CPB Discussion Paper

No 28
March, 2004

Wage moderation and labour productivity*

Frederik Huizinga and Peter Broer

Abstract in English

In the Dutch economic policy debate, wage moderation is widely considered as a key factor for achieving economic growth and low unemployment. However, some economists criticise the policy emphasis on wage moderation, claiming that high wages are needed to maintain structural labour productivity growth. This paper analyses the effects of a wage push on labour productivity within the framework of endogenous technological progress, endogenous technology adoption and insufficient competition. The conclusion is that a wage push raises labour productivity in the short run. However, this rise in labour productivity is temporary and inefficient. In the long run, a wage push may well harm labour productivity. The main message of the paper is that it is probably best not to use wage policy at all as a tool to influence productivity. As a tool against unemployment, however, it is very effective. These insights are applied in a review of the Dutch post-war productivity growth.

Keywords: wage moderation, productivity, technological progress, creative destruction

Abstract in Dutch

Een aantal economen heeft recent kritiek uitgeoefend op de nadruk op loonmatiging in het Nederlandse economische beleid. De critici betogen dat hoge lonen nodig zijn voor een gestage groei van de arbeidsproductiviteit. Dit artikel bespreekt het effect van een loongolf op de arbeidsproductiviteit in de context van endogene technologische vooruitgang, endogene technologische adoptie en gebrekkige concurrentie. De conclusie is dat een loongolf de arbeidsproductiviteit op de korte termijn verhoogt. Een door een loongolf veroorzaakte hogere arbeidsproductiviteit is echter tijdelijk van aard en inefficiënt. Op lange termijn schaadt een loongolf de arbeidsproductiviteit eerder. De belangrijkste boodschap van het artikel is dat beleid gericht op loonvorming beter niet gebruikt kan worden om de productiviteit te beïnvloeden. Het is wel effectief als middel om de werkloosheid te bestrijden. Deze inzichten worden gebruikt in een terugblik op de groei van de Nederlandse arbeidsproductiviteit in de naoorlogse periode.

Steekwoorden: loonmatiging, productiviteit, technische vooruitgang, creatieve destructie

Een uitgebreide Nederlandse samenvatting is beschikbaar via www.cpb.nl.

Contents

Summary

Wage moderation has been a constant factor in the Dutch debate about employment policies since the Wassenaar agreement of 1982. The benefits of wage moderation in terms of reducing unemployment are undisputed. Some economists argue, however, that wage moderation also causes a structural slowdown of productivity growth, for instance by allowing marginal firms with low profits and little innovation to remain in existence. In their view, the Dutch policy focus on wage moderation is, therefore, short-sighted. Instead, they argue for a wage push to raise productivity growth again.

This paper discusses possible links between a wage push and labour productivity. The central argument in the analysis is that equilibrium or sustainable wage level is determined by technological conditions and the required return to capital. The latter is assumed to be exogenous for a small open economy like the Netherlands. With exogenous technology, the equilibrium wage level is exogenous as well. Wages may deviate from this equilibrium in the short run for several reasons, such as a change in tax rates, a change in replacement rates or a change in union militancy. However, such deviations are not sustainable. A wage push, for instance, initially raises wages, but also reduces profits below the level required by the capital market. Unemployment rises until the wage is pushed back to its equilibrium level.

During the adjustment process firms initially respond to the wage push by substituting capital for labour. As a result, the capital-labour ratio and labour productivity rise. However, this rise in labour productivity is neither efficient nor sustainable. It is not efficient because it is based on wage costs that do not accurately reflect the true scarcity of labour. It is not sustainable because the return to capital of firms has fallen below international levels. As unemployment rises and the wage falls back down to equilibrium, the capital-labour ratio and labour productivity fall back to their original values as well.

So, a wage push in the end does not yield higher wages nor higher labour productivity, only higher unemployment. Unemployment can only return to its original level if the cause for the wage push, such as the rise in taxes, replacement rates or union militancy is also reversed. In that case wages and labour productivity will temporarily fall below equilibrium as the economy reabsorbs the unemployed.

Extending the model to allow for endogenous technological progress does not alter these basic insights. We consider the case in which an R&D sector produces new capital- or labour saving technology, depending on the relative profitability of either type. As before, a wage push initially raises wages and labour productivity. Then unemployment rises, and wages and labour productivity fall again. When the wage push raises wages, R&D firms devote more effort to the development of labour-saving techniques and less to capital-saving technical progress. When wages fall back down again, this shift is reversed. The intertemporal shift in resources devoted

to the two types of technological progress is dynamically inefficient. As a result, labour productivity in the end experiences a permanent downward shift. A wage push, therefore, now has a permanent negative effect on productivity.

We next consider the issue of technological adoption. The question we ask is whether the latest technology will actually be adopted to its full potential. This may not be the case, for instance because the economy is not able to transfer resources from old techniques to the newer ones at the appropriate level and pace. Will a wage push stimulate a rapid adoption of new techniques? The answer is no. A wage push reduces the profitability of investment, which deters the creation of new firms. The wage push, therefore, leads not only to higher unemployment but also fewer new firms. This makes it more difficult for workers in old firms to find jobs in new firms. The transfer of resources from old firms to new firms slows down and average productivity falls.

A final argument that we review is that a wage push may reduce inefficiencies in the operation of firms, by acting as a substitute for competition. Can cost pressure force firms to innovate in the absence of competitive pressure from other firms? We point out that with insufficient competition, firms will be able to pass on wage increases in the form of higher output prices. Thus increasing cost pressure only leads to more inflation. The proper instrument to improve innovation in this case is an effective competition policy.

The theoretical insights offered by the paper are applied to a review of observed Dutch post-war productivity growth. The paper argues that the rapid rise in labour productivity in the Netherlands over the period 1960-75 may have been due in part to the wage push in the sixties and early seventies. As predicted by our theory, the wage and productivity gains induced by the wage push turned out not to be sustainable. In the late 1970's and early 1980's, the rise in the labour income was stopped. Productivity growth also almost came to a full stop, and the gains made in the previous period relative to the EU-14 were more than lost. The low productivity growth in the nineties had other causes, viz. the rapid growth of labour supply.

Overall, the analysis indicates that a wage push is likely to raise productivity in the short run, but it is unlikely to raise productivity in the long run, and may well hurt it. The main message of the paper is that it is probably best not to use wage policy at all as a tool to influence productivity. As a tool against unemployment, however, the analysis indicates that wage moderation is very effective. Wage moderation remains, therefore, an effective and efficient tool against unemployment. The key to improve innovation is an effective competition policy.

1   Introduction

Wage moderation has been a constant factor in the Dutch debate about employment policies since the Wassenaar agreement of 1982. What are the benefits of wage moderation? They are first and foremost the positive effects it has on employment. It is undisputed that wage moderation has played a key role in the enormous reduction of Dutch unemployment in the 1980's and 1990's. The often-heard plea for wage moderation is mostly geared towards reducing the rise of unemployment during economic downturns and the structural level of unemployment in the economy.

Wage moderation, of course, also has other macro-economic effects, for instance on consumption, exports, inflation and labour productivity. Especially this last effect has been a topic of some debate. Wage moderation has a negative effect on labour productivity, and this side effect has led some economists to argue against wage moderation as a cure for unemployment.[1]

What is the relationship between wages and labour productivity? If wage costs are relatively high, firms try to economize on the expensive labour by substituting capital for labour, by applying innovations that save on the use of labour or by making products that require less labour input. As a result, labour productivity rises. Similarly, if wage costs are relatively low, labour productivity growth is reduced. This process is efficient if wage costs correctly reflect the relative scarcity of labour, that is, if wages are high when unemployment is low and vice versa. During a period of high unemployment, therefore, reduced labour productivity growth is an efficient side effect of wage moderation, not an argument against it.

The remainder of this paper is structured as follows. In Section 2 we set up the basic model of wage formation in imperfect labour markets and discuss whether a wage push can permanently affect wages or labour productivity. In Section 3 we incorporate exogenous technical change in the analysis, which in Section 4 we further extend by considering the interaction between wage formation and endogenous technical change. Section 5 then discusses the Schumpeterian notion of creative destruction as a motor of technical change. Section 6 considers whether product market imperfections such as X-inefficiencies can provide a rationale for an aggressive wage policy. Section 7 applies the analysis to the case of the Netherlands. Section 7 finally rounds up by offering some conclusions.

---

[1] See e.g. Naastepad and Kleinknecht (2002), Kleinknecht (2003), and an earlier debate in *Tijdschrift voor Politieke Ekonomie* (1995, No. 4, pp. 10-68).

2 A stylised model of wage moderation

There clearly is a very strong link between wages and productivity. Productivity growth is the main source for the growth of real wages, and in the long run, the only one. This fact is undisputed. This paper deals with the question of whether there is also a causal relationship in the other direction: is there an effect of wage growth on productivity growth? To answer this question we start with a simple model. We draw on an earlier paper by Draper and Huizinga (2000), who propose the concept of the equilibrium labour-income share (ELIS). They use this concept to investigate the relationship between the labour-income share and unemployment. Here we extend the analysis to define wage moderation and to analyse its effects on unemployment and labour productivity.

Assume that firms produce efficiently and minimise their costs based on a given, exogenous production function with labour and capital as input. We first assume that there is no technological progress. We normalise the price of value added to one, so that real and nominal values are the same. Assume that the elasticity of substitution between labour and capital is less than one, so that a rise in wages leads to a rise in the labour-income share. Also, assume that free entry ensures that price equals minimal cost (that is, no excess profits), at least in the long run. The factor-price frontier indicates that for a given level of the user cost of capital, the level of profitability the firm can realise varies inversely with the wage rate. This implies that for a given level of the user cost of capital, there is a unique level of wages that allows firms to realise a normal level of return (zero profits) in equilibrium. For a small open economy like the Netherlands, the cost of capital is mainly exogenously determined by the international capital market. In this paper we assume it is indeed exogenous. It follows that the equilibrium wage rate is exogenous as well. Given these exogenous relative factor prices, the equilibrium capital-labour ratio is constant as well, and so is the equilibrium labour-income share. We denote this equilibrium labour-income share by ELIS.[2]

The actual wage may, at least in the short run, differ from its equilibrium value, and depends on the system of wage formation. Previous CPB research (see, e.g., Graafland and Huizinga (1999), and Broer, Draper and Huizinga (2000)) has shown that the wage development in the Netherlands can be described rather well by a wage bargaining model between firms and unions. Firms and unions bargain about how to divide the proceeds from production (the value added) between them. The shares in the division depend on the relative bargaining power of the parties involved. The bargaining power of workers increases if they can easily replace the income from their current jobs with another source of income. Alternative sources of income are unemployment benefits or other jobs in the formal or informal sector. The bargaining position of workers rise, therefore, with the replacement rate, defined as the ratio of

---

[2] Note that the equilibrium wage and labour-income share are exogenous, not constant. According to the factor-price frontier, they move inversely with the user cost of capital, and thus with the real after-tax interest rate. See Draper and Huizinga (2000) for further analysis. Because we want to focus on the effects of a wage push, we abstract from the effects of interest rate fluctuations in this paper.

unemployment benefits to the wage rate. It also rises with the level of taxation, because taxes increase the relative attractiveness of working in the informal sector. The level of taxation is often measured by the wedge, defined as the ratio of the real labour costs of the firm to the purchasing power of the employee. It is the sum of direct and indirect taxes and social security contributions. A third determinant of the bargaining position of workers is the unemployment rate, since higher unemployment makes it more difficult to find another job. The overall result is that bargaining results in a labour-income share that rises with the replacement rate and the wedge and falls with the unemployment rate. Within the context of zero technological progress, this implies that the wage also depends on the replacement rate, the wedge and the unemployment rate.[3]

There are three types of sources for a wage push in this model. First, wages may rise because of higher taxes or a higher replacement rate, that is, as a result of government policy. Second, there may be an autonomous increase in union aggressiveness. This may be because unions care less about the unemployed, or for some generic reason. In terms of the wage equation, this corresponds to a reduction in the coefficient of the unemployment rate and an increase in the constant term, respectively. Third, unemployment may have been reduced. The first two types of sources imply a shift in the wage – unemployment schedule and cause what we will refer to as an exogenous wage push. A reduction in unemployment causes a shift along the wage – unemployment schedule and we will call the wage push endogenous in this case. Similarly, wage moderation may be exogenous - policy induced or caused by a shift in union preferences - or endogenous, caused by a rise in unemployment.

Suppose that, starting from equilibrium, there is a permanent exogenous wage push, in the sense that union preferences have shifted. What will happen? On impact, the wage shoots up. Then, a dynamic process of adjustment starts which conceptually at least, we may think of as consisting of two phases. First, the increase in the relative factor price of labour induces firms to raise the capital labour ratio. Since the capital stock is given in the short run, employment falls. The rise in unemployment lowers the wage somewhat, but not enough to bring it back to the original level. The economy reaches a short-run equilibrium in which costs are minimised given the capital stock, and in which wages, the capital-labour ratio and unemployment are all higher than before. However, this is not a long-run equilibrium. The wage is higher than warranted by the factor-price frontier, so firm profits are negative. Specifically, the return to capital is inadequate. Firms stop investing and the capital stock declines over time, which further reduces employment, raises unemployment and reduces union wage demands. As the wage continues to drop, the cost minimising the capital-labour ratio also falls, so the disinvestment outpaces the drop in employment in this phase. The adjustment process ends when unemployment has risen

---

[3] Note that structural labour productivity in the case of no technological progress depends on the structural capital-labour ratio, which as argued above, is constant.

so far that the wage rate has returned to its general equilibrium value, which is the same value as before the wage push started. At this point firms can earn zero profits again and stop disinvesting. The capital-labour ratio has returned to its original value as well. So, in the new long run equilibrium, the wage rate and the capital-labour ratio are both back to their original values. However, unemployment is higher. Unemployment has risen so as to offset the effects of the exogenous wage push through endogenous wage moderation.

So, a shift in union preferences towards higher wages leads in equilibrium not to higher wages, but to a higher level of unemployment. The wage push raises, ceteris paribus, union wage demands. To keep the negotiated wage outcome in line with the equilibrium wage, unemployment has to rise. By similar reasoning, a wage push caused by an increase in the wedge and the replacement rate also raises equilibrium unemployment. Equilibrium unemployment in this model is therefore not constant, but depends on union preferences, the wedge and the replacement rate.[4]

What happens to labour productivity during the adjustment process? Initially, labour productivity rises with the increase in the capital labour ratio. Then, in the second phase of the adjustment process, it falls back down to its original level, as does the capital labour ratio. So a wage push initially leads to a rise in labour productivity. However, this increase in labour productivity is not sustainable, as it is based on excess capital, which commands a very low return. In the end the only effect of a wage push is higher unemployment.

In order to bring unemployment back to its original level as well, the dynamic process described above has to be travelled in the opposite way. The union has to abandon its relatively aggressive wage policy and revert to its original bargaining position. Compared with the more aggressive policy, it therefore has to pursue a policy of wage moderation. This will initially imply lower wages, a rise in employment, a lower capital-labour ratio and lower labour productivity, but in the end only higher employment.

If we consider a whole cycle of recovery from a wage push, the model predicts that both exogenous and endogenous wage moderation take place, with a prolonged period of low labour productivity. This low productivity is efficient however, because it occurs when unemployment is high and thus labour is relatively abundant.[5] Reduced labour productivity growth is, therefore, an efficient temporary side effect of wage moderation, not an argument against it.

---

[4] In addition, it depends on the after tax real interest rate through its effect on the equilibrium labour-income share. See footnote 2 and Broer *et al.* (2002).

[5] By similar reasoning, the original increase in labour productivity was not efficient, as the increase in wages that caused it, did not reflect the true scarcity of labour.

This model is very stylised. Its strength is that it provides some clear basic insights about the general equilibrium effects of (policies of) wage moderation. Drawbacks are that other mechanisms are ignored. The remainder of the paper sketches some extensions of the model.

One extension is to allow for terms-of-trade effects. The basic model deals with a small open economy with free entry in the product markets. In that case the national economy can expand without terms of trade effects. This implies that production capacity will increase as long as the wage is below the equilibrium wage. This only stops when all available labour is employed, so that in equilibrium the capital-labour ratio is fixed and wage moderation has no lasting effect on labour productivity. If instead, we assume that the exports can only expand by accepting a loss in the terms of trade, in equilibrium reduced unemployment can only be achieved by a reduction in real wages, a lower ELIS, and lower labour productivity.

Another extension is to allow for heterogeneous skill levels in the labour force. If skills are exogenous, the analysis may be applied to each skill level separately. A policy of wage moderation may then be targeted, for instance towards groups of workers with high unemployment. In the Netherlands, that would mostly mean those with relatively low skills. That would change the overall mix of skills of the employed and thus macro productivity.

A third extension considers a model of efficiency wages, instead of bargaining, as the foundation for the wage equation. This would not change the results on the relationship between labour-income share and unemployment in a qualitative way, because the wage equation still contains the same elements. The value of the job to a worker, which is the driving force behind wage setting, is still at least partly determined by the value of the outside option, just as in bargaining. The complication is that wages are directly linked to worker productivity through an effort function. Whether labour productivity will be the same across equilibria then depends on the precise way the effort function is modelled.

14

3 Exogenous labour augmenting technological progress

We now allow for technological progress in the model. Assume that there is an exogenous rate of labour augmenting technological progress. This is a natural way to extend the simple static model of the previous section, because labour augmenting technological progress is the only type of technological progress consistent with a steady state growth path.

Technological progress shifts the factor-price frontier out. However, if we measure labour not in workers, but in efficiency units, the production function and the factor price frontier do not change. For a given level of the user cost of capital, there is still a unique and constant level of wages per efficiency unit of labour that allows firms to realise a normal level of return (zero profits) in equilibrium. The corresponding actual wage level grows with the level of labour augmenting technological progress. At this zero-profit wage per efficiency unit, the capital stock also grows with the rate of technological progress, so that the equilibrium labour-income share ELIS is constant.

The wage equation does not change much either. If we measure wages in efficiency units, the wage equation does not change at all. If we measure it in actual wages, we have to adjust it for the rate of technological progress. The wage rate divided by structural productivity equals the labour-income share. So the wage equation remains intact if we put on the left hand side either the wage per efficiency unit or the labour-income share.

The analysis proceeds in the same way as in the previous section, by confronting actual outcomes for the wage outcome, based on the wage equation, with the equilibrium value, based on the factor price frontier. For the concept of wage outcome we can use the wage per efficiency unit or the labour-income share. In empirical studies one may prefer the latter, since it operationally easier to use.

4   Endogenous technological progress

In this section we extend the analysis by allowing for endogenous technological progress. Firms optimally choose the amount of resources they devote to the creation of new techniques, or new products, to maximise profits. In this setting a more aggressive wage policy of unions creates an incentive for firms to devote a larger part of their resources to the invention and adoption of labour-saving techniques. Our interest is in the effect of a wage push on this process.

The effects of a wage push on technical change have been investigated in a recent set of papers by Acemoglu. Acemoglu (2002, 2003) distinguishes a final goods sector that uses capital and labour, and a separate R&D sector that produces new labour-saving and capital-saving intermediate goods, or equivalently, new technologies. New technologies are developed using scientists and existing knowledge of factor-saving production techniques. Firms in the R&D sector employ their scientists in developing the type of new technology that is the most profitable to supply to the final goods sector. Both types of technologies are developed under decreasing returns to scale in the number of scientists. Since Acemoglu is interested in the direction of technological change, the total number of scientists in the R&D sector is fixed.

It is intuitive that a rise in wages in the final goods sector induces a shift toward labour-saving technological progress, but this is not necessarily the result. At a given technology, a rise in wages also raises the capital labour ratio. As a result, there are two effects on the incentive to save on labour. The increase in the wage increases the incentive to save on it. The reduction in the relative use of labour reduces it. The first effect is called the price effect and the second the market-size effect. Acemoglu shows that for elasticities of substitution between capital and labour smaller than one, the price effect dominates. This makes sense, since then a rise in wages raises the labour cost share at the old technology, and thus the incentive to save on labour cost. We assume that the elasticity is indeed smaller than one, so a rise in wages causes a shift towards labour saving (labour augmenting) technological progress.

We can now sketch the effects of a wage boost in this economy. It starts out the same way as in the previous section. On impact, wages rise. Then, at the given levels of the capital stock and technology, employment falls, the capital-labour ratio rises, profits turn negative, and the labour cost share rises. The second part of the dynamic adjustment becomes more complicated as firm investment policy reacts in two ways. The negative profits induce disinvestment as before. In addition, firms react to the higher labour cost share by devoting more of their resources to labour saving techniques. Scientists will therefore be reallocated from the invention of capital-saving techniques to labour-saving research. This reallocation within the R&D sector boosts labour-saving technical progress, and lowers capital-saving technical progress. This further reduces employment.

So, the effect of a wage push on employment is unambiguously negative. What about wages? There is an increase in labour augmenting technological progress. The previous section showed that such technological progress, ceteris paribus, raises wages. May it cause a boost in wages here as well? The answer is no. The wage push does not cause a net rise in technological progress, but only a shift in its direction: more labour augmenting and less capital augmenting technological progress. Moreover, this shift is bad for wages. With limited substitution possibilities between capital and labour, a shift away from capital-augmenting technical progress will make capital relatively scarce in efficiency units compared to labour. This causes a reduction in the capital-labour ratio in efficiency units which hurts wages. The shift in technology makes labour more productive, but less valuable.

So, both from the technology side and from the labour market side (the increase in unemployment) there is a negative pressure on wages. Relative to the original growth path wages fall. This implies that also the incentive of the R&D sector to devote additional resources to the invention of labour-augmenting techniques gradually disappears. As a result, the percentage of scientists working on labour-saving technology gradually swings back to the pre-shock level. Acemoglu shows that the new long-run equilibrium is characterised by the same labour share, capital-labour ratio in efficiency units and the same growth rates as on the path without the wage push.[6] To sustain this equilibrium, unemployment must be higher.

To a large extent we have duplicated the results of the previous section with exogenous labour-saving technological progress. There are, however, two important additions. First, because of decreasing returns to scale in the production of the two types of innovations, the reallocation of scientists back and forth between capital- and labour augmenting techniques causes an inter-temporal inefficiency in the production of innovations. As a result, total factor productivity is lower on the new growth path than on the old one. In fact, we can be more specific than that, as Acemoglu shows that in the long-run the level of capital-augmenting technical progress is constant and does not change between equilibria. It follows that labour efficiency must be lower on the new path. The economy eventually returns to the same growth path, but when it reaches it, it has progressed less far along it than if there had been no wage push. The economy has 'lost time' by switching the scientists back and forth. Compared with the original growth path, labour productivity first shoots up during the first phase of the adjustment process, then has a period of relatively slow growth which lasts so long that the original gain is more than lost. When the economy returns to equilibrium, labour productivity growth is the same as before, but the loss in levels is never made up. Furthermore, if the increase in unemployment is to be reversed, an exogenous wage-moderation shock is needed. This again involves switching of scientists back and forth, causing a further lag in the level of labour productivity.

---

[6] This depends on a stability condition that is satisfied if the elasticity of substitution between capital and labour is below one. This is the empirically relevant case.

The second addition is that switching and reversing a direction of technological change may well cause the adjustment process to last longer than an adjustment that merely involves (dis)investment of homogeneous capital. Technological progress is embodied in capital and so the adjustment process may well not be completed until the capital with the 'wrong' technology is scrapped.

We have analysed the effects of a wage push starting from equilibrium and found its effects to be rather negative, both in terms of unemployment and productivity. Does this imply that it is advisable to push the other way, to try to keep wages as low as possible? Or can wages also be too low? The analysis in this section indicates that pushing wages to very low levels is bad for productivity growth as well. In fact, in terms of productivity, the analysis is qualitatively symmetric. Wages below equilibrium induce a shift away from labour-augmenting technological progress. Low wages are not sustainable as the shift in technology – the shift is labour biased in this case – and low unemployment will put upward pressure on wages. So, wages will go back to equilibrium. The benefit is a reduced level of equilibrium unemployment. However, the shifting back and forth of scientist leads to an irreversible drop in the level of labour productivity relative to the original path. If unemployment was inefficiently high on the original path, the welfare effect of the fall in unemployment dominates, and the accompanying drop in labour productivity is an efficient side effect as it speeds up the absorption of labour. However, if unemployment was already at an efficient level, or in the extreme case zero, wage moderation is counterproductive and simply hurts productivity growth.[7]

So, both a wage push and excessive wage moderation may have negative effects on long-term productivity. In terms of risk, a wage push is more dangerous. The productivity effects are similar, but the negative effect of a rise in unemployment only occurs in a wage push. The best policy in this model, however, would be not to tinker with wages to manipulate productivity at all. Welfare is optimised with unemployment at its efficient level, and wages growing based on the factor-price frontier.

---

[7] Wage moderation may still be beneficial, for instance as part of an active labour market policy.

5   Creative destruction

In this section we extend the model to allow for endogenous technology adoption. We return to the situation where technological possibilities evolve in an exogenous way. The question we ask is whether the latest technology will actually be adopted to its full potential. This may not be the case, for instance because the economy is not able to transfer resources from old techniques to the newer ones at the appropriate level and pace. If this transfer is more sluggish than optimal, the economy will experience sclerosis, that is, too many old and relatively inefficient techniques will be in use. Our interest is in the possible role a wage push plays in this process.

The model is based on a series of papers by Caballero and Hammour (1996, 1998a, 1998b) and Blanchard (1997). It involves a Schumpeterian model of growth through creative destruction in a vintage setting. If it is profitable, new firms will be created using the latest technology. Once older firms become unprofitable, they are scrapped. The important part of this analysis is that the decisions to create or scrap firms are taken separately and therefore, are not necessarily synchronised.

Prima facie, this Schumpeterian framework of creative destruction offers two different ways to boost growth. We can stimulate creation, or we can foster destruction. An example of the first route is a proper innovation policy. An example of the second type of policy would be a wage push, which destructs old production units so as to free up the resources that can be used in newly created production units. If the latter policy is an effective way to foster growth, it follows that the opposite policy, wage moderation, hampers innovation and growth by counteracting destruction.

Caballero and Hammour (1998) consider the general problem of investment in a project when the return to this investment depends on the actions of other agents, who enter into joint production with the investor. Typical examples are investments made by firms in worker skills, the career choices made by young workers, or the capital investment of firms in unionised industries. In such cases, the investment, once it is made, is worth less outside of the project than inside. Skills acquired may be worth less outside of the specific production match in which they were formed. Dismantling a plant and selling the capital goods invested does not recoup the original investment. The investment costs therefore acquire a sunk-cost aspect, i.e. they are wholly or in part specific to the project considered.

In a world with complete and binding contracts, the degree of specificity of investment does not affect the investment decision. The agents involved enter into a binding contract, which specifies the division of the return to the investment, contingent upon each state of the world. With incomplete contracts, the investor faces a problem. The sunk costs that are part of the

project imply the existence of quasi rents, i.e. the income that flows from the project, not counting the return to the sunk costs. In a situation where property rights cannot be fully protected by contracts, this makes these sunk costs vulnerable to rent-seeking behaviour of business partners. The partners in the contract will try to appropriate part of the return of the investment, not taking into account the initial sunk cost.

Labour relations are particularly sensitive to appropriation because contracts are inherently incomplete. Since the abolition of slavery, labour is inalienable to humans and contracts cannot enforce the continued participation of labour in a project, or indeed the effort level of the worker. In addition, labour market legislation intended to provide job security to workers makes it more difficult for capital to dissolve itself from a match, reinforcing the asymmetry. As a result, workers and unions have a strong bargaining position and are able to appropriate part of the quasi rent of a project.

Of course, investors are aware of the possibilities of rent appropriation before the investment project starts. As a result, investment projects are either not started, or are carried out at a suboptimal level. In equilibrium, the investor must still earn a non-negative profit, which includes a normal (i.e. competitive) return on the sunk cost. Caballero and Hammour (1998a) show that this implies that the appropriating factor (labour) must be partly unemployed. Unemployment lowers wages sufficiently to allow firms to earn an ex-post return high enough to make up for the initial sunk cost of the investment project and thereby earn a zero net rent. Thus, the wage push does not lead to higher wages in the new firms, but to a reduction in the number of new firms and an increase in unemployment. The net result is an under-utilisation of resources, lower production than in the first-best equilibrium, and a loss of welfare.

What happens to productivity if unions become more aggressive in their rent-seeking behaviour? Surprisingly, Caballero and Hammour (1998a) show that in equilibrium a wage push leads to more sclerosis, that is, the scrapping age for old firms rises. The reason is that, as we saw above, the net effect of a wage push in general equilibrium is a reduction in the number of new firms and an increase in unemployment. This reduces the probability that a worker in an old firm can find a job in a new firm if he becomes unemployed. This reduces the outside option of workers in old firms and hence their bargaining position. The net result is that the wage in the oldest existing firms actually declines, so that these firms remain in operation longer.[8] Thus in equilibrium the average age of the old firm rises and average productivity falls.

---

[8] Bargaining in this model takes place at the firm level. Firms and workers both receive as income their outside option plus a share in the surplus (defined as the value of output minus the combined value of the outside options of the firm and the workers). A wage push is interpreted as an increase in the share of the surplus going to labour. For a marginal firm, there is no surplus, so both firm and worker receive their outside option. A reduction in the outside option of workers in marginal firms therefore unambiguously reduces their wage.

The fear of a wage push deters the formation of new capital. The owners of new capital know that once they have committed, they may be hit with high wage demand, but then it is too late to withdraw their capital. New investors wait until unemployment has depressed the general wage level to such an extent that investment on new capital will be profitable even after a wage push occurs. Assuming that expectations are fulfilled and the wage push indeed occurs, wages in the new firms end up at the expected level, where firms with new capital have zero profits. For the new firms, the wage push has no net effect on wages or productivity, except that the sector will be smaller. The negative effects of the wage push fall on the unemployed, who otherwise would have had a job, and on the workers in the existing old firms. For them it has become risky to leave their current jobs, because if they do so, they may end up unemployed. They stay longer with their current job at relatively low wages and with relatively low productivity. Unemployment created by the wage push thus adds a friction in the process of transferring resources from old to new industries, reducing productivity.

Note that this process is driven by the fear that a wage push may occur after the investment has been made. Unions may wish to counteract or reverse this process by promising to moderate wages, but that is not enough. The promise has to be credible. This credibility cannot be created by a contract, because such a contract cannot be enforced. In this model, credibility is created by a high unemployment rate. Another source of credibility is reputation. The success of the Wassenaar agreement may also partly be due to the fact that the broad consensus behind it created credibility that the actual wage moderation would not be reversed as soon as economic conditions improved. Reputation may also be enhanced by consistent behaviour. It will be hurt by a sudden unexpected wage push. The negative effects of such a wage push may, therefore, last for a long time.

This analysis points out a fallacy in the theory of cleansing recessions, which argues that recessions are useful to free up the resources for use in more productive enterprises (see, e.g., De Long 1990). If the recession is caused by a wage push, there is no place for the freed up resources to go. The resources in the old plants stay where they are and accept lower wages. Sclerosis is not cured, but actually worsens.

As in the previous section, we may ask whether the result that a wage push works out badly for unemployment and productivity means that the economy always benefits from lower wages. Again, the answer is no. Excessive wage moderation also causes sclerosis, since low wages allows outdated capital to still be profitable. Moreover, while sunk costs are generally associated with capital, workers may also have sunk cost in a specific investment. To give workers an incentive to make this investment, the wage rate has to be high enough. Excessively low wages may thus hamper worker investment in specific skills. So, in terms of productivity,

there is an optimal level of wages. The conclusion that wage policy is better not used for productivity reasons therefore remains valid.

6   X-inefficiencies

The analysis so far assumed that firm actions are efficient given the circumstances they face. They are cost minimising, profit maximising firms. Key notions underlying this behaviour are free entry, competition and full transparency with respect to the technological possibilities. If these underlying conditions are not met, the analysis in this paper is not valid. One may ask, therefore, whether there may still be a case for wage push if firms are not innovative because there is no competitive pressure to innovate. What if the Schumpeterian drive to innovate is absent, allowing firms, or rather their directors, to be lazy? Can a wage push be a substitute for competition?

It is quite possible that some individual firms and to some extent whole industries face insufficient competition. However, even if a lack of competition still reduces productivity growth, raising wage costs is a strange, indirect way to solve the problem. If the lack of competition is not addressed directly, weak firms may well be able to pass on the higher wage costs into higher prices and thus avoid bankruptcy. Thus, the result may only be higher inflation, not a solution to the problem of innovation. Implementing rigorous open competition, however, would ensure that the Darwinian selection mechanism works. Moreover, firms would try to benefit from the wage moderation by expanding production and employment. Wage policy, therefore, is unlikely to be an appropriate tool to deal with an uncompetitive economy and may have very negative side effects.

If there is sufficient competition, a successful search for process and product innovation will be dependent on the access to high quality technological knowledge and on the cost of R&D. It is in this area that policy challenges exist to improve the quality and accessibility of the knowledge infrastructure, the availability of knowledge workers, and the reduction of market failure in R&D: for example by translating positive externalities in fiscal policy measures.

7   Application to the Netherlands

How does the discussion in the preceding sections apply to the developments in the Dutch labour market in the last decades? In this section we try to interpret the events in the past decades in terms of the mechanisms expounded above.

Our model indicates that the labour-income share is a relevant and convenient concept to study wage dynamics relative to equilibrium. Figures 7.1 and 7.2 plot the labour-income share in enterprise income and the unemployment rate in the Netherlands between 1970 and 2002. Figure 7.1 shows that there was a strong wage push in the 1970's. This wage push was partly induced by rising replacement rates and taxes. The first prediction of our model is that the resulting high labour-income share is not sustainable, but is stopped and ultimately reversed by rising unemployment. Figure 7.2 supports this prediction. Unemployment rose steadily until the early eighties. The rise in unemployment, together with a fall in replacement rate and taxes, stopped and later reversed the rise in the labour-income share, after which the unemployment rate also fell again.

Figure 7.1   Labour share in enterprise income in the Netherlands
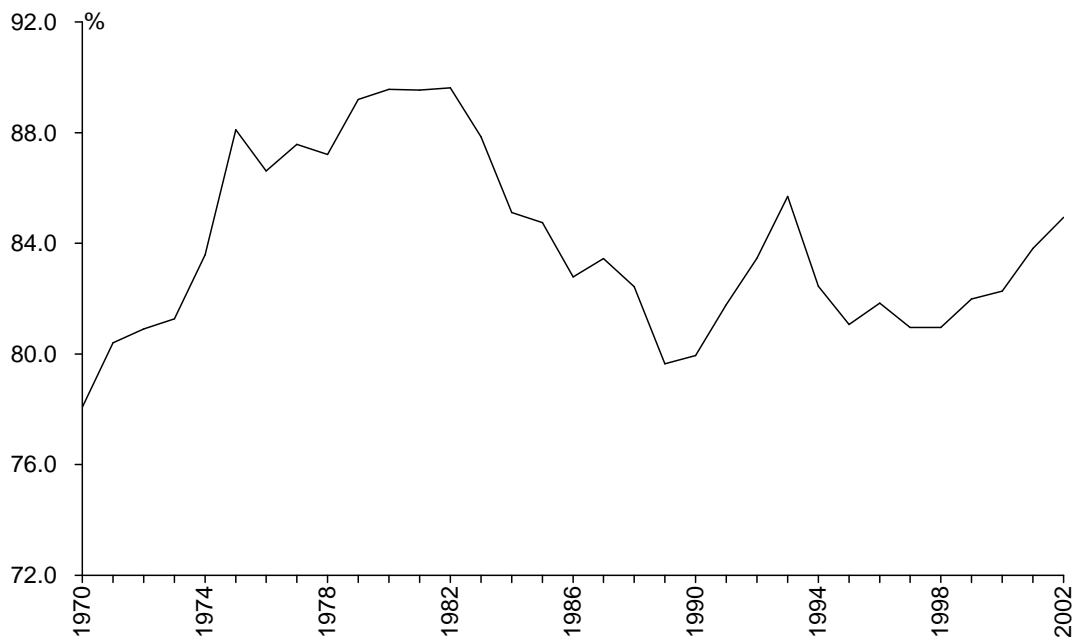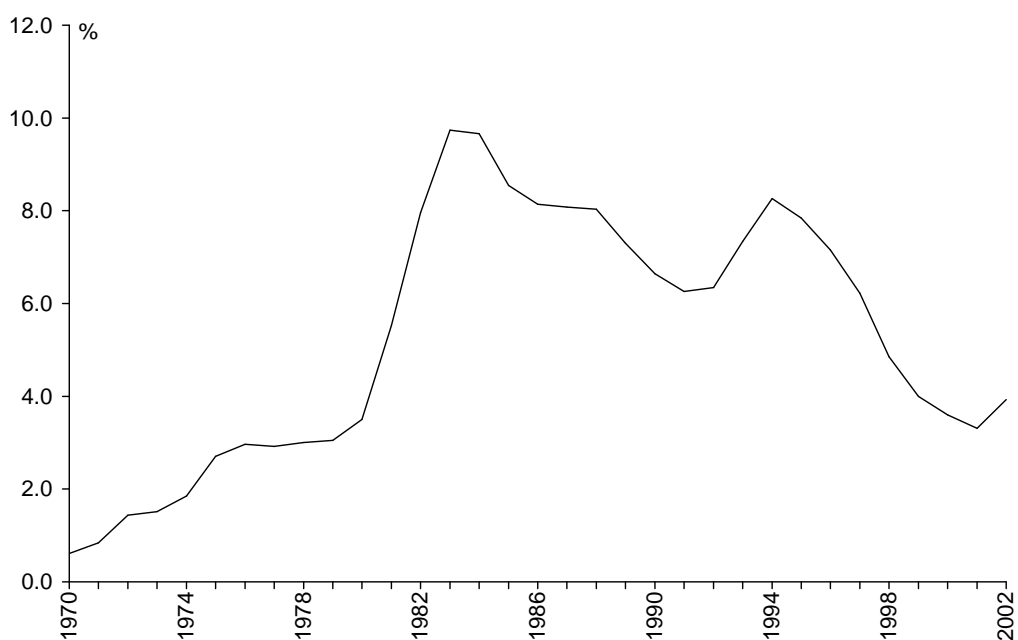
Figure 7.2   Unemployment in the Netherlands

Huizinga and Draper (2000) demonstrate this argument more formally. In an econometric study of the (equilibrium) labour-income share and unemployment, they find that, by and large, the predictions of the model hold up. In particular, unemployment rose when the actual labour-income share was above its equilibrium value and vice versa. The analysis indicates that there was wage moderation – in the sense that the actual labour-income share was below its equilibrium value - almost continuously between 1983 and 2000, with an exception in the early nineties. This corresponds with a continuous drop of the unemployment rate, again with an exception in the early nineties. An analysis with the JADE model further confirms the analysis (see CPB, 2003, for a description of the model and more detailed simulation results). A continued (not reversed) 1% point rise in the labour-income share leads to a continuous increase in the unemployment rate of about .1% per year (see also CPB, 2001).

Previous research on the employment growth in the eighties and nineties (see, e.g., CPB, 2001, and Huizinga, 2001) also indicates what type of wage moderation took place in that period. It was both exogenous and endogenous. The exogenous part was due to the reduction in taxes and replacement rates, and the endogenous part due to the very high unemployment rate in the early eighties. Numerically, the unemployment effect took the lion's share. Perhaps more surprisingly, the analysis indicates that there was no indication of exogenous wage moderation due to a change in union preferences. Econometric testing indicates that there was no structural break in the wage function in the early 1980's. So, the Wassenaar agreement did not change union preferences, it just induced unions to moderate wage demands in response to the high unemployment rate and the reduction in taxes and replacement rates. However, as indicated in

section 5, the formal status of the agreement may still have benefited the economic recovery because it made it more credible to investors that the wage moderation would be sustained.

What about the effects on productivity? The model predicts that an exogenous wage push ultimately does not affect productivity or the labour-income share unless the model is extended to allow for, for instance, a change in the terms of trade. An analysis with JADE confirms this. An exogenous wage push of 1% leads in the long run to an increase in unemployment of 0.5%-point, a small productivity gain (0.1%), and a small rise in labour's share in value added of enterprises (0.1%). The change in productivity and the labour share are caused solely by a gain in the terms-of-trade.

Figure 7.3 plots the log of the GDP per hour (in 1999 US $) for the Netherlands, the US and the EU-14 from 1950 till 2002.[9] The dominant feature of the figure is one of convergence, presumably based on a process of catching up. Looking more closely at turning points in figures 7.1 and 7.3 (and based on the availability of consistent data), we distinguish six periods: 1950-1966, 1967-1976, 1977-1982, 1983-1989, 1990-2000 and 2000-2002. Table 7.1 presents the average productivity growth rates for GDP per hour and for GDP in those periods.

Figure 7.3   GDP per hour in the Netherlands, the US and the EU-14

---
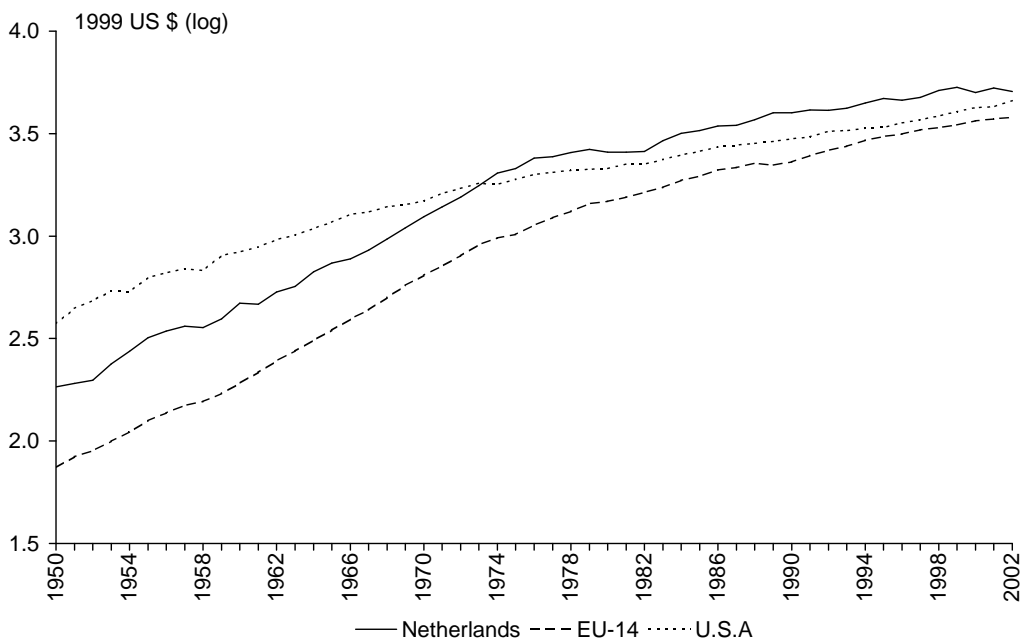
[9] The EU-14 is the EU-15 excluding Luxembourg, for which no data on hours are available. For the Netherlands, data on hours between 1950 – 1960 and 1960 – 1969 are calculated through interpolation.

Table 7.1   GDP growth Netherlands, EU-14 and USA, 1951-2002

	Average annual GDP growth per hour worked			Average annual GDP growth		
	Netherlands	EU-14	USA	Netherlands	EU-14	USA
	annual percentage changes					
1951-1966	4.2	4.8	3.1	4.8	5.0	4.0
1967-1976	5.0	4.3	2.1	3.9	3.4	2.7
1977-1982	0.5	2.7	0.8	1.1	1.9	2.4
1983-1989	2.7	2.4	1.6	2.8	2.8	4.3
1990-2000	0.9	2.0	1.5	3.0	2.1	3.1
2001-2002	0.3	0.8	1.7	0.7	1.3	1.3
1951-2002	2.8	3.4	2.1	3.4	3.4	3.4

EU-14 excluding Luxemburg

Source : University of Groningen and The Conference Board, GGDC Total Economy Database, July 2003

Our theory and the data suggest the following story. The first two decades saw a steady rise in productivity in all three regions, and a steady catching up of productivity in the Netherlands and the EU-14. From the late 1960's until the second half of the 1970's, productivity growth in the Netherlands accelerated in absolute terms, and relative to the US and the EU-14 to the highest level in any period or region. The level of productivity per hour even surpassed the US level, so that the catching-up process must already have levelled off. The rapid rise in productivity was, according to our theory, partly due to the wage push in that period. This caused firms to substitute capital for labour, raising productivity, but also unemployment. Moreover, substitution could not prevent profits from falling. As predicted by our theory, the wage and productivity gains induced by the wage push turned out not to be sustainable. In the late 1970's and early 1980's, the rise in the labour income was stopped. Productivity growth almost came to a full stop, and the gains made in the previous period relative to the EU-14 were more than lost. After 1982 the recovery started. The labour-income share fell because of the high unemployment rate and the reductions in the replacement rate and the tax rate. Dutch productivity growth also recovered and even outpaced the US and EU-14 growth rates.

In the 1990's the labour-income share initially rose, but then fell again in the mid-1990's. The fact that wage moderation was resumed again was partly due to the sharp increase in the supply of labour in the 1990's. This allowed the economy to expand for a longer period before running into a labour-supply shortage. The continued wage moderation, the high credibility of it, and the fast growth of labour supply, caused a very rapid growth of employment in this period. The same factors also reduced labour productivity growth in that period, as firms substituted labour for capital. The direction of technological progress may also have shifted from labour to capital. Eventually, the expansion did lead to a labour-supply shortage that reversed the wage

moderation in the second half of the 1990's. It is still too early to judge the effects on productivity in the last couple of years.

The reasoning here is very informal. It leaves out important aspects of productivity such as competition, education, ICT and business cyclical components other than wage dynamics. Also, as mentioned in section II, the change in composition of the labour force may have played a role. For instance, Pomp (1998) argues that the freezing of the minimum wage in 1983 increased the relative share of low wage, low skill jobs in the economy, which led on average to around a 0.2% point decline in macro productivity between 1983 and 1995. Also, data on productivity are fraught with measurement problems, especially in an international comparison. However, overall, it seems that the wage push in the 1970's and early 1980's, its subsequent reversal after 1982 and the labour supply shock in the 1990's, set in motion a period of adjustment in the labour-income share and productivity that fits the theory reasonably well.

In particular, the empirical evidence supports the theory that a wage push has a temporary, unsustainable effect on labour productivity.[10] This is in contrast to the suggestion of e.g. Kleinknecht that the effect of a wage push on productivity is a structural one. This difference is of central importance to the policy conclusion. Kleinknecht argues that a wage push is desirable because of its positive effect on structural productivity. Our analysis indicates that a wage push initially indeed raises productivity, but this rise in productivity is temporary and generally inefficient. The rise in productivity comes about because of a temporarily high capital-labour ratio and a shift in the direction of technical change. The wage push also causes unemployment. Moreover, while the effect on productivity is temporary, the effect on unemployment is permanent. A wage push, in our analysis, is therefore generally undesirable. Note that our model does not deny the existence of a structural relationship between wages and productivity, but in our view causality runs the other way. Our analysis, for instance in section 3, indicates that steady structural technological progress causes steady growth of wages, not the other way around.

---

[10] DNB (2003) also supports this result. The article shows that in a regression analysis there is no positive relationship between a wage push and future labour productivity growth.

8 Conclusion

Some economists argue that wage moderation reduces labour productivity by allowing marginal firms with low profits and little innovation to remain in existence. Wage moderation thus undermines the need for innovation. These economists, therefore, call for a wage push to raise productivity growth. The analysis in this paper indicates that a wage push is likely to raise productivity in the short run, but it is unlikely to raise productivity in the long run, and may well hurt it. The main message of the paper is that it is probably best not to use wage policy at all as a tool to influence productivity. As a tool against unemployment, however, the analysis indicates that it is very effective. Wage moderation remains, therefore, an effective and efficient tool against unemployment. The key to improve innovation is an effective competition policy.

References

Acemoglu, D., 2002, Directed Technical Change, *Review of Economic Studies*, Vol. 69, pp. 781-809.

Acemoglu, D., 2003, Labor- and Capital-Augmenting Technical Change, *Journal of the European Economic Association*, Vol. 1(1), pp. 1-38.

Blanchard, O.J.,1997, The Medium Run, *Brookings Papers on Economic Activity*, pp. 89-158.

Broer, D.P., D.A.G Draper and F.H. Huizinga, 2000, The Equilibrium Rate of Unemployment in the Netherlands, *De Economist*, Vol. 148, pp.345-371.

Caballero, R.J. and M.L. Hammour, 1996, On the Timing and Efficiency of Creative Destruction, *Quarterly Journal of Economics*, Vol. 111, pp. 805-852.

Caballero, R.J. and M.L. Hammour, 1998a, The Macroeconomics of Specificity, *Journal of Political Economy*, Vol. 106, pp. 724-67.

Caballero, R.J. and M.L. Hammour 1998b, Jobless Growth: Appropriability, Factor Substitution, and Unemployment, *Carnegie-Rochester Conference Series on Public Policy*, Vol. 48, pp. 51-94.

CPB, 2001, *Macro Economic Outlook 2001*, special section on Employment in the 1990s (in Dutch).

CPB, 2003, JADE: a model for the Joint Analysis of Dynamics and Equilibrium, CPB Document No. 30.

De Long, J. B., 1990, 'Liquidation' Cycles: Old-Fashioned Real Business Cycle Theory and the Great Depression, NBER Working Paper no. 3546.

DNB, 2003, "Leidt loonmatiging tot een lagere groei van de arbeidsproductiviteit op lange termijn?" (Does wage moderation lead to a lower labour productivity growth in the long run?), Kwartaalbericht December 2003, pp. 43-52 (in Dutch).

Draper, D.A.G and F.H. Huizinga, 2000, ELIS: Equilibrium Labour Income Share, *De Economist*, Vol. 148, pp.671-684.

Graafland, J.J and F.H. Huizinga, 1999, Taxes and benefits in a non-linear wage equation, *De Economist*, Vol. 147, pp. 39-54..

Huizinga, F.H., 2001, Employment in the 1990s, *CPB Report 2001/1*, pp. 22-29.
Kleinknecht, A., 2003, Causes of the Dutch job miracle: there is no free lunch! A reply to Fase and Tieman, *De Economist*, vol. 151, pp. 329-333.

Naastepad, C.W.N. and A. Kleinknecht,, 2002, The Dutch Productivity Slowdown: The Culprit at Last?, mimeo, Delft University of Technology. (downloadable from http://www.tbm.tudelft.nl./webstaff/ron/EJ-0702.pdf).

Pomp, M., 1998, Recent Trends in Dutch Labor Productivity: the Role of Changes in the Composition of Employment, CPB Working Paper No. 98.