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Empirical Evidence on the Role of Non Linear Wholesale Pricing and Vertical Restraints on Cost Pass-Through*

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Abstract

How a cost shock is passed through into final consumer prices may relate to nominal price stickiness and rigidities, the existence of non adjustable cost components, strategic mark-up adjustments, or other contract terms along the supply distribution chain. This paper presents a simple framework to assess the potential role of non linear pricing contracts and vertical restraints such as resale price maintenance or wholesale price discrimination in the supply chain in explaining the degree of pass-through from upstream cost shocks in the ground coffee category to downstream retail prices. We do so in the German coffee market where both upstream and downstream firms make pricing decisions allowing for non linear pricing and vertical restraints. Using counterfactual simulations of an upstream coffee cost shock, we find that the existence of resale price maintenance between manufacturers and retailers increases pass through rate by more than 10 points relative to the case when this assumption is not allowed with non linear pricing or when double marginalization along the distribution chain is present. The intuition for our findings is that resale price maintenance restrictions make it less possible for retailers to perform strategic mark-up adjustments when faced with a cost shock. We also find that the larger the simulated cost shocks or the less concentrated upstream sector, and also when faced with less elastic demands, the larger the role of vertical restraints in preventing retailers to perform strategic mark-up adjustments, and thus the higher the pass-through increases.

JEL Classifications: C13, L13, L41. Keywords: Non Linear Pricing, Multiple Manufacturers and Retailers, Ground Coffee, Pass-Through, Resale Price Maintenance, Wholesale Price Discrimination.

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1 Introduction

"Wholesale prices have collapsed over the last three years from nearly \$2.40 per lb to just under 50 cents, the lowest levels in thirty years. Allowing for the effects of inflation, coffee has never been so cheap. Not that the consumer would have guessed. In the supermarket, a 100g jar of Nescafé Gold Blend has risen in price from £1.56 to £2.14 since 1994.", The Guardian, 2001.[1]

Understanding the sources of the extent to which a cost shock is passed through into final consumer prices, defined as the degree of pass-through, has important implications for industry and for the economy generally. Assumptions about these sources shape economists' policy recommendations in many markets as diverse as oil, automobiles, and coffee. There is a large theoretical and growing empirical literature on explaining what would be contributing to incomplete retail price transmission of upstream cost shocks, or incomplete transmission of exchange rate shocks into countries domestic consumer retail prices (Campa and Goldberg, 2006). Several forces that may contribute to incomplete pass-through have been identified in the trade literature in terms of the existence of local non traded cost components (see e.g., Goldberg and Hellerstein, 2008). Nominal price stickiness and rigidities (Engel, 2002; Goldberg and Hellerstein, 2008; Nakamura, 2007; Noton, 2008), long terms contracts (e.g. Bettendorf and Verboven, 2002) and the possibility of making strategic mark-up adjustment along the supply distribution chain (Bettendorf and Verboven, 2000; Goldberg and Verboven, 2001; Nakamura, 2007; Hellerstein and Villas-Boas, 2008) may also explain the degree of pass-through.

The contribution of this paper is to examine empirically the role of non linear pricing and vertical restraints such as resale price maintenance or wholesale price discrimination as determining to what extent firms have the possibility of strategic mark-up adjustment along the supply distribution chain and hence affect retail pass-through of upstream cost shocks. Our empirical approach has two steps. In the first step we estimate the demand parameters and the wholesale and retail markups of the retailers and manufacturers for models, which we select among alternative models following Bonnet and Dubois (2009). In the second step, to assess the overall impact of non linear pricing contracts or vertical restraints on firms' pass-through behavior, we employ counterfactual simulations. In doing so, we simulate an upstream cost shock, compute the industry equilibrium that would emerge, and compare it to the same cost shock without non linear pricing contracts and/or without vertical restraints. We interpret the differential response of retail prices across these two cases as a measure of the overall impact of the possibility of non linear pricing and/or vertical restraints on the capability of transmitting upstream supply shocks.

Our empirical focus is on the German coffee market. Raw coffee bean prices are important components of marginal costs of the roasted coffee industry (Leibtag et al., 2008) making this a good setting to investigate retail cost pass-through. Moreover, during our sample period, coffee commodity prices steadily declined. We observe that the decline was not completely passed through into consumer retail prices in the German market and in other countries as well, as illustrated by the introductory quote in this paper. In our analysis, we use a retail level scanner data set for the top selling ground coffee products sold at a variety of large retail chains in the German market, that is the second largest world consumer market, with 9.3% share, relative to the U.S. 21.6% share (Koerner, 2002).

Our findings suggest that resale price maintenance between manufacturers and retailers increases the pass-through rate of a ten percent cost shock by more than ten percentage

[1] http://www.jubileeresearch.org/worldnews/africa/burning_coffee.htm, The Guardian, 15th May, 2001.

points relative to the case when resale price maintenance is not allowed in non linear pricing contracts or when double marginalization along the distribution chain is present. The intuition for our finding is that resale price maintenance makes it less possible for retailers to perform strategic mark-up adjustment when faced with a cost shock. We further simulate cost shocks under alternative scenarios, with the objective of taking the results beyond the market at hand. We find that the larger the simulated cost shocks or the less concentrated upstream sector, and also when faced with less elastic demands, the larger the role of non linear pricing contracts in preventing retailers to perform strategic mark-up adjustments, and thus the higher the pass through increases due to these contracts.

Empirical documentation of the sources of pass-through in different settings, is often hampered by a lack of data. In particular, intermediate prices along the distribution chain, that are called wholesale prices, cost data, and details on vertical contract terms are typically unavailable. Our paper is thus closely related to previous literature that models vertical relationships between manufacturers and retailers along the vertical channel without observing intermediate prices[2] where we specify a supply side model of vertical interactions where non linear pricing contracts, such as two part tariffs, are allowed following Bonnet and Dubois (2009).

While previous research has investigated cross country patterns (Campa and Goldberg, 2006) and determinants of cost pass-through in many markets such as automobiles (Goldberg and Verboven, 2001; Hellerstein and Villas-Boas, 2008; Norton, 2008), beer (Goldberg and Hellerstein, 2008), and coffee (Bettendorf and Verboven, 2000; Nakamura, 2007; Leibtag et al. 2008), this paper extends this literature in several directions, and is the first analysis to model and consider explicitly the role of non linear pricing and vertical restraints in explaining the degree of pass-through.

Our paper follows a structural approach to estimate pass-through rates in the German coffee market extending previous work by Leibtag et al., (2008) in several ways. They use a reduced form approach to relate current changes in U.S. retail coffee prices to current changes in costs and past changes in prices from a panel data set on commodity, intermediate, and final retail prices, for a variety of U.S. markets over time. They find that a ten percent increase in costs leads to a 3 percent increase in U.S. retail prices and that, intermediately, manufacturers's wholesale prices adjust perfectly. Our paper differs from the previous as, by using a structural model, we estimate a model of demand and supply pricing behavior as use the model for policy simulation. In particular, not only we simulate the effect of counterfactual changes in costs on the changes in equilibrium prices, but also, in addition, the structural model allows us to investigate some of the reasons behind our estimated pass-through rates, that the reduced form approach does not allow. We do so by performing cost shock simulations under alternative structural model specifications, taking the previous structural model based work (as in Bettendorf and Verboven, 2000; Goldberg and Verboven, 2001; Goldberg and Hellerstein, 2008; Hellerstein and Villas-Boas, 2008) one step further. Hellerstein and Villas-Boas (2008) investigate the role of multinationals in explaining patterns of pass-through in the automobile industry, finding there to be a positive empirical relationship between the degree of intra-firm trade and measures of exchange rate pass-through. A related paper by Nakamura (2007) estimates in the US coffee market the long run pass-through rate to be roughly 0.30 taking into account the role of price adjustment (menu) costs. We extend this structural approach by assessing the role of non linear vertical pricing in explaining incomplete pass-through rates in the German coffee market.

The next section sets up the problem by describing the market and the available data.

[2]See Goldberg and Verboven (2005), Manuszak (2001), Mortimer (2008), Villas-Boas and Hellerstein (2006), Villas-Boas and Zhao (2005), Villas-Boas (2007), and Villas-Boas (2009).

Section 3 describes the demand model and then supply models are solved for imperfectly competing manufacturers selling through imperfectly competing retailers, where linear and non linear pricing contracts are considered. Section 4 discusses the estimation method and presents the demand and supply results. Section 5 presents the simulation method and then turns to discussing the cost pass-through analysis. Finally, section 6 concludes by discussing implications of our findings and avenues for future research extensions.

2 The Market and the Data

The empirical focus is on the coffee market in Germany, the second largest consumer market in the world, during the years of 2000 and 2001. This market consists of an interesting and empirically attractive setup to study pass-through in the presence of imperfectly competitive retailers and manufacturers: while there is a systematic decline in commodity coffee prices during this period we do not find this trend to be reflected completely in consumer retail prices in our data. For instance, Figure 1 suggests there to be incomplete pass-through of these cost savings into consumer prices. This figure plots weekly data for raw coffee prices obtained from the New York Cost Exchange together with weekly retail prices for one of the products sold in this market chosen at random.[3] The figure also plots two smoothed nearest-neighbor regression lines, one for the predicted values from the regression of the product's price on weeks and the other from the regression of raw coffee prices on weeks. The figure graphically illustrates the relationship between the product's price and raw coffee price over time. It shows a positive relationship, although it appears that the response in the product's smoothed price series to the decline in the raw coffee smoothed price series is not perfect. Moreover, while the standard deviation of retail price relative to its average price (or alternatively relative to the modal price) is about 8 percent, the raw coffee price standard deviation relative to its average is 18 percent. Finally, the percent retail price movements amount only to less than one third of the raw coffee percent changes over the same period of time. We observe empirically a decrease of retail prices from 7.5 to 6.5 (or -13.3%) and a decrease of raw coffee prices from 6.2 to 3.3 (or -46.8%). This results in a reduced form average pass through of less than third, suggesting the presence of incomplete pass-through. Such a reduced form average estimate is consistent with the reduced form estimate in Leibtag et al. (2008) and it suggests there to be incomplete pass-through in this market. The reduced form approach suffers from the fact that the not complete (competitive) pass-through rates may originate from firm behavior that will result in markups chosen by firms given the cost shocks. There is selection present, when estimating this retail pass-through estimate using a reduced form approach. This selection would make out of sample predictions of alternative cost shocks problematic. This motivates us to use a structural model in the empirical section of this paper to investigate pass-through rates given hypothetical cost shocks via policy simulations.

The relatively small number of major firms in this industry is attractive from a modeling and empirical perspective. Five manufacturers produce coffee and sell it to consumers via four major retail chains throughout Germany, called Edeka, Markant, Metro, and Rewe.[4] The five manufacturers produce seven brands in the coffee market, and these are Jacobs, Onko, Melitta, Idee, Dallmayr, Tchibo, and Eduscho. These brands capture more

[3] All other products' prices show similar patterns.

[4] Another major retailer is Aldi, the largest German discounter but unfortunately Aldi does not make their data available. The coffee products produced by the seven manufacturers that are used in this analysis, are mainly sold to consumers via the above retail chains, and less through vertically integrated coffee shops.

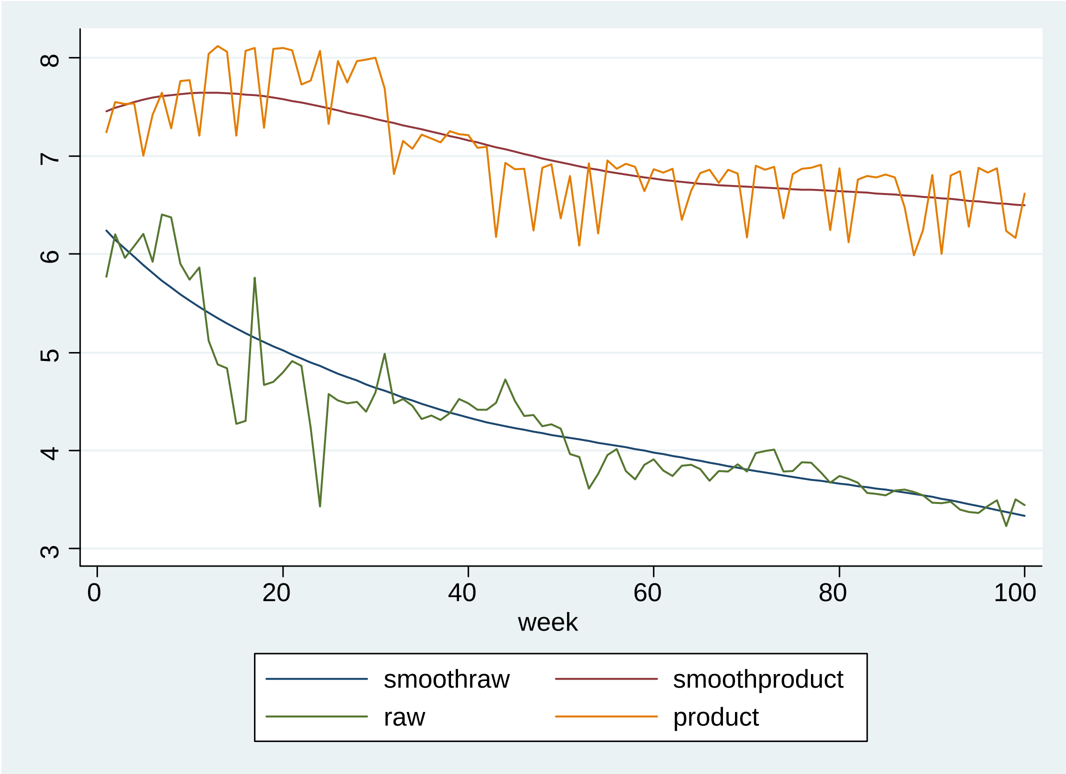

Figure 1: Raw coffee price and price of Jacobs in Rewe.

than 95% of the market, while the rest consists of private label brands and a few minor brands. Jacobs and Onko, who merged in the period before the start of our data set, are produced by Kraft while Tchibo and Eduscho are brands, previously produced by two firms but now merged into one, of the same firm called Tchibo.

The empirical analysis is based on a weekly data set on retail prices, aggregate market shares and product characteristics for seven coffee products produced by five manufacturers sold at four retail chains.[5] Note that there are seven brands at the manufacturer level that are sold through the different four retailers and thus creating the choice set equal to twenty eight products at the retail-consumer level. The price, advertising and market share data used in the empirical analysis were collected by MADAKOM, Germany, from a national sample of retail outlets belonging to the four major retailers Edeka, Markant, Metro, and Rewe, during the years of 2000 and 2001. These data contain weekly information on the sales, prices, and promotional activity for all brands in the ground coffee category. We focus on the 7 major national brands: the largest being Jacobs with 28% market share, Onko (20%), Melitta (16%), Idee (12%), Dallmayr (12%), Tchibo (9%), and Eduscho with 3 percent. Private label brands (1.71% market share) and a few minor brands (combined share of 2.57%) were dropped from the analysis.

Data summary statistics broken up for each of the four retail chains, for each of the seven brands in the data are available in the Appendix in Table A.1, and for more details see Draganska and Klapper (2007). For the retail chains considered, the data obtained to perform this analysis were already aggregated across the different stores for each chain, as the stores in the same chain have price correlation very close to one and they do appear to perform chain level retail pricing. Combined market shares for the products sold in Metro

[5]We thank Daniel Klapper for granting us access to the data.

represent over 46% of the market, Markant comes next with 29%, then Edeka with 14% and finally Rewe with 11%.

Looking at brand presence per retail chain, Jacobs is the market leader, followed by Melitta and Tchibo. However, Tchibo is the top-selling brand at Rewe. In terms of descriptive statistics for prices, Markant seems to be offering the lowest overall prices. Melitta, Jacobs, Onko, and Eduscho are somewhat lower-priced at all retailers, whereas Idee, Dallmayr and Tchibo occupy the upper end of the market. Price data are expressed in Deutsche Marks per 500 grams. Most of the quantity time series variation may be attributed to temporary price discounts. This is particularly true for the leading brands in the market, Jacobs, Tchibo and Melitta.

In terms of promotions data, the dataset contains a dummy variable for the presence of store-front advertisements, display and feature advertising, and this variable varies by brand and by retailer. Auxiliary data on total advertising expenditures by brand (but not by brand and retailer) varies by year.

The quantity data consist of quantities sold for each brand of coffee at the different retailers. A unit in this data set corresponds to 500 grams of coffee, the modal package size of the products sold. To calculate the market share of each brand allowing for no purchase option (also called outside good option), one needs a measure of the size of the potential market. Market size per key account is calculated based on individual consumer panel data obtained from MADAKOM, which records panelists' shopping trips. Given that the panel is representative, for each chain, the number of shopping trips in a given week is defined as the total market potential. We then use this measure of market size to calculate the share of the outside good and the brand shares.

3 The Models

The demand model is a standard discrete-choice demand formulation (McFadden 1984; Berry, Levinsohn and Pakes 1995; Nevo, 2001). We then derive manufacturer and retailer margins as function of demand substitution patterns in several cases of manufacturers and retailers relationships. In particular, we suppose linear pricing relationships, non linear vertical contracts in the form of two part tariffs with or without resale price maintenance, and allowing or not for wholesale price discrimination. Finally, we follow Bonnet and Dubois (2006) to select the best model to be used as benchmark in the simulation analysis of cost pass-through.

3.1 Demand

We assume that consumers choose among N different products indexed by j that consist of a variety of brands sold at different retail chains denoted by k, or decide to make no purchase in the category. Note that, if a certain brand is sold at two different retail chains it results in two products at the consumer choice level, since a brand A at chain 1 is different from the same brand sold at chain 2. The indirect utility U_{ijt} of consumer i from purchasing product $j = 1, 2, \ldots, N$, in time period $t = 1, 2, \ldots, T$ is given by:

$$U_{ijt} = \alpha_j - \beta_i p_{jt} + X_{jt}\beta_x + \xi_{jt} + \varepsilon_{ijt},$$

where α_j is a product fixed effect capturing the intrinsic preference for product j. The shelf price of product j at time t is denoted by p_{jt}. We include retailer promotions, manufacturer advertising and a time trend in X_{jt} and the corresponding parameters are in β_x. The term ξ_{jt} accounts for weekly changes in factors such as shelf space, positioning of the product among others that affect consumer utility, are observed by consumers and firms but are not observed by the researcher. ε_{ijt} is an i.i.d. type I extreme value distributed error term capturing consumer idiosyncratic preferences.

To allow for category expansion or contraction, we include an outside good (no-purchase option), indexed by $j = 0$, whose utility is given by:

$$U_{i0kt} = \varepsilon_{i0kt}.$$

The price coefficient β_i is assumed to vary across consumers according to $\beta_i = \beta + \sigma v_i,\ v_i \sim N(0,1)$, where β and σ are parameters to be estimated. As in Nevo (2000) we rewrite the utility of consumer i for product j as

$$U_{ijt} = \delta_{jt}(p_{jt}, X_{jt}, \xi_{jt}; \alpha, \beta, \beta_x) + \mu_{ijt}(p_{jt}, v_i; \sigma) + \varepsilon_{ijt},$$

where δ_{jt} is the mean utility, while μ_{ijt} is the deviation from the mean utility that allows for consumer heterogeneity in price response.

Let the distribution of μ_{ijt} across consumers be denoted by $F(\mu)$. The aggregate share S_{jt} of product j at time t across all consumers is obtained by integrating the consumer level probabilities:

$$S_{jt} = \int \frac{\exp(\delta_{jt} + \mu_{ijt})}{1 + \sum\limits_{n=1}^{N} \exp(\delta_{nt} + \mu_{int})} dF(\mu). \tag{1}$$

This aggregate demand system not only accounts for consumer heterogeneity, but also provides more flexible aggregate substitution patterns than the homogeneous logit model.

3.2 Supply Models

3.2.1 Linear pricing

On the supply side let us assume a Manufacturer Stackelberg model in which M manufacturers set wholesale prices w first, in a Bertrand-Nash manufacturer-level game, and then R retailers (chains) follow setting retail prices p in a Bertrand-Nash fashion. Let each retail chain r marginal costs for product j be given by c_j, and let manufacturers' marginal cost be given by μ_j. We also assume that the manufacturers who have merged behave as if they are the same manufacturer by maximizing joint profits over the set of products both produce.

Assume each retail chain r maximizes his profit function defined by

$$\Pi^r = \sum_{j \epsilon S_r} M \left[p_j - w_j - c_j\right] s_j(p) \quad \text{for} \quad r = 1, ...R, \tag{2}$$

where M is the size of the market, S_r is the set of products sold by retail chain r, and s_j is defined, given a potential market, as the market share of product j. The first-order conditions, assuming a pure-strategy Nash equilibrium in retail prices, are:

$$s_j + \sum_{m \epsilon S_r} \left[p_m - w_m - c_m\right] \frac{\partial s_m(p)}{\partial p_j} = 0 \quad \text{for} \quad j = 1, ...N \tag{3}$$

Let S_p be a matrix with general element $S_p(j,i) = \frac{\partial s_j}{\partial p_i}$, containing retail chain level demand substitution patterns with respect to changes in the retail prices of all products. We define I_r (of size $(N \times N)$) as the ownership matrix of retailer r which is diagonal and whose elements $I_r(j,j)$ are equal to 1 if the retailer r sells product j and zero otherwise.

Solving (3) for the price-cost margins for all products in vector notation gives the price-cost margins γ_r for all products in the retail chains under Nash-Bertrand pricing:

$$\underbrace{p - w - c}_{\gamma_r} = -[I_r S_p I_r]^{-1} I_r s(p), \tag{4}$$

which is a system of N implicit functions that expresses the N retail prices as functions of the wholesale prices. If retail chains behave as Nash-Bertrand players then equation (4) describes their supply relation.

Manufacturers choose wholesale prices w to maximize their profits given by

$$\Pi^f = \sum_{j \epsilon S_f} M[w_j - \mu_j]\ s_j(p(w)), \tag{5}$$

where S_f is the set of products sold by manufacturer f, and knowing that retail chains behave according to (4). Consider I_f the ownership matrix of manufacturer f which is diagonal and whose element $I_f(j, j)$ is equal to one if j is produced by the manufacturer f and zero otherwise. We introduce P_w the $(N \times N)$ matrix of retail prices responses to wholesale prices, containing the first derivatives of the retail prices p with respect to the wholesale prices w with general element $P_w(j, i) = \frac{\partial p_j}{\partial w_i}$[6]. Solving for the first-order conditions from the manufacturers' profit-maximization problem, assuming again a pure-strategy Nash equilibrium in wholesale prices and using matrix notation, yields:

$$\underbrace{(w - \mu)}_{\Gamma_f} = -[I_f P_w S_p I_f]^{-1} I_f s(p), \tag{6}$$

Under the above model, given the demand parameters $\theta = [\alpha\ \beta\ \beta_x\ \sigma]$, the implied price-cost margins for all N products can be calculated as $\gamma(\theta)$ for the retailers and $\Gamma(\theta)$ for the manufacturers.

3.2.2 Non Linear Contracts

We consider now that manufacturers and retailers can use non linear contracts in the form of two part tariffs. In addition, resale price maintenance (RPM) may be imposed. Finally, we also consider cases where manufacturers cannot discriminate in wholesale prices, as an additional vertical restriction. Details on two part tariffs contracts where wholesale price discrimination is allowed, as in Bonnet and Dubois (2009), with and without RPM, are in the appendix. Here we only derive the margins that result when manufacturers and retailers can use non linear contracts but now wholesale price discrimination is supposed to be forbidden, as it turns out to come out as the best model, among the alternatives considered, for this market.

A product is thus defined either by its number in the set of brand ($s \in \{1, 2, .., N_u\}$) and the number $r \in \{1, .., R\}$ of the retailer at which it is sold, or by the unique number $i \in \{1, 2, .., N\}$ defined as $i = (r-1)N_u + s$. Remark that the total number of differentiated products, defined as brand-retail combinations, is $N = N_u R$.

We assume that manufacturers make take-it or leave-it offers to retailers and characterize symmetric subgame perfect equilibria as in Rey and Vergé (2004). The manufacturers' offers consist in two-part tariffs contracts i.e. wholesale prices w_s and franchise fees F_{sr} paid by the retailer r for selling brand s but also retail prices p_{sr} when manufacturers can use resale price maintenance. Then retailers simultaneously accept or reject the offers that

[6]See Bonnet and Dubois (2006) for the derivation of P_w.

are public information. If one offer is rejected, all contracts are refused. If all offers have been accepted, retailers simultaneously set their retail prices and demand and contracts are satisfied.

Assuming that manufacturers and retailers use these two-part tariffs contracts, the profit function of retailer r is given by

$$\Pi^r = \sum_{s\in\{1,2,..,N_u\}} \left[M(p_{sr} - w_s - c_{sr})s_{sr}(p) - F_{sr}\right]. \tag{7}$$

The manufacturer f profit is then equal to

$$\Pi^f = \sum_{s\in S_f} \left[M(w_s - \mu_s)\left(\sum_{r=1}^{R} s_{sr}(p)\right) + \left(\sum_{r=1}^{R} F_{sr}\right)\right]. \tag{8}$$

Manufacturers set the two-part tariffs contracts parameters (wholesale prices and fixed fees) in order to maximize profits subject to the following retailers' participation constraints for all $r = 1,..,R$

$$\Pi^r \geq \overline{\Pi}^r, \tag{9}$$

where $\overline{\Pi}^r$ is a fixed reservation utility level.

Since manufacturers can always adjust the fixed fees such that all the constraints (9) are binding (Rey and Vergé, 2004), the manufacturer's maximization program is

$$\Pi^f = \sum_{k\in S_f} M(w_k - \mu_k)\left(\sum_{r=1}^{R} s_{kr}(p)\right) + \sum_{r=1}^{R}\sum_{s\in S_r} M(p_{sr} - w_s - c_{sr})s_{sr}(p) - \sum_{r=1}^{R}\overline{\Pi}^r.$$

In the case where resale price maintenance is allowed, manufacturers choose retail prices while wholesale prices have no direct effect on profit. Therefore, first order conditions of the firm f are obtained from the maximization program of her profit for all $j \in S_f$ and all $r' \in \{1,..,R\}$

$$\sum_{r=1}^{R}\sum_{k\in S_f}(w_k - \mu_k)\frac{\partial s_{kr}(p)}{\partial p_{jr'}} + s_{jr'}(p) + \sum_{r=1}^{R}\sum_{s\in S_r}(p_{sr} - w_s - c_{sr})\frac{\partial s_{sr}(p)}{\partial p_{jr'}} = 0, \tag{10}$$

and give in matrix notation

$$I_f S_p I_{fu}\Gamma_{fu} + I_f s(p) + (I_f S_p)\gamma = 0.$$

where I_{fu} is the ownership matrix of manufacturer f of dimension $(N_U \times N)$ whose element $I_{fu}(i,j)$ is equal to one if the brand i and product j are produced by the manufacturer f and zero otherwise.

There is an identification problem because wholesale margins Γ_u and retail margins γ are unknown, and there exists an equilibrium for any vector of wholesale prices. We need additional assumptions to identify both margins. First, we suppose that wholesale prices are equal to the marginal cost of production ($w_s^* = \mu_s$). Second, we suppose that wholesale prices are such that retailer's price cost margins are zero ($p_{sr}^*(w_s^*) - w_s^* - c_{sr} = 0$).

In the first case, retail margins are the same as in the case of wholesale price discrimination (see appendix for more details). In the second case, the expression (14) gives the following vector of wholesale margins for the manufacturer f

$$\Gamma_{fu} = -\left(I_f S_p I_{fu}\right)^{-1} I_f s(p). \tag{11}$$

In the case where resale price maintenance is not allowed, manufacturer f maximizes profit with respect to wholesale prices and we obtain these first order conditions for the manufacturer f

$$0=\sum_{r=1}^{R}\sum_{k\in S_f}(w_k-\mu_k)\frac{\partial s_{kr}(p)}{\partial w_j}+\sum_{r=1}^{R}\sum_{s\in S_r}\frac{\partial p_{sr}}{\partial w_j}s_{sr}(p)+\sum_{r=1}^{R}\sum_{s\in S_r}(p_{sr}-w_s-c_{sr})\frac{\partial s_{sr}(p)}{\partial w_j},\quad (12)$$

for all $j\in S_f$ and become in matrix notation

$$I_{fu}P_{w_u}S_pI_{fu}\Gamma_{fu}+I_{fu}P_{w_u}s(p)+I_{fu}P_{w_u}S_p\gamma=0 \quad (13)$$

where P_{w_u} is of dimension $N_u\times N$ and represents the vector of first order derivatives of retails prices with respect to the vector of wholesale prices. This matrix is deduced from the differentiation of the retailer's first order conditions with respect to wholesale prices

$$0=\sum_{r=1}^{R}\sum_{k\in S_f}(w_k-\mu_k)\frac{\partial s_{kr}(p)}{\partial w_j}+\sum_{r=1}^{R}\sum_{s\in S_r}\frac{\partial p_{sr}}{\partial w_j}s_{sr}(p)+\sum_{r=1}^{R}\sum_{s\in S_r}(p_{sr}-w_s-c_{sr})\frac{\partial s_{sr}(p)}{\partial w_j}.\quad (14)$$

Then, in the case of no resale price maintenance with uniform pricing, wholesale margins are function of retail margins and demand parameters

$$\Gamma_{fu}=-\left(I_{fu}P_{w_u}S_pI_{fu}\right)^{-1}\left[I_{fu}P_{w_u}s(p)+I_{fu}P_{w_u}S_p\gamma\right]. \quad (15)$$

3.3 Testing between alternative models

We now present how to test between the alternative models once we have estimated the demand model and obtained the different price-cost margins estimates according to their expressions obtained in the previous subsection and also detailed in the appendix for alternative models considered. Denoting by h and h' two different models considered, we can obtain estimates of the total marginal costs under both models: C_{jt}^h and $C_{jt}^{h'}$. Then one can test between these two models using non nested tests under the assumption that the total marginal cost C_{jt} of product j depends additively on a marginal cost of production $\mu_{b(j)t}$ of the brand $b(j)$ of product j, on a marginal cost of distribution $c_{r(j)t}$ of the retailer $r(j)$ of product j, and a mean zero *iid* idiosyncratic shock ϵ_{jt}^h (Bonnet and Dubois, 2006), that is

$$C_{jt}^h=\mu_{b(j)t}+c_{r(j)t}+\epsilon_{jt}^h \text{ for all } j=1,..,J \text{ and } t=1,..,T \quad (16)$$

Using the relationship between retail prices, total marginal cost and estimated margins under model h, $p_{jt}=\Gamma_{jt}^h+\gamma_{jt}^h+C_{jt}^h$, we obtain non nested price equations for models h and h'.

Under this cost restriction, we will then test between the two non nested equations

$$\begin{cases} p_{jt}-\Gamma_{jt}^h-\gamma_{jt}^h=\sum_{b=1}^B\mu_{bt}^h 1_{b(j)=b}+\sum_{r=1}^R c_{rt}^h 1_{r(j)=r}+\epsilon_{jt}^h \\ p_{jt}-\Gamma_{jt}^{h'}-\gamma_{jt}^{h'}=\sum_{b=1}^B\mu_{bt}^{h'} 1_{b(j)=b}+\sum_{r=1}^R c_{rt}^{h'} 1_{r(j)=r}+\epsilon_{jt}^{h'} \end{cases}$$

that can be estimated using ordinary least squares.

Then, we can use non nested tests (Rivers and Vuong, 2002)[7] to infer which model is statistically the best, and in the next section we present evidence based on these different statistical tests.

[7] See Bonnet and Dubois (2006) for more details and application of this non nested test.

4 Model Estimation and Results

4.1 Demand Estimation

When estimating demand, the goal is to derive parameter estimates that produce product market shares close to the observed ones. This procedure is non-linear in the demand parameters, and prices enter as endogenous variables. The key step is to construct a demand side equation that is linear in the parameters associated with the endogenous variables so that instrumental variables estimation can be directly applied. This follows from equating the estimated product market shares[8] to the observed shares and solving for the mean utility across all consumers, defined as

$$\delta_{jt}(\alpha, \beta, \beta_x) = \alpha_j - \beta p_{jt} + X_{jt}\beta_x + \xi_{jt}. \tag{17}$$

For the mixed Logit model, solving for the mean utility (as in Berry 1994) has to be done numerically (see Berry, Levinsohn, and Pakes, 1995 and Nevo, 2001). Finally, once this inversion has been made, one obtains equation (17) which is linear in the parameter associated with price. If we let θ be the demand side parameters to be estimated, then $\theta = (\theta_L, \sigma)$ where θ_L are the linear parameters (α, β, β_x) and σ is the non-linear parameter. In the mixed Logit model, θ is obtained by feasible Simulated Method of Moments (SMOM) following Nevo's (2000) estimation algorithm, where equation (17) enters in one of the steps.[9]

4.2 Instruments and Identification of Demand

The first step consists in estimating consistently the demand parameters. In the demand model consumers choose between different coffee products over time, where a product is perceived as a bundle of attributes, among which one is price. Since retail prices are not randomly assigned and likely correlated with demand shocks because retailers take into account unobserved preferences when setting retail prices, instrumental variables in the estimation of demand are required. Retailers consider both observed characteristics, x_{jt}, and unobserved characteristics, ξ_{jt}. Retailers also account for any changes in their products' characteristics and valuations. A product fixed effect is included to capture observed and unobserved product characteristics/valuations that are constant over time, furthermore, a time trend captures trending unobserved determinants of demand. The econometric error that remains in ξ_{jt} will therefore only include the (not-trending) changes in unobserved product characteristics such as unobserved promotions and changes in shelf display and/or changes in unobserved consumer preferences. This implies that the prices in (17) are correlated with changes in unobserved product characteristics affecting demand.

Hence, to obtain a consistent estimate of the price coefficients, instruments are used. We use, as instruments for prices, direct components of marginal cost, namely world market raw coffee prices, interacted with product-specific fixed effects as in Villas-Boas (2007). These cost instruments separate cross-coffee-brand variation in prices due to exogenous factors from endogenous variation in prices from unobserved product characteristics changes. The price decision takes into account exogenous cost-side variables, such as input prices. The identifying assumption is that changes in unobserved product characteristics ξ_{jt}, such

[8] For the random coefficient model the product market share in equation (2) is approximated by the Logit smoothed accept-reject simulator.

[9] The aim is to concentrate the SMOM objective function such that it will be only a function of the non-linear parameters. By expressing the optimal vector of linear parameters as a function of the non-linear parameters and then substituting back into the objective function, it can be optimized with respect to the non-linear parameters alone.

as changes in shelf display, are most likely not correlated with changes in raw coffee average prices.

The intuition for interacting input prices with product dummies is to allow raw coffee average price to enter the production function of each product differently, maybe because products use different blends or purchase from different regions in the world the raw coffee. The raw coffee cost measure used in the analysis is the trade-volume weighted average of the five most traded contracts at the New York Stock Exchange adjusted for exchange rates and taxes.

4.3 Demand Estimates

The demand model estimates are presented in Table 1. The first set of columns present the OLS estimates without instrumenting for price, the second set of columns present the Logit model estimates. In the last set of columns consumer heterogeneity is considered by allowing the coefficient on price to vary across consumers as a function of unobserved consumer characteristics, and the Generalized Method of Moments estimates of the random coefficient specification are presented, where the individual choice probabilities are given by (1). The first stage R-squared and F-Statistic are high suggesting that the instruments used are important in order to consistently estimate demand parameters. Also when comparing the first two set of columns corresponding to no instrumentation (OLS) with the other columns to the right, when price is instrumented for, one notices that the estimates of the other variables affecting utility are robust to instrumentation, and the price parameter increases in absolute value. On average, the price has a significant and negative impact on utility and, moreover, when comparing the Logit with the random coefficient Logit, it appears that unobservable characteristics in the population seem to affect the price coefficient significantly. The coefficients of promotion and advertising are significantly different from zero and positive, and are thus demand expanding factors. There is a significant and negative time trend effect, which is in line with the evidence in the market that the overall attractiveness of the category has been diminishing over time in the German coffee market.[10]

	OLS (1)		Logit (2)		GMM (3)	
Parameter	Estimate	Std	Estimate	Std	Estimate	Std
Price	-0.68	(0.02)	-0.75	(0.04)	-0.77	(0.07)
Constant	-2.14	(0.14)	-1.53	(0.28)	-1.62	(0.41)
Promotion	0.48	(0.015)	0.44	(0.03)	0.47	(0.03)
Trend	-0.002	(0.00)	-0.002	(0.00)	-0.002	(0.00)
Advertising	0.03	(0.01)	0.03	(0.01)	0.03	(0.01)
Random Coeff. Price					0.10	(0.04)
First Stage						
F(28,2766) (p-value)			50.78	(0.00)	50.78	(0.00)
R Squared			0.84		0.842	

Table 1. Demand Results.

OLS (in columns (1)), Logit (in columns (2)) and Random Coefficients (in columns (3)) GMM estimates and White standard errors are in parenthesis. Product fixed effects were included in all specifications. Source: Authors' calculations.

[10]Industry evidence from Germany shows that yearly consumption, measured as kilograms per capita per year, has fallen by ten percent from over 7.4 in the twelve year period of 1990-2002.

4.4 Supply Estimates

The demand estimates from the random coefficient specification are used to compute the implied estimated substitution patterns, which in turn are combined with models of retail and manufacturer behavior to estimate the retail and wholesale margins. After estimating the different price cost margins for all the models, for which summary statistics are available in Table A.2 in the Appendix, we can recover the marginal cost C_{jt}^h using equation $C_{jt}^h = p_{jt} - \Gamma_{jt}^h + \gamma_{jt}^h$ and then estimate the cost equation (16). The estimation of these cost equations are useful in order to test which model fits best the data. Results for the Rivers and Vuong (2002) show that the best model appears to be the case where manufacturers use two-part tariffs contracts with resale price maintenance particularly with zero retail margins and without wholesale price discrimination.[11]

Subtracting the estimated margins we obtain, with an average margins of 17.53%, from retail prices we also recover the sum of retail and manufacturer marginal costs of all products for the preferred model. The average estimated recovered cost of 5.9 Deutsche Marks per unit is very plausible (a unit is 500 grams), according to industry research, and also within the ball-park when comparing with the average raw coffee price after adjusting for the expected loss in volume when produced. Starting with an average raw coffee price including tax per unit (500 grams) of slightly over 4 Deutsche Marks, and given that there is a 15 to 25 % weight loss in the process of roasting the coffee which also needs to be taken into account when calculating the cost per unit of coffee, one obtains an interval of $[5.04, 5.7]$ Deutsche Marks per 500 grams. If distribution costs and other production costs are taken into account, this estimated cost is very plausible.

5 Analysis of Cost Pass-Through into Retail Prices

The estimation of the structural demand and cost parameters allows to investigate the role of non linear pricing on explaining incomplete pass-through via counterfactual policy experiments. Let's present first the method used to simulate these counterfactual policy experiments and then discuss the particular policies and simulation considered.

We consider the preferred pricing equilibrium according to our data to estimate a vector of marginal costs of production and distribution. We denote $C_t = (C_{1t}, .., C_{jt}, .., C_{Jt})$ the vector of these marginal costs for all products present at time t, where C_{jt} is obtained by

$$C_{jt} = p_{jt} - \Gamma_{jt} - \gamma_{jt}.$$

Then, given these marginal costs and the other estimated structural parameters, one can simulate the policy experiments of interest. Thus, let's consider the policy experiment where manufacturers and retailers relationships change. Then we have to change the equilibrium equation and solve

$$\min_{\{p_{jt}^*\}_{j=1,..,J}} \|p_t^* - \Gamma_t(p_t^*) - \gamma_t(p_t^*) - C_t\|,$$

[11] This corresponds to model 5 in Table A.3. in the Appendix. Table A.3. shows the results from the non nested test statistics. Recall that for a 5% size of test, the assumption that the two non-nested models are asymptotically equivalent is rejected in favor of the assumption that the model in column is asymptotically better than the model in row if the test statistic is lower than the critical value -1.64. In the same way, the assumption that the two non-nested models are asymptotically equivalent is rejected in favor of the assumption that the model in row is asymptotically better than the model in column if the test statistic is higher than the critical value 1.64.

where $\|.\|$ is a norm of $\mathbb{R}^J$. In practice we will take the euclidean norm in $\mathbb{R}^J$ and the formula of γ_t and Γ_t correspond respectively to the expression of the margins of the supply model simulated.

For the simulation of the upstream cost shock λ, for instance we use $\lambda = 1.1$ for an increase of 10% of the total production and distribution marginal cost, and equilibrium prices are deduced from the following minimization program

$$\min_{\{p_{jt}^*\}_{j=1,..,J}} \|p_t^* - \Gamma_t(p_t^*) - \gamma_t(p_t^*) - \lambda \times C_t\|.$$

It has to be noted that, whatever the model simulated, equilibrium prices depend only on total marginal cost. Thus, the effect of production or distribution cost shocks that result in the same total marginal cost will always be the same.

5.1 The Role of Non Linear Pricing and Vertical Restraints on Pass-Through

Table 2 shows percent retail price changes from a proportional cost shocks of 10%. Each column reports percent price changes under different supply models of vertical restraints. Along each column of Table 2 we report the simulated average percent retail price changes in the first row, then the changes broken up by brand in the next block of rows, and in the bottom of the table the retail price percent changes broken up by retailer. The first column of Table 2 corresponds to the model where double marginalization along the distribution chain is present, or under linear pricing. Then columns 2 until 5 report price changes under models considering different types of vertical restraints. In columns 2 and 3 the firms decide pricing without RPM restrictions, and thus both columns are labeled WRPM, while columns 4 and 5 consider that there are RPM restrictions. We also consider the distinction between uniform wholesale pricing and no uniform wholesale pricing, and we label columns 2 and 4 as corresponding to Uniform Pricing cases, while columns 3 and 5 are not. We also have to note that, on average, a cost shock of 10% on total marginal cost corresponds to a cost shock of 12% on the coffee commodity price because commodity coffee cost represents roughly 5/6 of total marginal costs.

Our objective is to compare each column with another column and interpret the differential retail price change as the result of adding or eliminating vertical restraints. First, we find that the uniform pricing restriction has no impact on the pass-through, as can be seen by comparing columns 4 and 5 (for RPM) or without RPM by comparing columns 2 and 3 (for WRPM), since they don't have statistically different mean pass-through into retail prices. Second, looking at averages we can see that for the linear pricing model (column 1) and for the non linear pricing without resale price maintenance the simulated retail prices change less, namely by 7.14% and 7.00% respectively. We can also note that non linear pricing contracts have a significant but small negative effect (-0.14%) on pass-through relative to linear pricing. Third, the simulated results show in columns 4 and 5 that two-part tariffs contracts with resale price maintenance lead to a larger pass-through, as a 10% cost shock has an effect of an average 8.20% increase on retail prices, regardless of whether wholesale uniform pricing is imposed. The fourth column's preferred model has the same effects as in the fifth column, as previously mentioned, as wholesale price discrimination related restraints add little to explaining pass-through. Taken together, these results would suggest that the vertical restraint in the form of resale price maintenance, increases the percent retail pass-through of a ten percent cost shock by more than one percentage point relative to the case when this vertical restraint is not allowed in non linear pricing contracts or when double marginalization along the distribution chain is present. This can be seen by comparing the last two columns with the first three of Table 2. The intuition of such a result is that without resale price maintenance, the double marginalization problem remains and implies that the manufacturers cannot price at the "monopoly" level. They thus have to set lower prices and obtain lower margins because they cannot collect the full variable profit. Therefore our result that non linear contracts without RPM would imply a lower pass-through of a cost shock than with RPM seems consistent.

We interpret the differential response of retail prices across cases as a measure of the overall impact of the possibility of vertical restraint on the capability of transmitting upstream supply shocks. The contribution of these contracts in increasing pass-through is between 1.2% for the brand Melitta and 0.95% for the brand Tchibo.

In terms of the magnitude of pass-through estimates we find evidence of incomplete but much larger rates of pass-through than the previous literature on the coffee category, such as the reduced form approach in Leibtag et al. (2008) and the dynamic approach of Nakamura (2007), that find a pass-through rate estimates of 0.30. We do estimate a larger rate, in the order of $0.71 = 7.14/10$ for WRPM and $0.82 = 8.2/10$ for RPM. According to the simulated results shown in columns 4 or 5, two-part tariffs contracts with resale price maintenance lead to incomplete pass-through, as a 10% cost shock has an effect of an average 8.20% increase on retail prices, regardless of whether wholesale uniform pricing is imposed. The difference can be due to several factors, for instance, while our demand elasticity is 5 percent, quite elastic, the estimates of demand elasticity for coffee in the U.S. are much smaller according to previous studies, and thus are consistent with a much lower pass-through rate into retail prices[12]. As a preview, we perform in the next subsection some alternative scenarios where we decrease demand elasticity closer to U.S. levels and indeed obtain much smaller retail pass-through rates. The difference in pass-through rate can be also due to the concentration of the market. The US coffee market is highly concentrated with respect to the German market. Indeed, the two main manufacturers in the US market have a market share of 38 and 33 percent by volume respectively from 2000 to 2004. The pass-through rate is then larger for the less concentrated German coffee market.

[12]We found studies using data for the 1980s and 1990s, that estimate demand elasticities for coffee in the U.S. around 2 and 4 percent, such as Bell et al. (1999), Chiang (1991), Krishnamurthi and Paj (1998), and Nakamura (2007).

	LP	NLP WRPM Uniform Pricing	NLP WRPM	NLP RPM Uniform Pricing	NLP RPM
Average	7.14 (0.40)	7.00 (0.40)	7.00 (0.46)	8.20 (0.32)	8.20 (0.33)
Brands					
Jacobs	7.02 (0.34)	6.91 (0.32)	6.84 (0.76)	8.08 (0.28)	8.08 (0.28)
Onko	6.74 (0.40)	6.59 (0.39)	6.53 (0.77)	7.78 (0.33)	7.85 (0.34)
Melitta	6.85 (0.32)	6.69 (0.32)	6.62 (0.74)	8.04 (0.23)	8.04 (0.24)
Idee	7.52 (0.23)	7.36 (0.23)	8.00 (1.02)	8.55 (0.15)	8.56 (0.16)
Dallmayr	7.37 (0.28)	7.22 (0.27)	7.55 (0.82)	8.42 (0.17)	8.43 (0.18)
Tchibo	7.40 (0.16)	7.30 (0.17)	7.23 (0.74)	8.35 (0.12)	8.35 (0.12)
Eduscho	7.07 (0.25)	6.95 (0.25)	6.88 (0.74)	8.11 (0.19)	8.11 (0.19)
Retailer					
Edeka	7.13 (0.37)	6.99 (0.38)	6.92 (0.79)	8.18 (0.31)	8.18 (0.31)
Markant	7.03 (0.41)	6.90 (0.41)	6.83 (0.80)	8.14 (0.32)	8.14 (0.33)
Metro	7.15 (0.43)	7.03 (0.41)	6.96 (0.81)	8.23 (0.34)	8.24 (034)
Rewe	7.24 (0.36)	7.09 (0.37)	7.66 (0.99)	8.25 (0.29)	8.25 (0.30)

Table 2. The Role of Non Linear Pricing and Vertical Restraints on Pass-Through.

While we now have an idea of the non trivial role of non linear pricing contracts or vertical restraints in varying pass-through for this German coffee market, we want to investigate the contribution on RPM contracts under alternative demand and supply scenarios. We do this in the next subsection.

5.2 The Role of Non Linear Pricing on Pass-through under Alternative Scenarios

In this last subsection we aim at identifying some of the potential reasons as to why non linear pricing contracts and vertical restraints affect or not pass-through and, in doing so, derive implications beyond the market at hand. We start by investigating the role of non linear contracts and vertical restraints for several different degrees of market power and results are reported in Table 3.

Case		pre-merger	post-merger	post-merger	post-merger
Average elasticity		-5	-5	-4	-3
LP	$\%\Delta p$	7.43 (0.71)	7.14 (0.40)	6.69 (0.44)	6.11 (0.59)
	Rate	0.74 (0.07)	0.71 (0.04)	0.67 (0.04)	0.61 (0.06)
NLP WRPM	$\%\Delta p$	7.14 (0.61)	7.00 (0.46)	6.57 (0.49)	6.01 (0.50)
	Rate	0.71 (0.06)	0.70 (0.05)	0.66 (0.05)	0.60 (0.05)
NLP RPM	$\%\Delta p$	8.72 (0.85)	8.20 (0.32)	7.87 (0.36)	7.37 (0.42)
	Rate	0.87 (0.09)	0.82 (0.03)	0.79 (0.04)	0.74 (0.04)

Table 3. Pass-Through from Cost Shock of 10% under Alternative Scenarios

The first row of Table 3 reports simulated retail price changes due to a ten percent cost shock and the second row the corresponding pass-through rate for the linear pricing (LP) model. The third and forth rows represent the percent change and rate of change, respectively, for the non linear pricing model without resale price maintenance (WRPM) and the bottom two rows present the change of retail prices and the pass-through rate for the non linear pricing (NLP) model with resale price maintenance (RPM). In the first column of Table 3 we simulate pass-through rates for a supply case where the manufacturer market is more competitive than in reality. We do this by simulating prices as if the brands Jacobs and Onko, and Tchibo and Eduscho were all produced by independent firms. This corresponds to the market situation before the two mergers in the 1990's and we label this column the "pre-merger" case. For this scenario we keep the underlying demand model that corresponds to an average demand elasticity of 5. The second column corresponds to the Table 2 results, where the elasticity is 5 and the firms have merged. Columns 3 and 4 have the firms already merged but decrease demand elasticity in absolute value from 5 to 4 and 3, respectively. The change of the average elasticity which is estimated to be around 5 is done by changing directly the parameter β in the demand model without changing other parameters. This is a simple modification which, after empirical checks, happen to change almost proportionately all own and cross price elasticities of product such that when decreasing the average own price elasticity from 5 to 4 or 5 to 3 by decreasing β, cross price elasticities also decrease. Indeed the range of cross price elasticities is [0.14 ;0.17] when the average own price elasticity of -5, it is [0.10 ;0.12] when own price elasticity is on average -4 and [0.7 ;0.9] when it is -3. Thus, there is no discrepancy on their effect on competition between own and cross price elasticities when changing β.

Going from left to right the market is becoming less and less competitive and thus our pass-through rates should decrease when the firms face the same ten percent cost shock. This is the theoretical prediction in Bettendorf and Verboven (2000) where they show that markup absorption is more important in oligopolies than competitive markets and that as consumers become less price elastic, pass-through will be less incomplete. We do indeed provide consistent evidence of this to be the case. For the linear pricing model (along row LP, from left to right) retail price changes go from 7.3% in the pre-merger case and with a very elastic demand (Elasticity=5%) down to 6.11% in the least competitive scenario of merged firms and demand elasticity of 3%. The same pattern occurs in the NLP rows, as pass-through rates decrease from 71% to 60% and from 87% to 74% without RPM and with RPM, respectively. The point estimates of the difference between LP and NLP with RPM point to the following economic force: the contribution of the RPM in increasing pass-through rates is larger the bigger market power in the market (or the smaller elasticities). This is the case as the point estimates from the second to the fourth column of Table 3 increase as the demand elasticity decreases[13]. Interestingly, the larger manufacturer collusion, column 1 to column 2, the smaller the effect of RPM in explaining the drop in pass-through.

Case		pre-merger	post-merger	post-merger	post-merger
Average elasticity		-5	-5	-4	-3
LP	$\%\Delta p$	56.41 (5.44)	54.15 (2.95)	50.88 (5.71)	46.77 (5.35)
	Rate	0.75 (0.07)	0.72 (0.04)	0.68 (0.08)	0.63 (0.07)
NLP WRPM	$\%\Delta p$	54.78 (4.25)	53.62 (2.91)	50.17 (5.25)	46.20 (3.90)
	Rate	0.73 (0.06)	0.71 (0.04)	0.67 (0.07)	0.62 (0.06)
NLP RPM	$\%\Delta p$	65.83 (6.09)	62.28 (2.17)	59.74 (2.53)	56.04 (3.12)
	Rate	0.88 (0.08)	0.83 (0.03)	0.80 (0.03)	0.75 (0.04)

Table 4. Pass-Through from Cost Shock of 75% under Alternative Scenarios

Finally, we also consider the role of the non linear contracts and vertical restraints on pass-through depending on the size of the upstream cost shock. Those results are reported

[13] All contributions of the resale price maintenance assumption in Table 3 are statistically and significantly different from each other according to the mean comparison test.

in Table 4 which is organized in the same fashion as Table 3. We simulate a cost shock of 75% on total marginal cost which is equivalent to a cost shock of 90% on coffee commodity price. The magnitude of this shock is motivated by the fact that raw commodity coffee prices have outside our sample time period indeed exhibited such large fluctuations, mostly driven by weather conditions in coffee-producing countries. For instance, during the year of drought in 1985 in Brazil this almost doubled the raw coffee price.

The results show a similar story as before in terms of the role of market power in affecting pass-through rates for each model separately. We find that the lower demand elasticity, the lower the pass-through rate in the LP model, dropping from 0.75 to 0.63. Interestingly, the drop is slightly lower for the NLP model without RPM, from 0.73 to 0.62. For the NLP model with RPM, we find a decrease from 0.88 to 0.75. When comparing the rates in Table 3 to the rates in Table 4, we find that lower cost shocks lead to significant lower point estimates of pass-through rates than for higher cost shocks. Thus pass-through rates are not always the same for different cost shocks in this analysis. Finally, once again the contribution of vertical restraints such as RPM is increasing the less elastic demand becomes, as the rate difference point estimates (performed along each column) increase from 0.11 to 0.13. As upstream market power increases, comparing column 1 with column 2 for each row separately, this is associated with lower pass-through rates: 0.75 to 0.72 in LP, 0.73 to 0.71 in NLP without RPM and 0.88 to 0.83 in NLP with RPM, however, the contribution of resale price maintenance decreases with upstream market power as the point estimate of the rate difference drops from 0.15 to 0.12.

6 Conclusions and Implications

This paper consider the implications of the firms using non-linear pricing and vertical restraints such as resale price maintenance or wholesale price discrimination in the ability to make strategic mark-up adjustments when faced with upstream cost shocks. For markets such as coffee, where the raw commodity prices is a fairly substantial component of costs of production and that suffers large price fluctuations, this is an important question to investigate. We use a structural model approach to investigate the role of non linear pricing contracts and vertical restraints in affecting the way firms along a distribution chain are able to adjust to upstream cost shocks.

We find that the resale price maintenance assumption has a role in explaining why pass-through is larger in this market when compared to linear pricing. Taking the results beyond this market, we find that when upstream cost shocks hit the markets with higher market power then the retail pass through decreases. As firms' ability to adjust mark-ups is restricted by resale price maintenance assumption, the larger market power in the market, there is a force towards resale price maintenance assumption becoming increasingly important in affecting the degree of pass-through. Next, while more upstream market power leads to overall lower pass-through, the contribution of resale price maintenance assumption becomes less important. Finally, the larger the simulated cost shocks, the higher the pass-through increases.

While our model is static, one extension of the present paper is to consider dynamic issues (as in Nakamura, 2007, and Norton 2008) while modeling explicitly the vertical pricing negotiations. Nakamura (2007), for the coffee market, and Noton (2008), for the automobile market, take the static approach started in Goldberg and Verboven (2001) and Hellerstein (2008) one step further to tackle the role of price adjustment (menu) costs, to explain price movements. For the coffee market, Nakamura (2007) finds that only two percent of the incomplete pass-through of cost shocks in the U.S. can be explained by the existence of menu costs and the most relevant factors responsible for the incomplete pass-through are static: local costs and markup adjustments. While comforting to our approach that according to Nakamura (2007) dynamic factors did contribute the least to explaining the phenomenon, we acknowledge that considering a static approach is a limitation. However, one limitation of Nakamura (2007) and Noton (2008) is that they abstract from vertical strategic behavior of sequential firms, by specifying a reduced form vertical pricing rule, leaving to future work combining both dynamic and strategic pricing into the model.

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A Details on Non Linear Contracts Considered in Model Selection

Here we consider that manufacturers and retailers can use non linear contracts when wholesale price discrimination is allowed as in Bonnet and Dubois (2009) and we refer the reader to this reference for more details, as what follows is a brief derivation.

In the case of these two part tariffs contracts, the profit function of retailer r is

$$\Pi^r = \sum_{j \in S_r} [M(p_j - w_j - c_j)s_j(p) - F_j]$$

and the profit function of firm f is equal to

$$\Pi^f = \sum_{k \in S_f} [M(w_k - \mu_k)s_k(p) + F_k].$$

We will assume like in the case of wholesale uniform pricing that manufacturer f chooses the terms of the contracts in order to maximize profits Π^f subject to the following retailers' participation constraints (9). As in the wholesale uniform pricing case, constraints are binding. Therefore the profit of each firm f can be re-written and its expression is the following one

$$\max_{\{p_k\} \in F_f} \sum_{k \in S_f} (p_k - \mu_k - c_k)s_k(p) + \sum_{k \notin S_f} (p_k - w_k - c_k)s_k(p).$$

In the case where resale price maintenance is allowed, the set of first order conditions in matrix notation for manufacturer f are

$$I_f S_p \gamma + I_f s(p) + I_f S_p I_f \Gamma_f = 0. \tag{18}$$

Again there is an identification problem because Γ and γ are unknown and we need additional restrictions to get identification. As before, we assume that the wholesale margins Γ are equal to zero ($w_k^* = \mu_k$) or retail margins γ are zero ($p_k^*(w_k^*) - w_k^* - c_k = 0$). First, when $w_k^* = \mu_k$, the expression (18) can be re-written stacking all the first order conditions

$$I_f S_p \gamma + I_f s(p) = 0.$$

This expression can be simplified to the case where the total profit of the integrated industry are maximized (Rey and Vergé, 2004)

$$\gamma = S_p^{-1} s(p).$$

Second, when $p_k^*(w_k^*) - w_k^* - c_k = 0$, then (18) becomes

$$I_f s(p) + I_f S_p I_f \Gamma_f = 0$$

and we obtain this expression for the vector of wholesale margins of the manufacturer f

$$\Gamma_f = -(I_f S_p I_f)^{-1} I_f s(p).$$

In the case where resale price maintenance is not allowed, the total price cost margin deduced from the first order conditions of the manufacturers maximization program is such that for all $f = 1, .., F$ (Bonnet and Dubois, 2009) we get

$$\gamma_f + \Gamma_f = (I_f P_w S_p I_f)^{-1} \left[-I_f P_w s(p) - I_f P_w S_p (I - I_f) \gamma\right] \tag{19}$$

where γ is the vector of all retailers margins deduced from the expression (4).

	Prices	std p	Shares	Promotion	Advertising
Retailer Edeka					
Jacobs	6.815	0.325	30.359	1.277	2.335
Onko	5.980	0.564	8.547	1.057	0.224
Melitta	6.241	0.320	12.706	1.018	1.776
Idee	8.008	0.638	4.989	0.726	0.302
Dallmayr	7.314	0.421	15.820	1.166	1.618
Tchibo	7.893	0.422	17.951	0.661	1.640
Eduscho	6.960	0.499	9.628	0.932	1.465
Retailer Markant					
Jacobs	6.537	0.523	30.619	1.024	2.335
Onko	5.978	0.541	7.306	1.033	0.224
Melitta	5.965	0.440	19.581	1.290	1.776
Idee	7.779	0.697	3.709	0.783	0.302
Dallmayr	7.304	0.491	12.248	0.939	1.618
Tchibo	7.826	0.446	15.845	0.684	1.640
Eduscho	6.916	0.553	10.692	0.904	1.465
Retailer Metro					
Jacobs	7.093	0.724	27.485	0.921	2.335
Onko	6.557	0.808	10.172	0.577	0.224
Melitta	6.669	0.808	23.375	0.857	1.776
Idee	8.093	0.930	3.735	0.536	0.302
Dallmayr	7.818	0.666	11.091	0.710	1.618
Tchibo	7.738	0.512	11.841	0.694	1.640
Eduscho	6.958	0.603	12.301	0.910	1.465
Retailer Rewe					
Jacobs	7.039	0.537	23.350	0.688	2.335
Onko	6.296	0.397	7.157	0.578	0.224
Melitta	6.565	0.392	15.892	0.863	1.776
Idee	8.279	0.480	2.812	0.410	0.302
Dallmayr	8.109	0.817	7.806	0.448	1.618
Tchibo	7.912	0.444	28.434	1.025	1.640
Eduscho	6.919	0.528	14.549	1.134	1.465
By Retailers					
Edeka	7.017	0.721	13.528	0.866	9.360
Markant	6.769	0.829	29.072	0.991	9.360
Metro	7.117	0.864	46.697	0.805	9.360
Rewe	7.260	0.829	10.703	0.842	9.360
	Mean	Std	Max	Min	Std/Mean (in %)
Raw Coffee Price	4.482	0.779			

Table A.1. Summary Statistics for the 28 Products in the Sample and Raw Coffee Prices.

The mean of the variables in the data is reported. Prices are in Deutsch Marks per 500 grams, Quantity in units sold of 500 grams, and Advertising in Million Euros. Source: MADAKOM, Germany. Raw Coffee Prices are from the New York Stock Exchange.

	Supply models	Price-Cost Margins (% of retail price p) Mean	Std.
Model 1	Linear Pricing (Double Marginalization)		
	Retailers	17.49	2.61
	Manufacturers	17.51	6.38
	Total	35.00	7.84
	No uniform pricing		
	Two part Tariffs with RPM		
Model 2	Manufacturer Marginal cost pricing ($w = \mu$)	18.56	2.76
Model 3	Zero retail margin ($p = w + c$)	17.48	2.69
	Two-part Tariffs without RPM		
Model 4	Retailers	18.51	2.83
	Manufacturers	17.49	2.61
	Total	36.00	5.40
	Uniform pricing		
	Two part Tariffs with RPM		
Model 5	Manufacturer Marginal cost pricing ($p = w + c$)	17.53	2.66
	Two-part Tariffs without RPM		
Model 6	Retailers	18.51	2.74
	Manufacturers	17.51	6.38
	Total	36.00	5.34

Table A.2.: Estimated Price-Cost Margins.

╲	H_2				
H_1	2	3	4	**5**	6
1	-2.87	-2.84	–2.77	**-2.94**	-2.84
2		29.89	6.23	**-33.54**	29.91
3			4.33	**-33.20**	-11.93
4				**-9.69**	–4.53
5					**33.37**

Table A.3.: Non Nested Tests (Rivers and Vuong, 2002).