RESTAURANT PRICES AND MINIMUM WAGE[1]

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Very preliminary results

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Abstract

This article investigates the strong price stickiness in the services sector using micro data. One candidate to explain the price rigidity in the services sector is the rigidity of minimum wage. In France, in the restaurants sector, more than 30% of employees are paid at the minimum wage. Using a rich and unique dataset of price quotes underlying the French Consumer Price Index, we evaluate the impact of minimum wages on price setting in the restaurant sector. To that end, we estimate a semi structural model of price rigidity allowing for asymmetric and variable costs of price adjustment. We fiund a strong asymmetry in the price setting behaviour in the restaurant sector and a positive impact of minimum wage on prices. Finally, using microsimulations we evaluate the impact of minimum wages on restaurant price inflation.

Keywords: Price stickiness, Minimum wages, Inflation.

JEL codes: E31, D43, L11

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1 Introduction

A recent challenge for microeconometrics is to understand the mechanisms explaining firm's price adjustment. In fact, most macroeconomic dynamics are underlied by micro hypothesis on the firm's price-setting behaviour (Goodfriend, King (1997)); most dynamic general equilibrium models assume that firms change their prices infrequently at the micro level. Some new empirical evidence of the price rigidity has been recently provided for several countries (Bils and Klenow (2005) for the U.S., and Dhyne et al (2006) for the Euro area, Baudry et al. (2005) for France). These studies are all based on micro dataset underlying the Consumer Price Index of the different countries. They provide basic key indicators as the probability of price change or the average price duration but they also point some common basic features on price-setting behaviour. In all countries the prices of the services sector are modified less often than others prices: in the Euro area and in the U.S. respectively, only 5.6% and 15% of services prices are modified each month (compared to 15% and 25% for whole CPI). Moreover, in the Euro area, 80% of price changes in this sector are rises whereas the share of price increases in other sectors is 60%. In this paper, we deepen our understanding of the determinants and the specific features of price adjustment in the services.

Some recent papers have taken interest in explaining the services prices rigidity and especially in the restaurants. Gaoitti and Lippi (2005) and Hobijn, Ravenna and Tambalotti (2004) constructed some theoritical models to explain the pricing behaviour of restaurants during the Euro cash changeover. Using microdata for Italian restaurants, they build up models with different microfoundations and calibrate them to test different theories. These two papers provide some insights on the mechanisms explaining the inflation peak at the particular date of the euro cash changeover. A recent paper of Goette, Minsch and Tyran (2005) provides some empirical evidence on the price adjustment for several items sold in Swiss restaurants. Contrary to the two latter papers, they use a long time micro dataset of prices, which allows them to test the influence of inflation on price adjustement. They show that size of price change does not respond to inflation rate and that the key variable is the frequency of price change.

The contribution of this paper is twofold :

First, using thousands of price quotes collected in restaurants, fast-foods and cafeteria, we evaluate and simulate the impact of minimum wage and VAT changes on prices. In France, in the restaurants sector, more than 30% of employees are paid at the minimum wage, which should impact the price setting behaviour of restaurants. In most empirical studies, inflation or cumulated inflation is systematically used to explain price adjustement (Cecchetti (1985), Goette et al (2005), Fougere et al (2005)). In this paper, we would like to extend this basic structure of costs by adding some labour costs. What are the consequences of minimum wage increases on prices? Card, Krueger (1994) and Katz, Krueger (1992) studied the consequences on employment and prices of minimum wage increases in Texas, New Jersey and Pennsylvania in the fast-food industry. They collected some price and employment information in several fast-food restaurants during the beginning of nineties. They failed to prove that minimum wage increases had some effects on employment and found little evidence of minimum wage's effects on price adjustment. However, their results are difficult to interpret and Neumark, Wascher (1993), Neumark, Wascher (2000) criticized these results and especially the method of data collection. Aaronson (2001) extended these works by using long subindices data on restaurant prices and minimum wages increases for U.S. and Canada. He used a reduced form equation and try to estimate the reaction of the prices subindices to an increase of the minimum wages. He found evidence of a lagged positive impact of minimum wage increase on prices. If the minimum wage raises by 10%, prices would increase by 0.72% two months after this wage increase. In this paper, we use price reports underlying the French Consumer Price Index (Baudry et al (2007)) and find a positive impact of minimum wages on prices.

Then, we estimate a semi-structural model explaining price rigidity. Most of evidence of minimum wage impact on prices are found by estimating reduced form, these models often do not explain why prices are sticky. Using BLS micro data of restaurant prices, Macdonald and Aaronson (2006) estimate linear equations of price change and found evidence on a significative impact of minimum wage increase on restaurant prices. They showed that this impact was stronger on fast food prices than on other restaurants types. Theoretical models justify price rigidity by the existence of menu costs paid at each price change. The consequences of these fixed costs of repricing are examined in Sheshinski, Weiss (1977). They found that the optimal behaviour of the firm is to adopt an (s,S) rule of repricing : (s,S) models suggest that at each period, inflation is eroding the nominal price; therefore, nominal price and optimal price become different. As long as this difference remains below the menu cost, it is optimal for the firm to wait. If the difference between the nominal price and the optimal price is higher than the menu cost, then the firm will optimally decide to modify her price. Most of recent empirical microeconomics on price-setting focuses on estimating reduced forms of these (s, S) rules, and explain the frequency of price change: Cecchetti (1986) followed by Willis (2005) and Baudry et al. (2005), used an univariate probit model with fixed effects to characterize the determinants of decision of price change. A semi-structural (s, S) model was estimated for the first time by Sheshinski, Tischler, Weiss (1981) on coffee and noddles prices. Using sample selection models, they provide some estimations of the parameters of the rule and of the determinants of the price adjustment. Dahlby (1992) on automobile insurance prices and Fisher and Konieczny (2006) on journal prices used a similar methodology to estimate a semi-structural model of price rigidity. In a recent contribution, Raftai (2006) suggests to use a basic multinomial logit to provide estimations of the parameters of (s S) rules. However, in these models, downward price rigidity and the size of price change can not be estimated. We extend these models by estimating a semi-structural model suggested by Tsiddon (1993), we provide estimations for s and S bands but also for I the repricing point. Moreover, we allow the s and S bands to be stochastic to explain why so many small price changes are observed in data.

In the next section, we present the theoretical model of price rigidity that we will estimate, the dataset and some descriptive statistics are exhibited in section 3, in section 4 we show the empirical model and the estimations of the model. In section 5, we simulate the macroeconomic impact of minimum wage changes on inflation.

2 Price rigidity : the theoretical models.

Theoretical models justify price rigidity by the existence of menu costs paid at each price change. Sheshinski, Weiss (1977) first show that in presence of menu-costs, the optimal behaviour of the firm is to adopt an (s,S) rule of repricing Dixit (1991) and Hansen (1999) extend this basic model to allow non- deterministic shocks. We present here a basic version of this model (see Ratfai (2006))

2.0.1 Flexible prices.

First, we consider the optimal price set by a monopolistically competitive store, prices are completely flexible here. Let us suppose that the economy is composed of n identical firms, they all set the same price of a same good (a menu in a restaurant).

The store i maximises its profit function at time t:

$$\max_{P_{it}} \Pi_i = \max_{P_{it}} (P_{it}Y_{it} - \Theta_{it}M_tY_{it})$$

where P_{it} is the price set by the store i, Y_{it} is the quantity produced, Θ_{it} is an idiosyncratic cost shock, M_t is a common cost shock to all stores. Stores maximise their profit function subject to a demand constraint:

$$Y_{it} = P_{it}^{-\theta_i}Y_t$$

where $\theta_i > 1$ is the demand elasticity of the product i and Y_t is total demand. The optimal price set by the firm is implied by the first order conditions of the maximisation pogramm:

$$P_{it}^* = \left(1 - \frac{1}{1-\theta_i}\right)\Theta_{it}M_t$$

The optimal price is the product of the marginal cost $\Theta_{it}M_t$ which includes here some idiosyncratic and common shocks and of the mark up $\left(1 - \frac{1}{1-\theta_i}\right)$ which is supposed to be time-invariant. If prices were completely flexible, at each period the observed price P_{it} would be equal to the optimal price P_{it}^*.

2.0.2 Sticky prices.

Now, we suppose that there is a fixed cost of price adjustment, which implies that it is not optimal for the firm to set her price equal to the optimal price but to wait. Let us consider $p_{it}^* = \ln(P_{it}^*) = a_i + \omega_{it} + m_t$. If there is a fixed cost of adjustment, we can observe a deviation z_{it} between the observed price p_{it} and the optimal price p_{it}^*. In this case, how to derive the optimal policy for the firm?

As suppose by Hansen (1999), let us assume that both shocks are stochastic, captured by two Brownian motions :

$$\begin{aligned} dm_t &= \sigma_m d\eta_m \\ d\omega_{it} &= \sigma_\omega d\eta_\omega \end{aligned}$$

where $dm_t \sim N(0, dt)$ and $d\omega_{it} \sim N(0, dt)$

Then , the log deviation of between the optimal price and the actual price is equal to :

$$\begin{aligned} z_{it} &= dp_{it} - dp^*_{it} \\ &= -dp^*_{it} \\ &= -\sigma_m d\eta_m - \sigma_\omega d\eta_\omega \\ &= -\sigma d\eta \end{aligned}$$

dp_{it} is null because the observed price is rigid.

Hence, the objective of the firm is to minimise the costs of being out of equilibrium and the costs of adjusting. Hansen (1999) : the former costs consists of the flow costs associated with a change in p^* when the price is kept constant and can by a second oreder Taylor approximation be written as $k(p^* - p)^2$ where $k = \frac{1}{2}\frac{\partial \Pi}{\partial p \partial p}$. This total flow costs $G(.)$ can be written in our case as:

$$\begin{aligned} G(T) &= \int_0^T k z_\tau^2 d\tau \\ &= \int_0^T \frac{1}{2}\frac{\partial \Pi_{i\tau}}{\partial p_{i\tau} \partial p_{i\tau}} z_\tau^2 d\tau \end{aligned}$$

where T is defined as the time of the price change; $T = \min[t > 0, s > z_{it} > S]$ where s and S are respectively the lower and the upper thresholds at which the firm changes its price.

The costs are associated to the menu costs are equal to c.

The dynamic optimisation programm becomes :

$$\min_{\{p_{it}\}} (E(G(T) + c)) = E_0 \left(\int_0^\infty e^{-\rho\tau} k z_\tau^2 d\tau + \sum_{T_k} e^{-\rho\tau} c \right)$$

Dixit (1991) solves this programm by using an approximation , Hansen (1999) solves the problem analytically and explicitly for symmetric bands $-s = S$.and he obtains that :

$$S = \left(\frac{6c\sigma^2}{k} \right)^{\frac{1}{4}} = -s$$

In this paper, we introduce asymmetric costs of price adjustments. A general framework for lumpy adjustments with asymmetric costs is developped by Caballero, Bertola (1990). The optimal rule is then defined by four parameters (L, l, u, U) and adjustment occurs when z is at points L and U, $L \leq U$; when z reaches L, z moves it instantaneously to l, with $L \leq l \leq U$, and when z reaches U, z moves it back to a point u, with $L \leq u \leq U$. Tp our knowledge, analytical results of this general framework do not exist but Caballero and bertola (1990) exhibit the results of simulations. Tsiddon (1993) investigate deepen analytical results for downward rigidity. He characterized the optimal policy by three parameters (b, I, u), which is a particular case of Caballero, Bertola's framework (where $l = u = I$). Price is adjusted when z reaches the band u or b, and it is adjusted so that $z = I$. In our empirical model, we will replace u by S, b by s and I by I.

To solve this model, Tsiddon (1993) introduce an approximation by considering that downward adjustment is infinitely high and firms never adjust prices downward. This leads to a new optimal policy only characterized by (b, I).which leads to a solution of this type :

$b = \frac{\sigma^2}{2\mu} + \left(\frac{3K\mu}{4c} \right)^{\frac{1}{3}}$ et $I = \frac{\sigma^2}{2\mu} - \left(\frac{3K\mu}{4c} \right)^{\frac{1}{3}}$

Finally, we will in this model introduce variable costs of adjustments, to our knowledge, no analytical results have been found for these models, Konieczny (1993) introduce these variable costs of adjustments and found some theoretical predictions on the frequency and the sizes of price changes.

3 Data: restaurant prices quotes

The dataset is a longitudinal dataset of monthly price quotes collected by INSEE from 1994:07 to 2003:02 to compute the Consumer Price Index (CPI). It provides the price of a specific item in

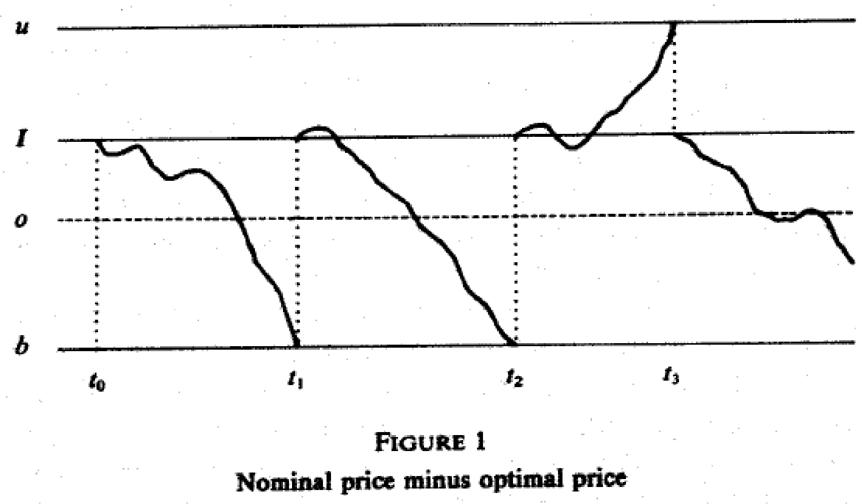


Figure 1: Theoretical predictions of the semi-structural model of Tsiddon (1993)

a particular outlet. The INSEE collects prices quotes for a particular product of specific brand and quality, this product is sold in a particular outlet. Consequently, a product is replaced by a similar product of different quality, a new identification number for the product is created, and a new price trajectory begins. The information on product replacement (quality change, closing of an outlet...) is available. The sample contains also some information on the geographical location of the restaurant, this information is quite precise: it situates the restaurant in an administrative region which is in average 100 kilometer wide. Baudry et al (2007) provides a more complete description of this dataset by computing several descriptive statistics on the frequency and size of price changes in all sectors. In this study, we concentrate our analysis on restaurant prices (menus in traditional restaurants, fast-food meals and cafeteria meals). Our database contains 178 251 price quotes for the item "menu in traditional restaurants", 15 548 for fast food meals, and 37 938 for meals in cafeterias.

On Figure 1, we have represented some typical product spells which last all over the sample period. For instance, at the beginning of the observation period, the price of item 2 is around 7.6 euros (or 50 FF). In August 1995, this price increased to reach 7.9 euros. The sequence of prices between 1994:07 and 1995:08 is a price spell. The length of the price spell is called the

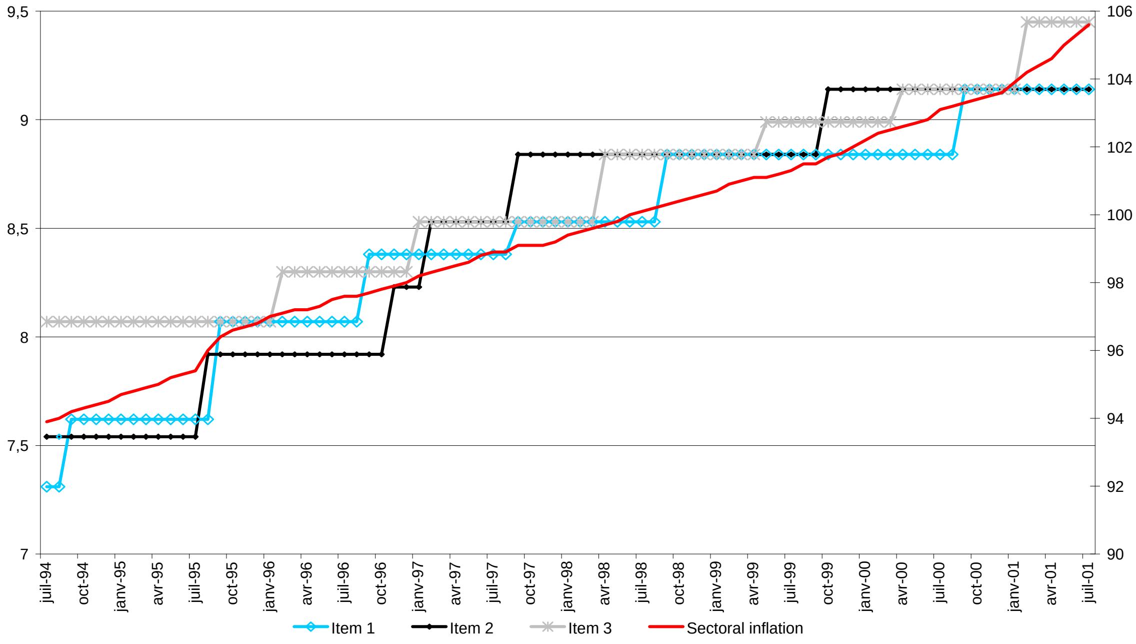


Figure 2: Examples of price trajectories.

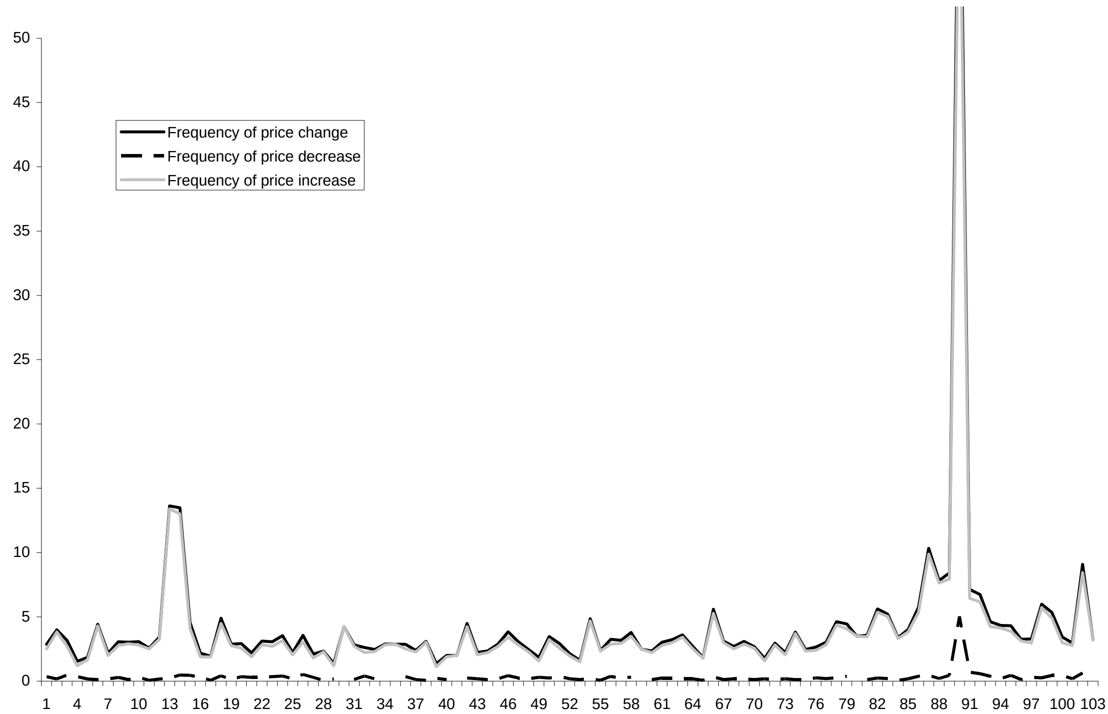
duration of a price quote. Some price durations are left-censored, which means that the first observations is not the first price quote for a product, some others are right censored because the observations stop before the product disappears. We concentrate our analysis on price durations which are left non-censored.

3.1 Descriptive statistics.

3.1.1 Frequency of price change: some evidence of price rigidity.

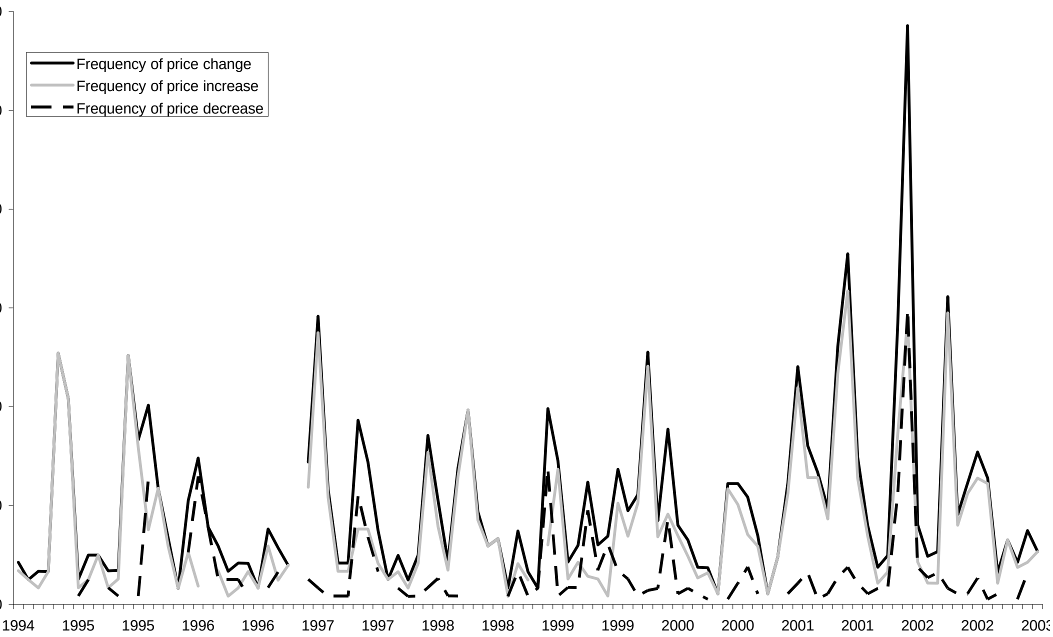
Prices are very rigid in restaurants. On average, each month, a little more than 4% of traditional restaurants prices are modified compared to 15% on average for all CPI price quotes (Baudry et al.(2007)). It implies that on average the price duration of a restaurant price is equal to more than one year. In U.S, Aaronson (2001) found that on average 85% of restaurants prices are not changed each two months, which implies on average that more than 97% of prices are not changed each month, and in the Euro area, 95.3% of restaurant prices are not modified each month (Dhyne et al. (2006)). In fast food restraurants and in cafeteria where the service is limited, the frequency of price change is quite higher 8.4% in cafeteria and 10.4% in fast food restaurants.

Seasonal patterns are very strong for restaurant prices. On figures 1-3, the frequency of price change over time has been computed for the three products considered in this study. The frequency of price change in traditional restaurants shows important peaks in September and at a lesser extent in January. Most of price changes occured at these both months during the sample.

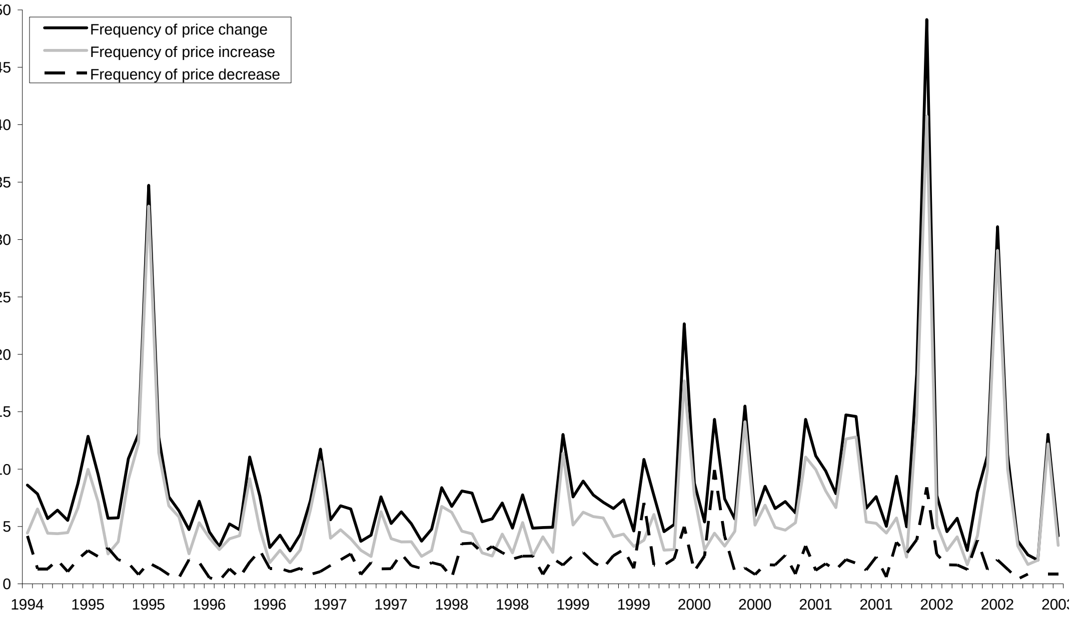


Frequency of price change: menu in a traditional restaurant

For cafeterias and fast-food restaurants, seasonal peaks are less pronounced but the same regularity is observed in January, and during the period July to September.



Frequency of price change: fast-food meals



Frequency of price change: price of a meal in a cafeteria

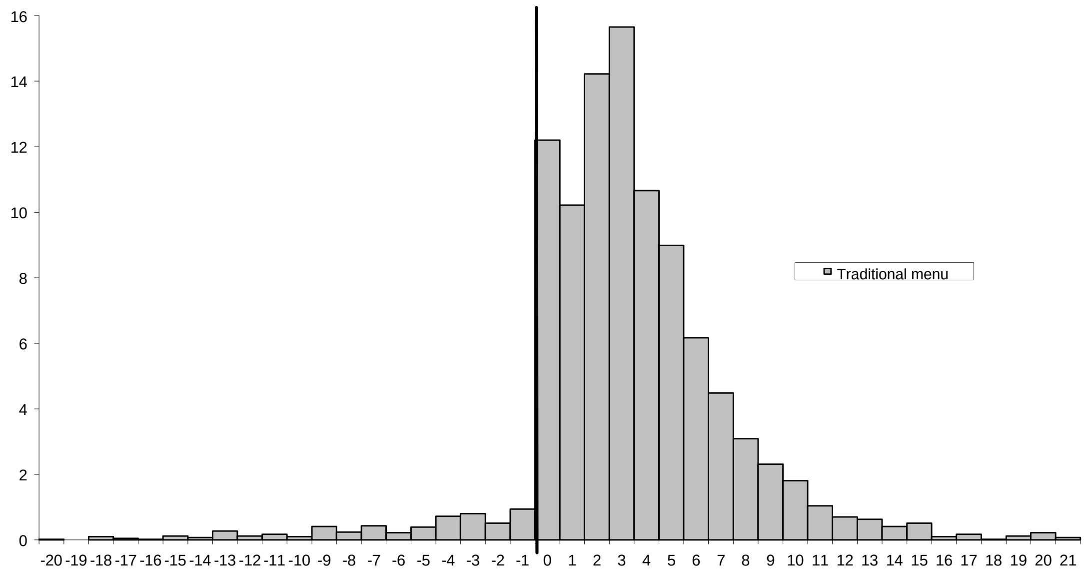


Figure 3: Size of price changes: traditional menu

3.1.2 Size of price changes : some evidence of downward price rigidity.

In traditional restaurants, more than 90% of price changes are increases and only 10% are price decreases, which implies a high degree of downward nominal rigidity. as comparison, for the whole CPI price changes, the proportion is around 60% for increases against 40% for decreases (Baudry et al. (2007)).

Secondly, the average size of price change is around 5%. However, amounts of price decreases are slightly more important than size of price increases (on average resp. 4.8 and 4.1%). This can be explained by the smaller number of small price decreases. This asymmetry in size of price changes could be also observed in the distribution of price changes on figure 3. However, we observe also some similarities for price decreases and price increases: the proportion of large price change is considerable, 10% of price increases are bigger than 8.4% and 10% price decreases are lesser than -12.5%. Aaronson (2001) observed similar patterns for U.S. restaurant prices : asymmetry on the right of price changes distribution, important proportion of small price changes, 12% of big price changes (above 10%), and the average size of price increases is

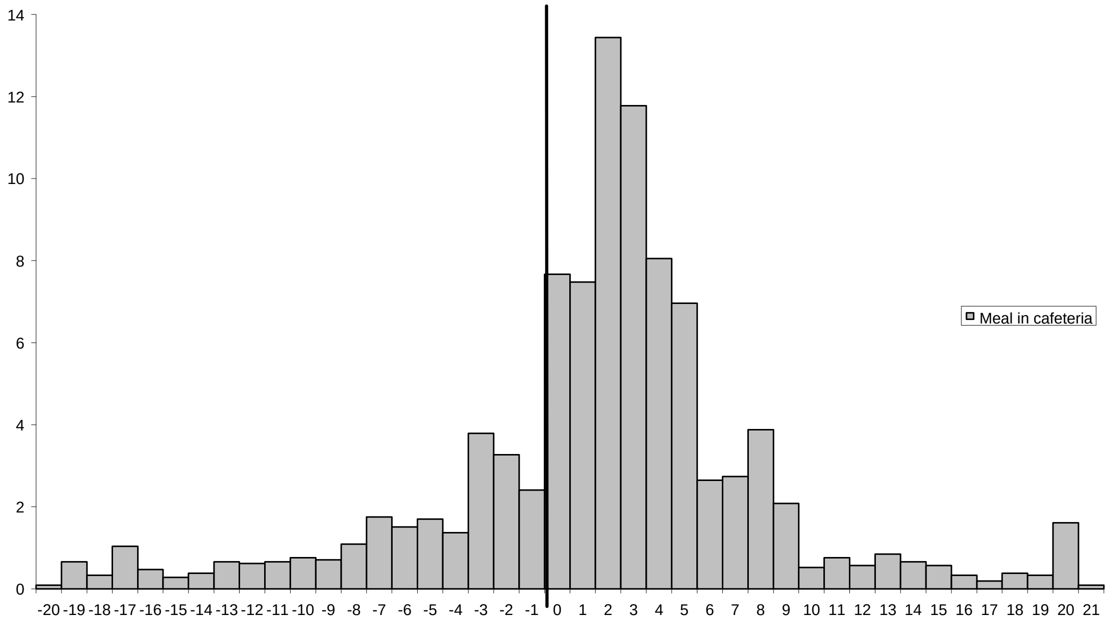


Figure 4: Size of price changes: meal in a cafeteria

smaller than the average size of price decreases.

Prices in fast food restaurants and in cafeterias also exhibit some nomnal downward rigidity but it is less prounonced. In fast food restaurant 33% of price changes are price decreases and in cafeterias 27% of price modifications are price decreases.

One of the main predictions of theoretical models of menu costs is that price changes are large. For the thee products considered here, there are many small price changes, which is inconsistent with this prediction. How to reconcile this stylised fact with theory? We will introduce stochastic (s,S) bands to explain that for example, at certain months (January for example) firms are more likely to change their prices because customers are less reluctant to prices changes (Rotemberg (2003)). During these months (September, January), menu costs are lower and the size of price changes would be also lower.

Table 1 : Size of price changes

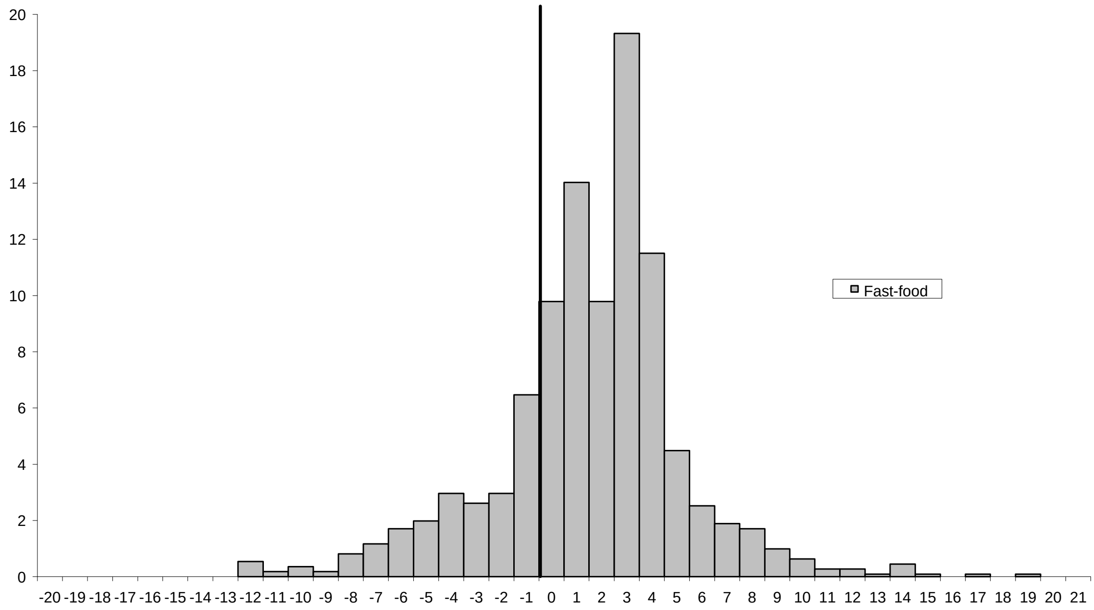


Figure 5: Size of price changes: meal in a fast food restaurant

(%)	NB	10%	25%	Med.	75%	90%	Mean
Traditional restaurant							
Increases	3 855	0.3	1.6	3.2	5.3	8.3	4.1
Decreases	293	-12.5	-7.2	-3.4	-0.8	-0.1	-4.8
Fast Food							
Increases	844	0.5	1.3	2.9	3.7	6.1	3.1
Decreases	269	-7.3	-5.0	-2.7	-0.9	-0.5	-3.3
Cafeteria							
Increases	1545	0.9	2.1	3.4	6.1	12.0	4.5
Decreases	568	-16.7	-9.7	-4.6	-2.1	-0.7	-6.8

3.1.3 Minimum wages, VAT changes and euro-cash changeover.

Minimum wages.

The minimum wage is a national minimum wage, in the restaurants more than 30% of employeees are paid at the minimum wage. The minimum wage is increased each year, it is partly indexed on inflation. It mostly changed in July over the last 10 years except in 1998 where it changed also in May. Most of minimum wage increases are in the intervall [+2;+5]%.

VAT changes.

Another candidate to explain price changes are VAT changes. Two changes in VAT occured during the study period: in August 1995, the VAT was raised from 18.6% to 20.6% and in April 2000 VAT was lowered from 20.6% to 19.6%. On figures of frequency of price changes, we see high peaks of frequency of price increases in Aaugust 1995 (especially for menus in traditional restaurants) and a peak of price decreases in April 2000 in cafeterias. How can we explain these peaks with a menu cost model?

PPI Food.Index.

We also introduce Producer price index for Food to capture the cost of raw materials in the restaurants.

Euro cash changeover.

Finally we introduce a euro cash changeover dummy to explain the peak of price changes in January 2002.

3.2 Price rigidity : an empirical model.

Empirical model:

First, let us suppose an optimal price p^*_{it} unobservable, if there were no menu costs or if price were flexible, it would be equal to p_{it} the observed price. We derive from the theoretical model that p^*_{it} depends from a set of exogenous variables X_{1it}:

$$p^*_{it} = X_{1it}\beta_1 + u_i + \varepsilon_{1it}$$

where $\varepsilon_{1it} \sim N(0; \sigma_1^2)$ et $u_i \sim N(0; \sigma_u^2)$

If prices are rigid, they do not change at each period, let's assume that they change at dates $\tau = (\tau_1, \tau_2 ..., \tau_T)$. Let's suppose that $p_{it-\tau}$ is the price set at the last price change. Prices are kept unchanged as long as the difference between $p_{it-\tau} - p^*_{it}$ fluctuates between a fixed interval

$[s,S]$. At dates τ, $p_{it-\tau} - p^*_{it}$ is below s, the price increases, above S, price decreases. In both cases, the prices are changed according :

$$p_{it} - p^*_{it} = I$$

We now suppose that the interval fluctuates over time and among individuals, the bands of the interval become $\widetilde{S} = S + X_{2it}\beta_2 + w_i + \varepsilon_{2it}$ and $\widetilde{s} = s + X_{2it}\beta_3 + w_i + \varepsilon_{2it}$ where $\varepsilon_{2it} \sim N(0;\sigma_2^2)$ et $w_i \sim N(0;\sigma_w^2)$. The price change decision becomes:

$$\begin{aligned} p_{it} &< p_{it-\tau} \text{ if } p_{i,t-\tau} - p^*_{it} > \widetilde{S} \\ p_{it} &= p_{it-\tau} \text{ if } \widetilde{s} < p_{i,t-\tau} - p^*_{it} < \widetilde{S} \\ p_{it} &> p_{it-\tau} \text{ if } p_{i,t-\tau} - p^*_{it} < \widetilde{s} \end{aligned}$$

If we introduce Y_{it} equal to 1 for an increase, -1 for a decrease and 0 for an unchanged price, we obtain :

$$\begin{aligned} Y_{it} &= -1 \text{ if } p_{i,t-\tau} - X_{1it}\beta_1 - X_{2it}\beta_2 - v_i - \varepsilon_{it} > S \\ Y_{it} &= 0 \text{ if } s < p_{i,t-\tau} - X_{1it}\beta_1 - X_{2it}\beta_2 - v_i - \varepsilon_{it} < S \\ Y_{it} &= 1 \text{ if } p_{i,t-\tau} - X_{1it}\beta_1 - X_{2it}\beta_2 - v_i - \varepsilon_{it} < s \end{aligned}$$

where $v_i = (u_i + w_i) \sim N(0;\sigma_v^2)$ and $\varepsilon_{it} = (\varepsilon_{1it} + \varepsilon_{2it}) \sim N(0;1)$. A constant variable is included in the vector X_{it}, $S - s$ is identified. The new price p_{it} is set according :

$$\begin{aligned} p_{it} &= p^*_{it} + I \\ p_{it} &= X_{1it}\beta_1 + u_i + \varepsilon_{1it} + I \end{aligned}$$

- **Likelihood:**

  This model is estimated by maximum likelihood, we suppose that $\binom{u_i}{v_i} \sim N\left(\binom{0}{0}; \begin{pmatrix} \sigma_u^2 & \rho\sigma_v\sigma_u \\ \rho\sigma_v\sigma_u & \sigma_v^2 \end{pmatrix}\right)$ and $\binom{\varepsilon_{it}}{\varepsilon_{1it}} \sim N\left(\binom{0}{0}; \begin{pmatrix} 1 & \rho\sigma_1 \\ \rho\sigma_1 & \sigma_1^2 \end{pmatrix}\right)$

  If price is unchanged the contribution to the likelihood is:

$$\begin{aligned} l_{it}(u_i, v_i) &= \Pr(s - p_{i,t-\tau} - X_{1it}\beta_1 - X_{2it}\beta_2 - v_i < -\varepsilon_{it} < S - p_{i,t-\tau} - X_{1it}\beta_1 - X_{2it}\beta_2 - v_i) \\ &= \Phi(p_{i,t-\tau} + X_{1it}\beta_1 + X_{2it}\beta_2 + v_i - s) - \Phi(p_{i,t-\tau} + X_{1it}\beta_1 + X_{2it}\beta_2 + v_i - S) \end{aligned}$$

If price is increased the contribution to the likelihood is:

$$\begin{aligned}
l_{it}(u_i, v_i) &= \frac{1}{\sigma_1}\phi\left(\frac{p_{it} - X_{1it}\beta_1 - I - u_i}{\sigma_1}\right) \times \\
&\quad (\Pr(\varepsilon_{it} > p_{i,t-\tau} + X_{1it}\beta_1 + X_{2it}\beta_2 + v_i - s | p_{it} - X_{1it}\beta_1 - I - u_i = \varepsilon_{1it}) \\
&= \frac{1}{\sigma_1}\phi\left(\frac{p_{it} - X_{1it}\beta_1 - I - u_i}{\sigma_1}\right) \times \\
&\quad \left(1 - \Phi\left(\frac{p_{i,t-\tau} + X_{1it}\beta_1 + X_{2it}\beta_2 + v_i - s + \frac{\rho}{\sigma_1}(p_{it} - X_{1it}\beta_1 - I - u_i)}{\sqrt{1-\rho^2}}\right)\right)
\end{aligned}$$

If price is decreased the contribution to the likelihood is:

$$\begin{aligned}
l_{it}(u_i, v_i) &= \frac{1}{\sigma_1}\phi\left(\frac{p_{it} - X_{1it}\beta_1 - I - u_i}{\sigma_1}\right) \times \\
&\quad (\Pr(\varepsilon_{it} < p_{i,t-\tau} + X_{1it}\beta_1 + X_{2it}\beta_2 + v_i - S | p_{it} - X_{1it}b_1 - I - u_i = \varepsilon_{1it}) \\
&= \frac{1}{\sigma_1}\phi\left(\frac{p_{it} - X_{1it}\beta_1 - I - u_i}{\sigma_1}\right) \times \\
&\quad \left(\Phi\left(\frac{p_{i,t-\tau} + X_{1it}\beta_1 + X_{2it}\beta_2 + v_i - S + \frac{\rho}{\sigma_1}(p_{it} - X_{1it}\beta_1 - I - u_i)}{\sqrt{1-\rho^2}}\right)\right)
\end{aligned}$$

The likelihood is then equal to:

$$\ln L = \sum_{i=1}^{n} \ln\left[\frac{1}{R}\sum_{r=1}^{R}\left(\prod_{t=1}^{T_i} l_{it}(u_i, v_i)\right)\right]$$

3.3 Price rigidity : estimation.

3.3.1 Estimate p^* .

The optimal price is explained by PPI food index (raw material cost), minimum wages (labour cost) and VAT changes (tax incorporated in the price).

3.3.2 Identification.

To identify this model, we have to find a variable that explain the variability of (s, S) bands and that does not explain p^*_{it}. We assume that monthly dummies will explain why (s, S) bands are stochastic, prices are more likely to be changed in January or September, because the customer anger costs are lower during these months. Customers are more likely to accept price increase during these months (Rotemberg (2003)). Menu costs will then be variable, a restaurant will have a lower menu cost in January, it will be easier to change its prices during certain months. We also introduce the euro cash changeover in January 2002, at this date, all firms have to change their prices from Francs to euros. They paid almost no menu cost to change their prices at this date. Finally, we could introduce dummies for VAT changes if we suppose that customers are less reluctant to see the prices increase after a VAT increase.

3.3.3 Results

Here are presented some of very preliminary results of the estimations of the model.

First, we estimate the model for meal in a cafeteria without including minimum wage and PPI for Food. We approximate p^* by the sectoral inflation for restaurants. We find no effect of VAT on the optimal price. We obtain an impact of the monthly dummies on s, S bands, and a strong impact of VAT changes on these bands. Vat changes would be interpreted as a trigger for restaurants to change their prices. In April 200, price decreases are more numerous because the menu cost associated with this date is lower than usual. The same interpratation holds for VAT increase in 1995 and price increases. finally, we find an asymmetry in bands, the distance between S and I (1.97) is bigger than the distance between I and s (1.56). This implies that menu costs associated with price increases are lower than those associated with price decreases.

Table : Estimation results - Meal in a cafeteria

	Parameters	Estimates	Std	P-value
p^*	Inflation restaurant	0.86	0.10	0.00
	VAT 95	0.01	0.01	0.26
	VAT 00	0.02	0.01	0.01
S	January	-0.18	0.07	0.01
	February	0.17	0.09	0.03
	April	-0.20	0.07	0.00
	September	-0.12	0.07	0.05
	VAT 95	0.06	0.13	0.34
	VAT 00	-0.12	0.10	0.10
	Pre euro	0.19	0.18	0.14
	Euro	-0.48	0.09	0.00
s	January	0.53	0.05	0.00
	July	0.14	0.05	0.00
	August	0.22	0.05	0.00
	November	-0.18	0.06	0.00
	VAT 95	0.48	0.08	0.00
	VAT 00	0.07	0.08	0.17
	Pre euro	0.84	0.08	0.00
	Euro	-0.37	0.11	0.00
	s	0.15	0.02	0.00
	I	1.61	0.01	0.00
	$S-s$	3.43	0.01	0.00
	σ_u	0.19	0.02	0.00
	σ_ε	0.06	0.02	0.00
	ρ	0.26	0.02	0.00

In the second model, we introduce minimum wage and we found a strong impact of minimum wage on p^*. For fast food restaurant we also find the asymmetry in price decisions.

Table : Estimation results - Meal in a fast-food restaurant

	Parameters	Estimates	Std	P-value
p^*	Minimum wage	0.66	0.07	0.00
	PPI Food	0.16	0.12	0.09
S	January	-0.64	0.08	0.00
	November	0.45	0.15	0.00
	Pre euro	-0.37	0.09	0.00
	Euro	-0.26	0.10	0.00
s	January	0.40	0.07	0.00
	February	0.30	0.07	0.00
	March	-0.21	0.08	0.01
	May	0.19	0.07	0.00
	July	0.38	0.07	0.00
	Pre euro	0.04	0.07	0.30
	Euro	0.23	0.07	0.00
	s	-6.12	0.35	0.00
	I	-4.84	0.35	0.00
	$S - s$	3.27	0.01	0.00
	σ_u	0.01	-	0.00
	σ_v	0.22	0.02	0.00
	$\rho_{u,v}$	0.52	0.02	0.00
	σ_ε	0.04	0.02	0.00
	ρ	0.25	0.02	0.00

4 Aggregation and minimum wage effect on the distribution of prices?

To be completed....

5 Conclusion

To be completed...

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