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

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*The content of these slides reflects the views of the authors and not necessarily those of the OeNB.
Introduction 1 – Main question

• **Main question**: Why are wages and prices so sticky?

• **“Inflation persistence problem”**: Standard models with nominal rigidities (Calvo, Taylor, …) imply less persistence than can be found in the data.

• **Common way to deal with this problem**
  Prices are fixed for some period plus some of the adjusted prices are assumed to be set in a backward-looking fashion:
  – **Rule-of-thumb behavior** (Gali and Gertler, 1999).
  – **Indexation** (Christiano et al., 2005; Smets and Wouters, 2003).
  – Useful short-cuts, but criticized as being “ad-hoc” or implausible
Introduction 2 –
Wage-setting as the source of backward-looking behavior?

- **Wage-setting** is rarely used to explain the *excess persistence* (mostly flexible labor market or staggered wages à la Calvo).

- **Empirical evidence** suggests that *past wages* influence wage-setting behavior. This is in line with theories based on efficiency and fair wages, relative wage concerns, wage norms etc.
   e.g.: Bewley (1999), Agell and Bennmarker (2007).

Reference wages are important, but it is hard to tell which concept (external, internal, habits,…).
Introduction 3 – Overview of the paper

• **Reference norms** in wage-setting are (partly) responsible for the observed persistence in nominal variables

• The precise **type** of reference norms and **asymmetries** across wage-setting units (e.g. “wage leadership”) matter.

• **Plan:**
  – **Theoretical Part**: Reference norms in a simple dynamic wage-setting model (Taylor, 1980).
  – **Empirical Part**: Use disaggregated Austrian data on collective wage bargaining (100 units, 1980-2006) to test the theory.
The Taylor Model 1 – Timing

Each year has two subperiods.

**Staggered wage-setting:** Wages in sector A are set in the **first half**, wages in sector B in the **second half**.

**Year t**

- **Subperiod 1**: 
  - $w_{1,t}^A$ 
  - $w_{1,t+1}^A$ 

- **Subperiod 2**: 
  - $w_{2,t}^A = w_{1,t}^A$ 
  - $w_{2,t}^B$ 
  - $w_{1,t+1}^B = w_{2,t}^B$ 
  - $w_{1,t+1}^B = w_{1,t+1}^B$

**Year t+1**

- **Subperiod 1**: 
  - $w_{1,t+1}^A$ 

- **Subperiod 2**: 
  - $w_{2,t+1}^A = w_{1,t+1}^A$ 
  - $w_{2,t+1}^B$ 

- $w_{1,t}^B = w_{2,t-1}^B$ 

- $w_{2,t}^B$ 

- $w_{1,t+1}^B = w_{2,t}^B$ 

- $w_{2,t+1}^B$
The Taylor Model 2 – Wage-setting

The wage-setting equations consist of two elements:

\[
W_{1,t}^A = \mu^A \cdot r_n_{1,t}^A + (1 - \mu^A) \cdot W_{1,t}^{A*}
\]

The “pure wage target” follows Taylor (1980) who describes it as being a “simple and plausible procedure”.

\[
W_{1,t}^{A*} = \frac{1}{2} \left( p_{1,t} + E_{1,t} p_{2,t} \right) + \gamma \cdot \frac{1}{2} \left( y_{1,t} + E_{1,t} y_{2,t} \right)
\]

Reference norm (benchmark: “backward-looking external norms”):

\[
r_n_{1,t}^A = W_{2,t-1}^B
\]

[parallel for sector B]
The Taylor Model 3 – Price-setting and aggregate demand

**Prices** are equal to wages (costs):

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

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

**Aggregate demand** depends on money supply and the price level:

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

\[
y_{2,t} = m_{2,t} - p_{2,t}
\]
The Taylor Model 4 – Solution for the standard case

No reference norms ($\mu^A = \mu^B = \mu = 0$).
This is the standard textbook model (cf. Romer, 2006, chap. 6).
The persistence of wages and prices is governed by the root $\lambda_1$ given by:

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

The model can also be microfounded (e.g. Ascari, 2000; Huang and Liu, 2002). Then $\gamma$ depends on „deep parameters“.

**Persistence problem:**
- For “reasonable” values of the deep parameters $\gamma$ is between 0.2 and 0.3. This implies a $\lambda_1$ between 0.08 and 0.15.
- Empirically $\lambda_1$ is larger than 0.25.
Reference Norms 1 – Symmetric external norms

Symmetric reference norms \((\mu^A = \mu^B = \mu > 0)\) can increase the degree of persistence considerably:

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

![Graph showing \(\lambda_1\) vs. \(\mu\) for different values of \(\gamma\)]
Asymmetries in the importance of norms $\mu$ decrease the degree of persistence.

<table>
<thead>
<tr>
<th>$s^A = 1/2$</th>
<th>$\mu^A = \mu^B = 0$</th>
<th>$\mu^A = \mu^B = 0.5$</th>
<th>$\mu^A = 0, \mu^B = 1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\gamma = 0.2$</td>
<td>0.146</td>
<td>0.702</td>
<td>0.5</td>
</tr>
<tr>
<td>$\gamma = 0.3$</td>
<td>0.085</td>
<td>0.602</td>
<td>0.368</td>
</tr>
</tbody>
</table>

A system with wage-leadership will thus show less persistence than a system with a normal pattern of staggering.
Different assumptions about reference norms can be found in the literature.

The impact of reference norms on persistence depends on their degree of “backward-lookingness” and whether they are external (i.e. related to the other sector).

This might be important: Sizable differences in reference norms between the US and Sweden (Agell and Bennmarker, 2007)

→ **Overall**: Specific type of reference norms and asymmetries in their importance matter for the persistence of inflation.
Empirical Analysis 1 – Estimation equation and data

Wage-setting for unit $i$ in month $j$ in year $t$.

\[
\Delta w_{j,t}^i = \beta_0 + \beta_1 \cdot E_{j-1,t} \Delta p_{j,t}^y + \beta_2 \cdot E_{j-1,t} \Delta y_{j,t}^y + \beta_3 \cdot \Delta r_{n,j,t} + \varepsilon_{j,t}^i
\]

- **Data:**
  - **Wages:** Austrian collective wage-bargaining agreements ("Tariflohnindex"), 1980 – 2006 (100 minimum-wage index series). → Time series for wage growth, the month of the change and the length of the contract (mostly 1 year).
  - Expected inflation and expected real activity (GDP growth or unemployment rate): Forecasts from leading Austrian institute for economic research (WIFO).
  - **Annual panel:** All variables are constructed such that they correspond to the exact month of the wage change.
Empirical Analysis 2 – Time pattern of wage changes (quarters)

Most changes at **beginning of the year**. A fairly **constant pattern** over time.

The Quarters With Changes in Collective Wages

- **Winter (I, II, III)**
- **Spring (IV, V, VI)**
- **Summer (VII, VIII, IX)**
- **Fall (X, XI, XII)**
- **No Contract**

**Unweighted**

Frequency (in %)

<table>
<thead>
<tr>
<th>Year</th>
<th>Winter</th>
<th>Spring</th>
<th>Summer</th>
<th>Fall</th>
<th>No Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td></td>
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<tr>
<td>1985</td>
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<tr>
<td>1990</td>
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<td>1995</td>
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<td>2000</td>
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<tr>
<td>2005</td>
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</tbody>
</table>
Empirical Analysis 3 – Reference norms used in the estimations

Following the theoretical and empirical literature we use various proxies for the reference norms:

• External reference norms: Weighted average increase of wages in other sectors since the last own wage change.
• Wage leadership reference norms: Wage increase of the metal sector (4 wage-setting units) as the reference norm.
• Habit reference norms: Own last wage change.
• Aggregate reference norms: Average wage (or price) increase over the last year („simple indexation“).
## Empirical Analysis 4 – Results from panel estimation

Dependent Variable: growth rate of unit-specific wage rates ($\Delta w^i_t$)

<table>
<thead>
<tr>
<th></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><strong>External Norm</strong></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><strong>Leadership Norm</strong></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><strong>Inflation (forecast)</strong></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><strong>GDP growth (forecast)</strong></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><strong>Change in unemployment rate (forecast)</strong></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><strong>Time Dummies</strong></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Constant</strong></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>(0.00052)</td>
<td>(0.00025)</td>
<td>(0.0026)</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>2621</td>
<td>2621</td>
<td>2621</td>
<td>2621</td>
<td>2621</td>
<td>2621</td>
<td>2621</td>
<td>2621</td>
</tr>
<tr>
<td><strong>Number of groups</strong></td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td><strong>Hausman-Statistics</strong></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><strong>H0: Random effects model</strong></td>
<td>0.000</td>
<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><strong>H1: Fixed effects model</strong></td>
<td>0.66</td>
<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>

Robustness tests: different time periods (<1993 vs. >1993), different samples, additional variables, …
Empirical Analysis 5 – Which Type of Reference Norms?

- **Alternative norms** (habit norms, aggregate norms) give less consistent results.

- **Model specification tests** suggest that the leadership norm is superior to all others, followed by the external norm (confirmed by nested and non-nested tests).
Empirical Analysis 6 – Asymmetries in norms / wage leadership

- Already **indirect evidence**: leadership norm (asymmetric) more consistent than external norm (symmetric)
- Direct evidence from **random coefficients** estimations:
  - **Temporal pattern** for the case without norms and for external norms (→ no symmetry).
  - (Almost) **no temporal pattern** for the leadership norm.
  - Wage leader reacts much more strongly to unemployment than followers
Conclusions

- **Reference norms** can be responsible for extra persistence in standard dynamic macroeconomic models.

- The amount of extra persistence depends on the precise **type** of reference norm and possible **asymmetries** in the importance of norms.

- Empirical analysis:
  - The **impact** of reference norms is **typically large**.
  - **Leadership norms** give the best results (habits and past nominal aggregates the worst).
  - Strong indication for **wage leadership** in Austrian wage-setting practices.

- Differences in reference norms could also be responsible for the **cross-country differences** in the observed degrees of inflation persistence and wage rigidity.