The Impact of Reference Norms on Inflation Persistence When Wages are Staggered: Theoretical Analysis and Empirical Results*

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Abstract

In this paper we extend the Taylor model with staggered wages to allow for reference norms. We show that reference norms can considerably increase the persistence of inflation and the extent of real wage rigidity but that these effects depend on the definition of reference norms (e.g. how backward-looking they are) and on whether the importance of norms differs between sectors. Using data on collectively bargained wages in Austria from 1980 to 2006 we show that wage-setting is strongly influenced by reference norms, that the wages of other sectors seem to matter more than own past wages and that there is a clear indication for the existence wage leadership (i.e. asymmetries in reference norms).

Keywords: Inflation Persistence, Real Wage Rigidity, Staggered Contracts, Wage Leadership

JEL-Classification: E31, E32, E24, J51

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1 Introduction

Numerous studies have documented that standard models with wage rigidities (like the models by Taylor [1980] and Calvo [1983]) do produce considerably less endogenous persistence in output and inflation than can be found in the empirical data (cf. Roberts, 1995; Fuhrer and Moore, 1995; Chari et al., 2000). The most common way to deal with this problem is to assume that there exists some amount of additional intrinsic persistence in prices. This is motivated, e.g., by the existence of “rule-of-thumb” price setters (cf. Galf and Gertler, 1999) or by the assumption that some firms simply use indexation instead of optimization when choosing their prices (cf. Christiano et al., 2005; Smets and Wouters, 2003). These are useful short-cuts that help to bring the standard models with nominal rigidities closer in line with the main properties of the observed data. Nevertheless, the assumptions of automatic indexation and rule-of-thumb behavior are also controversial and they have been criticized as being ad-hoc, implausible and at variance with the available evidence on actual price-setting behavior of firms (cf. Mankiw and Reis, 2002; Rudd and Whelan, 2007).

Given this controversial role of backward-looking price-setting it seems natural to ask whether the process of wage-setting could be responsible for the observed excessive persistence. In fact, there exists an extensive survey literature documenting that wage-setting is affected by many more factors than can usually be found in standard labor market models (cf. Campbell and Kamlani, 1997; Bewley, 1999; Agell and Benmmarker, 2007). In particular, it has been shown that actual wage-setting policies are considerably influenced by benchmark values, e.g. by the workers’ own past wages or by the wages in other sectors of the economy. Paying workers less than their benchmark value might cause motivational problems with detrimental effects on morale and productivity. Interestingly, these arguments from the labor market literature are only rarely incorporated into the commonly used dynamic macroeconomic models. The few existing papers that can be found in this realm differ in their focus and point of departure. Some use models with relative wages (Buiter and Jewitt, 1981; Fuhrer and Moore, 1995; Ascari and Garcia, 2004) while others are based on efficiency wages (Danthine and Kurmann, 2004) or wage norms (Hall, 2005; Gertler and Trigari, 2006). The common thread in this literature is that wage-setters are assumed to have (explicit or implicit) benchmark wages or reference norms that influence their wage-setting behavior and thereby contribute to real wage rigidities.\footnote{The important role of real wage rigidities is also documented in the growing literature on downward real wage rigidities (cf. Dickens et al., 2007; Goette et al., 2007). Some authors (e.g., Blanchard and}
under which circumstances the introduction of reference norms in wage-setting might help to explain the observed excessive persistence of nominal variables.

The paper contributes to the literature from both a theoretical and an empirical angle. In the theoretical part we extend the classical, two period staggered-wage model by Taylor (1980) to allow for reference norms. In the benchmark case the reference norm is specified as a “backward-looking external norm”, i.e. wage-setters are assumed to look at the last wages that has been set in the other sector. We show that the introduction of this reference norm can considerably increase inflation persistence. In this respect the model has similar properties to the approaches that assume backward-looking price-setters. The model with reference norms in wage-setting is, however, better supported by empirical (survey) evidence and we would thus argue that it is a promising avenue to improve the performance of models with nominal rigidities.

In a further step we move beyond this baseline result and show that in order to assess the contribution of wage-setting models it is also important to specify the precise type of the prevalent reference norm and whether the importance of reference norms differs between different sectors of the economy. Both of these factors might be important although the existing empirical literature does not give unambiguous results. As far as the first issue is concerned, it is still highly controversial which variables determine reference norms. Campbell and Kamliani (1997) and Bewley (1999), e.g., report that workers mainly compare their wage rate with their own past wages and with the wages of other workers within the same firm. Agell and Lundborg (2003) and Agell and Benmmarker (2007), on the other hand, document a large role for external norms and considerable differences between Swedish and US survey data.\(^2\) These differences are potentially important since the precise nature of reference norms can have a considerable impact on the extent of persistence and real rigidities. In a static modelling framework this is analyzed, e.g., by Danthine and Kurmann (2006) and Koskela and Schöb (2007). We also show this in our dynamic model where the amount of persistence turns out to be depend on the degree of “backward-lookingness” and on the importance of external (i.e. cross-sectional) comparisons.

The second important open question concerning reference norms and wage-setting is related to the issue whether there exist sectoral differences in the determination and

\(^{2}\)In sharp contrast to this evidence [by Campbell and Kamliani (1997) and Bewley (1998)], most of our respondents indicated that both internal and external wages were important norms of comparisons in the local wage bargain” (Agell and Benmmarker, 2007, 362).
importance of norms. In fact, it is frequently argued that a structure of “wage leadership” is present in a number of Scandinavian and continental European countries. In such a system a specific sector-union (often the one of metal or public sector workers) acts as a wage leader that sets its wage levels more or less irrespective of what other unions have done in the past while the other unions will take this wage rate as their reference norm (cf. Smith, 1996; Lindquist and Vilhelmsson, 2006; Traxler et al., 2008). Despite the empirical importance we know of no paper that has studied wage leadership in the framework of standard dynamic macroeconomic models. The set-up of our model allows us to tackle this issue. We show that asymmetries in the importance of reference norms between sector reduce the extent of persistence. This means that for two economies that are characterized by an identical structure and an identical average importance of reference norms the economy with asymmetric norms (e.g. wage leadership) will also exhibit less persistence.

In the empirical part of the paper we then proceed to analyze whether the implications of the model are more than just a theoretical possibility. In particular, we use a data set on collectively bargained wages in Austria from 1980 to 2006 that comprises around 100 individual wage-setting units that cover almost the complete national labor force. The process of wage-setting in Austria has a clear element of staggering since employers and employees in the metal sector traditionally start their negotiations after the summer (“autumn bargaining round”) while the wage-setters in other sectors follow until May of the following year. We use these data to study empirically the importance, the prevalent type and the possible asymmetric structure of reference norms. The available data do not allow a direct test for the relevant reference norm as can be done in survey studies. We therefore have to construct different reference norms that follow the suggestions in the literature. We generate, e.g., an external reference norm that comprises for all wage-setting units the average wage increase since their last wage settlement. Similarly, we also construct a “habit norm” (defined as the last increase of the own wage rate) and a wage leadership reference norm (where only the wage increase in the metal sector is assumed to act as the benchmark). These constructed reference norms will certainly only approximate the true comparison groups of the wage-setting parties and do not allow a detailed account of reference norms as it is done in survey studies. On the other hand the available survey studies are mostly based on interviews with a small number of firm managers and thus focus only on a small subset of the economy and primarily on the perspectives of one

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3In the literature one can find a number of synonymous expressions for this phenomenon like “pay leadership”, “wage spillovers”, “pattern bargaining” or “key bargaining.”
side of the negotiating process. In contrast to this, our data on collectively bargained wages involve the reference norms of both parties and they refer to almost the complete labor force of a highly corporatist country. In this respect we think that our paper can be regarded as an interesting complement to the existing survey studies.

Our results indicate that reference norms are in fact an important factor for Austrian wage settlements. By and large the coefficient of the reference norm is about as large as the coefficient of the forecasted inflation. Furthermore, our findings clearly suggest that the wage rates of other units (either the wage rate of the metal sector or an average of all wage settlements since the last negotiations) matter more than internal habits (i.e. the own last settlement). Finally, we get strong indication of asymmetries and wage leadership in Austrian wage-setting behavior. This conclusion is based on nested and non-nested statistical tests involving different kind of reference norms. It is also suggested by the results of random coefficients estimations where we find that the importance of reference norms is significantly smaller for the wages that are negotiated in the first month of a wage round. These findings thus clearly suggest that the metal sector that traditionally starts the annual rounds of Austrian wage negotiations does in fact act as a wage leader. This corresponds to the “folk wisdom” about the system of industrial relations in Austria that is often repeated in the media. It also confirms the results in Traxler et al. (2008) who use a different framework. There exists a small number of papers that have documented a similar structure of wage leadership for other countries. In contrast to our paper, however, these studies mostly refer only to a subsample of an economy (e.g. Smith, 1996).

Our findings have a number of consequences concerning inflation persistence and real wage rigidity. First, reference norms are an important factor in wage-setting and they should be included in realistic and comprehensive dynamic macroeconomic models. Second, in order to get a complete picture about the sources and consequences of nominal rigidities it is important to move beyond the collection and documentation of average numbers. Economies that are characterized by differences in the importance of reference norms between sectors will show less persistence than countries with a symmetric structure. Fourth, underlying differences in reference norms could also be responsible for the observed cross-country differences in inflation persistence and wage rigidities (cf. Cecchetti and Debelle, 2004; Dickens et al., 2007).

The paper is organized as follows. In the next section we present a simple model with staggered wages that allows for reference norms. In section 3 we describe our data on

\footnote{Carvalho (2005) and Dixon and Kara (2007) study the consequences of asymmetries in the contract length on the amount of persistence in Taylor models.}
collective wage-bargaining in Austria and we report the results. Section 4 concludes.

2 A model with staggering and reference norms

2.1 The set-up

We use a variant of the Taylor model with staggered wage contracts (1980) that allows for reference norms in wage-setting. The model assumes that all wage contracts are valid for one year and that the total workforce is divided into two sectors of equal size where in each year $t$ wage-setters in sector $A$ ($B$) negotiate the wage in the first (second) half. The wage-setting equations for the two sectors are assumed to take the following form:

\[ w_{1,t}^A = (1 - \mu^A) w_{1,t}^{A*} + \mu^A r_{1,t}^A \]  
\[ w_{2,t}^B = (1 - \mu^B) w_{2,t}^{B*} + \mu^B r_{2,t}^B, \]

where $w_{1,t}^{A*}$ ($w_{2,t}^{B*}$) is the “pure wage target” of wage-setters in sector $A$ ($B$) in the first (second) half of year $t$, $r_{1,t}^A$ ($r_{2,t}^B$) stands for their reference norm and $\mu^A$ ($\mu^B$) is the relative weight of these two magnitudes. The pure wage targets follow the specification in Taylor (1980), i.e.:

\[ w_{1,t}^{A*} = bp_{1,t} + (1 - b)E_{1,t}p_{2,t} + \gamma (by_{1,t} + (1 - b)E_{1,t}y_{2,t}) \]  
\[ w_{2,t}^{B*} = bp_{2,t} + (1 - b)E_{2,t}p_{1,t+1} + \gamma (by_{2,t} + (1 - b)E_{2,t}y_{1,t+1}) \]

The pure wage target $w_{1,t}^{A*}$ of wage-setters in sector $A$ in the first subperiod of year $t$ depends on the expected price level and the expected level of real activity (or excess demand) during the duration of the contract. The expected price level is given by $[bp_{1,t} + (1 - b)E_{1,t}p_{2,t}]$, where $p_{1,t}$ ($p_{2,t}$) is the price level in the first (second) half of the year and $b$ is the relative weight of the two subperiods. Similarly $y_{1,t}$ ($y_{2,t}$) is the measure of aggregate demand in the first (second) half of the year and $\gamma$ represents the degree of “real rigidity” (cf. Ball and Romer, 1990). The higher is $\gamma$, the stronger the wage target $w_{1,t}^{A*}$ reacts to the conditions in the real economy and thus the smaller is the degree of real rigidity. The expectations operator $E_{1,t}$ indicates that all information up to sub-period 1 of year $t$ is used in forming expectations about the future. The determinants of the pure
wage target \( w_{2,t}^{B*} \) in sector \( B \) are completely analogous.\(^5\)

If \( \mu^A = \mu^B = 0 \) wage-setters do not have reference norms and the wage-setting equations (1) and (2) coincide with the original formulation in Taylor (1980). For \( \mu^A > 0 \), \( \mu^B > 0 \), however, wage-setting is assumed to be influenced by reference norms. This specification is based on the observation that in their negotiations wage-setters typically also care about other nominal variables in a direct fashion (and not only via their impact on current and future price levels). The reasons for such a behavior can be manifold and various explanations have been proposed in the literature that range from efficiency wage and relative wage models (Fuhrer and Moore, 1995; Danthine and Kurmann, 2004; Ascari and Garcia, 2004) to models with wage norms (Hall, 2005; Gertler and Trigari, 2006). Although these models differ in their motivation and also in their particular specifications they share the broad implication that the wage-setting equations can be written in a form similar to (1) and (2).

For our benchmark model we will use the simple assumption of “backward-looking external norms” (i.e. norms that refer to past wages in the other sector):

\[
\begin{align*}
\bar{n}_{1,t}^A &= w_{2,t-1}^B \quad \text{and} \quad \bar{n}_{2,t}^B = w_{1,t}^A
\end{align*}
\]  

Equation (5) says that wage-setters in sector \( A \) look at the past wage level in sector \( B \) and wage-setters in sector \( B \) at the past wage rate in sector \( A \). This is a reasonable specification that is in line with the results from survey studies (e.g. Agell and Bennmarker, 2007). Other reference norms will be discussed below. Note that for the extreme case with \( \mu^A = \mu^B = 1 \) assumption (5) implies complete stickiness of wages, i.e. \( w_{1,t}^A = w_{2,t-1}^B \) and \( w_{2,t}^B = w_{1,t}^A = w_{2,t-1}^B \).

All wages are assumed to be fixed for two (sub)periods, i.e.:

\[
\begin{align*}
w_{2,t}^A &= w_{1,t}^A \\
w_{1,t+1}^B &= w_{2,t}^B
\end{align*}
\]  

Equations (1) to (7) describe the basic structure of wage-setting in our framework that will underlie our empirical estimations. In the following we want to use this empirically

\(^5\)Taylor did not derive his wage-setting equation from “first principles” but he motivated it as being “simple and plausible” (Taylor, 1980, p. 4). It can be shown, however, that a system of equations that is very similar to the ad-hoc specification of the Taylor model can be derived as the linearized solution to a fully fledged intertemporal optimization model (see appendix A and Ascari, 2000; Huang and Liu, 2002). In this case all the variables have to be interpreted as being percentage deviations around their respective steady states.
plausible description of wage-setting behavior in an otherwise standard dynamic model in order to show how the existence of reference norms can change the persistence of inflation. To this end we have to specify how the other endogenous variables are determined.

Prices are set as a mark-up over wages and the subperiod price levels \( p_{1,t} \) and \( p_{2,t} \) are then equal to the average subperiod wage:\(^6\)

\[
p_{1,t} = \frac{1}{2} \left( w_{1,t}^A + w_{1,t}^B \right) = \frac{1}{2} \left( w_{1,t}^A + w_{2,t-1}^B \right) \tag{8}
\]

\[
p_{2,t} = \frac{1}{2} \left( w_{2,t}^A + w_{2,t}^B \right) = \frac{1}{2} \left( w_{1,t}^A + w_{2,t}^B \right) \tag{9}
\]

The second equality in equations (8) and (9) follows from (6) and (7). The average (end-of-year) price level \( \bar{p}_t \) is given by the average of the two sub-periods price indices, i.e.:\(^\)

\[
\bar{p}_t = \frac{1}{2} (p_{1,t} + p_{2,t}) \tag{10}
\]

Using (8) and (9) in (10) we can derive that:

\[
\bar{p}_t = \frac{1}{2} w_{1,t}^A + \frac{1}{4} \left( w_{2,t}^B + w_{2,t-1}^B \right) \equiv \bar{w}_t \tag{11}
\]

The average annual price level \( \bar{p}_t \) equals the average annual wage level \( \bar{w}_t \) and is thus a weighted sum of the wages that have been valid in year \( t \). Since the wage that is contracted in the first subperiod is valid throughout the whole year it gets a larger weight than the wage that is negotiated in the second subperiod.

As in many versions of the Taylor model we also assume that aggregate demand \( y_{i,t} \) depends on nominal demand (or the money supply) \( m_{i,t} \) and the price level \( p_{i,t} \).\(^7\) In particular:

\[
y_{1,t} = m_{1,t} - p_{1,t} \tag{12}
\]

\[
y_{2,t} = m_{2,t} - p_{2,t} \tag{13}
\]

This completes the description of the model.

\(^6\)The mark-up does not appear in (8) and (9) since all variables are defined as deviations around the steady state and the mark-up is constant over time.

\(^7\)This is done in Taylor’s original model (1980) and also in various later contributions to this topic (e.g., Chari et al., 2000; Karanassou and Snower, 2007). Other papers, especially in the context of the “New Keynesian Phillips Curve”, treat \( y_{i,t} \) as an exogenous forcing variable (e.g., Roberts, 1995; Galí and Gertler, 1999).
2.2 The solution for the general case

Setting $b = \frac{1}{2}$ (to simplify notation) and inserting (8), (9), (12) and (13) into (1) we can derive that

$$w^A_{1,t} = \psi_1 w^B_{2,t-1} + \psi_2 E_{1,t} w^B_{2,t} + \psi_3 (m_{1,t} + E_{1,t}m_{2,t}),$$

where $\psi_1$ to $\psi_3$ are parameters depending on $\gamma$ and $\mu^A$. In a similar fashion (see appendix A) we can also express $w^B_{2,t}$ and $w^B_{2,t-1}$ in terms of wages of the other sector (i.e. in terms of $w^A_{1,t-1}$, $w^A_{1,t}$ and $E_{2,t}w^A_{1,t+1}$). Inserting these expressions for $w^B_{2,t-1}$ and $w^B_{2,t}$ into (14) gives an equation for $w^A_{1,t}$ that takes the form:

$$w^A_{1,t} = \omega_1 w^A_{1,t-1} + \omega_2 E_{1,t}w^A_{1,t+1} + \Gamma^A_{1,t},$$

where $\omega_1$ and $\omega_2$ are coefficients that depend on the underlying structural parameters ($\gamma$, $\mu^A$, $\mu^B$) and $\Gamma^A_{1,t}$ is a linear function of the exogenous money supplies in various subperiods (see appendix A). A similar expression can also be derived for $w^B_{2,t}$:

$$w^B_{2,t} = \omega_1 w^B_{2,t-1} + \omega_2 E_{2,t}w^B_{2,t+1} + \Gamma^B_{2,t},$$

Equations (15) and (16) are second order difference equations and using standard methods they can be solved for their roots $\lambda_1$ and $\lambda_2$. Due to the fact that the two sectors are mirror images of one another (the weights $\omega_1$ and $\omega_2$ are identical in (15) and (16)) the same roots govern the dynamics of $w^A_{1,t}$ and $w^B_{2,t}$. From (11) we can thus conclude that $\lambda_1$ and $\lambda_2$ will also determine the dynamics of the average wage (or price) level.

We can write the solution for the roots as:

$$\lambda_{1,2} = \frac{1}{2\omega_2} \pm \sqrt{\frac{1}{4(\omega_2)^2} - \frac{\omega_1}{\omega_2}},$$

Following the general convention we will assume $\lambda_1 \leq 1$ and $\lambda_2 \geq 1$. The stable root $\lambda_1$ thus characterizes the dynamics of the sectoral wage levels $w^A_{1,t}$ and $w^B_{2,t}$ and of the average price and wage levels $\bar{p}_t$ and $\bar{w}_t$.

In the following we want to discuss some special cases of this model.

2.3 The standard case without reference norms

As a benchmark case for our discussion it is useful to begin with the case without reference norms ($\mu^A = \mu^B = 0$). Under this assumption the only difference between the two sectors derives from the staggered structure of wage-setting. In this case we can write
the model in terms of the subperiods denoted by the time index \( \tau \) (i.e. \( \tau \) stands for the first subperiod of year \( t \), \( \tau + 1 \) for second subperiod of year \( t \) etc.) and the period wage level \( x_{\tau} \). Thus: \( x_{\tau-1} = w_{2,t-1}^B, x_{\tau} = w_{1,t}^A, x_{\tau+1} = w_{2,t}^B, p_{\tau} = p_{1,t}, p_{\tau+1} = p_{2,t} \) etc. The three pairs of equations (1) and (2), (8) and (9), (12) and (13) can then be summarized in three equations: 

\[
x_{\tau} = \frac{1}{2}(p_{\tau} + E_{\tau}p_{\tau+1}) + \frac{\gamma}{2}(y_{\tau} + E_{\tau}y_{\tau+1})
\]

\[
p_{\tau} = \frac{1}{2}(x_{\tau} + x_{\tau-1})
\]

\[
y_{\tau} = m_{\tau} - p_{\tau}
\]

This is the symmetric formulation of the Taylor model that can be typically found in the literature (e.g. Romer, 2006, chap 6; Asciari, 2003; Karanassou and Snower, 2007). One has to note, however, that the time index \( \tau \) in this version refers to one subperiod and not to a full year.

In this case we can calculate that \( \omega_1 = \omega_2 = \frac{(1-\gamma)^2}{2(1+6\gamma+3\gamma^2)} \) and thus the stable root in (17) can be written as:

\[
\lambda_1 = \left( \frac{1 - \sqrt{\gamma}}{1 + \sqrt{\gamma}} \right)^2
\]

It is visible from (21) that \( \lambda_1 \) decreases in \( \gamma \) (\( \frac{\partial \lambda_1}{\partial \gamma} < 0 \)). The more strongly wages react to excess demand (the lower real rigidities) the lower will be the degree of persistence.

It is well-known from the standard Taylor model with symmetry that the persistence between subperiods is governed by the root \( \lambda_1^* = \frac{1 - \sqrt{\gamma}}{1 + \sqrt{\gamma}} \). We thus get the expected result that \( \lambda_1 = (\lambda_1^*)^2 < \lambda_1^* \). The degree of persistence \( \lambda_1 \) on an annual basis (i.e. from \( w_{1,t-1}^A \) to \( w_{1,t}^A \) or from \( \bar{w}_{t-1} \) to \( \bar{w}_t \)) is smaller then the degree of persistence between subperiods \( \lambda_1^* \) (i.e. from \( w_{2,t-1}^B \) to \( w_{1,t}^A \) etc.).

2.4 The “persistence puzzle”

We can use (21) to briefly discuss the inflation or output persistence puzzle (cf. Fuhrer and Moore, 1995; Chari et al., 2000). There exist various forms of this puzzle but here we want to focus on the version of the puzzle that arises in the context of the Taylor model. The basis of the problem is that in microfounded models \( \gamma \) is not a free variable but rather depends on a number of structural parameters. In particular, under certain assumption one can show (see appendix A) that \( \gamma = \frac{\eta_{CC} + \eta_{LL}}{1 + \theta_{LL}}, \) where \( \theta \) is the elasticity

\(^8\text{For simplicity we continue to set } b = \frac{1}{2}.\)
of substitution between different varieties of goods and $\eta_{cc}$ and $\eta_{ll}$ are the inverses of the intertemporal elasticity of substitution of consumption and of labor supply, respectively. Standard numbers for these parameters are (cf. Ascari, 2000, Table 1 or Dixon and Kara, 2007): $\eta_{cc} = -1$, $\eta_{ll} = 3.5$, $\theta = 6$. These values imply a value for the real rigidity of $\gamma = 0.21$. Using different acceptable parameter values (e.g. a higher elasticity of marginal consumption $\eta_{cc}$ or a lower elasticity of labor supply $\eta_{ll}$) would suggest even higher values of $\gamma = 0.3$ or above.\footnote{The assumption of decreasing returns to scale in production ($\alpha < 1$) does not change the main message. In particular, in this case we get that (see Ascari, 2003): $\gamma = \frac{-\eta_{cc} - \eta_{ll}}{1 + \eta_{cc} + \eta_{ll}}$. Using $\alpha = \frac{2}{3}$ and again $\eta_{cc} = -1$, $\eta_{ll} = 3.5$ and $\theta = 6$ we get $\gamma = 0.26$. In a model with price-setting Chari et al. (2000) get a value for $\gamma$ that is even larger than 1 (since they have $\gamma = \eta_{ll} - \eta_{cc}$).} These calibrated parameters of $\gamma$ are in conflict with empirical estimations, where it is typically found that one needs a parameter $\gamma$ between 0.05 and at most 0.1 to explain the observed degree of inflation and output persistence.\footnote{Taylor (1980), e.g., estimates values for $\gamma$ between 0.05 and 0.1 while Sachs (1980) estimates it to be between 0.07 and 0.1. Gali and Gertler (1999) estimate it to be between 0.007 and 0.047 and Gordon (1982) puts it at 0.1. See also Karanassou and Snower (2007) or Dixon and Kara (2007). Note that in the context of the New Keynesian Phillips Curve (where one abstracts from endogenous demand as in (12) and (13)) the “persistence puzzle” is even more pronounced since in the absence of reference norms there is only persistence in the price level but not in inflation (cf. Roberts, 1995).} Put differently, this maximum value ($\gamma = 0.1$) that is in line with the empirical observations would lead to a measure of year-to-year persistence in the symmetric standard model of: $\lambda_1 = \left(\frac{1-\sqrt{0.1}}{1+\sqrt{0.1}}\right)^2 = 0.27$. This corresponds (in the two-period staggered wage model) to a subperiod-to-subperiod level of persistence of $\lambda_1^* = \frac{1-\sqrt{0.1}}{1+\sqrt{0.1}} = 0.52$. This is in fact the value used in the survey by Ascari (2003) who “defines a significant degree of persistence to be a value of $\lambda$ of at least 0.5” (p. 526).\footnote{The $\lambda$ in Ascari (2003) refers to the subperiod-to-subperiod level of persistence, i.e. to what is denoted by “$\lambda_1^*$” in our framework.} We will use this benchmark value of $\lambda_1 = 0.25$ or ($\lambda_1^* = 0.5$) in the following in order to judge whether extensions to the standard symmetric model are successful in increasing the degree of persistence towards the empirically observed values even if the average value of $\gamma$ stays in the neighborhood of the values that are in line with the estimated structural parameters (i.e. between $\gamma = 0.2$ and $\gamma = 0.3$).

### 2.5 The case with symmetric reference norms

We want to analyze now whether the existence of reference norms can increase inflation persistence and real wage rigidity. For this purpose we start with the case where the importance of the reference norm is the same in both sectors (i.e. $\mu^A = \mu^B = \mu > 0$).
Equation (17) simplifies to a compact expression for the stable root $\lambda_1$:

$$\lambda_1 = \left( \frac{1 + \gamma + \mu(1 - \gamma) - 2\sqrt{\gamma(1 - \mu^2) + \mu^2}}{(1 - \gamma)(1 - \mu)} \right)^2 $$

(22)

Note that for $\mu = 0$ (22) reduces to (21). On the other hand, we have seen above that a value of $\mu = 1$ implies perfect stickiness (i.e. $w_{1t}^A = w_{1t-1}^A$ and $w_{2t}^B = w_{2t-1}^B$). This result can be repeated in terms of $\lambda_1$ since we get that $\lim_{\mu \to 1} \lambda_1 = 1$. This means that under the assumption of external reference norms (cf. (5)) we can have complete persistence ($\lambda_1 = 1$) if comparisons play an overwhelming role in wage-setting.

Even for lower values of $\mu$ one can observe large increases in inflation persistence as illustrated in Figure 1 for two values of $\gamma$. In both cases an increase in the importance of reference norms to values between $\mu = 0.2$ and $\mu = 0.5$ is sufficient to increase $\lambda_1$ to levels between 0.28 and 0.7 which corresponds to the empirically observed degrees of persistence.

**Insert Figure 1 about here**

### 2.6 Asymmetries in the importance of reference norms

We have seen in the last subsection that the introduction of reference norms can increase inflation persistence considerably. In the next two subsections we want to study how this impact changes once we allow for different references norms and for possible asymmetries between sectors in the importance of reference norms.

The case of asymmetric importance of reference norms is highly relevant since it captures the argument that there exist sizable differences in the behavior of wage-setters and corresponds to the case of wage leadership. In the language of our model this would mean that $\mu^B > \mu^A$ (if sector $A$ is the wage leader) and possibly $\mu^A = 0$. The values for $\omega_1$ and $\omega_2$ that determine the solution for $\lambda_1$ (cf. (17)) are stated in the appendix (equations (46) and (47)). We want to illustrate the result with some numerical examples. We denote by $\bar{\mu}$ the average importance of reference norms in the economy, i.e. $\bar{\mu} = \frac{1}{2} (\mu^A + \mu^B)$. In panel A of Table 1 we report the values of $\lambda_1$ for two levels of $\gamma$ ($\gamma = 0.2$ and $\gamma = 0.3$) and under different assumptions about the importance and possible asymmetries in backward-looking external reference norms. In the first column we show the results for $\bar{\mu} = 0$ and in the second block of columns the results for $\bar{\mu} = 0.5$ (for two cases with $\mu^A = \mu^B = 0.5$ and $\mu^A = 0$ and $\mu^B = 1$, respectively).

**Insert Table 1 about here**

12
Panel A of Table 1 contains a number of interesting results. Starting with the case \( \gamma = 0.2 \) we see that the increase in the importance of reference norms from \( \bar{\mu} = 0 \) to \( \bar{\mu} = 0.5 \) increases \( \lambda_1 \) from 0.15 to 0.7. If there are, however, asymmetries in reference norms (\( \mu^A = 0 \) and \( \mu^B = 1 \)) then \( \lambda_1 \) is significantly lower at 0.5. This drop in \( \lambda_1 \) is even larger for \( \gamma = 0.3 \) where the increase in \( \lambda_1 \) from 0.09 (for \( \bar{\mu} = 0 \)) to 0.6 (for \( \bar{\mu} = 0.5 \)) is almost halved (to \( \lambda_1 = 0.37 \)) for the case of asymmetric reference norms.

The results of Table 1 indicate that it is important to know if wage-setting is characterized by asymmetries, e.g. by an outright system of wage leadership. In the latter case, corporatist countries with a clear pattern of staggered wage-setting might still face a rather low level of persistence (even if the average importance of reference norms is large). This phenomenon could thus be partly responsible for the fact that different countries with apparently quite similar labor market institutions show considerably different degrees of inflation persistence.

### 2.7 The role of different reference norms

Thus far we have assumed that wage-setters have backward-looking external reference norms as specified in (5). In the related literature, one can find however a large number of different assumptions concerning the variable(s) that primarily influence wage-setting decisions (see Agell and Benmammer, 2007; Danthine and Kurmann, 2006). In this section we will show that the choice of the reference norm can have an important impact on inflation persistence.

The most direct way to see this is if we assume that instead of (5) wage-setters only make **contemporaneous comparisons**, i.e.

\[
\begin{align*}
\ell_{1,t}^A &= w_{1,t}^A \\
\ell_{2,t}^B &= w_{2,t}^B
\end{align*}
\]

In this case we can transform (1) to derive that \( w_{1,t}^A = (1 - \mu^A) w_{1,t}^A + \mu^A w_{1,t}^A \). From this it follows that \( w_{1,t}^A = w_{1,t}^A \) and we are back to the model without reference norms. In general, the impact of the reference norm on the stickiness of wages will depend on the degree of “backward-lookingness” and on the extent to which they are directed to the other sector. We want to illustrate this by using two alternatives to the backward-looking external norm.\(^{12}\) For the first alternative specification we assume a “standard of living

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\(^{12}\)These are perhaps not the most plausible alternatives. A habit persistence reference norm, e.g., would be specified as: \( \ell_{1,t}^A = w_{1,t-1}^A \) and \( \ell_{2,t}^B = w_{2,t-1}^B \). This assumption leads to a third order difference equation that can be solved by numerical methods. A similar result emerges if we use the past average price level as the norm, i.e. \( \ell_{1,t}^A = \ell_{2,t}^B = \hat{\pi}_{t-1} \). We could also specify \( \ell_{1,t}^A \) and \( \ell_{2,t}^B \) in such
norm” where reference norms are given by the actual price (or wage) level:

\[ rn^A_{1,t} = p_{1,t}, \quad rn^B_{2,t} = p_{2,t} \]  \hspace{1cm} (24)

In the second example we assume that wage-setters only look at the wage levels in the other sector (as in (5)) but they take into account that such a norm will be present today and in the next subperiod. This “forward-looking external norm” is given by:

\[ rn^A_{1,t} = \frac{1}{2} (w^B_{2,t-1} + E_{1t}w^B_{2,t}) , \quad rn^B_{2,t} = \frac{1}{2} (w^A_{1,t} + E_{2t}w^A_{1,t+1}) \]  \hspace{1cm} (25)

In the lower panels B and C of Table 1 we show the degrees of inflations persistence for the two alternative reference norms and for the same parameter values as before.

We observe that inflation persistence is lower for both of the new reference norms. In the first case this follows from the fact that the norm \( p_{1,t} \) now not only includes the past wages of the other sector \( w^B_{2,t-1} \) but also wages \( w^A_{1,t} \) that are set in sector \( A \) in the current period and thus react to the current economic situation. Persistence is even lower for the forward-looking external norm where wage-setters are assumed to take into account that high wages today will induce the other wage-setters to increase their wages which again will increase the wage-setters’s own future reference norm. We have, e.g., that for \( \gamma = 0.2 \) and \( \bar{\mu} = 0.5 \) the parameter \( \lambda_1 \) is 0.7 for the case of the external norm while it is only 0.54 for the standard of living norm and even lower (0.35) for the forward-looking external norm. The results imply that the type of the reference norm can have a higher impact than asymmetries in the strength of the norms.

Differences in reference norms are likely to be more than just a theoretical possibility. In fact, Agell and Benmmarker (2007) document considerable differences in reference norms between Sweden and the US where external norms seem to play a larger role for Swedish firms.\(^{13}\) On the whole we can conclude that both the specific nature of the wage norms and asymmetries in the importance of the norm matter for the persistence of inflation.

\(^{13}\)They explicate: “Bewley (1998) conjectures that unions might play a role and he notes that the precision of the information about external pay appears to be higher among workers in unionized firms” (Agell and Benmmarker, 2007, p. 363).
3 Empirical Part

In the second part of this paper we use data on Austrian collective wage bargaining to investigate the role of reference norms. We want to answer three questions: First, do wage-setters have reference norms or is their behavior only influenced by expectations about prices and aggregate demand as assumed in the standard model? Second, if reference norms do play a role, can we determine *which* formulation of reference norms is most appropriate? Third, is their any indication of asymmetries in wage-setting behavior, in particular with respect to the importance of reference norms (“wage leadership”)?

3.1 Estimation Equation

The main equation for estimation follows directly from equations (1) and (2). If we take the first difference of equation (1) together with (3) we get (for $b = \frac{1}{2}$):

\[
\Delta w_{1,t}^i = (1 - \mu^i)^{\frac{1}{2}} \left\{ \Delta p_{1,t} + E_{1,t} \Delta p_{2,t} + \gamma \left( \Delta y_{1,t} + E_{1,t} \Delta y_{2,t} \right) \right\} + \mu^i \Delta r n_{1,t}^i + \gamma \left( \Delta y_{2,t} - E_{1,t} \Delta y_{2,t} \right) \}
\]

Equation (26) states that wage growth in sector $A$ will depend on expected inflation and expected growth of aggregate demand over the duration of the contract. The expressions in the second line of (26) are expectational errors that should be zero on average if people form rational expectations (see Roberts, 1995). We can generalize this equation to a model with monthly subperiods. We assume now that a wage-setting unit that sets its wage in a specific month has only information available up to the previous month.$^{14}$

Furthermore, we denote by $\Delta y_{j,t}^y$ the rate of inflation over the upcoming year starting in month $j$. This means, e.g., that $\Delta p_{1,t} = \frac{1}{12} \left( \Delta p_{1,t} + \Delta p_{2,t} + ... + \Delta p_{12,t} \right)$, $\Delta p_{2,t}^y = \frac{1}{12} \left( \Delta p_{2,t} + ... + \Delta p_{12,t} + \Delta p_{1,t+1} \right)$ etc., where $\Delta p_{j,t} = (p_{j,t} - p_{j,t-1})$. In a similar fashion we denote the rate of aggregate demand growth over the next year by $\Delta y_{j,t}^y$. We can then write the wage-setting equation for the wage-setting unit $i$ that sets its wage in month $j$ in year $t$ as:

\[
\Delta w_{j,t}^i = (1 - \mu^i) E_{j-1,t} \Delta p_{j,t}^y + (1 - \mu^i) \gamma^i E_{j-1,t} \Delta y_{j,t}^y + \mu^i \Delta r n_{j,t}^i + \eta_{j,t}^i,
\]

where $\eta_{j,t}^i \equiv (1 - \mu^i) \left\{ \left( \Delta p_{j,t}^y - E_{j-1,t-1} \Delta p_{j,t-1}^y \right) + \gamma^i \left( \Delta y_{j,t}^y - E_{j-1,t-1} \Delta y_{j,t-1}^y \right) \right\}$ is an expectational error. For the empirical estimations we want to follow as closely as possible

$^{14}$For equation (26) this would amount to use the expectations operator $E_{2t-1}$ instead of $E_{1t}$. 

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the theory-based equation (27). In fact, this is not often done in the related literature where one can mostly find tests of the Taylor model that are based on reduced form estimations in terms of the inflation rate. The main reason for this practice seems to be that a direct test of the wage-setting equation is not feasible due to problems with data availability. Furthermore, many empirical studies do not use explicit forecasts to control for $\Delta p^*_j,t$ and $\Delta y^*_j,t$, but they rather employ realized values for these variables together with instrumental variables techniques (e.g. GMM). This procedure is only valid if people form rational expectations (cf. Roberts 1995; Rudd and Whelan, 2007). A potential problem with this approach is that it confounds a number of hypotheses (accuracy of the rational expectations assumption, structure of the economy and the price mark-up equation) which makes it difficult to judge whether the core of the Taylor model — the wage-setting equation — is a reasonable description of real world behavior. In order to directly test the wage-setting equation (27) we have to find (or construct) data for the main variables $\Delta w^i_{j,t}$, $\Delta p^*_j,t$, $\Delta y^*_j,t-1$, and $\Delta r^n_{j,t}$. We will describe our data sources after giving a short overview of some specificities of the Austrian system of wage bargaining.

### 3.2 The Austrian system of collective wage bargaining

Wage determination in Austria is strongly dominated by a system of collective bargaining. On the side of the employees there is a peak organization, the Austrian Federation of Trade Unions, to which the individual trade unions are attached. These individual trade unions are mainly organized along sectoral and occupational dimensions. On the side of the employers there is also a central organization, the Austrian Federal Economic Chamber, which covers basically all private companies. Collective bargaining takes mainly place at the sectoral and industry level and regional differences in wage agreements do not play an important role. Although collective bargaining is in principle confined to the private sector there is also an influential public sector union that negotiates over wages with representatives of the government. The coverage rate of the collective agreements is very high (above 98%). At the moment around 400 collective agreements are signed each year of which around 250 are national agreements. Many of these agreements, however, refer only to a small number of employees while around 20 large agreements together cover more than half of the complete labor force. Since the beginning of the 1980s the annual bargaining process follows a similar pattern where the metalworking industry starts the round of negotiations in September or October ("autumn bargaining round"). Since 1984 the collective agreement in this sector (which represents about 11% of the total labor

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15Details can be found in Traxler et al. (2001).
force) always takes effect in November. The other wage-setting units follow the metal sector in a staggered fashion. The collective agreement of the retail sector that also represents are large part of the labor force (around 13%) normally becomes effective in January as is the case for the public sector (representing more than 20% of employees). Finally, a number of important sectors typically have their wages only set in May (this is true, e.g., for construction and the chemical and tourism sector which together represent around 10% of the labor force).

3.3 The data

3.3.1 Collective wage agreements

Unfortunately, there does not exist an accessible complete database for all collective wage agreements in Austria. There exists, however, an “index of agreed minimum wages” that subsumes data for a large number of disaggregated wage-setting units that are mostly organized along sectoral lines. We use these disaggregated series to construct an annual data-set that contains for each included wage-setting unit the annual increase in the collectively bargained wage, the month in which this agreement came into effect and the duration until the next agreement is reached. We have to exclude some units either because we do not have data over the whole time span or because they refer to quite heterogeneous sectors with rather erratic patterns (e.g. many small changes each year). This leaves us with a number of 100 individual times series for collectively bargained wages. We focus on the time period from 1980 to 2006. Table 2 summarizes these data.\textsuperscript{16} One sees that most contracts are signed in winter or spring (January to June). In fall only around 10% of new agreements are concluded but these include the important agreement of the potentially wage leading metal sector. Most wage agreements (>80%) are valid for exactly one year.

Insert Table 2 about here

Our data on disaggregated wages have two potential drawbacks. First, the available data only indicate when a new collective agreement became effective and not when the change was negotiated. It could in principle be the case that there is a longer time lag between a wage increase and the time when it has been scheduled. For the estimation of equation (27) it is important to know on which macroeconomic forecasts the wage-setters could have based their decisions. Casual observations of the Austrian system suggest,

\textsuperscript{16}In appendix B we provide more details on the construction of our dataset.
however, that the time lags between the end of the negotiations and the implementation is rather short and mostly around one month. Second, the available time series only report the collectively bargained increase in the minimum wage for each unit. As in many other countries, in Austria effective wages are often higher than these agreement-specific minimum wages. Although this is admittedly a handicap of the dataset it is probably less severe than one could expect. The collectively bargained increase in effective wages (for which there exists no dataset) is mostly parallel to the increase in minimum wages. Furthermore, the development of the collective wage index follows closely the one of the comprehensive time series for the compensation rate per employee of the total economy.

3.3.2 Macroeconomic forecasts and forecast errors

For the expected values $E_{j-1,t} \Delta p_{j,t}^{y}$ and $E_{j-1,t} \Delta y_{j,t}^{y}$ in (27) we use the quarterly forecasts of the Austrian Institute of Economic Research (WIFO). This institute has a long tradition in forecasting the future path of the Austrian economy and its results are widely published in the media and are also the “official” numbers that are used in the collective wage negotiations. The forecasts are typically published in March, June, September and December each year and they include forecasts for the current and for the next year for a number of macroeconomic variables. We use the figures for the growth rate of GDP, for the rate of inflation and for the unemployment rate. In order to match these forecasts with the time series of collectively bargained wages we assume that wages that come into effect in a certain month are based on the most recent forecasts available in the previous month. The expected development of a variable over the duration of the wage contract is calculated as the weighted average of the forecasts for the current and for the next year.$^{17}$

As far as the variable for real activity $E_{j-1,t} \Delta y_{j,t}^{y}$ is concerned there exists a long discussion on which is the most appropriate way to measure it (cf. Roberts, 1995; Galf and Gertler, 1999; Rudd and Whelan, 2007). In the related literature one can find specifications that use — among others — the output gap, real marginal costs, the labor share and the unemployment rate. Due to problems with data availability we base our estimations on forecasts of GDP growth and the change in unemployment. The first is an appropriate measure for real activity as it is closely related to changes in the output gap. The use of the change in the unemployment rate as a measure for business cycle conditions can be motivated by Okun’s law as noted by Roberts (1995).$^{18}$

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$^{17}$So we assume, e.g., that the wage agreement that became effective in May 2002 is based on an expected rate of inflation that is calculated as 7/12 of the WIFO-March-2002 forecast for the current year plus 5/12 of WIFO-March-2002 forecast for the next year. For details see appendix B.

$^{18}$In a later section with robustness tests we will also include the level of unemployment as a measure
In some of our estimations we also use forecast errors as suggested by the theory that leads to the empirical specification in (27). The forecast error of a variable is measured as the difference between the realized and the expected value. For some of our robustness tests we will also use different macroeconomic aggregates (e.g. lagged instead of forecasted values). In all cases where we do not have monthly variables we interpolate them in the same way as is done in the construction of monthly series for the forecasts.

3.3.3 Reference norms

We use 4 reference norms that correspond to commonly made assumptions in the literature:

- **External reference norms** (“external norms”): For each wage-setting unit the reference norm is given by the (weighted) average increase in wages that could be observed since the last time that its own wage level had been changed.

- **Wage leadership reference norms** (“leadership norms”): Each wage-setting unit takes the wage increase in the metal sector as its reference norm. The wage-setters in the metal sector do not have reference norms.\(^{19}\)

- **Habit reference norms** (“habit norms”): Each wage-setting unit regards its own last wage change as the reference norm.

- **Aggregate reference norms** (“aggregate norms”): All wage-setting units take the average wage increase over the last year as their reference norm. This would be a reasonable assumption if e.g. unemployment benefits are indexed to prices or wages.

It is not straightforward to say which reference norm is the correct assumption. The results of the survey studies indicate that wage-setters might be influenced by multiple reference norms at the same time. Furthermore, some of the norms are clearly not independent of each other. For example, even if all wage-units have a leadership norm the external norm will also show a significant influence due to the staggered structure of wage agreements. Therefore we will not a priori limit ourselves to a single norm but rather try

\(^{19}\)In an alternative specification we assume that the wage-setters in the metal sector have external reference norms. All results are basically identical if we use this alternative specification.
to find out empirically which norm provides a better description of the data. In particular, we will first present results for the external and the leadership norms and later compare them to the latter two concepts.

3.4 Main results

In Table 3 we present the results of estimating equation (27) under various specifications. In particular, we use either external norms (columns (1) to (4)) or wage leadership norms (columns (5) to (8)) and either GDP growth or the change in unemployment as our measure for real activity. Furthermore, we present estimations that include or exclude time dummies. The inclusion of time dummies can be advisable if one wants to correct for a common trend in the data (like a general decrease in the rate of inflation). On the other hand, the use of annual time dummies is in our case potentially problematic since it could capture year-to-year changes in wage growth that follow the development of the reference norms and that are not the consequence of exogenous time trends. As a compromise between these two views we include five year time dummies (for 1980-1984, 1985-1989 etc.).

Insert Table 3 about here

Looking at Table 3 we can make the following observations:

- **Reference norms** are an important factor for the determination of wages. The coefficient for the reference norm is highly statistically significant in all specifications and its size is considerable (always larger than one half). The influence of reference norms seems to be slightly higher in the external than in the wage leadership specification.

- The **expected rate of inflation** over the duration of the contract \((E_{t-1,1} \Delta p^*_p(l))\) is also an important factor for negotiated wage rates as suggested by New Keynesian theories. Its influence is slightly lower than the influence of reference norms. The theoretical model underlying equation (27) implies that the coefficients of expected inflation \((1 - \mu)\) and reference norm \((\mu)\) will sum up to 1. In fact, if we look at the leadership norms in Table 3 this implication is partly borne out by the data. The sum of the coefficients is between 1.04 and 1.11. Using F-tests the sums are not statistically different from one at the 1% significance level for columns (5) and (8) while the F-tests reject the theoretical prediction for the other specifications in Table 3. This indicates that the leadership norm is probably a more accurate reflection of wage setters’ reference norms.
• The **expected development of real activity** contributes to the size of the wage increase. If GDP is expected to grow faster by 1% this will increase the average wage agreement by between 0.09% and 0.33%. On the other hand, if unemployment rate is expected to decrease by 1 percentage point this is expected to boost wage claims by between 0.38% and 1.28%. Interestingly, these different values for GDP growth and the change in unemployment imply an Okun coefficient of about 4 which is broadly compatible with empirical estimations for Austria. We have no clear explanation why the coefficient is lower for the leadership norm. One interpretation that is compatible with the wage leadership story would be that the wage-setters in the metal sector look closely at the macroeconomic variables. The other wage-setters that follow, however, orient themselves primarily on the result on the metal sector. Thus, the general macroeconomic outlook is already contained in the leadership norm and over and above this norm there is little influence on the negotiated wages. Equation (27) implies that the coefficient on real activity is given by \((1 - \mu)\gamma\). We can use the estimates for the coefficients of expected inflation to get estimates for \(\gamma\), the size of “real rigidities”. Depending on the specification it comes out between 0.17 and 0.59. These values are in line (although somewhat on the higher end) with the calibrated values of \(\gamma\) that have been mentioned before.

• The inclusion of **time dummies** has no sizable impact on the results.\(^{20}\) The changes are smaller in the case of the leadership norm which suggests that this might be the more appropriate specification for the reference norm. The changes are also smaller if we look at the models with the change of unemployment as the measure for real activity. This suggests that this variable better captures the assessment of the wage-setting units of business cycle conditions.

The estimations in Table 3 are all based on a fixed effects model. This is suggested by our empirical question since we do not look at a random sample of wage agreements in Austria but rather at a large population of wage agreements that covers almost the entire labor force. In a case like this it is generally recommended to use a fixed effects specification (cf. Hsiao, p. 43). We have also performed Hausman tests to confirm these theoretical considerations. As shown at the bottom of Table 3 in all cases the null hypothesis of the random effects specification is rejected at conventional levels of significance.

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\(^{20}\)The use of annual time dummies does not change any of our results in a qualitative way. For some specifications, however, it can have a significant impact on the coefficient size.
3.5 Which Reference Norms?

In Table 3 we have only looked at two commonly used reference norms. We have not yet tried to find out which one of the two is the more appropriate concept although some of our findings suggest that the leadership norm leads to more stable results. In this section we want to undertake a more formal investigation of this important matter. In addition to the external and the leadership norm we will also look at two other norms that correspond to proposals in the related literature and that have been described above: a habit norm (past changes in the own wage) and aggregate norms (past changes in the average wage). It is quite difficult to distinguish between the alternative formulations since most of them are highly correlated. It is therefore not surprising that if we estimate the benchmark equations in Table 3 with the two alternative norms (results not shown) they also come out with a significant positive coefficient (although their coefficients are in general smaller and less stable than for the first two norms).

In order to get an idea about the relative importance of the different norms we use non-nested J-tests (cf. Smith, 1996; Greene, 2003, chap. 8). We first regress the dependent variable \( \Delta w_i^1 \) on the benchmark set of regressors including the change in reference norm \( \Delta r_{n1} \). The fitted values of this regression are then included in a regression of \( \Delta w_i^2 \) on the benchmark variables plus an alternative norm \( \Delta r_{n2} \). If \( \Delta r_{n2} \) is the correct measure then the coefficient on the fitted values from the first regression should be close to zero (which is determined by a t-test). In a next step we reverse the roles of \( \Delta r_{n1} \) and \( \Delta r_{n2} \). Unfortunately, this test does not guarantee unambiguous results since it is possible that we reject an independent role of \( \Delta r_{n1} \) in the first and of \( \Delta r_{n2} \) in the second regression. In Table 4 we report the results of the J-test. We follow the practice of Smith (1996) and interpret the relative size of the t-statistics as an indicator of “dominance” in order to deal with the inconclusive cases. Overall, the results in Table 4 suggest that the leadership norm is the most consistent and important measure of reference norms. It is the dominant measure in all pairwise comparisons and often the alternative measure is not even statistically significant. The external norm is also an influential measure that is dominant in all regressions except the one where it is paired with the leadership norm.

Insert Table 4 about here

Similar conclusions also result from nested tests in which all pairwise combinations of reference norms are included at the same time into the benchmark estimation. This is shown in Table 5. Although collinearity is likely to affect the estimates, the coefficient on the leadership norm always stays significant and also its variations in size are rather small.
The external norm, on the other hand, becomes much smaller (although still statistically significant) once entered together with the leadership norm while it seems to be rather stable in the other comparisons. The coefficients on the habit norm and the aggregate norms are rather small and often insignificant.

Insert Table 5 about here

On balance, these results suggest that the leadership norm seems to be the most appropriate description of the reference norm that influences the process of wage-setting in Austria. Since the comparisons with the external norm have not lead to completely decisive results we will continue to refer to both formulations in the following.

3.6 Further Robustness Tests

So far we have used a rather parsimonious specification to study the role of reference norms in wage-setting. In this section we want to check the robustness of our benchmark estimations by using different samples and including additional regressors. In Table 6 we present the results for the leadership norm and the change in the unemployment rate as the measure for real activity. The results (not shown) for the external norm and for GDP growth as a measure of real activity are similar.

Insert Table 6 about here

In columns (2) and (3) of Table 6 we look at the benchmark estimation for two different time samples (before and after 1993). The results are fairly similar although the coefficient of the reference norm and expected inflation is somewhat smaller. If we focus only on the private sector (79 instead of 100 wage-setting units) the main results are also unchanged (see column (10)). The private sector seems to react more sensitive to business cycle condition (−0.48 instead of −0.44 ) which is the expected result. In column (11) we have pooled similar wage-setting units together (i.e. units in identical sectors that negotiate at the same time of the year and reach very similar agreements). This leaves us with 55 “independent” instead of the 100 total units. Despite this decrease in the number of cross sections the results are again basically unaffected.

In column (4) we include forecast errors as suggested by the theory-based formulation in (27). This decreases the role of expected inflation and considerably increases the role of expected real activity. The sign of errors in inflation forecasts are positive: if wage-setting units have underestimated the increase in inflation last period they will try to make up for this in the next negotiating round. The positive sign for errors in forecasts of the change
in unemployment are somewhat puzzling and we have not yet found an explanation for this result. It is, however, interesting to note that now the sum of the coefficients on reference norms and expected inflation are very close to one which is the result implied by the theoretical model. This suggests that forecast errors should not be easily neglected as is often done in the literature.

In column (5) we include lagged inflation in the benchmark equation. This corresponds to a “hybrid” Phillips curve that is quite popular in the recent macroeconomic literature. The results are similar to the ones in column (4). The coefficient of expected inflation decreases and the same is true for the coefficient of the reference norm. Nevertheless, the reference norm has again the highest influence on wage agreements and it is thus not only a proxy for past inflation.

In the benchmark estimation we have implicitly assumed that wage-setting is mainly guided by aggregate variables. In order to allow for the possibility that specific sectoral conditions might also be important we add in column (6) the changes in the sectoral unemployment rate. The variable has the expected negative sign although it is not statistically significant.\(^{21}\) The other coefficients remain unchanged. The same is also true if we add the length of a wage contract as is shown in column (7). One would expect that a longer contract duration is associated with a higher wage increase. This is in fact borne out by the data although the effect is rather tiny.

If we add the expected level of unemployment instead of the change in unemployment as a measure of real activity this slightly decreases the coefficients on reference norms and expected inflation. It is interesting to note, however, that if we include the expected and the lagged level of unemployment (not shown) then these two coefficients are of approximately equal size but have different signs. This suggests that the expected change in unemployment is in fact the more appropriate specification as is suggested by our theoretical model that implies a wage curve.

Finally, in column (9) we have used a random coefficients method to estimate the model. This method is suggested if one has reason to assume that different groups will show a different wage-setting behavior. The results show that there is in fact some indication for such heterogeneity as one can observe an impact on the average size of the coefficients. The sensitivity to expected inflation and especially to expected real activity is decreased while the influence of reference norms is increased. We will come back to this result in the next section.

\(^{21}\)In other specifications with the external reference norm the coefficient is in fact statistically significant at the 10% level.
The basic message of the robustness tests in Table 6 is that the main results of the benchmark specifications are unchanged: reference norms have a considerable impact on collective wage agreements and their weight seems to be at least as high as the one of expected inflation and larger than the one of expected real activity. This holds for a large number of samples, different specifications and in the presence of various additional variables.

3.7 Asymmetries in reference norms and wage leadership

The model of section 2 suggests that the existence of asymmetries can considerably affect the impact of reference norms on inflation persistence. In this section we want to study whether our data indicate that reference norms in Austrian wage-setting are in fact asymmetric. The first thing to note in this respect is that our results so far already suggest that reference norms are not completely symmetric since the leadership norm (which is by construction an asymmetric norm) gives the most consistent and unambiguous results. A large number of additional estimations (e.g. including more lagged variables, sectoral and monthly dummies etc.) has further confirmed this conclusion.

There exists, however, additional evidence on this issue. In particular, if wage-setting were completely symmetric then this would imply that (i) reference norms are identical for all wage-setting units and (ii) the importance of reference norms does not differ across sectors. The external norm is defined in a symmetric way but it remains to be analyzed whether the data also confirm the fulfillment of the second requirement for symmetry. In order to accomplish this we return to the random coefficients specification which gives separate coefficients for all 100 wage-setting units. Symmetry in the context of our model would imply that the variation of the individual coefficients across units does not contain a noticeable temporal pattern (e.g. higher in spring than in fall). In Figure 2 we report results along these lines. The pictures show the size of the coefficients of the reference norm and of expected inflation and real activity where the left (right) column refers to specifications with external (leadership) norms. We have ordered the coefficients according to the (median) month in which each wage-setting unit typically concludes its wage agreement. The pictures give a strong indication for the prevalence of asymmetric reference norms. In particular, for the use of external norms the random coefficients model reveals a clear temporal pattern where the importance of reference norms is smaller for the wage-setting units that contract in November (including the wage leading sector) than for the following units. On the other hand, the wage leader seems to put a considerably higher weight on the general macroeconomic situation and seems to react more strongly.
to both higher expected inflation and higher expected unemployment. For the latter the result is particularly pronounced and the average coefficient for the units contracting in November (−2.78) is more than double the size than for the rest of the economy (−0.98). If we only look at the wage-leader the result is similar and the average coefficient on unemployment is −2.77 while it is only −1.12 for the following units.22

**Insert Figure 2 about here**

If we repeat the same exercise for the leadership norm we find different results as shown in the pictures of the right column of Figure 2. There is no discernible temporal pattern in the importance of reference norms anymore. All wage units following the wage leader put on average an identical weight on the reference norm. If anything, the importance of norms seem to decrease after November although the effect is insignificant. The same is also true for the coefficients on the macroeconomic development (inflation and the change in unemployment) where the temporal pattern is weak. This is especially remarkable for unemployment where for all units the coefficient is much smaller than in the case of external norms, even for most of the 10 units that typically contract in November and which are not part of the wage-leading sector.

The results taken together suggest that the assumption of symmetric reference norms is not appropriate for the Austrian situation. One possible conclusion from the evidence is that there are symmetric external norms with wage-unit-specific weights. The increasing temporal pattern is, however, rather implausible and contradicts anecdotal evidence that — if anything — the importance of norms should decrease over the course of a wage round (see Traxler et al., 2008). It is in fact more suggesting to interpret the upward sloping temporal pattern in the case of external reference norms as an indication of a misspecification of the type of reference norms. This also supports our overall conclusion that wage-setting in Austria is characterized by a system of wage leadership.

So far we have, however, simply assumed that the wage-leader is the metal sector. There exists strong evidence ranging from the pattern of wage rounds to interviews with leading proponents of wage-setting that this is in fact the correct assumption. Nevertheless, this assumption probably deserves more attention, particularly since it is sometimes argued that a system of wage-leadership is marked by latent or unintentional processes. To this end we have constructed reference norms that assume that the retail sector (the

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22 There are 14 wage-setting units which typically contract in November. We have subsumed 4 of these units into the category “wage-leader” since all of these units belong to the metal sector and negotiate together. The remaining 10 wage-setting units in November include, e.g., units in the chemical and the paper industry.
largest private sector in our data sample) or the public sector (as sometimes maintained for other countries) acts as the wage leader.\textsuperscript{23} We have estimated the same set of equations as above. The results (not shown) are, however, disappointing. The alternative leadership norms perform rather badly (when compared to the metal sector or to the external norm) and they are less robust across specifications.

We can conclude this subsection by emphasizing that wage setting in Austria is characterized by a system of wage leadership by the metal sector. In the negotiations of fall ("autumn bargaining round") the wage leader mostly focuses on the macroeconomic conditions that are expected to prevail in the upcoming year and puts less weight on the wage rates that have been set in the last round of negotiations. This is different for the wage negotiations that follow the metal sector since they seem to regard these earlier settlements as a benchmark that acts as a reference point for the success of their own wage agreements.\textsuperscript{24} The fact that the wage leader is mostly concerned with the general macroeconomic environment and less with wage comparisons is likely to contribute to a system that shows less endogenous persistence than in other countries.

4 Conclusions

In this paper we have studied the influence of reference norms in an otherwise standard Taylor model with staggered wages. We have shown that the inclusion of reference norms considerably increases inflation persistence. On the other hand, we have also shown that the impact on persistence very much depends on the precise definition of reference norms and on possible asymmetries in their importance between sectors. In the empirical section we have documented that reference norms play an important and significant role in the setting of collectively bargained wages in Austria. The impact of our most preferred measures of reference norms is typically about as large as the impact of expected inflation. When we compare different concepts of reference norms we find that the leadership

\textsuperscript{23}Note that both of these sectors normally set their wage rates in January. For the estimations with the public sector as wage leader we excluded the years with “zero wage growth agreements” (1996, 1997) from the estimation.

\textsuperscript{24}The results on wage leadership confirm parallel findings by Traxler et al. (2008) who work with a similar dataset on collectively bargained wages in Austria and also conclude that the metal sector acts as the wage leader. Their approach to the topic is, however, more from the perspective of industrial relations and they provide more detailed evidence on the emergence of this system around 1980 and on the specific role played by employer organisations and unions. In contrast to their work, we derive the estimation equation from an explicit theoretical model, we focus on the implications of asymmetries in reference norms on inflation persistence, we use explicit forecasts for the macroeconomic variables and we also consider alternative hypotheses concerning reference norms.
norm gives the best description of the data followed by the external norm. We do not
find support for the theory that wage-setting is affected by habit persistence or by the
development of the aggregate wage level. Finally, the data support the hypothesis that
wage leadership by the metal sector is a crucial factor for wage-setting in Austria. This
is confirmed by empirical specifications that allow for asymmetries in wage-setting.

Taken together, the theoretical and empirical results suggest that differences in ref-
erece norms or the existence of wage leadership can be at least partly responsible for
the observed cross-country differences in inflation persistence and in wage rigidity (cf.
Cecchetti and Debelle, 2004; Dickens et al., 2007; Holden and Wulfsberg, 2007). Differ-
ent reference norms and/or intrasectoral differences in the importance of norms can be
reflected in the dispersion of the aggregate measures. What is more, our results also offer
an explanation for the often weak correlation between various measures of labor market
institutions and the observed degrees of wage rigidity. A recent summary paper concludes,
e.g., that “the connection between unions and wage rigidity, although it may seem obvious
in theory, appears somewhat shakier in our data than one might expect” (Dickens et al.,
2007, p. 211). The results of our paper suggest that the shaky and often nor very robust
findings concerning the relation between inflation persistence or real wage rigidity and
labor market institutions is probably caused by the fact that these institutional variables
mostly refer to country averages and do not take possible variations and asymmetries
within countries into account.
References


5 Appendices

5.1 Appendix A - The microfounded model

5.1.1 Production

The set-up of the model follows Ascari (2000, 2003) and we only want to sketch it here rather briefly. There is a continuum of industries \( i \in [0, 1] \) and two sectors (A and B) of equal size, where sector A consists of the industries in \( i \in [0, \frac{1}{2}] \) and sector B of those in \( i \in [\frac{1}{2}, 1] \). The wages in both sectors are set by unions where we assume that there is one union that is attached to each firm. Furthermore, we assume that workers are attached to their sector and there is no labor mobility between sectors.\(^{25}\) Sector A unions set their wages in the first half of each year \( t \) while unions in sector B decide in the second half. Later we will denote the newly set wages in the two sectors by \( W_{1, t}^A (j) \) and \( W_{2, t}^B (j) \).\(^{26}\)

There is a homogeneous output good \( Y_\tau \) that is produced by competitive firms with the following CES production function:

\[
Y_\tau = \left( \int_0^1 Y_{i, \tau}^{\frac{\alpha-1}{\alpha}} \, di \right)^{-\frac{1}{\alpha}}, \tag{28}
\]

where the \( Y_{i, \tau} \) are intermediate inputs that are necessary to produce the final output and \( \theta > 1 \) is the elasticity of substitution between these different intermediate goods. This leads to the demand functions for intermediate goods:

\[
Y_{i, \tau} = \left( \frac{P_{i, \tau}}{P_{\tau}} \right)^{-\theta} Y_\tau, \tag{29}
\]

where the aggregate price index is given by:

\[
P_{\tau} = \left( \int_0^1 P_{i, \tau}^{1-\theta} \, di \right)^{\frac{1}{1-\theta}} \tag{30}
\]

The intermediate goods \( Y_{i, \tau} \) are produced by the firms indexed by \( i \in [0, 1] \). Firms

\(^{25}\)This is a crucial assumption as argued by Ascari (2003): “Only models with some form of labour immobility could potentially deliver a substantial degree of persistence” (p. 527, original emphasis).

\(^{26}\)The time index \( \tau \) stands for one subperiod, i.e. smallest time unit considered. This is mainly done to distinguish it from the index \( t \) that is used in the paper and which stands for one year.
have access to a production function:

\[ Y_{it} = A_i L_{it}^{\alpha}, \]  

where \( 0 < \alpha \leq 1 \) and where \( L_{it} \) is the amount of labor used by firm \( i \) in period \( t \). For the purpose of this paper we set \( A_i = 1 \) and \( \alpha = 1 \) (constant returns to scale). The firms are assumed to be price takers (perfect competition in intermediate goods production). They thus set prices equal to marginal costs or:

\[ P_{it} = W_{it}, \]  

where \( W_{it} \) is the wage rate that firm \( i \) faces in period \( t \). Put differently, firms will hire labor until the real wage equals the marginal product of labor which in this case is just \( A_i = 1 \).

We can insert (29) and (31) into (32) in order to derive an expression for labor demand \( L_{it} \) in terms of the wage rate \( W_{it} \).

\[ L_{it} = W_{it}^{-\theta} \left( P_{it}^\theta Y_t \right), \]  

A wage-setting union uses equation (33) to take into account the effect of an increase in the wage rate \( W_{it} \) on labor demand \( L_{it} \). Due to the assumption that unions are atomistic they neglect any possible effect of their wages on the aggregate variables \( P_t \) and \( Y_t \).

5.1.2 Households

The intertemporal utility function is given by:\(^{27}\)

\[ U_{jt0} = \sum_{s=0}^{\infty} \beta^s u(C_{js}, \frac{M_{js}}{P_s}, L_{js}) \]  

where \( \beta \) is the time discount factor, \( C_{js} \) is real consumption, \( \frac{M_{js}}{P_s} \) are real money holdings and \( L_{js} \) is labor supply by household \( j \) in period \( s \). There is a series of budget constraints:

\[ P_t C_{jt} + M_{jt} + B_{jt} = \psi_t M_{j\tau-1} + (1 + i_{\tau-1}) B_{j\tau-1} + W_{jt} L_{jt} + T_{jt} + H_{jt} \]  

\(^{27}\)We abstract in the following from uncertainty as in Ascani (2000). As noted there (FN 7) the introduction of uncertainty would be straightforward.
The nominal income in period $\tau$ consists of a predetermined level of wealth, given by the money balances $M_{j\tau-1}$ and the amount and interest earned on bonds that are carried over from period $\tau - 1$, i.e. $(1 + i_{\tau-1})B_{j\tau-1}$. Money holdings are subject to a common multiplicative shock $\psi_\tau$ (see Ascari, 2003). In addition households have labor income $W_{j\tau}L_{j\tau}$ and a lump-sum government transfer $T_{j\tau}$. Households might also receive insurance payments $H_{j\tau}$ that occur in the presence of monetary shock.\(^{28}\) The total nominal income can be used for purchases of consumption $P_\tau C_{j\tau}$, money $M_{j\tau}$ and bonds $B_{j\tau}$.

Maximization of (34) with respect to $C_{j\tau}$, $M_{j\tau}$ and $B_{j\tau+\delta}$ leads to the FOCs:

$$u_C(C_{j\tau}, \frac{M_{j\tau}}{P_\tau}, L_{j\tau}) = \beta(1 + i_\tau)\frac{P_\tau}{P_{\tau+1}}u_C(C_{j\tau+1}, \frac{M_{j\tau+1}}{P_{\tau+1}}, L_{j\tau+1})$$ (36)

$$u_M(C_{j\tau}, \frac{M_{j\tau}}{P_\tau}, L_{j\tau}) = u_C(C_{j\tau}, \frac{M_{j\tau}}{P_\tau}, L_{j\tau}) \left( \frac{i_\tau}{1 + i_\tau} \right),$$ (37)

where $u_x(C_{j\tau}, \frac{M_{j\tau}}{P_\tau}, L_{j\tau}) = \frac{\partial u(C_{j\tau}, \frac{M_{j\tau}}{P_\tau}, L_{j\tau})}{\partial x}$. Equations (36) and (37) represent the Euler equation for consumption and the money demand equation. For a more compact expression we will write in the following: $u_x(C_{j\tau}, \frac{M_{j\tau}}{P_\tau}, L_{j\tau}) = u_x(\tau)$.

Union $j$ sets the wage for two periods, i.e. under the constraint that $W_{j\tau} = W_{j\tau+1}$. The unions take into account that labor demand $L_{j\tau}$ by the firm is given by (33) and that the income of the household $W_{j\tau}L_{j\tau}$ also depends on this magnitude. In particular: $L_{j\tau} = W_{j\tau-\delta}^\theta Y_\tau$, $W_{j\tau}L_{j\tau} = W_{j\tau-\delta}^\theta P_\tau^\theta Y_\tau$ (and similar for the second period). Maximization of (34) with respect to $W_{j\tau}$ taking these relations into account thus leads to the wage-setting equation:

$$W_{j\tau} = -\frac{\theta}{\theta - 1} \frac{u_L(\tau) P_\tau^\theta Y_\tau + \beta u_L(\tau + 1) P_{\tau+1}^\theta Y_{\tau+1}}{u_C(\tau) P_\tau^\theta Y_\tau + \beta u_C(\tau + 1) P_{\tau+1}^\theta Y_{\tau+1}}$$ (38)

This corresponds to equation (15) in Ascari (2000) and to equation (22) in Huang and Liu (2002) in a multiperiod framework. In the absence of staggering (38) reduces to the usual optimality condition: $\frac{W_{j\tau}}{P_\tau} = -\frac{\theta}{\theta - 1} \frac{u_L(\tau)}{u_C(\tau)}$.

\(^{28}\)On this see Ascari (2000, 670) and Huang and Liu (2002).
5.1.3 Linearizations

We can linearize the FOCs of this model around a zero inflation steady state. The linearized wage-setting equation can be written as:

\[ w_{j\tau} = b p_{\tau} + (1 - b)p_{\tau+1} + \gamma(by_{\tau} + (1 - b)y_{\tau+1}), \tag{39} \]

where lower case letters stand for deviations around the steady state. Furthermore, \( b = \frac{1}{1+\beta} \) and \( \gamma = \frac{\eta_{xx} + \eta_{tt}}{1 + \eta_{tt}} \) where \( \eta_{xx} = \frac{\partial u_{xx}}{\partial x} \) is the elasticity of the marginal utility of \( x \) with respect to \( x \). In particular, \( \eta_{cc} \) and \( \eta_{tt} \) are the inverses of the intertemporal elasticity of substitution of consumption and of labor supply, respectively. Note that for the general case with decreasing returns to scale (\( \alpha \leq 1 \)) we would get: \( \gamma = \frac{-\eta_{cc} + \frac{\partial u_{ct}}{\partial c} + \frac{\partial u_{ct}}{\partial t}}{1 + \frac{\partial u_{ct}}{\partial c} + \frac{\partial u_{ct}}{\partial t}} \).

The wage \( w_{j\tau} \) stands for the wage that is set in period \( \tau \) by union \( j \). Since all unions in a sector are assumed to be identical we can write \( w_{j\tau} = w_{A}^j \) and \( w_{j\tau} = w_{B}^j \) if union \( j \) belongs to sector \( A \) (\( B \)). Expressed in terms of subperiods 1 and 2 in year \( t \) and adding expectation operators this corresponds to (3) and (4) in the paper.

The price index (30) for the two-sector model is given by

\[ P_{\tau} = W_{\tau} = \left( \frac{1}{2} (W_{\tau}^A)^{1-\theta} + \frac{1}{2} (W_{\tau}^B)^{1-\theta} \right)^{\frac{1}{1-\theta}} \]

Linearizing this around the steady state leads to:

\[ p_{\tau} = \frac{1}{2} \left( w_{A}^t + w_{B}^t \right) \tag{40} \]

This corresponds to equations (8) and (9) in the paper (again rewritten in terms of subperiods and years).

Finally we can also linearize the FOC conditions (36) and (37). It can be shown that under specific assumption concerning the multiplicative shock on money holdings \( \psi_t \), the velocity of money is constant over time. In this case the linearization of (37) leads to:

\[ -\eta_{cc} y_{\tau} = m_{\tau} - p_{\tau} \tag{41} \]

In the paper we focus on the case where \( \eta_{cc} = -1 \) (which corresponds to a utility function that is logarithmic in consumption). This is stated in equations (12) and (13).

\[ ^{29}\text{See Ascarl (2000, p. 674) and Ascarl (2003, 520f.).} \]

\[ ^{30}\text{See Ascarl (2003, p. 514f.) and Ascarl (2000, FN 23).} \]
5.1.4 The derivation of $\lambda_1$

As stated in the text we can set $b = \frac{1}{2}$ and insert (8), (9), (12) and (13) into (1) to derive:

$$w_{1,t}^A = \psi_1 w_{2,t-1}^B + \psi_2 E_{1,t} w_{2,t}^B + \psi_3 (m_{1,t} + E_{1,t} m_{2,t})$$  \hspace{1cm} (42)

where $\psi_1 = \frac{1 - \gamma (1 - \mu^A) + 3 \mu^A}{\psi_4}$, $\psi_2 = \frac{1}{2} (1 - \gamma) (1 - \mu^A)$, $\psi_3 = \frac{\gamma (1 - \mu^A)}{\psi_4}$ and $\psi_4 = 1 + \gamma + \mu^A (1 - \gamma)$. Similarly we can write:

$$w_{2,t}^B = \Phi_1 w_{1,t}^A + \Phi_2 E_{2,t} w_{1,t+1}^A + \Phi_3 (m_{2,t} + E_{2,t} m_{1,t+1})$$  \hspace{1cm} (43)

and

$$w_{2,t-1}^B = \Phi_1 w_{1,t-1}^A + \Phi_2 E_{2,t-1} w_{1,t}^A + \Phi_3 (m_{2,t-1} + E_{2,t-1} m_{1,t})$$  \hspace{1cm} (44)

where $\Phi_1 = \frac{1 - \gamma (1 - \mu^B) + 3 \mu^B}{\psi_4}$, $\Phi_2 = \frac{1}{2} (1 - \gamma) (1 - \mu^B)$, $\Phi_3 = \frac{\gamma (1 - \mu^B)}{\psi_4}$ and $\Phi_4 = 1 + \gamma + \mu^B (1 - \gamma)$. We can insert (43) and (44) into (42) to derive:

$$w_{1,t}^A = \omega_1 w_{1,t-1}^A + \omega_2 E_{1,t} w_{1,t+1}^A + \Gamma_{1,t}^A$$  \hspace{1cm} (45)

where $\omega_1$ and $\omega_2$ are given by:

$$\omega_1 = \frac{(1 - \gamma (1 - \mu^A) + 3 \mu^A)(1 - \gamma (1 - \mu^B) + 3 \mu^B)}{2 \Theta}$$  \hspace{1cm} (46)

$$\omega_2 = \frac{(1 - \gamma)^2 (1 - \mu^A)(1 - \mu^B)}{2 \Theta}$$  \hspace{1cm} (47)

where $\Theta = \left[ 1 + \mu^A + \mu^B + \gamma^2 (1 - \mu^A)(1 - \mu^B) + 5 \mu^A \mu^B + 6 \gamma (1 - \mu^A \mu^B) \right]$. The term $\Gamma_{1,t}^A$ is a linear function of the exogenous money supplies in various subperiods. In particular:

$$\Gamma_{1,t}^A = \frac{\gamma}{\Theta} \left[ \begin{array}{c} (1 - \mu^B) (1 - \gamma (1 - \mu^A) + 3 \mu^A) m_{2,t-1} + \\ (3 + \mu^A + \mu^B + \gamma (1 - \mu^A)(1 - \mu^B) - 5 \mu^A \mu^B) m_{1,t} + \\ (1 - \mu^A) (3 + \gamma (1 - \mu^B) + \mu^B) m_{2,t} + \\ (1 - \gamma) (1 - \mu^A)(1 - \mu^B) E_{1,t} m_{1,t+1} \end{array} \right]$$  \hspace{1cm} (48)

\[\footnote{In fact there is an additional term $\omega_3 (E_{2,t-1} w_{1,t}^A - w_{1,t}^A) + \omega_4 (E_{2,t-1} m_{1,t} - m_{1,t})$ that captures expectational errors. Under rational expectations this term will be zero on average and we neglect it in the following.}

37
In a similar fashion we can use:

$$w_{1,t+1}^A = \psi_1 w_{2,t}^B + \psi_2 E_{1,t+1} w_{2,t+1}^B + \psi_3 (m_{1,t+1} + E_{1,t+1} m_{2,t+1})$$  \hspace{1cm} (49)$$

together with (42) in (43) to derive:

$$w_{2,t}^B = \omega_1 w_{2,t-1}^B + \omega_2 E_{2,t} w_{2,t+1}^B + \Gamma_{2,t}^B$$  \hspace{1cm} (50)$$

where $\Gamma_{2,t}^B$ is now:

$$\Gamma_{2,t}^B = \frac{\gamma}{\Theta} \left[ \begin{array}{c} (1 - \mu^A) (1 - \gamma(1 - \mu^B) + 3\mu^B) m_{1,t} + \\
(3 + \mu^A + \mu^B + \gamma(1 - \mu^A)(1 - \mu^B) - 5\mu^A\mu^B) m_{2,t} + \\
(1 - \gamma)(1 - \mu^A)(1 - \mu^B) E_{2,t} m_{2,t+1} \end{array} \right]$$  \hspace{1cm} (51)$$

Note that the weights $\omega_1$ and $\omega_2$ are identical in (45) and (50) and thus the same roots $\lambda_1$ and $\lambda_2$ govern the dynamics of $w_{1,t}^A$ and $w_{2,t}^B$. These roots are given by equation (17) where $\lambda_1 \leq 1$ and $\lambda_2 \geq 1$. The wage levels $w_{1,t}^A$ and $w_{2,t}^B$ can thus be written as:

$$w_{1,t}^A = \lambda_1 w_{1,t-1}^A + \frac{1}{\omega_1} \left( \frac{(\lambda_2)^{-1}}{1 - (\lambda_2 L)^{-1}} \right) \Gamma_{1,t}^A$$  \hspace{1cm} (52)$$

$$w_{2,t}^B = \lambda_1 w_{2,t-1}^B + \frac{1}{\omega_2} \left( \frac{(\lambda_2)^{-1}}{1 - (\lambda_2 L)^{-1}} \right) \Gamma_{2,t}^B$$  \hspace{1cm} (53)$$

where $L$ is the lag operator and $\Gamma_{1,t}^A$ and $\Gamma_{2,t}^B$ are given by (48) and (51). Using (52) and (53) in (11) we can finally write the evolution of the average wage (or price) level as:

$$\bar{w}_t = \lambda_1 \bar{w}_{t-1} + \frac{1}{\omega_2} \left( \frac{(\lambda_2)^{-1}}{1 - (\lambda_2 L)^{-1}} \right) \left( \frac{1}{2} \Gamma_{1,t}^A + \frac{1}{4} \left( \Gamma_{2,t}^B + \Gamma_{2,t-1}^B \right) \right)$$  \hspace{1cm} (54)$$

For the case without reference norms ($\mu^A = \mu^B = 0$) we can derive that:

$$\omega_1 = \omega_2 = \omega = \frac{(1 - \gamma)^2}{2 \left[ 8\gamma + (1 - \gamma)^2 \right]} > 0$$

The roots in (17) now simplify to:

$$\lambda_1 = \frac{1 - \sqrt{\Phi}}{1 + \sqrt{\Phi}}, \quad \lambda_2 = \frac{1 + \sqrt{\Phi}}{1 - \sqrt{\Phi}} = \frac{1}{\lambda_1}$$

38
where $\Phi = \frac{1-2\omega}{1+2\omega}$. The expression for $\lambda_1$ is given by (21).

For symmetric reference norms ($\mu^A = \mu^B = \mu$) we can derive that:

$$\omega_1 = \frac{[1 - \gamma(1 - \mu) + 3\mu]^2}{2[1 + \gamma^2(1 - \mu)^2 + \mu(2 + 5\mu) + 6\gamma(1 - \mu^2)]}$$

$$\omega_2 = \frac{(1 - \gamma)^2 (1 - \mu)^2}{2[1 + \gamma^2(1 - \mu)^2 + \mu(2 + 5\mu) + 6\gamma(1 - \mu^2)]}$$

The roots can be calculated from (17) and $\lambda_1$ simplifies to (22).

### 5.2 Appendix B - Data

Available upon request.
Figure 1 – The Effect of the Importance of Reference Norms on Inflation Persistence $\lambda_i$

Note: The figure reports the degree of inflation persistence $\lambda_i$ as the importance of reference norms increases from $\mu^A = \mu^B = \mu = 0$ to $\mu = 1$ for $\gamma = 0.2$ and $\gamma = 0.3$. 
Table 1 – The Effect of Different Reference Norms and Asymmetries in Reference Norms on Inflation Persistence $\lambda_i$

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<th>Asymmetric Reference Norms</th>
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<tr>
<td>$\gamma=0.2$</td>
<td>0.146</td>
<td>0.348</td>
<td>0.268</td>
</tr>
<tr>
<td>$\gamma=0.3$</td>
<td>0.085</td>
<td>0.27</td>
<td>0.191</td>
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</table>

Note: The numbers report the degree of persistence $\lambda_i$ for two levels of the real rigidity ($\gamma$) and the importance of reference norms in the two sectors ($\mu^A$ and $\mu^B$). The three reference norms are explained in the text.
<table>
<thead>
<tr>
<th>Year</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Winter</th>
<th>Spring</th>
<th>Summer</th>
<th>Fall</th>
<th>No Contract</th>
<th>12</th>
<th>&lt;12</th>
<th>13-24</th>
<th>&gt;24</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>0.0596</td>
<td>0.0207</td>
<td>44%</td>
<td>24%</td>
<td>13%</td>
<td>17%</td>
<td>2%</td>
<td>76%</td>
<td>3%</td>
<td>19%</td>
<td>2%</td>
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<tr>
<td>1981</td>
<td>0.0767</td>
<td>0.0209</td>
<td>45%</td>
<td>24%</td>
<td>12%</td>
<td>16%</td>
<td>3%</td>
<td>87%</td>
<td>1%</td>
<td>9%</td>
<td>3%</td>
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<tr>
<td>1982</td>
<td>0.0647</td>
<td>0.0114</td>
<td>47%</td>
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<td>16%</td>
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<td>1983</td>
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<td>0.0098</td>
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<td>16%</td>
<td>1%</td>
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<td>0.0095</td>
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<td>89%</td>
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<td>0.0111</td>
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<td>4%</td>
<td>87%</td>
<td>2%</td>
<td>7%</td>
<td>4%</td>
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<td>30%</td>
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<td>13%</td>
<td>1%</td>
<td>65%</td>
<td>2%</td>
<td>32%</td>
<td>1%</td>
</tr>
<tr>
<td>1988</td>
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<td>0.0096</td>
<td>24%</td>
<td>31%</td>
<td>32%</td>
<td>12%</td>
<td>1%</td>
<td>64%</td>
<td>26%</td>
<td>9%</td>
<td>1%</td>
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<tr>
<td>1989</td>
<td>0.0377</td>
<td>0.0146</td>
<td>49%</td>
<td>30%</td>
<td>6%</td>
<td>14%</td>
<td>1%</td>
<td>95%</td>
<td>0%</td>
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<td>1%</td>
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<tr>
<td>1990</td>
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<td>7%</td>
<td>13%</td>
<td>0%</td>
<td>98%</td>
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<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>1992</td>
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<td>0.0089</td>
<td>49%</td>
<td>31%</td>
<td>7%</td>
<td>13%</td>
<td>0%</td>
<td>94%</td>
<td>0%</td>
<td>6%</td>
<td>0%</td>
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<tr>
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<td>26%</td>
<td>7%</td>
<td>17%</td>
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<td>90%</td>
<td>6%</td>
<td>3%</td>
<td>1%</td>
</tr>
<tr>
<td>1994</td>
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<td>0.0078</td>
<td>51%</td>
<td>28%</td>
<td>7%</td>
<td>13%</td>
<td>1%</td>
<td>92%</td>
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<tr>
<td>1995</td>
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<td>30%</td>
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<td>12%</td>
<td>3%</td>
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<td>7%</td>
<td>23%</td>
</tr>
<tr>
<td>1996</td>
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<td>4%</td>
<td>14%</td>
<td>21%</td>
<td>62%</td>
<td>2%</td>
<td>14%</td>
<td>22%</td>
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<tr>
<td>1997</td>
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<td>0.0122</td>
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<td>30%</td>
<td>6%</td>
<td>14%</td>
<td>24%</td>
<td>62%</td>
<td>5%</td>
<td>9%</td>
<td>24%</td>
</tr>
<tr>
<td>1998</td>
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<td>31%</td>
<td>7%</td>
<td>15%</td>
<td>0%</td>
<td>85%</td>
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<tr>
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<td>4%</td>
<td>19%</td>
<td>0%</td>
<td>94%</td>
<td>3%</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
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<td>48%</td>
<td>28%</td>
<td>4%</td>
<td>17%</td>
<td>3%</td>
<td>93%</td>
<td>2%</td>
<td>2%</td>
<td>3%</td>
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<tr>
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<td>0.0298</td>
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<td>50%</td>
<td>29%</td>
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<td>16%</td>
<td>1%</td>
<td>90%</td>
<td>2%</td>
<td>7%</td>
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<tr>
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<td>2%</td>
<td>94%</td>
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<td>2%</td>
</tr>
<tr>
<td>2004</td>
<td>0.0199</td>
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<td>32%</td>
<td>5%</td>
<td>9%</td>
<td>2%</td>
<td>93%</td>
<td>1%</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>2005</td>
<td>0.0244</td>
<td>0.0051</td>
<td>51%</td>
<td>33%</td>
<td>6%</td>
<td>10%</td>
<td>0%</td>
<td>94%</td>
<td>3%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>2006</td>
<td>0.0250</td>
<td>0.0045</td>
<td>53%</td>
<td>32%</td>
<td>5%</td>
<td>9%</td>
<td>1%</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Total</td>
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<td>0.0212</td>
<td>46%</td>
<td>29%</td>
<td>9%</td>
<td>13%</td>
<td>3%</td>
<td>80%</td>
<td>4%</td>
<td>9%</td>
<td>7%</td>
</tr>
</tbody>
</table>

*Note:* The numbers in the table refer to the sample of 100 wage-setting units comprising 92% of the total labor force. The numbers are unweighted. The quarters are defined as follows: Winter (Jan., Feb., Mar.), Spring (Apr., May, Jun.), Summer (Jul., Aug., Sep.), Fall (Oct., Nov., Dec.). The length of new agreements refers to the year when they start.
### Table 3 – Determinants of Collective Wage Agreements (Benchmark Estimations)

<table>
<thead>
<tr>
<th>Dependent Variable: growth rate of unit-specific wage rates ($\Delta w_t^i$)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Norm</td>
<td>0.540***</td>
<td>0.564***</td>
<td>0.647***</td>
<td>0.623***</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>(0.026)</td>
<td>(0.026)</td>
<td>(0.024)</td>
<td>(0.025)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leadership Norm</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.571***</td>
<td>0.554***</td>
<td>0.571***</td>
<td>0.544***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.017)</td>
<td>(0.018)</td>
<td>(0.016)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>Inflation (forecast)</td>
<td>0.566***</td>
<td>0.725***</td>
<td>0.554***</td>
<td>0.626***</td>
<td>0.473***</td>
<td>0.552***</td>
<td>0.501***</td>
<td>0.547***</td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.050)</td>
<td>(0.033)</td>
<td>(0.049)</td>
<td>(0.026)</td>
<td>(0.043)</td>
<td>(0.027)</td>
<td>(0.044)</td>
</tr>
<tr>
<td>GDP growth (forecast)</td>
<td>0.333***</td>
<td>0.312***</td>
<td></td>
<td></td>
<td>0.0952***</td>
<td>0.0916***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.037)</td>
<td></td>
<td></td>
<td>(0.032)</td>
<td>(0.033)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in unemployment rate (forecast)</td>
<td>–</td>
<td>–</td>
<td>-1.279***</td>
<td>-1.191***</td>
<td>–</td>
<td>–</td>
<td>-0.378***</td>
<td>-0.438***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.10)</td>
<td>(0.11)</td>
<td></td>
<td></td>
<td>(0.10)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>Time Dummies</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.00569***</td>
<td>-0.0144***</td>
<td>-0.000579</td>
<td>-0.00217</td>
<td>-0.00164**</td>
<td>-0.00891***</td>
<td>0.000176</td>
<td>-0.00475*</td>
</tr>
<tr>
<td></td>
<td>(0.00086)</td>
<td>(0.0025)</td>
<td>(0.00055)</td>
<td>(0.0026)</td>
<td>(0.00076)</td>
<td>(0.0052)</td>
<td>(0.00052)</td>
<td>(0.0026)</td>
</tr>
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<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
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<td>Hausman-Statistics</td>
<td>-0.656</td>
<td>-1.733</td>
<td>7.005</td>
<td>6.592</td>
<td>-281.1</td>
<td>-108.041</td>
<td>-375.775</td>
<td>-14.547</td>
</tr>
<tr>
<td>H0: Random effects model</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1: Fixed effects model</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Probability value of $H_0$</td>
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<td>0.000</td>
<td>0.928</td>
<td>0.527</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
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<td>0.66</td>
<td>0.68</td>
<td>0.68</td>
<td>0.70</td>
<td>0.70</td>
<td>0.70</td>
<td>0.70</td>
</tr>
</tbody>
</table>

**Note:** The tables contain the result of fixed effects panel estimations of the determinants of unit-specific collective wage agreements $\Delta w_t^i$ in Austria, where $i=1, 2, \ldots, 100$ and $t=1980, 1981, \ldots, 2006$. The reference norms are either given by the external norm (columns (1) to (4)) or the leadership norm (columns (5) to (8)). The time dummies in columns (2), (4), (6) and (8) are defined as five year dummies (i.e. for 1980-1984, 1985-1989, etc.). The bottom line reports the statistics of a Hausman test where the null hypothesis is a random effects model. Robust standard errors are in parentheses. ***, ** and * denote statistical significance at the 1, 5 and 10 % level, respectively.
### Table 4 – Comparison of Different Reference Norms with J-Tests

<table>
<thead>
<tr>
<th>In regression including:</th>
<th>External Norm</th>
<th>Leadership Norm</th>
<th>Habit Norm</th>
<th>Aggregate Wage Norm</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Norm</td>
<td>–</td>
<td>4.37 (0.000)</td>
<td>17.705* (0.000)</td>
<td>12.489* (0.000)</td>
</tr>
<tr>
<td>Leadership Norm</td>
<td>14.695* (0.000)</td>
<td>–</td>
<td>23.721* (0.000)</td>
<td>20.48* (0.000)</td>
</tr>
<tr>
<td>Habit Norm</td>
<td>0.002 (0.998)</td>
<td>1.79 (0.073)</td>
<td>–</td>
<td>0.511 (0.61)</td>
</tr>
<tr>
<td>Aggregate Wage Norm</td>
<td>0.832 (0.405)</td>
<td>4.076 (0.000)</td>
<td>12.259* (0.000)</td>
<td>–</td>
</tr>
</tbody>
</table>

**Note:** The values in the table are based on an approach where the fitted values of a benchmark regression with the respective reference norm in the column are added to a regression that includes the reference norm in the respective row. The numbers reported are the t-statistic of these fitted values while p-values are shown in parentheses. A “*” indicates that the t-statistic in one pair of comparisons is higher than in the case where the role of the two reference norms is reversed.

### Table 5 – Nested Comparison of Different Reference Norms

<table>
<thead>
<tr>
<th></th>
<th>Dependent Variable: growth rate of unit-specific wage rates (( \Delta w_i ))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>External Norm</td>
<td>0.177*** (0.040)</td>
</tr>
<tr>
<td>Leadership Norm</td>
<td>0.450*** (0.031)</td>
</tr>
<tr>
<td>Habit Norm</td>
<td>–0.00007 (0.028)</td>
</tr>
<tr>
<td>Aggregate Wage Norm</td>
<td>–0.0485 (0.058)</td>
</tr>
<tr>
<td>Inflation (forecast)</td>
<td>YES</td>
</tr>
<tr>
<td>Change in unemployment rate (forecast)</td>
<td>YES</td>
</tr>
<tr>
<td>Time Dummies</td>
<td>YES</td>
</tr>
<tr>
<td>Constant</td>
<td>YES</td>
</tr>
</tbody>
</table>

**Note:** The table contains the results if two reference norms are included in pairs into the benchmark estimation.
Table 6 – Robustness Tests for the Benchmark Estimation (leadership reference norms)

<table>
<thead>
<tr>
<th>Estimation Method</th>
<th>Fixed effects</th>
<th>Fixed effects</th>
<th>Fixed effects</th>
<th>Fixed effects</th>
<th>Fixed effects</th>
<th>Fixed effects</th>
<th>Fixed effects</th>
<th>Random coeff.s</th>
<th>Fixed effects</th>
<th>Fixed effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benchmark</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
<td>(8)</td>
<td>(9)</td>
<td>(10)</td>
</tr>
<tr>
<td>Leadership Norm</td>
<td>0.544***</td>
<td>0.573***</td>
<td>0.492***</td>
<td>0.509***</td>
<td>0.507***</td>
<td>0.544***</td>
<td>0.552***</td>
<td>0.501***</td>
<td>0.574***</td>
<td>0.552***</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.019)</td>
<td>(0.072)</td>
<td>(0.027)</td>
<td>(0.021)</td>
<td>(0.017)</td>
<td>(0.018)</td>
<td>(0.022)</td>
<td>(0.025)</td>
<td>(0.020)</td>
</tr>
<tr>
<td>Inflation (forecast)</td>
<td>0.547***</td>
<td>0.549***</td>
<td>0.316***</td>
<td>0.476***</td>
<td>0.473***</td>
<td>0.546***</td>
<td>0.542***</td>
<td>0.456***</td>
<td>0.469***</td>
<td>0.565***</td>
</tr>
<tr>
<td></td>
<td>(0.044)</td>
<td>(0.050)</td>
<td>(0.075)</td>
<td>(0.049)</td>
<td>(0.043)</td>
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<td>(0.043)</td>
<td>(0.055)</td>
<td>(0.047)</td>
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<tr>
<td>Change in unemployment rate (forecast)</td>
<td>-0.438***</td>
<td>-0.414***</td>
<td>-0.349**</td>
<td>-0.637***</td>
<td>-0.450***</td>
<td>-0.429***</td>
<td>-0.426***</td>
<td>-0.268**</td>
<td>-0.481***</td>
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<tr>
<td>Forecast error (inflation)</td>
<td>0.222***</td>
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<td>2E-07***</td>
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<td></td>
<td>(0.045)</td>
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<td></td>
<td>(0.084)</td>
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<td></td>
<td>0.183***</td>
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<td>(0.043)</td>
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<td>(0.087)</td>
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<td>YES</td>
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<td>0.71</td>
<td>0.71</td>
<td>0.70</td>
<td>0.70</td>
<td>0.71</td>
<td>0.69</td>
<td>0.65</td>
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</tbody>
</table>

Note: The columns contain various robustness tests to the benchmark estimation with leadership reference norms in column (8) of Table 3, here repeated in column (1). All estimations include time dummies, a constant term and they are based on fixed effects models except the one in column (9) that uses a random coefficients model. Robust standard errors are in parentheses. ***, ** and * denote statistical significance at the 1, 5 and 10 % level, respectively.
Figure 2 – The Reaction of Different Wage-Setting Units in a Random Coefficients Model

<table>
<thead>
<tr>
<th>External Reference Norm</th>
<th>Leadership Reference Norm</th>
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</thead>
<tbody>
<tr>
<td><strong>Coefficients for Reference Norm</strong></td>
<td><strong>Coefficients for Reference Norm</strong></td>
</tr>
<tr>
<td><img src="image1" alt="Graph" /></td>
<td><img src="image2" alt="Graph" /></td>
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<tr>
<td><strong>Coefficients for Inflation</strong></td>
<td><strong>Coefficients for Inflation</strong></td>
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<tr>
<td><img src="image3" alt="Graph" /></td>
<td><img src="image4" alt="Graph" /></td>
</tr>
<tr>
<td><strong>Coefficients for Change in Unemployment Rate</strong></td>
<td><strong>Coefficients for Change in Unemployment Rate</strong></td>
</tr>
<tr>
<td><img src="image5" alt="Graph" /></td>
<td><img src="image6" alt="Graph" /></td>
</tr>
</tbody>
</table>

Note: The graphs report the coefficients for the 100 individual wage-setting units when the benchmark equation (including time dummies) is estimated with a random coefficients model. For the leadership norm (right column) the average result of the RC estimation is reported in column (9) of Table 6. For the external norm (left column) the coefficients for the reference norm, for inflation and the change in the unemployment rate are 0.660, 0.575 and -1.134, respectively (all significant at the 1% level). The individual coefficients are ordered according to the typical (median) month in which each wage-setting unit has concluded its wage agreements.