

Ederer, Stefan

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Employment, Inflation and Income Distribution in an Open Economy. Pricing-to-market in a Modified NAIRU Model

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**Employment, Inflation and Income
Distribution in an Open Economy
Pricing-to-market in a Modified
NAIRU Model**

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Pricing-to-market in a modified NAIRU model

Stefan Ederer

Austrian Institute of Economic Research (WIFO) ^{1 2}

Abstract

The paper modifies a standard NAIRU model by implementing 'Pricing-to-market' as the basic assumption for the price setting behaviour of firms in an open economy. This entirely changes the outcomes of the model: First, inflation in equilibrium is stable at any rate of unemployment; the long-run Phillips curve is horizontal. Second, income distribution varies with the level of employment. Third, supplemented with a demand equation which allows for effects of both income distribution and international competitiveness, the NAIRU ceases to be a 'strong attractor'. These characteristics to a certain extent open up the space for expansive wage and demand policies.

Key words: Wages, Inflation, NAIRU, Demand, Distribution

JEL classification: E12, E24, E31, E64, F41

¹ PO Box 91, 1103 Wien, Austria. E-mail: stefan.ederer@wifo.ac.at

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1. Introduction

The NAIRU model and its derivative, the Phillips curve, are still at the core of modern macroeconomics.³ This model is usually based on the assumption of monopolistic competition in the goods market. Firms set prices as mark-up over unit labour costs. Consequently, every increase in nominal wages is fully passed through on prices.

The implications of the NAIRU model are straightforward. There is a unique rate of unemployment, where claims of workers and firms are compatible. At this unemployment rate, which is called the 'Non-accelerating inflation rate of unemployment', inflation is stable. Contrarily, every deviation of the actual unemployment rate from the NAIRU level leads to accelerating inflationary or deflationary processes.

A second important implication of NAIRU models is that income distribution between workers and firms is constant. The actual real wage is determined by the price-setting behaviour of firms. If workers raise their nominal wage claims, firms will raise their prices to the same extent and consequently real wages remain constant. An accelerating inflationary process starts, which is typically labelled as a 'wage-price spiral'. Inflation will continue to rise until employment is reduced high enough to resume the compatibility of workers' and firms' claims. Wage moderation on the other hand will automatically lead to a fall in prices of the same magnitude, leaving real wages constant.

The NAIRU model is usually supplemented by a demand curve which reproduces the negative effect of higher prices on the level of aggregate demand via a real balance effect and/or lower international competitiveness. The changing price level ensures that the actual unemployment rate is always pushed back to the NAIRU level. The NAIRU is a 'strong attractor'.

These unambiguous results of the NAIRU model depend uniquely on a certain assumption regarding the pricing setting behaviour of firms: If changes in unit labour costs are passed through entirely, prices always change to the same extent as wages. This assumption however is not realistic, especially not in the context of a small and open economy. Usually firms compete with foreign firms in domestic markets as well as abroad. Prices therefore will not be set simply by marking up unit labour costs. Competitors' prices have to be considered. This kind of pricing behaviour is named 'Pricing-to-market' (PTM).

³ See e.g. Blanchard (2009), Carlin and Soskice (2005), Galí (2008) and Layard et al. (2005).

If there is substantial PTM in the economy, the existence of a unique NAIRU is no longer the case. Inflation in equilibrium is stable at any rate of unemployment; the long run Phillips curve becomes horizontal. In the short run, deviations from the NAIRU only lead to temporary inflation/deflation. After the adjustment process is completed, however, inflation will remain stable at the same level as before the shock. There is no such thing as an endless 'wage-price-spiral'. Income distribution on the other hand is not constant but changes with the level of employment. The higher is employment in the economy, the higher will be the real wage.

Both income distribution and international competitiveness affect the level of aggregate demand, though in opposite directions. Deviations of the actual unemployment rate from the NAIRU level are not 'automatically' counteracted by changes in the price level. The NAIRU ceases to be a 'strong attractor'.

In the PTM model, expansive demand and wage policies are feasible without the fear of triggering endless and accelerating inflation. Prices temporarily rise and consequently also the real exchange rate. However, the wage share also rises. These effects have opposing impacts on aggregate demand and can push employment in both directions. Even in the – for the open economy – more likely case of a strong effect via international competitiveness, employment rises income distribution is shifted towards wage incomes.

On the other hand, a policy of wage moderation becomes less attractive. The price level falls and consequently improves international competitiveness. Furthermore, it directly reduces the wage share. Consequently, aggregate demand and employment are reduced. These policy conclusions are entirely different from the implications of the NAIRU model.

This paper will discuss the implications of the PTM model compared to the standard NAIRU model. It is structured as follows: Section 2 summarizes the related literature. In section 3, the standard NAIRU model is briefly discussed. In section 4, we present the PTM version of the model, discuss the long-run equilibrium solution and illustrate its behaviour in the light of different kinds of shocks. Section 5 supplements the basic model with a demand equation that allows for both effects of income distribution and international competitiveness on aggregate demand. Finally, section 6 summarizes and discusses the policy implications.

2. A brief literature survey

Pricing-to-market has been identified by the literature for a long time as the usual price setting behaviour of firms in small and open economies.⁴ In a standard NAIRU model for the open economy, such as Layard et al. (2005), however the foreign price level is usually included into the wage equation. The underlying assumption is that world inflation leads to higher consumer prices and subsequently to a higher wage pressure. Production prices on the other hand are not affected. These models usually generate a trade-off between unemployment, competitiveness and inflation. Some authors – e.g. Carlin and Soskice (1991) – recognise that this implies a horizontal long-run Phillips curve. However, they fail to analyze the effects of wage and price changes on income distribution and consequently also on consumption expenditures. In these models the NAIRU remains a ‘strong attractor’. The adjustment of the actual unemployment rate to the NAIRU is safeguarded by the necessity of a balanced current account.

Post-Keynesian models of variable mark-up pricing on the other hand usually do not incorporate specific wage and price equations. Blecker (1989, 1999, 2002) assumes a mark-up which is sensitive to changes in international competitiveness of an economy.⁵ Domestic firms take advantage of higher competitiveness by raising their mark-ups. Contrarily, if competitiveness is reduced, domestic firms cut mark-ups in an effort to limit the loss of market shares. The wage share then becomes sensitive to unit labour costs and the real exchange rate. In these models nominal wages are assumed to be exogenous. Their purpose is to show changes in the target wage of workers or the target mark-up of firms are related to income distribution and international competitiveness. However, they do not specify wage and price equations and can therefore not be considered as fully-fledged models of wage and price determination in an economy. These models do not allow for effects of changes in demand, productivity or world prices on the wage and price level and consequently also not on income distribution and the real exchange rate.

⁴ See e.g. Krugman (1978).

⁵ Monopolistic mark-up pricing in Post-Keynesian models can be traced back to Kalecki (1954) and Steindl (1952). In these models the mark-up was exogenously given and constant. Full cost pricing was therefore the basic assumption. Kalecki (1971) nevertheless discusses the limits of full cost pricing in the case of different sectors in the economy. Arestis and Milberg (1993-94) show how partial pass-through behaviour can arise in the Post Keynesian pricing models of Kalecki (1971) and Eichner (1976, 1980). Similarly, Blecker (1999) discusses the original analysis of Kalecki (1971) and extends it to open economies.

In Post Keynesian models of conflict inflation (e.g. Lavoie 1992, Setterfield 2009), the inflation generating process is modelled differently from the NAIRU models. Inflation arises because of a conflict workers and firms over national income. Nevertheless, they usually replicate the standard relation between the degree of capacity utilization and the rate of inflation, and thereby the Phillips curve. Any increase in demand in these models is therefore followed by an increase in the inflation rate.

This paper aims to close these gaps by incorporating Pricing-to-market and a flexible mark-up into a fully-fledged model of the inflation generating process. With this model, we can analyze the reaction of wages and prices, and consequently also of the wage share and the real exchange rate to all kinds of nominal and real shocks. Additionally, we allow for both income distribution and international competitiveness to affect aggregate demand. Thereby, interactions between the income generating process and the inflation generating process can be considered.

3. The standard NAIRU model

In this section we briefly summarize the standard NAIRU model, as it is usually presented in economic textbooks.⁶ As the model is widely known and the purpose of the section is only to provide a starting point for the discussion of the PTM model in the next section, we refrain from a lengthy presentation and from a review of its wide modifications.

The standard NAIRU model consists of a wage-setting curve (WS) and a price-setting curve (PS). The WS curve is derived from the wage bargaining process. The bargaining power of workers depends – among other things – on the situation in the labour market. Lower unemployment will augment bargaining power; consequently the real wage which workers try to achieve is higher. Thus, we get a positive relation between employment and the real wage expected by workers. The bargained real wage curve is based on a certain expected price level; higher expected prices would lead to higher nominal wage claims, trying to maintain the expected real wage. Productivity growth is assumed to be translated one-to-one into real a wage increase. Expressing the WS curve in terms of real wages, we get:

$$(1) \quad w - p^e = \mu + a - \gamma u \quad , \gamma \geq 0 ,$$

⁶ This section is largely a summary of the basic model presented in Layard et al. (2005).

where w is the nominal wage, p^e is the expected price level, μ is the autonomous component of wages, a is labour productivity and u the unemployment rate.

The PS curve is derived from the price-setting behaviour of firms and is usually based on the assumption of imperfectly competitive product markets. Firms set prices as a mark-up over unit labour costs, thus determining the real wage which workers actually get:

$$(2) \quad p = \lambda + (w - a),$$

where λ is the constant mark-up. Reformulating equation (2) in real wages, and replacing λ with v to facilitate the comparison with the model presented in the following section, we get the PS curve:

$$(3) \quad w - p = a - v$$

The actual real wage thus depends on the level of productivity and the mark-up.

The implications of the NAIRU model are straightforward. Firstly, there is only one rate of unemployment where claims of workers and firms are compatible. At this unique unemployment rate, inflation is stable. Therefore it is usually named as 'Non-accelerating rate of unemployment' (NAIRU). It is determined by the intersection of the WS and the PS curve. From equations (1) and (3) we get the definition of the NAIRU:

$$(4) \quad u_N = \frac{\mu - v}{\gamma}$$

The NAIRU only depends on the autonomous components of wages and prices, reflecting the institutional setting in the labour and product market, respectively.

Secondly, all deviations from the NAIRU produce accelerating changes in the price level. If unemployment is below the NAIRU the bargaining power of workers increases and consequently workers demand higher wages. As firms are not willing to pay higher real wages, they start to raise their prices to the same extent in order to maintain their mark-up. In the subsequent period, workers will not only demand higher wages because of higher bargaining power, but also include higher prices in their expectations. Thus, inflation is accelerating. This inflationary process only comes to an end, when unemployment is pushed back to the NAIRU level.

The same adjustment process is taking place in the opposite direction when unemployment is higher than the NAIRU. Wage claims are reduced because of diminishing bargaining power of workers. Firms therefore reduce their prices in order to keep their mark-up stable. This will

trigger a disinflationary process, which continues until the level of unemployment is back at the NAIRU level.

A third important implication of NAIRU models is that income distribution between workers and firms is determined by the price-setting behaviour of firms. If the mark-up is unchanged, firms raise their prices to the same extent as nominal wages increase. As a consequence, the real wage remains constant. Only a change in the mark-up, due to changes in the degree of competition in the product market, leads to an alteration of the distribution of incomes.

The wage-price-model is usually supplemented by an aggregate demand function, in which demand depends negatively on prices. This relation works through a real balance effect and/or through the changes in international competitiveness. The higher are prices, the lower is aggregate demand. Because income distribution does not change in any case, no repercussions of distribution on aggregate demand are considered. Inflationary and deflationary processes lead to changes in the level of aggregate demand, and consequently the actual unemployment rate is pushed back to the NAIRU level. The NAIRU thus is a strong attractor. The actual unemployment rate always adjusts to the level of the NAIRU and not vice versa.

In the case of a nominal wage shock – due to a better bargaining position of workers – they expect higher real wages and raise their nominal wage claims. In order to maintain their desired profitability, firms raise their prices to the same extent. As a consequence, real wages remain constant. However, an accelerating inflationary process will start, which is typically labelled as ‘wage-price spiral’. Inflation will continue to rise until employment is reduced high enough to resume compatibility of workers’ and firms’ claims. Because the NAIRU has risen, unemployment in the new long-run equilibrium will be higher than before. The inflationary process pushes actual unemployment up to the new NAIRU level.

A negative wage shock on the other hand will automatically lead to a fall in prices of the same magnitude, leaving real wages and income distribution unchanged. A disinflationary process will start and continue until unemployment is reduced to the new (lower) NAIRU level. Similarly, a rise in demand and employment raises wage claims which also induce higher prices. As long as unemployment remains lower than the NAIRU, the wage gap remains open. Consequently, an accelerating inflationary process is triggered which reduces aggregate demand and pushes unemployment back to the NAIRU level. Income distribution does not change at all.

In the case of a nominal price shock, reflected by a rise in the mark-up also opens a wage gap. The NAIRU has risen, thus inflation starts and continues until the rising price level pushes demand and the unemployment rate to the new higher NAIRU level. Contrarily to the other two shocks, a change in the mark-up always shifts income distribution.

These unambiguous results of the NAIRU model depend uniquely on the assumption regarding the pricing setting behaviour of firms: If changes in unit labour costs are passed through entirely, prices always change to the same extent as wages. Income distribution remains constant; the only effect of higher demand or higher wage claims is an accelerating inflation, whereas lower wage claims will always lead to a disinflationary process and higher employment. This assumption however is not realistic. Usually firms compete with foreign firms in domestic markets as well as abroad. Prices therefore will not be set simply by marking up unit labour costs. Competitors' prices have to be considered. This kind of pricing behaviour is named Pricing-to-market (PTM). The next section deals with the modifications of the standard NAIRU model due to PTM.

4. The PTM version of the NAIRU model

This section presents the modified NAIRU model and briefly discusses its consequences in the light of real (demand, productivity) and nominal (wage, price, world price) shocks. The model is based on the imperfect competition model for the labour markets in open economies, as it is discussed in the previous section. As we will see, the conclusions that can be drawn out of this model are entirely different from the ones of the standard NAIRU model.

As in the standard NAIRU model, the PTM model consists of a wage-setting curve (WS) and a price-setting curve (PS), which are derived from imperfect competition in the labour and in the product market, respectively. The bargained real wage depends on productivity and the unemployment rate. Expressed in a log-linear form, the wage equation can be written as (with lower case letters denoting logarithms of the variables):

$$(5) \quad w - p^e = \mu + \beta a - \gamma u \quad , \beta \geq 0, \gamma \geq 0.$$

w is the nominal wage, p^e is the expected price level, μ is the autonomous component of wages, a is labour productivity and u the unemployment rate. The wage equation is basically the same as in the baseline model. The only exemption is the coefficient on productivity, which can be unequal to one. The motivation to allow for a more general wage policy with

respect to productivity changes is to show that the outcomes of the model do not depend on this assumption but uniquely on the price setting behaviour of firms.

Price expectations are usually formulated as expectations about changes in the variable, in particular about price inflation rates. In the short run, inflation expectations can deviate from the actual inflation rates. In the long run however, the expected price level has to be equal to the actual (stable) long-run price level. With $p^e = p$ equation (5) may be rewritten as:

$$(6) \quad w = \mu + p + \beta a - \gamma u \quad , \beta \geq 0, \gamma \geq 0.$$

The parameter μ is the autonomous component of wages. It can be interpreted as reflecting the institutional features of the labour market. An increase in, say, union power would increase the autonomous component and induce higher wage claims. Consequently, every ‘wage shock’ is reflected by a change in the parameter μ . Equation (6) implies that an increase in productivity also increases the real wage. The extent to which productivity gains are translated into higher nominal wages is measured by the coefficient β . If $\beta < 1$, productivity gains are not fully passed through on wages. Only in the case of $\beta = 1$, all productivity gains are translated into higher wages in the long-run. Furthermore it implies that a decrease of the unemployment rate – due to higher aggregate demand – increases the bargained nominal wage. Low unemployment increases the bargaining position of workers relative to firms and therefore raises the bargained (expected) real wage. The parameter γ measures the elasticity of wages reacting to changes in unemployment.⁷

With imperfect competition in the product market, firms set their prices as a mark-up over marginal costs. Assuming constant returns to scale and therefore constant marginal costs, prices are set as a mark-up over unit costs. For simplicity, we assume that all raw materials are imported. The price equation then can be written as (lower cases again denoting logarithms of the variables):

$$(7) \quad p = \lambda + \phi(w - a) + (1 - \phi)p_w \quad , \phi \leq 1,$$

where λ is the mark-up and ϕ measures the share of unit labour costs in total unit costs.

As firms compete with foreign firms in domestic as well as in export markets, the mark-up is not necessarily constant, but depends on the level of international competitiveness of the

⁷ In the literature, this parameter is usually considered as measuring wage flexibility. See e.g. Layard et al. (2005)

economy. A higher real exchange rate means lower international competitiveness and consequently the mark-up will be lower (Blecker 1999). Such a pricing behaviour is called 'pricing-to-market' (Krugman 1987). The mark-up then becomes:

$$(8) \quad \lambda = \varphi + \kappa(p - p_w)$$

where φ is an autonomous component of the mark-up, $p - p_w$ measures the real exchange rate, and κ is the elasticity of the mark-up with respect to changes in the real exchange rate. The price equation then may be rewritten as:

$$(9) \quad p = \nu + \delta(w - a) + \chi p_w$$

where $\nu = \frac{\varphi}{1 - \kappa}$, $\delta = \frac{\varphi}{1 - \kappa}$, and $\chi = \frac{1 - \phi - \kappa}{1 - \kappa}$.

International competitiveness thus determines prices via two channels. First, an increase in the real exchange rate raises import costs. Second, higher international competitiveness also increases the mark-up. Because the mark-up is flexible, the parameters δ and χ in equation (9) do not necessarily add up to 1.⁸

Equations (6) and (9) can be solved for wages and prices and be reduced to equations (10) and (11):

$$(10) \quad w = \frac{1}{1 - \delta} [(\beta - \delta)a + \chi p_w - \gamma u + \mu + \nu]$$

$$(11) \quad p = \frac{1}{1 - \delta} [\delta(\beta - 1)a + \chi p_w - \delta \gamma u + \delta \mu + \nu]$$

The wage and price levels now both depend on the variables labour productivity, world prices and the unemployment rate as well as the autonomous components of wage and price setting. The parameters of the behavioural equations (6) and (9), β , δ and χ are now also contained by both equations (10) and (11). However, the parameter β , which measures the degree of productivity-orientation in wage setting, continues to appear only in the productivity term of the two equations. For the subsequent analysis of the effects of shocks on

⁸ Empirically, estimations of the price equation (9) usually suggest that $\delta + \chi = 1$, reflecting homogeneity of prices vis-à-vis changes in unit labour costs and world prices. This empirical observation cannot be justified theoretically. Therefore, we do not impose this restriction into the model.

the long- and short-run behaviour of the model, this coefficient is only relevant for the results of a change in the productivity level. Similarly χ , which represents the elasticity of prices with respect to changes in the world price level, continues to appear only in the world price term. The parameter δ enters equations (10) and (11) in many places. Besides affecting the implications of wage and price shocks, as well as demand and productivity shocks, as it will be discussed below, all the original shocks are 'multiplied' by the factor $\frac{1}{1-\delta}$. Thus, the higher the pass-through of unit labour costs on prices – the lower the extent of PTM – the higher are the changes in the wage and price level subsequent to the initial shocks.

The evolution of wages and prices also determines functional income distribution. With wages and prices according to equations (10) and (11), real wages become:

$$(12) \quad w_r = w - p = \beta a - \gamma u + \mu$$

Real wages therefore depend on the level of productivity, the unemployment rate and the autonomous wage component. Note that a change in the autonomous component of prices or of world prices do not affect real wages at all because they have an equal effect on wages and prices.

As the wage share is real wages divided by productivity, it can be expressed in logarithms as:

$$(13) \quad \Omega = w - p - a = (\beta - 1)a - \gamma u + \mu$$

Functional income distribution therefore also depends only on productivity, the rate of unemployment and the autonomous component of wages. The wage share is consequently a stable function of unemployment. The lower the unemployment rate, the lower is the wage share. An autonomous change in wages is translated one-to-one into a change in the wage share.

The temporary inflationary process and the rise of the price level do also affect international competitiveness of an economy. With equation (11) and p_w representing world prices in domestic currency, the real exchange rate becomes:

$$(14) \quad z = p - p_w = \frac{1}{1-\delta} [\delta(\beta - 1)a + (\delta + \chi - 1)p_w - \delta\gamma u + \delta\mu + \nu]$$

International competitiveness thus depends on productivity, the unemployment rate and world prices, as well as on the autonomous components of wages and prices.

The outcomes of our model are entirely different from the NAIRU model. Firstly, if there is substantial PTM in the economy, the existence of a unique NAIRU is not longer the case. Any deviations from the (short-run) NAIRU cause changes in the nominal wage claims of workers. The price level also rises, but not to the same extent. The real wage gap consequently remains open, leading to further wage and price increases. The process continues until real wages have risen to the same extent as the original shock on wages and the wage gap is closed. During this process, wage and price inflation rates rise temporarily. After adjustment is completed, inflation rates return to their original (stable) level. At any rate of unemployment, claims of workers and firms in the long run are compatible. When all claims are satisfied, no inflation arises. Thus, every unemployment rate in the long run is a stable or non-accelerating inflation rate of unemployment. The long-run Phillips curve – the locus of all combinations of the rate of unemployment and inflation for which inflation is constant – thus becomes horizontal and the unique equilibrium rate of unemployment ceases to exist.

By transforming equation (11) and assuming $\delta + \chi = 1$ for simplicity, it is easily shown that the PS curve adjust through the alteration of the real exchange rate:

$$(15) \quad w - p = a + \frac{1 - \delta}{\delta} z - \frac{1}{\delta} v$$

The real wage determined by the price-setting of firms therefore is dependent on the real exchange rate, which adjusts endogenously through the temporary inflationary process.

In the long-run equilibrium the real wage determined by price setters is equal to the real wage bargained by wage setters. The NAIRU consequently also depends on the real exchange rate:

$$(16) \quad u_N = \frac{1}{\gamma} \left[(\beta - 1)a - \frac{1 - \delta}{\delta} z + \frac{1}{\delta} v + \mu \right]$$

In the short run however, a unique rate of unemployment with stable inflation rates and a Phillips curve continue to exist. Deviations from the short-run NAIRU consequently lead to temporarily higher or lower inflation rates which in turn change the level of international competitiveness. With unemployment below the short-run NAIRU, the bargaining power of workers increases and workers claim higher wages. Firms consequently start to raise prices, but not to the same extent as wages. Thus, gradually the real wage increases until it has risen to the level bargained between workers and firms. However, after this adjustment process is

completed, inflation will return to world price inflation and remain stable. The new price level however is now higher than before. International competitiveness thus has decreased.

The same adjustment process is taking place in the opposite direction when unemployment is higher than the NAIRU. Wage claims are reduced because of diminishing bargaining power of workers. Firms therefore reduce their prices, although not as much as their unit labour costs have declined. This triggers a temporary disinflationary process which will come to an end after the new (lower) bargained real wage is accomplished. The price level is now lower than before, international competitiveness has increased. Nevertheless, in neither case inflation is accelerating endlessly until demand is restored to its initial level as in the NAIRU model. There is no such thing as an unlimited wage-price-spiral.

The third important implication of our model is that income distribution is not constant, but changes with the level of employment. The higher employment is in the economy, the higher will be the wage share. Additionally, every increase in the autonomous component of wages will fully translate into a higher wage share. Contrarily, if firms try to raise their mark-up, PTM and the adjustment process will re-establish the initial income distribution. Workers always get their expected real wage.

After having established the model, the effects of various shocks on the long-run solution represented by equations (10) to (14) are straightforward. A positive *nominal wage shock* – e.g. due to greater bargaining power of workers – is represented by a rise in the autonomous component of wages μ . The initial shock on wages is followed by a rise in the price level, though not to the same extent. The real wage gap consequently remains open, leading to further wage and price increases. The process continues until real wages have risen to the same extent as the original shock on wages and the wage gap is closed. The initial shock is 'multiplied'. The increase in the wage and price level following such a shock is therefore greater the higher is the pass-through coefficient δ . The reaction of prices compared to the rise in wages is scaled down by the same coefficient, so that the initial shock is consequently translated one-to-one into a rise of the wage share. The real exchange rate is rising to the same extent as the price level. The loss in international competitiveness due to a positive wage shock is consequently higher the higher the pass-through of unit labour costs on prices. The short-run NAIRU remains at its previous level.

Contrarily to a wage shock, a *nominal shock on prices* due to an autonomous increase in the mark-up because of e.g. lower competition in product markets does not affect income

distribution. Nominal wages and prices rise to the same extent, with the extent of both effects and also of the effect on the real exchange rate depending on the magnitude of the pass-through coefficient.

As we have assumed that employment goes line in line with production, a positive *demand shock* proportionally reduces unemployment. The effects of the demand shock are similar as in the case of a rise in wages, corrected by the elasticity of the wage reaction following the original shock. The rise in the price level is smaller than in the level of nominal wages and consequently the wage share increases. Furthermore, a positive demand shock is raising the real exchange rate. The magnitude of the wage and price effects and consequently on the effect on international competitiveness depend positively on the pass-through coefficient δ .

A shock in *world prices* is turned into a change of the wage and price level to the same extent. The magnitude of the effect depends on the elasticity with which prices react to a change in the world price level, χ and the pass-through coefficient δ . The higher both parameters are, the greater is the effect on the wage and price level. Since wages and prices react equally, the wage share is not affected by a world price shock.

To discuss the effect of a change in the world price level on the real exchange rate, we have to distinguish three cases: First, if $\delta + \chi < 1$, the effect of a rise in world prices on international competitiveness is negative. The change in the domestic price level is smaller than the original change in world prices, and consequently the real exchange rate decreases. If contrarily $\delta + \chi > 1$, domestic prices react stronger as the initial shock, thereby reducing international competitiveness. Finally, in the case of $\delta + \chi = 1$, the change in world prices is passed through one-to-one on wages and prices, leaving the real exchange rate unaffected.

The consequences of a *productivity shock* on the variables are determined by the wage policy which is conducted in the economy, represented by the parameter β , and the extent of pass-through of unit labour costs on prices, δ . If $\beta < 1$, the productivity gains are not passed through on nominal wages to the full extent. Unit labour costs and the price level consequently decrease.⁹ A falling price level reduces the initial wage increases. Therefore, if

⁹ Although the decline of the wage share during the last 25 years is an empirical fact that one can observe in numerous countries, it is questionable if this is sustainable in the long run. For the purpose of the theoretical discussion however we do not restrict the parameter β .

$\beta < \delta$, the dampening effect of the lower price level is even higher than the original wage increase, so that both nominal wages and prices decrease. Thus, a competition-oriented wage policy in combination with a very high pass-through effect is augmenting the deflationary tendencies in the economy. In the opposite case of $\beta > 1$, a high pass-through coefficient is favouring an inflationary environment.

Only in the case of a productivity-oriented wage policy, where $\beta = 1$, productivity increases are fully translated into a rise of nominal wages, leaving the price level unchanged. Consequently, income distribution and the level of international competitiveness are also unaffected. In the employment – real wage diagram, both the WS and the PS curve have shifted upwards according to the increase in productivity.

Summarizing the model, the long-run effects of the various shocks on nominal wages, prices, the wage share and the real exchange rate are presented in table 1. The limits of the effects in the two cases of full pass-through and full PTM are also illustrated.

| x | μ | ν | u | α | ρ_m |
|----------------------|--|---|---|---|--|
| $\frac{dw}{dx}$ | $\frac{1}{1-\delta}$ $\delta=0 \rightarrow 1$ $\delta=1 \rightarrow \infty$ | $\frac{1}{1-\delta}$ $\delta=0 \rightarrow 1$ $\delta=1 \rightarrow \infty$ | $-\frac{\gamma}{1-\delta}$ $\delta=0 \rightarrow \gamma$ $\delta=1 \rightarrow \infty$ | $\frac{(\beta-\delta)}{1-\delta}$ $\delta=0 \rightarrow \beta$ $\delta=1 \rightarrow \pm\infty$ | $\frac{\chi}{1-\delta}$ $\delta=0 \rightarrow \chi$ $\delta=1 \rightarrow \infty$ |
| $\frac{dp}{dx}$ | $\frac{\delta}{1-\delta}$ $\delta=0 \rightarrow 0$ $\delta=1 \rightarrow \infty$ | $\frac{1}{1-\delta}$ $\delta=0 \rightarrow 1$ $\delta=1 \rightarrow \infty$ | $-\frac{\gamma\delta}{1-\delta}$ $\delta=0 \rightarrow 0$ $\delta=1 \rightarrow \infty$ | $\frac{\delta(\beta-1)}{1-\delta}$ $\delta=0 \rightarrow 0$ $\delta=1 \rightarrow \pm\infty$ | $\frac{\chi}{1-\delta}$ $\delta=0 \rightarrow \chi$ $\delta=1 \rightarrow \infty$ |
| $\frac{d\Omega}{dx}$ | 1 | 0 | $-\gamma$ | $\beta-1$ | 0 |
| $\frac{dz}{dx}$ | $\frac{\delta}{1-\delta}$ $\delta=0 \rightarrow 0$ $\delta=1 \rightarrow \infty$ | $\frac{1}{1-\delta}$ $\delta=0 \rightarrow 1$ $\delta=1 \rightarrow \infty$ | $-\frac{\gamma\delta}{1-\delta}$ $\delta=0 \rightarrow 0$ $\delta=1 \rightarrow \infty$ | $\frac{\delta(\beta-1)}{1-\delta}$ $\delta=0 \rightarrow 0$ $\delta=1 \rightarrow \pm\infty$ | $\frac{\delta+\chi-1}{1-\delta}$ $\delta=0 \rightarrow \chi-1$ $\delta=1 \rightarrow \infty$ |

Table 1: Summary of the long-run effects of a change in the autonomous components of wages and prices, unemployment, productivity and world prices on wages, prices, income distribution and international competitiveness. Columns: Variable which is shocked. Rows: Change in variables following the shock.

5. Demand effects

So far we have treated the level of aggregate demand as exogenous and only investigated the wage-price-model independently. In order to incorporate the effects of changes in wages and prices on aggregate demand and vice versa, we need a demand closure. We use a generalized open economy version of the Kaleckian model by Bhaduri and Marglin (1990), where both income distribution and the real exchange rate have (opposite) effects on aggregate demand:

$$(17) \quad Y = Y(\underset{+}{\Omega}, \underset{-}{z})$$

In this type of model, the propensity to consume out of wage incomes is always higher than out of profit incomes. A redistribution of incomes from profits to wages, which is equivalent to a higher wage share, will therefore increase consumption expenditure. The lower profitability on the other hand reduces investment; empirical investigations nevertheless support the hypothesis that the effect on investment is always much smaller than on consumption, so that the total effect of a higher wage share on domestic demand is positive.¹⁰ A higher real exchange rate on the other hand deteriorates international competitiveness and therefore net exports which has an attenuating effect on aggregate demand.

The total effect of one of the shocks discussed before on aggregate demand thus depends on two factors: First, on the relative magnitude of the effects of the initial shock on income distribution and the real exchange rate and second, on the reaction of aggregate demand to changes of these two variables. The overall effect can therefore go in either direction: If the change in the real exchange rate is high compared to the effect on income distribution, and/or demand is reacting stronger to changes in the real exchange rate than to changes in income distribution, then the overall effect of e.g. a (positive) wage shock is likely to be negative. The demand regime is called 'profit-led'. In the opposite case, we call the demand regime 'wage-led'.¹¹

¹⁰ We therefore assume that the domestic sector of the economy is always 'wage-led'. See e.g. Stockhammer et al. (2009) and Ederer (2008) for a detailed discussion of the Bhaduri and Marglin (1990) model for the open economy and its empirical estimations.

¹¹ The terms 'wage-led' and 'profit-led' usually refer to the effect of a rise in the wage share on aggregate demand. Here, we call the demand regime 'wage-led', when the effect of the initial (positive) shock (wage, price, demand, productivity and world price shock) on demand is positive, and 'profit-led' if it is the opposite. It is therefore a somehow broader definition with a similar meaning.

According to table 1, the effect of all the shocks discussed above on income distribution does not depend on the degree of PTM in the economy. Contrarily, the impact on the real exchange rate always depends on the parameter δ . The higher is the pass-through coefficient, the higher is also the effect of the initial shock on international competitiveness. The relative magnitude of the two effects thus depends uniquely on the degree of PTM in the economy. The reaction of aggregate demand to changes of the two variables on the other hand depends on the corresponding elasticities and the relative size of the domestic and foreign sector in the economy.

The demand effects of the original shocks discussed before can either reinforce or dampen the original shock and its subsequent changes in wages, prices, income distribution and the real exchange rate. A wage shock and a demand shock both have a positive effect on income distribution. On the other hand, the real exchange rate also rises. If the overall demand effect is 'wage-led', demand increases and, assuming that productivity and the labour supply are constant, the unemployment rate goes down. According to table 1, this in turn leads to higher prices, a higher wage share and a rise in the real exchange rate. The original shocks are therefore reinforced by the demand side of the economy. If the demand effect on the other hand is 'profit-led', the initial shock is dampened or even reversed, if the overall effect is high enough.¹²

In the case of a mark-up shock, there is no effect on income distribution. The demand effect can therefore only be negative ('profit-led'). The rise of the real exchange rate due to a positive mark-up shock reduces aggregate demand. This in turn reduces wages and prices, as well as income distribution and the real exchange rate. As a consequence, the original wage, price and real exchange rises are (partly) offset. Additionally, the wage share which was not affected by the initial rise of the mark-up, declines.

In the case of a productivity-oriented wage policy, a productivity shock has no effect either on the wage share or on the real exchange rate. Consequently, aggregate demand is also not affected. If productivity gains are not fully translated into higher real wages, the wage share is declining, and so does the price level. Thus, in the case of a 'wage-led' economy, demand is falling, reinforcing the decrease of prices, income distribution and the real exchange rate. Thereby it is creating a deflationary situation, in which the negative effects on

¹² We are assuming that the new equilibrium is always stable. For the discussion of the stability conditions and the unstable case see e.g. Taylor (2004).

income distribution and prices are reinforced. If on the other hand the economy is 'profit-led', the original changes in the variables are (partly) offset. In the rarely seen case of an 'expansionary' wage policy, where real wages are increased more than productivity, a productivity shock would lead to a higher wage share and higher prices. In combination with a wage-led economy, this would also reinforce demand, employment and reinforce the original shock. The case of a profit-led regime would create the opposite situation.

A shock in the world price level does not affect income distribution. Thus, there is no 'wage-led' case. The effect on the real exchange rate can be either positive or negative, depending on the elasticity with which prices react to the increase in world prices. It can thus either reduce or increase demand. In both cases the original effect on the variables is attenuated.

Supplementing the standard NAIRU model with a negative relation between prices and aggregate demand usually guarantees the return to the NAIRU in the long run. Income distribution is not affected, thus no effects of changes in income distribution on demand can be considered. In the PTM model, both international competitiveness and income distribution change. Thus, supplementing this model with a demand curve that allows for both effects, the overall effect on demand becomes ambiguous and can either reinforce or contradict the initial shock. In the – for open economies – more likely case of profit-led demand, the effects on both income distribution and the real exchange rate are diluted. Nevertheless, the short-run NAIRU adjusts to a certain extent to the actual unemployment rate. Thus, the NAIRU ceases to be a strong attractor.

With the discussion of the demand closure, our model is now complete. However, it is worth briefly discussing its limitations. Firstly, during the whole discussion we have assumed that the nominal exchange rate is constant. If the nominal exchange rate reacts to changes in the real exchange rate, offsetting the change in prices and leaving the real exchange rate constant, the effect on international competitiveness would be zero. The only effect of a shock therefore would be on income distribution, ruling out the case of a 'profit-led' demand effect. However, we do not include a theory about the determination of the exchange rate into the analysis and remain with the more general case. Similarly we also assume that there is no reaction of the central bank, and therefore no effect of changes in the level of aggregate demand on the interest rate. We thereby exclude a subsequent change in the nominal exchange rate via the interest rate parity relation. Finally, it is also supposed that a change in the income distribution has no effect on the willingness of firms to stay in the country. A

capital flight as a consequence of a higher wage share would reduce the bargaining power of workers and restore at least partly the former level of income distribution.

6. Summary and Conclusions

The standard NAIRU model has some important implications. First, there is a unique rate of unemployment at which inflation is stable. This rate is called the 'Non-accelerating rate of unemployment' (NAIRU). Second, all deviations from the NAIRU produce accelerating inflationary or disinflationary processes, which only come to an end when unemployment is restored to the NAIRU level. Third, the income distribution between workers and firms is constant. Any changes in the relative bargaining positions of workers and firms will lead to a 'wage-price-spiral'. The model is usually supplemented by a demand equation, which uniquely depends on the price level. Any deviations from the NAIRU lead to changes in the price level and consequently to changes in aggregate demand. This brings the unemployment rate back to the NAIRU level. The NAIRU is a strong attractor.

These outcomes exclusively depend on the assumption of a full pass-through of labour costs on prices. This assumption however is not realistic. To a certain extent, firms have to conduct Pricing-to-market (PTM). PTM completely changes the implications of the NAIRU model.

First, the unique equilibrium rate of unemployment ceases to exist. The long-run Phillips curve consequently becomes horizontal. Second, deviations from the equilibrium lead to a temporary inflationary or disinflationary process which ends after actual real wages have adjusted to the bargained real wage in the new equilibrium. There is no endless wage-price-spiral. Third, income distribution changes with the level of employment. The higher is the employment in the economy, the higher is the labour income share. Workers always get their expected real wage after the adjustment process is completed.

The model is complemented with a demand function which allows for effects of both income distribution and international competitiveness. Consequently, the effect of changes in wages and prices on demand is ambiguous. In the more probable case of a profit-led demand regime, the effects on the wage share and the real exchange rate are moderated. However, the short-term NAIRU adjusts to the actual unemployment rate to some extent. The NAIRU consequently is not a strong attractor.

If substantial PTM behaviour can be found for an economy, the policy conclusions will be important. Expansionary demand and wage policy would resume being feasible without the

fear of triggering an endless wage-price-spiral. Any increases in demand and wages are followed by temporary inflation which leads to changes in the levels of prices and international competitiveness. After adjustment is completed, inflation returns to its initial rate. Income distribution however is also changing. Both higher aggregate demand and higher wages translate into a higher labour income share. A higher wage share in turn is likely to induce additional consumption. If the positive effects on demand exceed the negative effect of lower international competitiveness, as in the case of a 'wage-led' demand regime, the deterioration of the trade balance will be more than offset by augmented consumption expenditures. Both the wage share and the level of employment could be increased to a higher long-run sustainable rate. But even in the more likely case of a 'profit-led' regime, an increase in employment and the wage share is possible to a certain extent.

Contrarily, a policy of wage moderation becomes less attractive. Given that it directly reduces income distribution, this leads to reductions in consumption expenditures which at least partly compensate the stimulating effect of higher international competitiveness on net exports. Consequently, it would not only have a negative impact on income distribution but possibly also reduces demand and employment in an economy.

So far the paper has discussed only the theoretical model and its implications. Further research is required to empirically assess the extent of PTM behaviour in the economy and quantify the effects of various shocks on real and nominal variables.

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