Chapter 14

Skill Biases in Employment Opportunities and Income Perspectives

*Should We Try to Shake the Invisible Hand?*

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Abstract: The rigidities inherent in the stable wage development in Europe hamper the Schumpeterian process of creative destruction and therefore are a barrier to productivity growth. This notion, amongst others, motivated the deregulation programme in Europe. However, in the discussion on this programme and in its far-reaching policy implications, a crucial public good aspect of technological change has been ignored. Recognition of this aspect and the market failures it invokes, together with concern about the income inequality implied by forceful deregulation of the labour market, inspired us to the current analysis. We show that well-targeted wage subsidies are welfare improving.

1. INTRODUCTION

The (continental) European economy is often compared to the US economy in order to analyse and emphasise the impact of economic institutions on economic performance. Although both economies have been exposed to similar shocks in the seventies of the last century, their performance in the eighties and nineties was quite different. A typical example, which has been widely discussed in the literature, is the strong increase in unemployment in

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Europe as opposed to the situation of near full employment in the US. This coincided with an increasing wage inequality in the US, while the relative wage structure in Europe remained remarkably stable. Krugman (1995) dubbed this phenomenon as two sides of the same coin, suggesting a trade-off between wage flexibility and unemployment. 2

An element that has attracted less attention in the literature, is that the rigidities inherent in the stable wage development – for instance due to minimum wages – might also be a barrier to productivity growth and hence may serve as an additional explanation of the poor performance of Europe relative to the US in the eighties and nineties. The reason is that these rigidities hamper the Schumpeterian process of creative destruction. 3 This notion is also one of the arguments that inspired the deregulation programme in Europe.

We think that in the discussion on this programme and in its far-reaching policy implications, a crucial public good aspect of technological change has been ignored. Recognition of this aspect and the market failures it invokes, together with concern about the income inequality implied by forceful deregulation of the labour market, inspired us to the current analysis.

In our view the two-sides-of-the-same-coin debate is part of the discussion on the trade-off between equity and efficiency. Actually, this discussion is almost as old as the science of economics itself – if not older. Simon Kuipers contributed to this discussion for a large part of his professional life. He particularly emphasised the importance of macro-economic stability to reduce uncertainty and therefore pointed at market failures as a result of uncertainty – both implicitly and explicitly. 4 Such an interference with the free markets process is something we phrase tongue in cheek as ‘shaking the invisible hand’. However, Kuipers also recognises a complicated trade-off with efficiency, since he is in favour of a medium-term oriented stabilisation policy in “an institutional structure which makes it possible to prevent the allocational distortions to a considerable extent” – in particular preventing the use of these policies for distributional aims. 5

3 This notion is reminiscent of Kleinknecht’s (1998) critique on wage moderation (not minimum wages) in the Netherlands. However, Kleinknecht also opposes wage flexibility, because he thinks it would allow badly performing firms to lower their wages instead of innovating. In our view this is not correct because Kleinknecht then ignores the fact that better performing firms that do apply technological change would also be able to pay higher wages, thus outcompeting the non-innovating firms by taking over their labour force. That is the true nature of the Schumpeterian creative destruction.
4 See Kuipers (1990) for a discussion in a macroeconomic setting and Kuipers (1995) in a somewhat more microeconomic setting.
5 Kuipers (1990, p. 254). He considers the guided wage policy in the Netherlands in the Fifties as a good example of such an institution.
In this contribution, we intend to provide an additional argument to show that the popular belief of a trade-off between efficiency and equity is not quite as simple as is often perceived. However, we look at market failures created by the public good nature of technological change, also from a macroeconomic perspective.\textsuperscript{6}

Romer (1990) argues that technological knowledge is not a totally excludable good. He exemplifies this by distinguishing between a variety of new products. The designs of these products can be protected by copyrights. These designs are excludable since their use can be limited to the owners of the products. However, the knowledge embodied in these designs is widely observable and will inspire further designs – this aspect of new designs is not excludable and serves therefore as a public good. Thus creation of new designs has spill-over effects, which are not accounted for when these designs are traded on the market.

Inspired by this notion, Van Zon and Sanders (2000) developed a model in which they distinguish between two varieties of goods: a high-tech variety produced by skilled workers and a low-tech variety produced by unskilled workers. The research sector, which employs skilled workers only, generates both product and process innovations. Product innovations lead to new varieties – which in the initial stages of their life cycle are high-tech by assumption. Process innovations enable unskilled workers to produce varieties that initially were of a high-tech nature – these then become low-tech. The process innovations also induce a ‘business stealing’ effect: by buying designs for these innovations firms can employ unskilled labour, hence freeing skilled labour that can be employed elsewhere. Producers of established products can thus outcompete the early adopters of new products. The spill-over effects of new designs mentioned by Romer, are present in the production of both product and process innovations.

We use this model to analyse the impact of a rise in consumer preferences for high-tech goods, while consumers love variety of goods in general too. It is obvious that in the free market this leads to a higher rate of product innovation, i.e. more new varieties, and to a stronger divergence in wages between skilled and unskilled workers. The introduction of a binding minimum wage would then typically hamper this form of technological change and cause unemployment. This is in line with the popular notions underlying the deregulation policy. However, if we correct for the market failure on the research market by subsidising R&D, financed in an otherwise neutral way, we find that a minimum wage could in principle be sustained and a higher welfare can be obtained than in the free-market solution: it may therefore help to ‘shake the invisible hand’.

\textsuperscript{6} Kuipers (1996) also points at market failures due to spill-over effects.
The structure of the chapter is as follows. We present the model in Section 2. In Section 3 we analyse the results of some simulation experiments. Some concluding remarks follow in Section 4.

2. THE MODEL

General features

There are intrinsic asymmetries between the employment opportunities of unskilled and skilled workers. As in Hirsch’s (1965) life-cycle theory, unskilled workers produce goods and services using established production techniques, while skilled workers are used in the initial stages of a product’s life cycle. For reasons of simplicity, we assume that established products are generated using unskilled labour only, whereas new products are produced using skilled labour only: we disregard other production factors. As in Krugman (1979), production technologies are linear, while the demand for goods is described using a CES utility function with love of variety. All new products enter the utility function in a symmetric way. This also holds for established products. However, the direct contribution to utility of a new product may differ from that of an established product.

Technical change is the result of R&D efforts driven by profit seeking motives — cf. Romer (1990) and Aghion and Howitt (1992, 1998). We distinguish two types of research: basic R&D that leads to new products that can only be produced (initially at least) by skilled workers, and process R&D by firms that ‘borrow/steal’ the ideas embodied in the products coming from the basic R&D sector. The firms use these ideas to devise a production process that is suitable for unskilled workers to use — the products in question then become ‘established’ instead of ‘new’. The right to use this production process is then sold to the final output sector, as are the designs for new products.

Price-setting and equilibrium on the goods market

For reasons of simplicity, we use a homothetic CES utility function with degree of homogeneity equal to $\alpha$, and an elasticity of substitution equal to $\sigma = 1/(1 - \alpha)$ to describe the demand for each good. Each established good is weighted with intensity $\beta^*$ and each new good with intensity $\beta^*$ in the utility function. Moreover, due to love of variety consumers positively value an increase in the total number of goods $n$ for a given real budget.
Utility maximisation, after normalising prices such that the price of an util equals unity, then results in:

\[ c_i = \left( \frac{p_i}{\beta^i} \right)^{-\sigma}, \]  

where \( c_i \) is the level of demand for good \( i \), \( p_i \) is its corresponding price and \( \beta^i = \beta^e \) or \( \beta^a \) is the associated distribution parameter of the CES utility function. We assume \( 0 \leq \alpha < 1 \), so that the elasticity of substitution \( \sigma \geq 1 \).

Every good is produced by a single producer. That producer must first buy the right to produce the good in question from the R&D sector that generates blueprints for new products — in case of a new good — or the right to use a new production process — in case of established products. The demand schedule given by (1) serves as a constraint for the monopolist to set his profit maximising price. This price is given by the Amoroso-Robinson condition, that in turn summarises the first order condition for a profit maximum:

\[ p_i = \frac{m_i}{\alpha}, \]  

where \( m_i \) is the marginal production cost of good \( i \). In that case (and for constant marginal cost), profits at time \( t \) from producing good \( c_i \) are given by:

\[ \Pi_i = (1 - \alpha) p_i c_i = (1 - \alpha) p_i^{1-\sigma} (\beta^i)^{\sigma} = (1 - \alpha) (m_i / \alpha)^{1-\sigma} (\beta^i)^{\sigma}. \]  

**Wage formation and equilibrium in the labour market**

Let \( \mu_e \) and \( \mu_n \) be parameters that describe the productivity of labour in new and established product industries. Then we can obtain aggregate demand for unskilled and skilled production workers — \( l \) and \( s \), respectively — directly from (1) and (2) and the within product group demand and supply symmetries:

\[ l = n_e (w_e / (\beta^e \alpha))^{-\sigma} \mu_e^{1-\sigma}, \]  

\[ s = n_n (w_n / (\beta^a \alpha))^{-\sigma} \mu_n^{1-\sigma}, \]
where \( w_e \) and \( w_n \) are the wage rates of unskilled workers in the established industries and of skilled workers in the new product industries, respectively. The number of established and new products is \( n_e \) and \( n_n \), respectively.

The total supply of unskilled and skilled workers is given, and equals \( \bar{l} \) and \( \bar{h} \), respectively. Equilibrium wages by skill can then be obtained by equating labour supply to labour demand by skill.

Substituting the exogenous supply of labour used for the production of established and new products into Equation (4a), we can obtain the equilibrium wage rates by skill by solving (4a-b) for wages:

\[
\begin{align*}
    w_e &= \beta^\sigma (\bar{l} / n_e)^{-1/\sigma} \alpha \mu_e^{1-1/\sigma}, \\
    w_n &= \beta^\sigma (s / n_n)^{-1/\sigma} \alpha \mu_n^{1-1/\sigma},
\end{align*}
\]
(5a)
(5b)

where \( s = \bar{h} - r \) is the number of skilled production workers and \( r \) is the total number of skilled research workers, employed in the research sector.

**Profit erosion**

For a typical industry we may combine Equations (3) and (5) to obtain:

\[
\Pi_i^x = (1 - \alpha)(w_e / \mu_e / \alpha)^{1/\sigma} \mu_x^{\sigma-1} (\beta^x)^\sigma,
\]
(6)

for \( x = n, e \). Equation (6) shows that profits will be eroded over time by increases in wage rates, since \( \sigma \geq 1 \). Wages in the established industries and the new industries rise with the number of goods produced by those industries — cf. Equation (5). Hence, the rate of profit erosion depends on the absolute amount of R&D and also on its distribution over basic R&D and process R&D. The latter depends on the relative profitability of both activities as compared to final output production.

**The R&D sectors**

Substitution of Equation (5) into (6) provides the value of both types of blueprints to a producer, which is the price that a producer would be willing to pay to the R&D sector. Combining Aghion and Howitt (1998) and Van on, Sanders and Muysken (1998), we assume that this willingness to pay

This obviously implies that a wage tax or subsidy will change only the sectoral distribution of labour, and not total labour supply.
provides the incentive to a competitive research sector to hire skilled labour and to try and invent a new product or a new process. In a competitive R&D sector arbitrage ensures that the value of the marginal blueprint is equated to the marginal cost of producing that new blueprint. These marginal costs consist of skilled wages only.

In the research sector that generates new products an intertemporal externality exists – cf. Romer (1990). With respect to research into new processes we assume a positive external spillover from the introduction of new goods that can be turned into established ones. However, this type of research is subject to diminishing returns in the sense that once all products are established, none are left to transform. Defining \( z = n_r / n_e \), the above can be summarised by:

\[
\frac{dn}{dt} = \kappa_n n r_n \quad \Rightarrow \quad \hat{n} = \kappa_n r_n , \\
\frac{dn_e}{dt} = \kappa_e n_r r_e \quad \Rightarrow \quad \hat{n}_e = \kappa_e r_e / z , \\
\frac{dn_n}{dt} = \frac{dn}{dt} - \frac{dn_e}{dt} \quad \Rightarrow \quad \hat{n}_n = (1 + z)\hat{n} - z\hat{n}_e ,
\]

where \( r_n \) and \( r_e \) refer to the number of research workers engaged in generating new or established products, respectively, and where \( \hat{x} = (dx / dt) / x \).

Assuming that the probability of any new product becoming established is independent of the product under consideration, it follows that each new product has a certain probability per unit of time of becoming an established product. This probability is given by the ratio of the number of newly established products \( (\text{i.e. } \frac{dn_e}{dt}) \) relative to the number of not yet established products \( (\text{i.e. } n_n) \). As in Aghion and Howitt (1998), the probability of a new product being replaced by an established one can be accounted for in the present value of the corresponding expected profit stream in the effective rate of discount:

\[
V^\pi = \Pi^\pi / (\rho + \delta_\pi) ,
\]

where \( x = n_r e \). In Equation (8), \( \rho \) is the nominal rate of discount, while \( \delta_\pi \) is the additional discount on the expected present value of a blueprint due to
'business stealing' and wage induced profit erosion. The wage changes are in turn induced by the growth of the number of new and established products, as is apparent from Equation (5).

From Equation (5) it is easily seen that for a constant size and skill-composition of the labour force, as well as a constant allocation of skilled and unskilled workers (which would be the case in the steady state) we have:

\[ \dot{w}_x = \dot{n}_x / \sigma, \]  
\[ (9) \]

for \( x=n,e \). From Equations (6) and (9) it follows that the growth of profits due to technical change induced changes in wages would be equal to \( 1 - \sigma \) times the growth in wages as given by Equation (9). Obviously, for \( \sigma \geq 1 \), the growth in profits would be non-positive for a positive growth in wages. In addition to this, the profits in the new products final output sector are also eroded due to new products becoming established. The proportional rate at which this happens is given by \( (dn_x / dt)/n_x = z\dot{n}_x \), as was mentioned earlier. Using this information and Equations (7a-c) and (9) we find for the additional discount factors in Equation (8):

\[ \delta^u = \alpha(1 + z)\kappa_u r_x + (1 - \alpha)\kappa_e r_e, \]  
\[ (10a) \]

\[ \delta^e = \alpha\kappa_e r_e / z. \]  
\[ (10b) \]

Equation (10a) shows that the rate of profit erosion in the new products final output sector depends positively on the number of research workers in the other research sector. However, it also depends positively on the number of research workers employed in the research sector that generates new products. The latter is due to the fact that more new products make skilled workers scarce, which tends to increase wage costs in the R&D sectors. The former effect is our version of business-stealing effect – cf. also Aghion and Witt (1992, 1998).

\subsection*{steady state solution}

The steady state solution requires the constancy of the ratio \( z = n_e / n_x \). This ratio would in constant only if the rates of growth of the number of new and shed products are equal to the growth rate of total products. Let the state value of \( z \) be denoted by \( \bar{z} \). Then it follows directly from equations (7a-c) that:
14. Skill Biases

\[ \hat{n} = \hat{n}_e = \hat{n}_n \quad \Rightarrow \quad \bar{z} = \frac{r_e \kappa_e}{r_n \kappa_n}. \]  

(11)

It follows from Equation (11) that for a given allocation of research workers, the ratio of established products to new products will be larger, the higher is the ratio of the R&D productivity parameters \( \kappa_e / \kappa_n \).

Following Romer (1990) and Aghion and Howitt (1998), labour market arbitrage for skilled workers now implies:

\[ \frac{dn}{dt} = \frac{\Pi^n}{\rho + \delta_n} / r_n = \frac{dn^e}{dt} = \frac{\Pi^e}{\rho + \delta_e} / r_e = w_n = \]

\[ \beta^n((\bar{h} - r) / n_n)^{-1/\sigma} \alpha \mu_n^{-1/\sigma}. \]

(12)

The right-hand side of (12) is the skilled wage rate in the new product final output industries. The left most part of (12) is the present value of total expected profits per researcher associated with the marginal blueprints in the basic R&D sector. The middle part of (12) refers to the present value of total expected profits per researcher associated with the marginal blueprint in the other research sector.

The model cannot be solved analytically, but both a graphical and a numerical solution are provided in Van Zon and Sanders (2000).

3. POLICY INTERFERENCE WITH MARKET OUTCOMES: SOME SUBSIDY EXPERIMENTS

Since the model presented above cannot be solved analytically, in particular its out of steady state dynamics, we illustrate its most interesting properties by means of a number of simulation experiments. Of course, there are some parameter constraints that have to be satisfied in order to obtain generally meaningful results, but these are easily met in practice.\(^8\) Nonetheless, it should be kept in mind that other (relatively unlikely) parameter sets can be envisaged that would change the analysis in a qualitative way. For our present illustrative purposes, we don’t need generality, however: likely qualitative results will suffice.

We used the base-run of the model presented in Van Zon and Sanders (2000, Section 4) as a starting point for some simulation experiments in

\(^8\) See Van Zon and Sanders (2000) for more details. For their simulations, Van Zon and Sanders have chosen a parameter set consistent with these restrictions.
order to analyse the impact of minimum wages and subsidies on technical change, economic growth and the distribution of income.\textsuperscript{9} The aim is to show that the market failures implied by the public good character of technological change can be partly remedied by subsidies paid out of taxes on wage income, and that minimum wages are not necessarily harmful in that context.\textsuperscript{10} The latter implies that equity considerations do not have to hamper the restoration of efficiency.

In order to induce a change in the rate of process and product innovations, we investigated the impact of a preference shift towards high-tech goods on the economy. As might be expected, this leads to a higher production of new designs, because of the increase in profits to be earned on new products. This results in a reallocation of skilled labour from the production of both high-tech goods and in particular of process innovations to the production of new designs. As a consequence, skilled wages increase while unskilled wages fall. Thus we find an increase in technological change accompanied by a strong wage divergence as the outcome of the free-market process. It is obvious that in this context a minimum wage will cause unemployment and will hamper technological change.\textsuperscript{11} However, things are different when we introduce wage-costs subsidies, as we did in four separate simulation experiments, where we subsidised wage costs in each of the four sectors.\textsuperscript{12}

The outcomes of the simulation experiments are summarised in Table 1, where a "+' indicates an increase relative to the free-market solution, a "−".

\textsuperscript{9} In this base-run, about one third of the skilled labour available is allocated towards R&D and the relative wage for unskilled workers is roughly half that of skilled workers. As one would expect, the profits in the new goods sector are discounted at a much higher rate than those in the established goods sector due to the business stealing effect. Finally the economy grows at about 3.6 % in steady state.

\textsuperscript{10} The model has been constructed in such a way that all income earned is eventually (and completely) paid as wages in either the final output sector or the R&D sectors. Thus, income taxes boil down to wage taxes. We furthermore assume that labour itself is inelastically supplied, hence neutral taxation simply implies the same tax rate for all workers, regardless of their sector of employment. Because of the assumed neutrality, we do not formally specify the taxation side of our illustrative simulation experiments later on.

Van Zon and Sanders (2000) did an experiment (nr. 7) in which they introduce a minimum wage. They find unemployment and an initial increase in technical change. However, they ignore the costs of unemployment that have to be borne somehow. Moreover, they do not consider the impact on utility, which certainly is negative in the longer run, because then technological change grows at its initial rate, while unemployment persists.

As we have indicated above, these subsidies are financed by taxing wage income. An important simplifying assumption in this context is that this does not affect labour supply – which is true by construction, since labour supply is price-inelastic.
indicates a decrease and a "0" means no change. "+/-" signals a positive deviation from the reference run at first, followed by a negative one later on.

*Table 1. Effects of subsidising wage costs in the four sectors, relative to the 'free-market' solution*

<table>
<thead>
<tr>
<th>Technological change</th>
<th>Skilled labour</th>
<th>Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old $(n_o)$</td>
<td>New $(n_n)$</td>
<td>Tot $(n)$</td>
</tr>
<tr>
<td>Low-tech</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High-tech</td>
<td>+/-</td>
<td>-</td>
</tr>
<tr>
<td>Process innovation</td>
<td>+/-</td>
<td>-</td>
</tr>
<tr>
<td>New designs</td>
<td>+/-</td>
<td>+</td>
</tr>
</tbody>
</table>

The first experiment shows that subsidising wage costs in the established goods sector will increase competition for unskilled workers, while profits will not increase. The outcome is that all subsidies will be passed on to unskilled workers and, since profits are not affected, relative demand for high-skilled workers will not change. Total utility will not change either, but it is redistributed in favour of unskilled workers. Therefore, a minimum wage at a level higher than the free-market outcome together with subsidising unskilled wage costs can be imposed without lowering total utility in the process. Market failures do not grow worse, because of the effective isolation of the unskilled labour market from the rest of the economy through the lack of a real impact of the unskilled wage cost subsidy on profits. The latter leaves the incentives that influence the allocation of skilled workers, and therefore R&D efforts, unchanged.

Subsidising wage costs in the high-tech-goods producing sector will generate adverse results, since skilled workers will be lured away from the R&D sector and both the generation of process and product innovations will be lower in comparison to the free-market outcome. Utility of skilled workers will be higher initially, because of the upward pressure on skilled wages, but in a later stage it will decrease relative to the free-market outcome because of the relative decrease in innovations. The latter is self-reinforcing due to negative external effects. Total utility will be lower over the whole period.

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13 The experiment for each sector is a permanent subsidy of 10 percent on the wage costs of that sector, financed by a tax on wage income in all sectors. Because labour is supplied inelastically, this has no real effects on the supply of labour. Moreover, full employment is always maintained.
Subsidising wage costs in the process innovation part of the R&D-sector will affect unskilled wages positively, since the unskilled workers will be involved in the production of more low-tech goods, relative to the free-market solution. The downside of this subsidy is that business stealing will be stimulated. Moreover, more skilled workers will be employed in the process-innovation part of the R&D-sector at the detriment of the design of new products — again with self-reinforcing negative external effects. This will be the cause of a lower total utility, although the utility of the unskilled will increase.

As one might expect, the market failure due to the public good character of new designs will lead to too low a production of those designs. Subsidising wage costs in this part of the R&D sector therefore might be expected to improve both total utility and the utility of the unskilled. One can see that this is indeed the case. Initially, however, the utility of the unskilled will be lower in comparison to the free-market solution, because skilled workers will be involved in the design of new varieties instead of process innovations. But the external effect of new designs will soon increase the productivity of the R&D-sector in process innovations, and from then on utility of unskilled workers increases too, despite the decrease in relative unskilled wages. Moreover, the utility will increase persistently at a faster rate, when compared to the free-market solution, due to these external effects.

This last experiment shows that subsidies can indeed be used to correct for the market failure in technological change. Moreover, a combination with the first experiment — i.e. temporarily subsidising unskilled wage costs in the low-tech sector — seems to be an attractive policy option if one would want to avoid, or at least limit, the initial decrease in per capita utility of the unskilled.

4. THE ART OF SHAKING THE INVISIBLE HAND

In Van Zon, Muysken and Meijers (1998) we argue that in a situation of excess supply of skilled workers, the creation of skilled jobs may promote unskilled employment more than the creation of unskilled jobs does. The reason is that these skilled jobs will reduce the bumping down of unskilled workers by skilled workers who occupy unskilled jobs. This is the so-called himmey effect. In Van Zon et al. (2001), we provide some empirical results in the Netherlands and Germany, after having extended the model above with asymmetries in learning costs by skill. We show that policies aimed at influencing the employment prospects of the unskilled may take different forms, ranging from subsidising the creation/use of unskilled jobs to
subsidising the creation of skilled jobs. Not surprisingly, the effectiveness of each policy measure depends very much on the existence of binding supply constraints in the various skill-segments of the labour market. Moreover, technological change does not play an explicit role in these models.

The perspective taken in the previous models is short term rather than the long-term perspective taken in this chapter. In the long run the binding character of a supply constraint at a certain moment invokes counteracting technology responses through the reallocation of R&D activities. This is recognised in Muysken et al. (2001), although technological change is exogenous. There we point out that the activation of the chimney effect by stimulating product innovation may have serious equity implications, because of the negative impact on both wage inequality and asymmetries in unemployment. Therefore we argue in favour of stimulating process innovations, that is to make the production of new goods accessible to unskilled workers as an alternative to educating these workers and raising their skill levels. In that paper, however, we have focused on the influence of employment asymmetries in a given technology environment. Thus we neglect again the endogenous technology reactions that dominate economic developments in the long run, as we have highlighted in our wage cost subsidy experiments in Section 3 of this chapter. This change of perspective also makes for differences in the corresponding policy considerations, as will become more clear below.

Since we treated the process of technological change as exogenous in our earlier papers, we have also ignored the spill-over effects inherent in this process. It is obvious that these spill-over effects, that are at the heart of the public good aspects of technological change, may lead to a serious underestimation of the full impact of technological change on economic activity. The market imperfections implied by these public good aspects might lead to underinvestment in R&D and new technologies.

Underinvestment has been a central theme in the work of Simon Kuipers. However, as we already mentioned in the introduction, his focus was on market failures due to uncertainty rather than spill-over effects. In the analysis above, we have ignored the aspect of uncertainty, although one could argue that a long-term perspective should include uncertainty from the outset, in particular when the effects of technological change in the long run are analysed. Clearly, our long-term analysis applies to a steady state situation where all adjustments in wages, prices and the (re-)allocation of (skilled) labour are both certain, flexible and complete.

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14 In that paper the focus is more on the response under different labour market institutions (in Europe and the US) to technological change.

15 The most recent contribution is Kuipers (1999).
Pending these uncertainties, our long-term analysis leads to the conclusion that product innovations should be stimulated in order to improve the position of unskilled workers, while the stimulation of process innovations will have an adverse effect on the economy. On the other hand our short-term analyses typically favour subsidising process innovations and indicate a negative impact of product innovations.

The apparent policy dilemmas do underline the notion that economic policymaking is an art as much as a science. However, they are also a warning of the danger of taking too narrow a policy stance too early. Shaking the invisible hand may help, but it is a very delicate process. With this in mind, the main conclusion that we draw from our experiments is that it is of crucial importance to have a keen eye for the intertemporal distribution of the effects of policy measures – repairing in the short run what is clearly undesirable, without however endangering long term growth and employment perspectives, through the forceful and coordinated application of technology policy, structural policy as well as employment policy. Guess who already said that early in our careers, in 1979 ..."!

REFERENCES


14. Skill Biases


