-f)\mu^{1/(\gamma-1)} + (1-q)h_2(1-f)} \tag{12}$$

The regime prevails if and only if

$$\omega_H h_2(1-\tau) - e \geq l_2(1-\tau) \tag{13}$$

Suppose equation (13) holds with strict inequality. Then, one may reduce q without any effect on innovation. Such a reduction increases ψ, and thus unambiguously benefits the poor. [3] Such a reduction in IPRs may proceed until one reaches a frontier where (13) holds with equality. For $\tau = 0$, this defines a benchmark level of q, $\tilde{q}$, such that the part of intellectual property

[3] One may also believe aggregate welfare has to go up, since the price distortion is reduced. However, that intuition is incorrect. The price distortion may actually be increased, because it depends on the relative number of proprietary and non proprietary goods. If all goods (including the numéraire) were proprietary, then they would be charged at the same price, and there would not be any relative price distortion. The same holds if all goods are non proprietary. Intermediate situations are more inefficient than these two extremes. If leisure enters the utility function, then IPRs create another distortion because they push down real wages, thus reducing labor supply. In such a case a situation where all goods are proprietary involves greater distortions than one where they are all non proprietary, although depending on the elasticity of labor supply it may still dominate intermediate situations. In the present case, however, the two extremes are equivalent, implying that nonmonotonicity of aggregate output (in hedonic terms) with respect to q cannot be ruled out.

which does not incentivate innovation has been eliminated. The frontier is upward sloping (Figure 4) and given by the equation:

$$\tau = \frac{\omega_H h_2 - l_2 - e}{\omega_H h_2 - l_2}, \tag{14}$$

where ω_H depends on q via (12).

From the situation where $q = \tilde{q}$ and $\tau = 0$, one may consider moving along the frontier, by increasing IPRs and redistributive taxation at the same time. Alternatively, one could move beyond the frontier and accept a reduction in innovation—this would bring us back to the previous section's analysis (with an infinite response of occupational choice to noncompensated increases in τ or reductions in q), so I will not consider that possibility. Finally, one can further reduce q while remaining on the frontier, but in that case one has to engage in counter-redistribution by setting τ at a negative level.

This brings us to the key question: what is the point that a social planner would select on the frontier? In particular, is one likely to select greater or smaller levels of intellectual property if one cares more about the poor?

To answer that question I have again run a variety of numerical simulations.[4] Parameters were set in such a way that $\tilde{q} = 0.5$. For each set of

[4] The grid of parameters that were simulated was as follows. h_2 was allowed to vary between 0.2 and 2, with a step of 0.2.α varies between 0.3 and 0.9, with a step of 0.1.c varies between 0.0005 and 0.005, with a step of 0.0005. l_1 varies between 0.1 and 2, with a step of 0.1. l_2 varies between l_1 and $2l_1$, with a step of $0.2l_1$. h_1 remains equal to zero. For any set of the previously defined parameters, one can compute $f_{\min}$, the minimal value of f compatible with $\tilde{q} = 0.5$ for some $\rho \geq 0$. This value is given by

$$f_{\min} = \frac{1 + \mu^{1/(\alpha-1)} + (\mu - 1)\mu^{1/(\alpha-1)} c/(l_2 + c)}{1 + \mu^{1/(\alpha-1)} + (\mu - 1)\mu^{1/(\alpha-1)}(l_1 + c)/(l_2 + c)}.$$

One then uses the values of f between $f_{\min}$ and 1, with a step of 0.01. Finally, ρ is defined residually to guarantee that $\tilde{q} = 0.5$, i.e.

$$\rho = \frac{0.5(\mu - 1)\mu^{1/(\alpha-1)}(fl_1 - c(1 - f))h_2}{l_2 + c} - 0.5h_2(1 - f)(1 + \mu^{1/(\alpha-1)}).$$

For each set of parameters, one computes the value of q which maximizes the utility of the unskilled, as given by

$$U_{POOR} = (l_1(1 - \tau) + T)^\alpha \psi^{1-\alpha},$$

parameters the values of q along the frontier which maximize (i) the utility of the poor U_{POOR}, denoted by q_1^*; and (ii) the hedonic value of aggregate GDP $Y' = Y^{\gamma}\psi^{1-\gamma}$, denoted by q_2^*, have been computed.

The message is slightly different from the one in the previous section: the optimal levels of IPRs do not appear to be very much above the minimum value of 0.5. This is due to the fact that a slight increase in q allows the social planner to afford quite a deal of redistribution, i.e. the frontier is quite steep. For example, across 626,000 simulations, the average value of q_1^* is 0.63, and the corresponding average value of τ is 0.7. Clearly, there is not much need to go beyond that.

That the optimal level of IPRs is substantially below 1 essentially comes from the strong inelasticity of occupational choice, which has been calibrated so as to allow to take out as much as 50 % of potential intellectual property without reducing innovation. This could have been calibrated at any other level, and therefore is not an important feature of the results. The important feature, which fully confirms the insights of the previous section, is that a social planner who maximizes Y' will actually choose a *lower* level of intellectual protection, and thus a *lower* tax rate, than one who maximizes U_{POOR}. Thus, the average of q_2^* is equal to 0.56 across all simulations, and the average corresponding tax rate is 0.14. In *all* the 626,000 parameter sets, q_1^* is greater than q_2^*.

To summarize, caring about inequality is not an argument for reducing IPRs. In this section's version of the model, inelastic labor response allows a large reduction in q. But a government which cares more about inequality will actually prefer a higher level of IPRs, because it allows to achieve much greater redistribution, which helps the poor more.

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where τ is defined by the frontier (12) and T is the corresponding transfer given by $T = \tau(Y + c(1-f))$.

Similarly, one computes the value of q which maximizes the hedonic value of aggregate output, $Y^{\alpha}\psi^{1-\alpha}$.

These optimal values of q were computed by grid search with a step of 0.1 for q between 0.5 and 1.

6 Beyond isoelastic preferences

The preceding analysis yields a clear-cut advice: Do not reduce intellectual property rights on the basis of distributional concerns. Address these concerns with traditional fiscal instruments.

One important characteristic of the model, is that all agents are "equally" sensitive to changes in diversity, because of their isoelastic preferences. This implies that in the social welfare function, which is itself isoelastic, there is a separability between income distribution, on the one hand, and the welfare effects of IPR and product diversity, on the other hand. These factors increase social welfare if and only if they uniformly increase utility for all agents.

Can one get out of this separability, and consider a case where IPRs will differentially affect the agents of different income levels?[5] For example, a lower degree of product diversity could harm the poor proportionately less than the rich. A priori, one might think that in such a situation, the case for IPRs restrictions should be enhanced.

In this section I establish a result which indeed goes in that direction. One can show that under a plausible property of the utility function, poorer agents are more likely to gain from a a policy move which increases q and reduces N than richer agents.

To see this, assume that utility is now given by

$$U = \int_0^N u(c_i)di + u(m). \tag{15}$$

Assume again that there are Nq proprietary goods, sold at price $\mu > 1$, and $N(1-q)+1$ nonproprietary ones (including the numéraire), sold at a unit price. Call $\eta(c) = cu'(c)/u(c)$ the elasticity of utility with respect to consumption. Consider a policy change such that $dq < 0$ and $dN < 0$. Then the following holds:

[5] Non isoelastic preferences yield a rich set of predictions regarding income distribution and innovation. See Saint-Paul (2001b), and Foellmi and Zweimuller (2002)

THEOREM – Assume $\eta(.)$ is increasing with c. Consider a marginal change in q and N such that $dq < 0$ and $dN < 0$ and μ is held constant. Then the poor are more likely to benefit from it than the rich, in the sense that if an individual with income y gains, then any individual with income $y' \leq y$ gains.

PROOF – The consumer's optimization problem boils down to

$$\max \ (1 + N(1 - q))u(c_{NP}) + Nqu(c_P),$$

subject to

$$\mu N q c_P + (N(1 - q) + 1)c_{NP} \leq y. \tag{16}$$

Consequently, calling $R(c) = u(c) - cu'(c)$ the consumer's 'rent' from consuming any given good, we have that

$$\frac{\partial U}{\partial N} = R(c_{NP}) - q(R(c_{NP}) - R(c_P)) \tag{17}$$

$$\frac{\partial U}{\partial q} = -N(R(c_{NP}) - R(c_P)). \tag{18}$$

An agent gains if and only if

$$\frac{-\partial U/\partial q}{\partial U/\partial N} > \frac{dN}{dq}.$$

This is more likely for poorer agents if the LHS is falling with income, which is equivalent to $R(c_P)/R(c_{NP})$ being rising with income. It turns out that it is more convenient to express things in terms of λ, the Lagrange multiplier of (16), which is negatively related to y. We just want to show that

$$\frac{\mathrm{d}}{\mathrm{d}\lambda} \ln \frac{R(c_P)}{R(c_{NP})} < 0 \tag{19}$$

One can then note that $dR(c_P)/d\lambda = -u''(c_P)c_P\frac{dc_P}{d\lambda} = -u''(c_P)c_P\mu(u'^{-1})'(\lambda\mu) = -\mu c_P$, and $dR(c_{NP})/d\lambda = -c_{NP}$, implying, using the property that $\mu = u'(c_P)/u'(c_{NP})$, that (19) is equivalent to

$$\frac{c_P u'(c_P)}{R(c_P)} - \frac{c_{NP}u'(c_{NP})}{R(c_{NP})} < 0,$$

which is clearly equivalent to $\eta(c_{NP}) > \eta(c_P)$, and hence true given that $c_{NP} > c_P$ and that η is increasing with c. Q.E.D.

This result tells us that for the class of utilities with increasing elasticity, the poor are more likely to benefit from a reduction in q than the rich, for a given cost in terms of lower product diversity.

The intuition is as follows: when q goes up, some nonproprietary goods will appear and some proprietary goods will disappear.[6] A consumer loses the utility rent $R(c_P)$ for each proprietary good which disappears, and gains $R(c_{NP})$ for each good which appears. He gains if the ratio $R(c_P)/R(c_{NP})$ is small enough, and if $\eta(.)$ is rising with consumption, so is this ratio.

How much additional mileage does that result give us for arguing in favor of restricted IPRs from a welfare point of view? I conjecture that it does not go very far. First, it is not enough to show that social welfare may in principle go up. One has to show that the policy is not dominated by a simple redistributive one. The preceding results suggest that redistribution is way superior to restricted IPRs, and this is unlikely to be overturned by non isoelastic preferences. Second, the assumption of an increasing $\eta(.)$ is not necessarily very realistic; for example, it is violated for a quadratic $u(.)$. Third, the result only holds under constant markups, but there are reasons to belive that they might rise in response to a reduction in the number of goods.[7] Finally, if one really cares about the *poorest* (as would be the case for a Rawlsian policymaker), then one runs into the problem that for agents with arbitrarily low income levels the effects of N and q are only second-

[6] Some of these can be the same, but this is irrelevant, it is simpler to reason as if some goods disappeared and others appeared.

[7] This is what happens in my "limited" needs model with a quadratic $u(.)$. See Saint-Paul (2001b).

order. As long as $u(0) = 0$, which is the only reasonable assumption if N is endogenous and U is defined by (15)[8], then $R(0) = 0$, so that $\partial U/\partial N$ and $\partial U/\partial q$ are close to zero for agents with and income close to zero. In contrast, a transfer would have a first-order effect on these agents' welfare.

7 Conclusion

This paper's analysis confirms the basic doctrine of mainstream economics, i.e. that equity concerns are best addressed by using taxes and transfers rather than distorting markets. Reduced property rights on innovation do not seem to be a good idea to enforce a more equitable distribution of income, despite the fact that IPRs generate a static inefficiency associated with monopoly pricing. The reason is two-fold. First, alleviating that inefficiency does not particularly help the poor relative to other agents. Second, the dynamic inefficiency, due to imperfect appropriation of an invention's social surplus by the innovator, seems much stronger, and it is reinforced by lower levels of intellectual property.

This suggests that in order to vindicate the idea that limitations on IPRs are justified on grounds of fairness, one has to explore other routes.[9] One possibility is to consider that as a form of *in-kind* redistribution in a world where monetary transfers are difficult or impossible. One argument implicit, or sometimes explicit, about reducing IPRs in the context of helping LDCs, is that monetary redistribution to these countries, which, as the preceding analysis suggests, is likely to work better, is in fact diverted by local interest groups and does not go to those who are really in need. By contrast, free licenses for producing valueable drugs would directly help the poorest. Arbitrage could be prevented by preventing these drugs from being reexported.

[8] Otherwise, there would be a difference to a consumer between a situation where he consumes a zero amount of a good and a situation where this good does not exist.

[9] Of course, one may consider that the nature of competition is such that there is too much R and D, because part of it is dissipated in "business stealing" effects. In such a case a limitation on IPRs could enhance welfare by reducing overinvestment in R and D. See Tirole (1988). Note however that this argument has nothing to do with fairness concerns.

The merits of this argument is unclear. It rests on one kind of redistribution being more "corruption-proof" than the other. It is not clear why it would be so much easier for local authorities to divert aid money rather than setting up an infrastructure in order to bypass the reexport ban for their own profit. It is also not clear that the poor would not lose in the long-run because of lower innovation, as is the case here.

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Figure 1

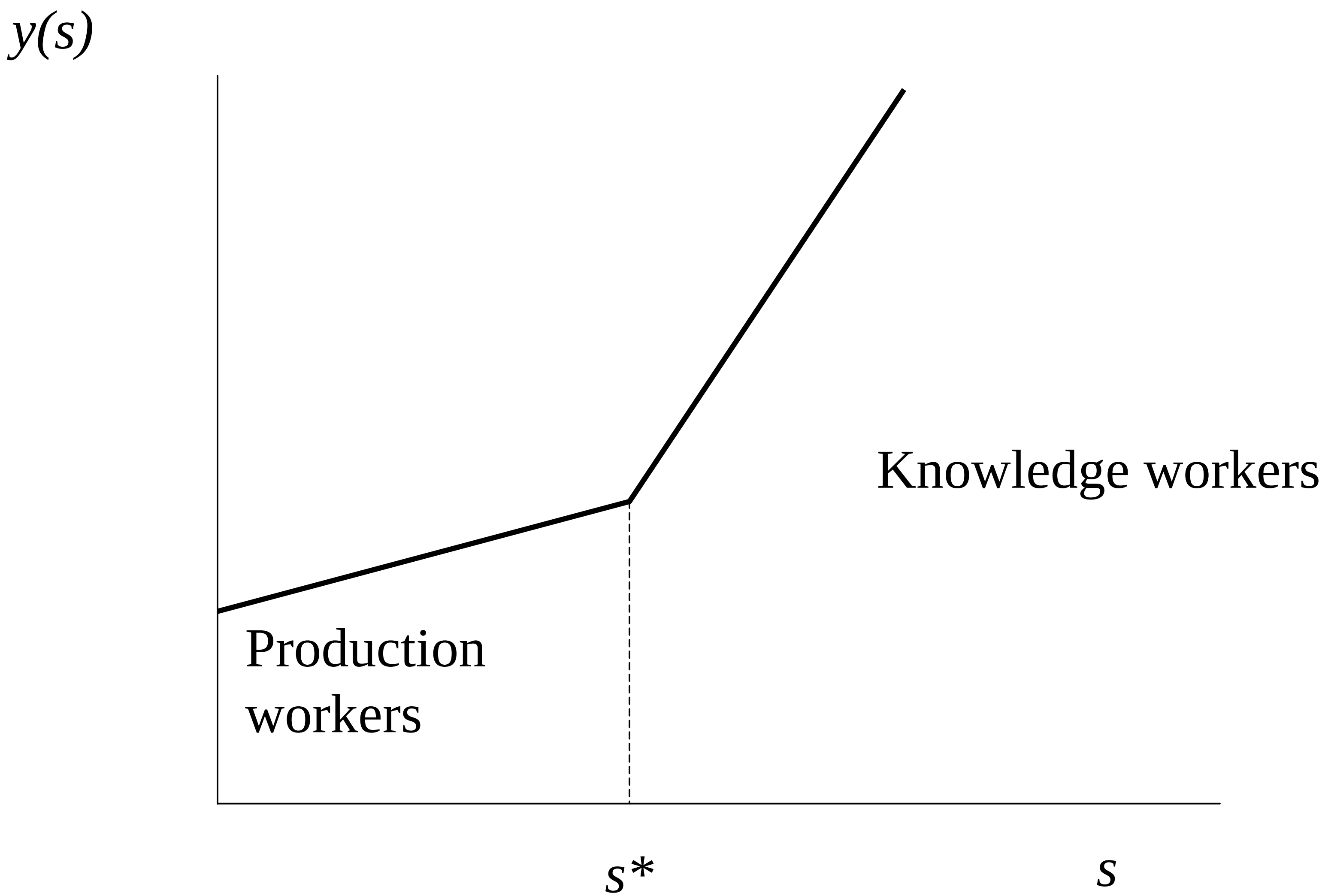
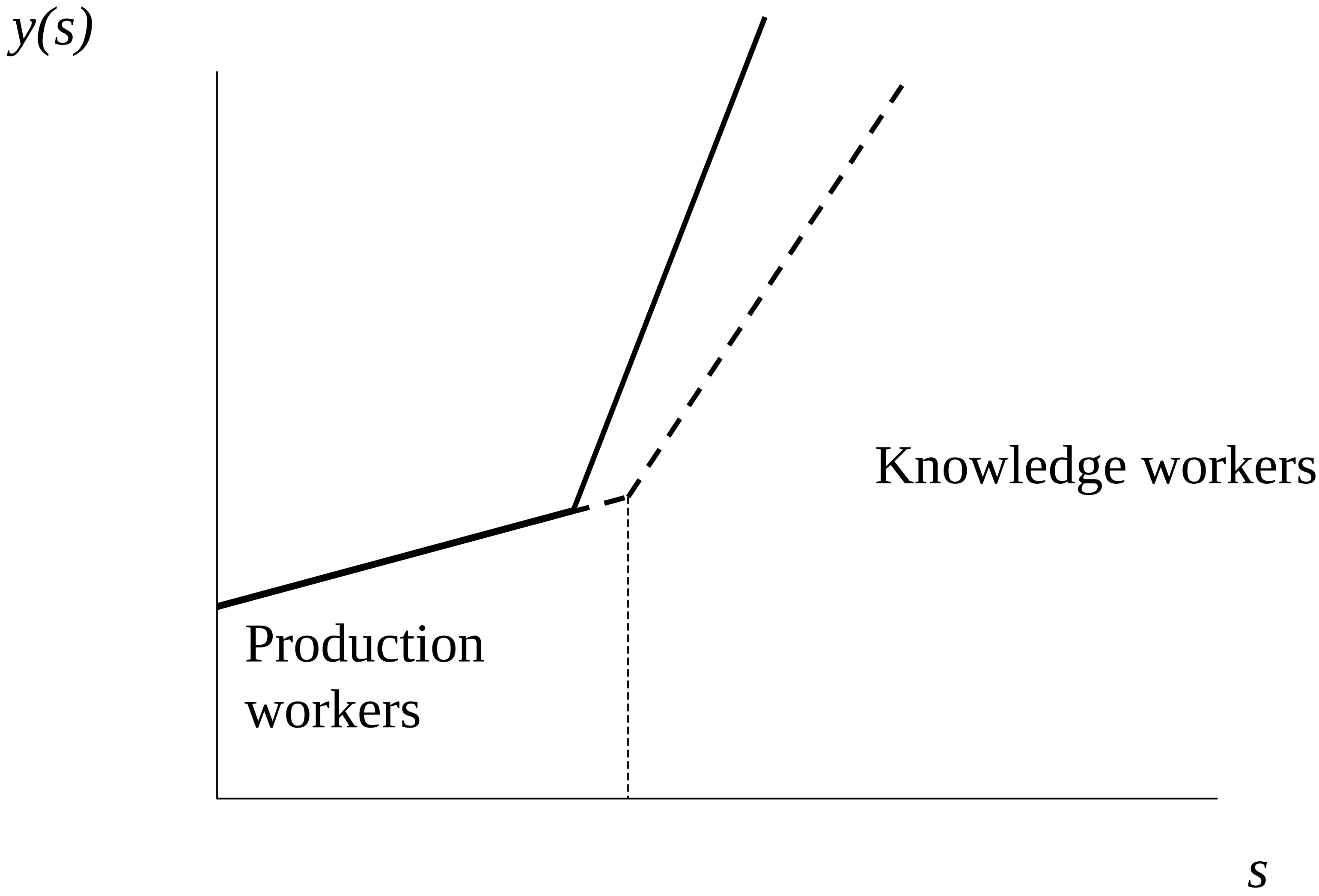
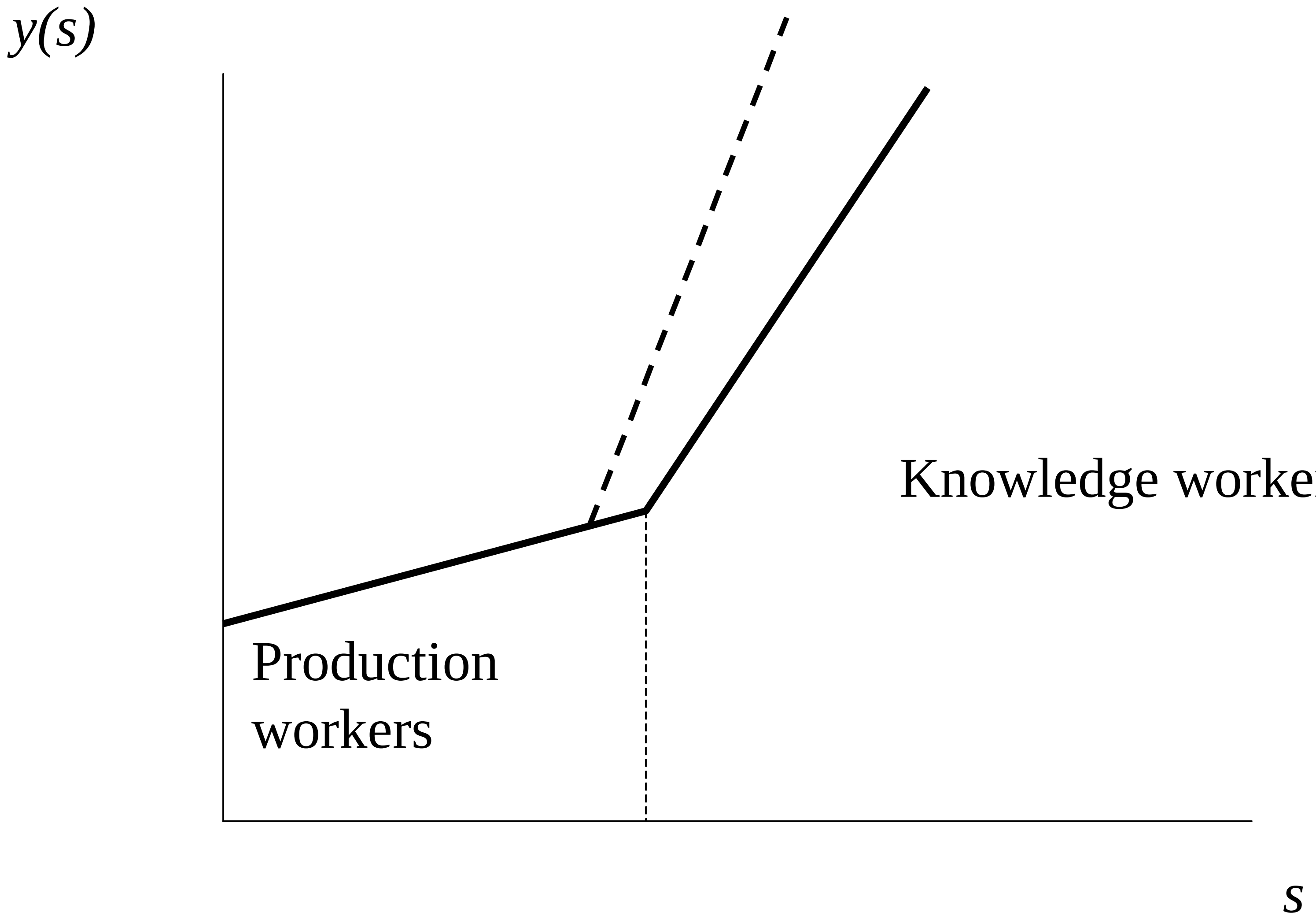


Figure 2



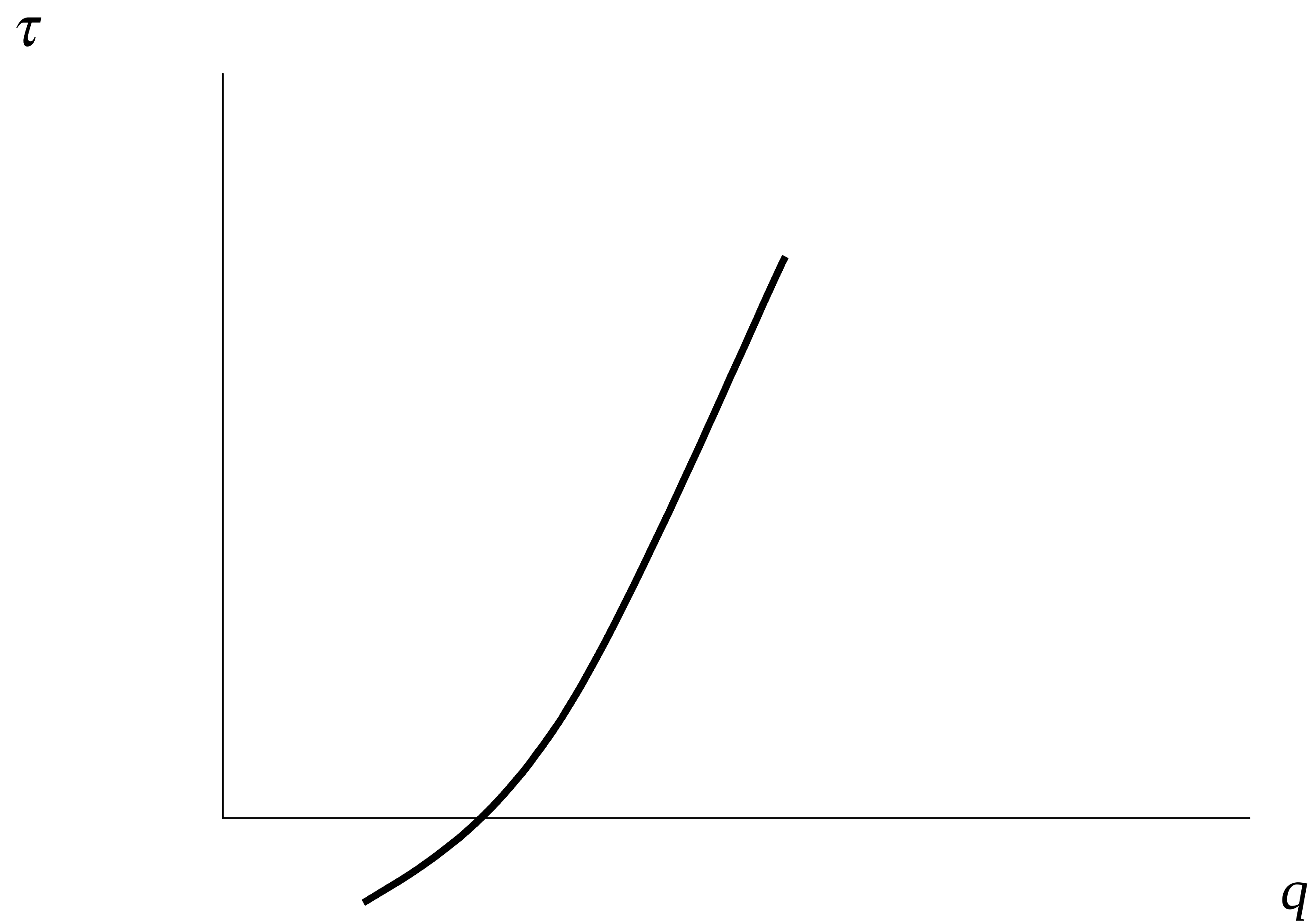
Impact of an increase in IPRs

Figure 3



Impact of an increase in taxation

Figure 4



The policy frontier