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**Working Paper**

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Wage formation under low inflation

by

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# Wage formation under low inflation\*

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## Abstract

This paper reviews the literature on the effects of low steady-state inflation on wage formation, focusing on four different effects. First, under low inflation, downward nominal wage rigidity (DNWR) may prevent real wage cuts that would have happened had inflation been higher. Second, wages (and prices) are given in nominal contracts, and inflation affects both how often wages are adjusted, and to what extent wages are set in a forward-looking manner. Third, incomplete labour contracts may provide workers with scope for inflicting costs on the firm without violating the contract, thus forcing the firm to accept a rise in nominal wages. Fourth, if effort depends on wages relative to a reference level, and workers and firms underweight inflation when updating the reference level, positive but moderate inflation may reduce wage pressure. The paper ends by a brief survey of empirical evidence, and a discussion of whether labour markets may adapt to a low inflation environment.

JEL Classification: J5, J3, E31

Keywords: wage formation, nominal contracts, downward nominal wage rigidity, inflation

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## 1 Introduction

Economists and practitioners now agree that monetary policy should aim at low inflation. Yet a number of economists and observers have argued that if monetary policy aims at inflation that is too low, this may involve considerable costs for society (Tobin, 1972, Holden, 1994, Akerlof, Dickens and Perry, 1996, 2000, the Economist, 2003). A key concern is that under low or zero inflation, downward rigidity of nominal wages may induce higher wage pressure, involving higher equilibrium unemployment. Other economists have countered this view, arguing that any downward nominal wage rigidity that may exist is the result of an inflationary environment, and that society will adapt to a zero inflation policy without large and persistent effects on output and unemployment (Ball and Mankiw, 1994, Gordon, 1996).

In this paper I shall review what the economic literature has to say on the effects of low steady-state inflation on wage formation.<sup>1</sup> Crudely, one can distinguish four arguments for why inflation may affect wage setting. First, under low inflation, downward nominal wage rigidity (DNWR) may prevent real wage cuts that would have happened had inflation been higher. Second, wages (and prices) are given in nominal contracts, and inflation affects both how often wages are adjusted, and to what extent wages are set in a forward-looking manner. Third, incomplete labour contracts may provide workers with scope for inflicting costs on the firm without violating the contract, thus forcing the firm to accept a rise in nominal wages. Unless there is sufficient inflation to provide “room” for this “minimum” wage growth, wage pressure will rise, thus increasing unemployment. Fourth, if effort depends on wages relative to a reference level, and workers and firms overweight inflation when updating the reference level, positive but moderate inflation may reduce wage pressure.

Among many economists, these mechanisms will be met with considerable scepticism, based on the argument that rational agents care only about real variables, so that any effect of nominal variables must be due to money illusion that will disappear over time. However, as will become apparent below, many of the mechanisms are developed in models with rational agents, who only care about real variables. Thus, they are not subject to this critique. Other effects do hinge on money illusion, but these effects are accompanied by considerable supporting evidence.

A basic underlying assumption throughout the literature that I review is that there is some sort of nominal rigidity in wages. This assumption can be justified in various ways. First, it is a fact of life that, in most industrialised economies, most workers have their wage set in some type of contract, either a collective agreement or an individual labour contract. Payment is typically specified in nominal terms, although annual, partial indexation to the consumer price index is sometimes used, in particular in periods of high inflation. Such contracts are not ad-

justed continuously; see survey in Taylor (1999), and Calmfors et al. (2001) for documenting the extensive coverage of collective agreements in most Western European countries.

There may be several reasons for the prevalence of rigid wage contracts. One aspect is that contracts may prove useful so as to prevent continuous haggling over the wage level. Contracts might also be useful to share risk or to protect against opportunistic behaviour. Nominal contracts might be practical, as continuous or frequent adjustment to some price index might involve additional cumbersome calculations and updating. Indexation may also entail a risk (as perceived of the wage setters) that the index exhibits surprising and unwarranted changes. Gottfries (1992) provides a possible justification for why wage contracts are set in nominal terms, as seen from the point of view of the firm and the insiders (the current workforce).

Note that what matters for the issues discussed here is not the rate of inflation *per se*, but to what extent there is room for nominal wage growth. Clearly, if there is high productivity growth, or low growth in import prices, there will be more room for nominal wage growth even at low cpi inflation. This distinction is important in empirical work and in policy discussion, but will be neglected in the following.

The paper does not aim to explore what the optimal rate of inflation is. As is well known, inflation involves a number of costs and benefits that are not directly related to wage setting (interaction with tax systems, effects on money holdings, seignorage, uncertainty and the effects of zero bound to nominal interest rates, etc.). These costs and benefits are neglected in the present paper.

The remainder of the paper is organised as follows. In section 2, I discuss the effects of downward nominal wage rigidity. The effect of inflation on staggered nominal wage contracts is surveyed in section 3. Section 4 covers the effect of incomplete labour contracts and section 5 deals with multi-level bargaining. In section 6, I discuss near-rational wage setters. Some of the empirical evidence is surveyed in section 7. Section 8 discusses to what extent society might adapt to a low inflation environment. Section 9 concludes.

## **2 The effect of downward nominal wage rigidity (DNWR)**

The seminal contribution on DNWR is Tobin (1972). Tobin argued that low (zero) inflation involves higher unemployment because nominal wages are rigid downwards. Sector-specific demand shocks imply that demand varies between different parts of the economy. In the parts of economy where there is excess demand, wages increase, while in parts of the economy with excess supply, DNWR implies that wages do not go down (or they go down less). Thus,

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<sup>1</sup> Clearly, an unanticipated reduction in inflation induces higher real wages, and thus also affects output. Such temporary effects are neglected here.

widespread excess supply – lower aggregate employment – is necessary to keep inflation very low.

Several different justifications for DNWR have been suggested in the literature:<sup>2</sup>

- co-ordination failure and the concern for relative wages.
- fairness; nominal wage cuts are viewed as unfair
- legal restrictions: wages are given in contracts that can only be changed by mutual consent

Co-ordination failure was a key argument of Keynes (1936). He argued that workers are concerned about relative wages, and thus oppose nominal wage cuts as this leads to lower relative wages. Workers are less opposed to the same reduction in real wages if it takes place via higher prices, as this does not affect relative wages. Bhaskar (1990) provides additional microfoundations for this idea, based on the assumption that workers' disutility of being paid less than others is greater than the utility gain of being paid more.

The fairness argument – that employers avoid cutting nominal wages because employees and employers think that nominal wage cuts are unfair – is the common hypothesis underlying much empirical work. Many economists are sceptical towards this idea, as it involves money illusion, and thus runs counter to the standard rationality arguments. However, there is now considerable survey evidence by Bewley (1999) and Shafir, Diamond and Tversky (1997), among others, documenting that money illusion does exist. Fehr and Tyran (2001) report experimental evidence that money illusion may have important effects. Akerlof, Dickens and Perry (1996) explore the consequences of DNWR within a simulation model, formalising the ideas of Tobin (1972).

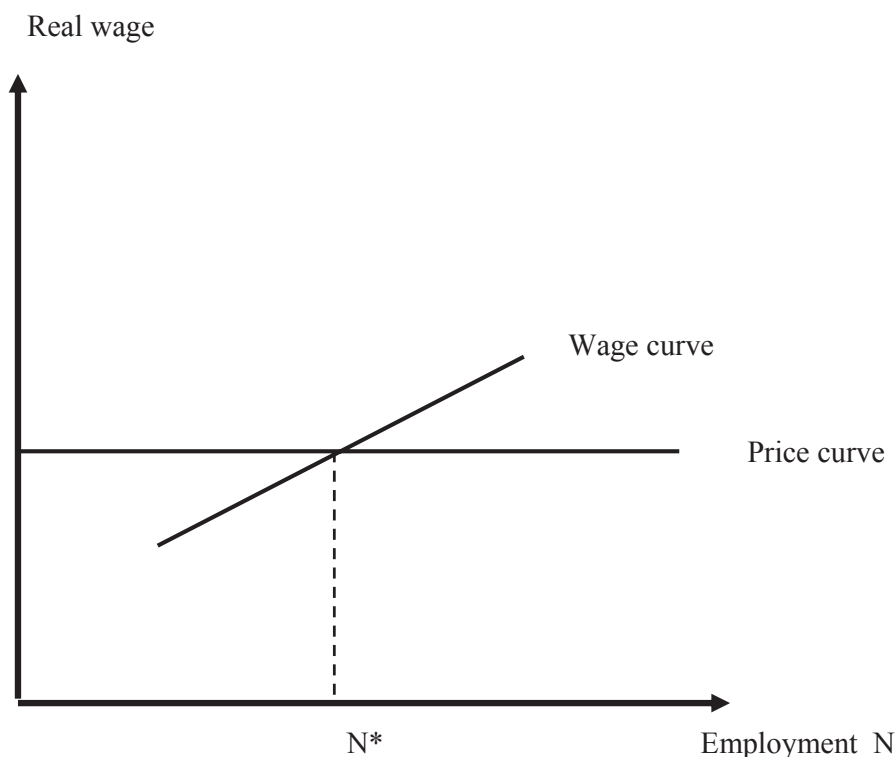
As to the legal restrictions argument, MacLeod and Malcomson (1993) point out that under European legal rules, wage contracts for individual workers can only be changed by mutual consent. (This is in contrast to US law, where workers are assumed to consent to a wage cut if they show up at work, see Malcomson, 1997.) Holden (1994) makes the same observation for collective agreements.<sup>3</sup> MacLeod and Malcomson (1993) and Holden (1999) show that this feature - fixed nominal wage contracts that can only be changed by mutual consent - may be crucial to prevent hold-up inefficiency, and thus induce efficient levels of investment. Larsen (undated) shows how fixed wage contracts are consistent with an efficiently operating economy in a dynamic general equilibrium model.

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<sup>2</sup> Efficiency wage theories and insider-outsider theories are also sometimes mentioned as explanations of DNWR, but these theories explain real wage rigidity and need additional assumptions to generate DNWR.

<sup>3</sup> The legal position of collective agreements varies between countries, and between various types of agreements within countries, but this falls outside the scope of this paper.

Akerlof et al. (1996) and Holden (1994, 2004) use the same macroeconomic framework to analyse the implications of DNWR (see Andersen, 2001, for a textbook-like version of Akerlof et al.'s model, and Palley, 1994, for a related argument). Let me therefore use some space to describe this. Consider a standard monopolistic competition economy, with a large number of symmetric firms, each producing a different good. Production takes place under constant returns to scale, with labour as the only input. Firms face downward-sloping demand curves (with uniform elasticity), and set prices so as to maximise profits. As is well known, this implies that prices are set as a constant mark-up over wages, implying that the real wage is a constant, independent of the aggregate employment rate. (See the horizontal price curve in figure 1.) Wages are set at firm level, in a bargain between workers and firms. The outcome of the bargaining is affected by the aggregate employment rate, as a higher employment rate improves the bargaining position of the workers. Thus the wage curve, representing the outcome of the wage setting, is upward-sloping in the employment – real-wage space, see figure 1.



**Figure 1. The standard model. Equilibrium employment is given by the intersection of the wage and price curves.**

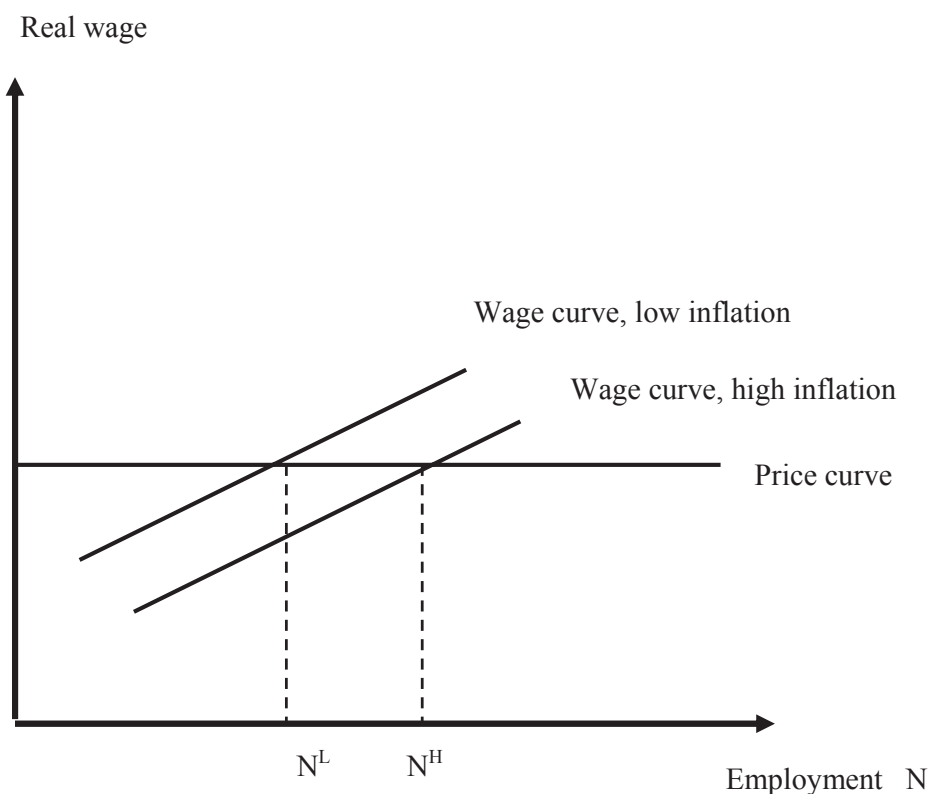
Without any nominal wage rigidity, figure 1 illustrates the standard result that the equilibrium rate of employment (and also the equilibrium rate of unemployment) is given by the intersection of the wage and price curve, and thus is independent of the rate of inflation. The model is then essentially that of Layard, Nickell and Jackman (1991) (see page 19), or Blanchard (2003, page 132), where the same figure is depicted. In this model, any change that



weakens the bargaining position of the workers (e.g. a reduction of unemployment benefits) moves the wage curve downwards, raising equilibrium employment.

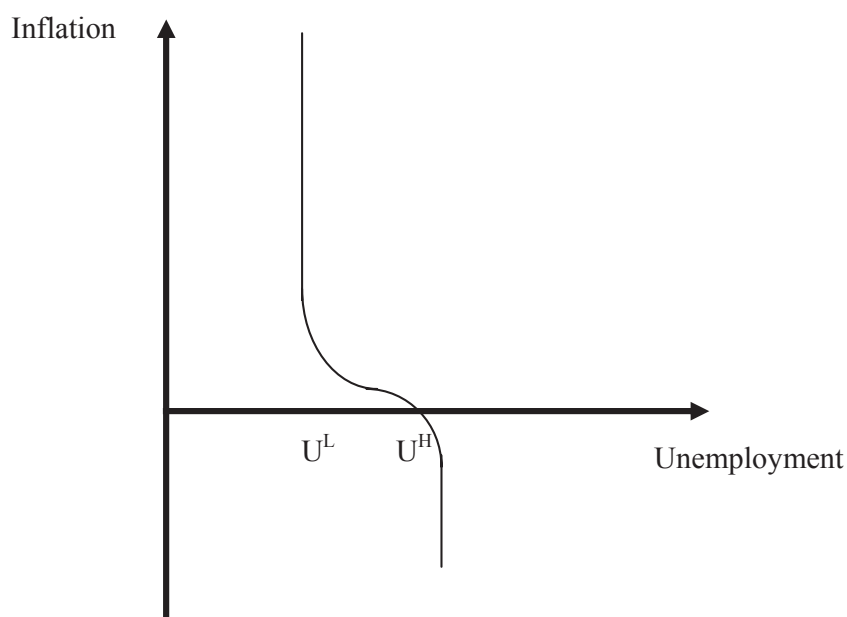
In Akerlof et al. (1996), a simulation model is explored where firm-specific shocks induce changes in what they refer to as the notional real wage, i.e. the real wage that would prevail without any nominal wage rigidity. If a negative shock takes place so that the notional real wage involves a nominal wage cut, Akerlof et al. assume that DNWR (due to fairness reasons) prevents the cut, implying that real wages are higher than they would otherwise have been. Under low or negative inflation, this will happen in a large part of the economy, so that wage pressure increases, the wage curve moves up in figure 1, and the equilibrium rate of employment is reduced.

In Holden (1994, 2004), DNWR is justified by the legal feature mentioned above. Consistent with institutional regularities in many countries, it is assumed that when collective agreements are up for renewal (usually annually), they will be prolonged in nominal terms unless both parties agree to a change. Holden shows that the party that must initiate the change has a strategic disadvantage in the bargaining process. Under positive inflation, workers want a nominal wage rise, so that they have a strategic disadvantage. Thus, wage pressure is reduced, the wage curve moves downwards, and equilibrium employment increases. Under negative inflation, or under low inflation in firms experiencing a negative shock so that wages should be cut, it is the firm who wants to reduce wages, and thus have the strategic disadvan-



**Figure 2. Inflation weakens the bargaining position of the workers, lowering the wage curve and increasing equilibrium employment.**

tage. In this case, wage pressure is increased, the wage curve moves up, and equilibrium employment is decreased (see figure 2). The upshot is a Phillips curve which is vertical for high



**Figure 3. The long run Phillip curve.** Zero or negative inflation involves higher unemployment on permanent basis

inflation and negative inflation, but high inflation involves lower unemployment than negative inflation, cf. figure 3. (The smoothing reflects firm-specific shocks.)

Why is the party who wants to initiate the change at a strategic disadvantage? Holden analyses this in a non-cooperative bargaining model of the Rubinstein (1982) type. Both parties may disrupt production (strike or lock-out) as a means of enforcing a renegotiation of the wage contract. If a strike or lockout takes place, the outcome will be a real wage which depends on the bargaining position of the parties, including the effect of the aggregate employment rate. However, initiating a strike or lockout also involves costs to both parties, in the form of lost output during the work stoppage, and possibly also due to adverse effects on reputation, increased uncertainty etc

To fix ideas, consider the following simple numerical illustration. (See Holden, 1994, 2004, for a rigorous treatment.) Assume for simplicity a stationary economic environment, where wage negotiations undertaken during a work stoppage (strike or lock-out) lead to a real wage of 100. Consider first an inflation scenario, where inflation has eroded the real value of the nominal wage specified in the contract. Thus, we assume that the real value of the existing contract wage is 90. Now the contract is up for possible renegotiation. If a strike takes place, there will be an agreement on a new wage of 100. Furthermore, a strike (or lock-out) will involve costs corresponding to a per time unit loss of 5 over the contract period, for both workers and firms. Thus, if the workers initiate a strike, they will obtain a payoff of  $100 - 5 = 95$ .

Clearly, strike threats are credible, as this will give the workers a higher payoff than they will obtain from prolonging the existing contract. However, if the firm offers a new contract of  $95 + \varepsilon$ , where  $\varepsilon$  is a small positive number, strike threats will no longer be credible. Workers will obtain a higher payoff from accepting the firm's offer of  $95 + \varepsilon$  than from initiating a strike. Thus, the workers will accept the offer, and no strike will take place.

Then consider a negative inflation scenario, where the real value of the existing nominal contract wage has increased to, say, 110. In this case, it is the firm who wants to reduce wages. A lockout is credible, as it provides the firm with a payoff corresponding to a wage of 105 (wage 100 + costs 5 = 105), which is better than the existing wage of 110. But if the workers offer a wage of  $105 - \varepsilon$ , a lockout is no longer credible, as it yields a lower payoff to the firm than the workers' new wage offer. Thus, the firm will accept the offer of  $105 - \varepsilon$ , and no lockout will take place.

The example above shows that even if the real situation is the same in the two scenarios – absent an initial wage, the new contract should give a real wage of 100 – the existence of the initial nominal contract wage affects the bargaining outcome. High inflation erodes the real value of the nominal wage given in the contract, putting workers at a strategic disadvantage. Negative inflation, or low inflation and a firm-specific negative shock, puts firms at a strategic disadvantage.

Consider the effect of indexation in this example. Under low but positive inflation, partial indexation to the general price level will raise the nominal wage that is specified in the contract. Thus, it will raise the nominal wage at which DNWR prevails, implying that DNWR may be binding when relative wages change under higher rates of inflation than what would be the case if there were no indexation. On the other hand, under negative inflation, symmetric, partial, indexation that entails a reduction in nominal wages will work in the opposite way, reducing the nominal wage specified in the contract. However, under negative inflation, DNWR seems likely to be binding in parts of the labour market anyway.

Holden (2004) extends the analysis in the 1994 paper by also allowing for an unorganised sector. Here, DNWR hinges on the strength of the employment protection legislation, which provides workers with a means of refusing a wage cut proposed by the employer. Thus, this analysis suggests that DNWR is prevalent in countries with a high coverage of collective agreements/high union density (as unions have a stronger position to refuse nominal wage cuts than individual workers have) and in countries with strong employment protection legislation.

### *Some counter-arguments*

The macroeconomic effects of DNWR implied by the models above are not undisputed cf. Hogan (1997) and Yates (1998). Most importantly, Hogan (1997) argues that if wage setting is forward-looking, firms will take the possible future effect of DNWR into consideration. Elsby (2004) takes the argument further within a fully specified forward-looking model of wage setting under DNWR arising from fairness considerations. Elsby argues that the risk of future DNWR may lead to attenuation of wage increases, i.e. that firms raise wages less than they would have done if wages were fully flexible. The attenuation of wage increases will be stronger under low inflation. The idea here is that, under high inflation, firms facing a positive demand or technology shock will raise wages considerably, as they know that the high real wage can be reversed in the future by just letting nominal wages be constant. Under low inflation and DNWR, firms facing a positive shock will be more reluctant to raise wages a lot, as raising wages increase the risk that DNWR will push up wages in the future. (Bewley, in his discussion of Akerlof et al., 2000, reports conversations with managers who express exactly this concern.) Elsby then shows that previous studies, by neglecting this effect, have overstated the costs of DNWR.

Note, however, that this argument is not fatal for the effect of inflation on the workers' bargaining position. The feature that rational agents take into consideration the possibility that DNWR may affect wages in the future, will diminish the negative effect of inflation on the union's bargaining position, but it will not remove it (Holden, 1997).

A second counter-argument by Hogan (1997) against the effect of DNWR on employment is that higher real wages need not lead to lower employment if firms hoard labour, or if higher real wages make an unemployed person more likely to accept a job. It is, however, not clear that this point is valid. If wage pressure is increased, wage and price setting are not consistent, and something has to change so as to make wage and price setting consistent. If firms hoard labour, so that unemployment does not increase, the real wage implied by the wage setting would remain higher than the real wage implied by the price setting. Thus, it seems that excessive wage pressure would prevail until firms started to shed labour, raising unemployment.

A more general argument against the idea that nominal wages affect output is based on evidence that real wages seem to be acyclical or slightly pro-cyclical. The argument runs as follows: If nominal wages are rigid, and the labour demand curve is downward sloping, demand shocks will involve movement along the labour demand curve and thus involve counter-cyclical real wages. But evidence suggests that real wages are acyclical or slightly pro-cyclical. This has been raised as a key objection to macroeconomic models with nominal wage rigidity. However, as Spencer (1998) pointed out, if there are both demand shocks and technology shocks, the latter will induce procyclical behaviour of real wages. The overall cyclicity of real wages will de-

pend on both types of shocks. Spencer shows that US postwar data indicates that a positive demand disturbance is associated with a temporary decline in real wages, consistent with a model with nominal wage rigidity.

An interesting approach to the effect of inflation on wage setting is the Grease and Sand argument of Groshen and Schweitzer (2000). They note the well-known effect that, under downward nominal wage rigidity, inflation may facilitate changes in wage distribution across occupations (Grease). On the other hand, they also argue that inflation involves greater expectational errors that may cause unintended changes in the wage distribution across firms (Sand). These effects are analysed in a unified framework, making it possible to evaluate benefits and costs of inflation in the labour market.

### **3 The effect of inflation on staggered nominal wage contracts**

In the literature on staggered wage and price setting, it is usually implicitly or explicitly assumed that one can abstract from trend inflation without any problems. However, as shown by Ball, Mankiw and Romer (1988), this is not so. Under high inflation, wage adjustment will be more frequent, and this will cause the short-run Phillips curve to be steeper, reducing the persistence of shocks. In related models, Helpman and Leiderman (1990) and Kolsrud and Nymoen (1998) argue that inflation reconciles the conflicting claims of workers and firms, and thus may affect the equilibrium output. More recently, Ascari (2000) has shown that inflation increases the forward-lookingness of wage setters, again reducing the persistence of shocks to the economy.

Allowing for steady-state inflation in standard staggered-contracts models has several and opposing effects on long-run output and employment. Ascari (2003) shows that under time-contingent price setting, trend inflation implies that otherwise symmetric firms will set different prices in steady state. Due to the usual non-linearities in the utility and production functions, this leads to an aggregate output loss. Ascari concludes that “a very mild level of trend inflation implies huge and unrealistic changes in the steady-state output level.” In contrast, Karanassou, Sala and Snower (2003a,b) argue that the reduction in inflation over the last decades plays an important role in explaining increased unemployment. Karanassou et al. refer to their idea as “frictional growth”, and the key point is as follows. Under staggered, time-contingent nominal contracts, nominal variables are a weighted average of their past and expected future variables. Owing to time discounting, wage setters will put less weight on the last part of the contract period, implying that inflation causes wages and prices to lag behind money growth. Consequently, the higher the rate of inflation, the more wages and prices lag behind money, thus increasing the real money stock, which again increases output and

employment. Furthermore, Karanassou et al. argue that the weighting is amplified owing to uncertainty and multiple nominal rigidities, i.e. both rigid wages and rigid prices.

#### **4 Incomplete labour contracts and nominal wage growth**

Almost all the literature on DNWR deals with the idea that nominal wages are constant in situations where flexible wages would fall. However, there is a small body of literature that argues that there are mechanisms inducing a certain nominal wage growth, implying that unless inflation is sufficiently high to allow for this nominal wage growth, other mechanisms (read unemployment) must be at work to prevent the nominal wage growth.

A key possible cause of nominal wage growth is incomplete labour contracts. As argued by Moene (1988), workers can impose costs on a firm even when working under the existing contract, e.g. by strictly adhering to the working rules (work-to-rule). Such behaviour is well known from real-world wage negotiations in many industrialised economies. On the other hand, the firm may reduce flexible types of remuneration as bonus payments etc. Yet if workers can impose larger costs on the firms than vice versa, which appears to be a plausible assumption in most cases, nominal wages increase during work-to-rule (Holden, 1997). Intuitively, firms are willing to raise the nominal wages so as to avoid a costly period of work-to-rule; see Holden (1989) for supporting empirical evidence. Nickell and Quintini (2003) find evidence for the UK that there are employees “who would have had negative nominal wage changes without the distortion who, in fact, have significantly positive, rather than zero, nominal wage changes”, i.e. as predicted by the idea that work-to-rule may induce nominal wage growth, inducing higher real wages, even in a situation where real wages would have gone down had inflation been higher.

#### **5 Multi-level bargaining and the co-ordination of wage setting**

Most of the literature on DNWR presumes that wage setting is unco-ordinated. Allowing for centralised or co-ordinated wage setting implies additional effects. Most importantly, several Nordic researchers have argued that multi-level wage setting systems, as in the Nordic countries, where wages are negotiated both centrally (at national and/or industry level) and locally, may cause a minimum rate of growth in nominal wages. In the literature, two versions of this feature have been discussed.

Rødseth (1985), Holden (1988), Rødseth and Holden (1990), and Calmfors (1993) argue that wage setters at the central level both generally want wage restraint, and, to a large extent, are able to predict wage growth at the local level. However, some wage growth at the local

level is unavoidable, in part due to the possibility of work-to-rule under the peace clause that prevails at the local negotiations, given that the central agreements are in force. Under low inflation, wage restraint may require a nominal wage cut at the central level, and in this situation DNWR at the central level may induce higher real wages and lower employment. Holden (1998) provides empirical evidence for the existence of a floor to nominal wage growth of 2 – 3 percent at the central level in the manufacturing sectors of the four major Nordic countries for the period 1961 – 1985/92.

The other version of the inflationary bias of multi-level wage setting, advocated by, among others, Hibbs and Locking (1996) and Iversen (1999), emphasises that central wage setting has historically involved compression of relative wages. This causes a need for wage growth at the local level to restore relative wages, wholly or partially, to their market values. Under low inflation, the combination of wage growth at both levels will induce excessive real wage growth and lower unemployment.

Note that one can also argue for the opposite conclusion: that wage setting systems with a co-ordinated or centralised element are better suited to adapt to changes in the rate of inflation. The idea here is that the centralised wage settlements often end up in a general increase which is a little below the sum of inflation and average productivity growth. Thus, if inflation is reduced, a coordinated, multi-level system may, in principle, easily adapt by reducing the general increase, without being bothered by coordination problems that may exist in less centralised wage-setting systems. One may argue that countries with extensive incomes policies and social pacts, like the Netherlands and Norway, have adapted better to the low inflation era than countries with less co-ordinated wage setting as France and Spain.

## **6 Near-rational wage and price setters**

For decades, most economists have frowned upon explanations based on non-rational agents. While such behaviour is often viewed as plausible, many economists have argued that it is *ad hoc*. Furthermore, one has wanted to avoid a situation where different researchers invoke different behavioural assumptions as key foundations in their own theories. However, research by cognitive psychologists and experimental economists has provided strong support for behavioural assumptions that differ systematically from the standard economic main assumption (see Kahneman and Tversky, 1979, and the surveys in Rabin, 1998, and Fehr and Schmidt, 2002).

Building on this research, Akerlof, Dickens and Perry (2000) argue that wage and price setters treat inflation differently from what most economists assume. First, when inflation is low, many people ignore it. Second, workers view nominal wage increases as a sign that they are



appreciated, without reflecting about nominal wage increases as being an element of a general rise in wage and price levels.

More specifically, Akerlof et al. consider a model where workers' effort depends on their wage relative to a reference level. Near-rational firms do not take low inflation into account when updating their reference level; thus, wages are increased by less than they should. Correspondingly, rational firms who know that their workers are near-rational will also underweight inflation when updating the reference level. Thus, wage pressure is reduced, and equilibrium employment increased, for positive but moderate inflation.

When inflation is high, however, underweighting of inflation will involve much larger costs. Thus, near-rational wage and price setters will take inflation fully into account when it is high. Hence, the reduction in wage pressure induced by low inflation only prevails for moderate, positive levels of inflation, and not for high rates of inflation.

## **7 Empirical evidence**

The last few years, a rapidly increasing literature has emerged testing for the existence and implications of DNWR. Due to the size and speed of increase of this literature, only a brief selective survey will be provided. Different types of evidence have been put forward. Akerlof et al (1996), Bewley (1999), Agell and Lundborg (2003) and Agell and Benmarker (2003) report results from interviews and surveys where employers and employees are asked about (among other thing) DNWR. These studies report that nominal wage cuts are rare in the US and Sweden.

Other studies investigate DNWR in large micro-data sets based on wage surveys, administrative files, personnel files, or data for union contracts. While these studies generally find nominal wage cuts to be more frequent than one finds in interviews, the studies with few exceptions nevertheless find evidence that DNWR exists. Broadly, one can distinguish two approaches. The skewness-location approach of McLaughlin (1994) focuses on the effect of inflation on the distribution of wage changes. Recent applications include Christofides and Leung (2003) for Canada, Ekberg (2002) for Sweden, Kimura and Ueda (1997) for Japan, Nickell and Quintini (2003) for the UK, and Lebow et al. (2003) for the US. (The latter two papers also discuss previous empirical findings for the UK and the US.) Typically, the studies find (i) a spike in the distribution of nominal wage changes at zero and (ii) that the rate of inflation affects the distribution of nominal wage changes, both features as would be implied by the existence of DNWR. The study by Lebow et al is also noteworthy because it includes data on total compensation. Lebow et al find that even if total compensation is somewhat more flexible than wage and salaries alone, there is a significant amount of rigidity for compensa-



tion. Furthermore, firms do not seem to circumvent wage rigidity by changing other types of compensation.

The other approach, referred to as the earnings function approach by Knoppik and Beissinger (2003), add other explanatory variables that are usually included in wage equations, see e.g. Altonji and Devereux (1999) for the US, Fehr and Goette (2000) for Switzerland, Knoppik and Beissinger (2003) and Bauer, Bonin and Sunde (2003) for Germany, Devicienti, Maida and Sestito (2004) for Italy, and Barwell and Schweitzer (2004) for the UK. The latter three papers also distinguish between real and nominal wage rigidity, and find evidence of both. An exception to the general picture of evidence of DNWR in recent studies is Biscourp, Dessy and Fourcade (2004), who in a micro-data set for France find evidence of flexible nominal wages. However, Biscourp, Dessy and Fourcade also find evidence for asymmetric adjustment of wages, where negative shocks have less impact than positive, which may be interpreted as a type of DNWR.

Few studies attempt to discriminate between the fairness- and the contract-theories of DNWR, as the key implications are shared by both hypotheses. One possible way to circumvent this problem is to compare differences between countries. Based on the cross-country differences of ten EU countries, Dessy (2002) finds evidence that DNWR is more prevalent in countries with intermediate levels of bargaining than in countries with centralized or decentralized wage setting, while high bargaining coverage seems to reduce DNWR. Holden and Wulfsberg (2004) use industry panel data from Eurostat, covering 12 countries over the period 1973-99, and find evidence that strict employment protection legislation and high union density increase DNWR, while the effect of bargaining coverage is positive but insignificant. These latter results support the contract theory of Holden (2004). On the other hand, the fact that downward nominal rigidity is also found in countries with weak legal protection of workers' nominal wages, as in the US and Switzerland, suggests that fairness considerations are also of importance.

Another way to discriminate between theories is to derive testable implications that differ. Elsby (2004) suggests a test based on the idea that the effect of inflation on DNWR differs between the fairness and the contract justifications. As explained in section 2 above, the risk of future DNWR will lead forward-looking firms to attenuate wage increases. Elsby argues that if DNWR is caused by fairness concerns, the attenuation will be weaker under low inflation (as DNWR is less likely to be binding in the future), but inflation will not affect attenuation caused by contract effects. Elsby finds evidence for the UK that attenuation of wage increases is stronger under low inflation, supporting the fairness hypothesis. Holden (2002) also suggests a test for discriminating between these two theories, but this test has not yet been implemented.

While most studies use recent data, there is also evidence for the existence of DNWR in earlier time periods. Among others, Hines (2000) shows that nominal wages were rigid in the downturns in the US in 1893, 1929 and 1981. Fregert (2000) provides evidence of downward nominal wage rigidity in Sweden during the Great Depression.

### *Evidence of a long-run inflation - unemployment – trade-off*

According to the standard view, there is no long-run trade-off between inflation and unemployment. Yet there are now a number of studies that report evidence in support of such a trade-off. Some illustrative examples are these: Bullard and Keating (1995) studying the long-run relationship between inflation and output in 58 countries over the period 1960-90. They find a positive and significant long-run response of the level of real output to a permanent inflation shock for the four European countries with the lowest rates of inflation. Karanassou et al. (2003a) find a long-run Phillips curve trade-off for a panel of EU countries for the period 1977 – 1998. Akerlof et al. (1996) and Karanassou et al. (2003b) find a long-run Phillips curve trade-off in the US. Ahmed and Rogers (2000) also find that the long-run effects of inflation on output in the US are positive. Lundborg and Sacklén (2001) finds evidence of a long-run Phillips curve trade-off in Sweden for the period 1963-2000, indicating that a reduction in inflation from 2 ½ per cent to zero is associated with an increase in unemployment of more than two percentage points. Correspondingly, Fortin and Dumont (2000) find evidence on Canadian aggregate data suggesting that an increase in inflation from 1 ½ percent to 2 ½ percent would reduce unemployment by 1 ½ percentage points.

These findings are consistent with other studies reporting persistent negative output effects of too strict monetary policy. Ball (1999) presents evidence supporting the view that a too strict monetary policy in the 1980s and 1990s in some European countries has led to a long-lasting increase in unemployment. Bernanke and Carey (1996) document that countries that stuck longer to the Gold standard in the 1930s, involving years with falling prices, experienced higher real wages and lower output than the countries that left the Gold standard.

So far it would, nevertheless, be fair to say that the evidence of a long-run inflation – unemployment trade-off is disputed. Among other things, several of the studies are based on rather restrictive assumptions; see, for example, the discussion of Akerlof et al. (1996) by Gordon (1996) and Mankiw (1996), as well as Canmba-Mendez, Carcia and Palenzuela (2003).

## 8 Will society adapt?

Many economists are sceptical towards the idea that low inflation will entail important and persistent effects on output and employment, based on the argument that any downward rigidity that may exist is the result of an inflationary environment, and that society will adapt to a zero inflation policy without a large and persistent impact on output and employment (see, for example, Gordon, 1996, Hogan, 1997, Yates, 1998). Such changes may affect the institutional setting, e.g. the type of labour contracts, or people's view of what is fair behaviour.

It seems reasonable to expect that the costs associated with higher unemployment under very low inflation will induce changes in the way labour markets operate. One would expect pay systems to become more flexible, for example by a more extensive use of bonus systems, although the evidence in Lebow et al (2003) referred to above may indicate that this will have limited effect.

Holden (2001) explores a model where firms choose between fixed wage contracts (where the employer cannot lay off the worker, and the wage can only be changed by mutual consent), or contracts where employment is at will, so that either party may terminate employment. It is shown that a fixed wage contract provides better incentives for investment and training, while employment at will facilitates efficient mobility. High inflation makes fixed wage contracts more attractive as seen from the firm, because it erodes the real value of a fixed contract wage over time, so that badly matched workers are more likely to quit for other jobs. Thus, disinflation has opposing effects on labour market rigidity: fixed wage contracts become more rigid in real terms, but fewer firms will choose fixed wage contracts.

An alternative interpretation of Holden's (2001) model is that fixed wage contracts correspond to jobs in countries with strong employment protection legislation, where labour market laws and regulations constitute important barriers to firms' possibility of unilaterally cutting nominal wages. Employment at will resembles jobs in countries with weak employment legislation, like the UK and the US, or it can be thought of as temporary jobs. Under this interpretation, a reduction in the rate of inflation will exacerbate the real wage rigidity imposed by employment protection legislation. On the other hand, firms are likely to try to opt out of the rigidity by choosing more temporary labour contracts, consistent with evidence of increased use of temporary labour contracts in Sweden in the low-inflation period in the 1990s (Agell and Lundborg, 2003). In addition, the political pressure towards a weakening of the employment protection legislation is likely to increase.

Regarding the effect of fairness, Gordon (1996) argues that in a low-inflation economy, nominal wage cuts will become more common, and there will be less reason to view them as unfair. Against this view one can argue that the fairness and legal explanations for DNWR may be complementary, and that they may strengthen each other in the sense that the exis-

tence of both makes either more persistent: The fact that many labour market participants find nominal wage cuts unfair may also contribute to the continued existence of the legal protection of nominal wages. The legal protection of nominal wages makes wage cuts rare even in a low-inflation environment, thus preventing Gordon's (1996) argument that the fairness considerations will be undermined by wage cuts being "too common".

Empirical evidence also indicates that one should not be too optimistic that labour markets and wage-setting institutions will adapt rapidly to low inflation. The extensive downward nominal wage rigidity in Sweden and Switzerland documented by Agell and Lundborg (2003) and Fehr and Goette (2000), even after years of close to zero inflation and high unemployment, also shows that rigidities may be highly persistent. Fehr and Goette also find that the wage "sweep-up" caused by nominal rigidity is strongly correlated with unemployment, suggesting that downward rigidity of nominal wages does contribute to higher unemployment.

## 9 Concluding remarks

Let me briefly summarise the main conclusions, as seen from a policy-oriented perspective. Both the theoretical arguments and the empirical evidence indicate that wage pressure is increased under low inflation. To keep wage growth down, and to ensure consistency between the wage and price setting, higher unemployment is probably required if one aims at very low inflation. Over time, labour markets and wage setting institutions will probably adapt partially to low inflation, by increased use of flexible remuneration and temporary wage contracts. However, it is difficult to predict how far-reaching these changes will be.

In macro and monetary economics, wage and price rigidities are often the key source of inefficiencies. However, as observed above, wage and price rigidities may also play useful roles, as sharing risk or protecting against opportunistic behaviour. In particular, the legal rule that contract renegotiations require mutual consent plays an important role in ensuring efficient investments. Thus, if lower inflation leads to wages being more flexible, this would involve costs as well as benefits. Furthermore, without restrictions on the employer's right to unilaterally cut nominal wages, employment protection legislation is unlikely to be effective. Thus, proposals for changes in labour laws are likely to be met with strong resistance from unions and insiders. Evidence also suggests that the notion that nominal wage cuts are unfair is persistent. Thus it seems likely that adaptation will not be complete, so that, even in the very long run, a very low inflation target will imply permanently higher unemployment.

From a policy point of view, a key question is clearly at which rate of inflation wage pressure increases to the extent that it involves non-negligible costs. Lundborg and Sacklén (2001) find evidence for Sweden that a reduction in long-run inflation from 2 ½ to zero per cent would be associated with an increase in unemployment of more than two percentage points.

In contrast, Nickell and Quintini (2003) find evidence for the UK that an increase in long-run inflation from 2 ½ to 5 ½ per cent would cause equilibrium unemployment to fall by only 0.13 percentage points. However, there is obviously a lot of uncertainty involved with these estimates, and there is also likely to be considerable variation across countries with different labour market institutions. One should also remember that if low inflation is associated with high productivity growth, lower price margins or low import price growth, there will be more room for nominal wage growth, and thus fewer problems with increased wage pressure.

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