# Price Regulation and Competition in Japanese Pharmaceutical Market

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## Abstract

Pharmaceutical price control has achieved attentions of policy makers in the world. Japanese pharmaceutical market provides a good case study for price control. First, the Japanese pharmaceutical market has been tightly regulated by price control. Second, the difference between the official price for the National Health Insurance purpose and the wholesale price is expected to distort demand and supply of pharmaceuticals. This paper studies Japanese pharmaceutical price control by using data on 39 cardiovascular pharmaceuticals in the period between 1985 and 1999.

We estimate a relationship how demand is determined by official price, wholesale price, and other variables. This study finds that pharmaceuticals have fairly elastic coefficient with the wholesale price. This underscores importance of wholesale price reduction to gain demand. We find significant differences between new products and old products. For new products without generic entry, pharmaceutical firms tend to maintain official price as high as possible to achieve demand while they refrain from lowering wholesale price. For old products with generic competition, pharmaceutical firms resort to wholesale price competition. The government should distinguish old products from new products in its price control. This study also finds that product specific effects are more important than price related variables in determining pharmaceutical demand. Finally, this study finds that product specific effects have declined as products gets old up to 15 years after introduction. Then product specific effects start to increase after 15 years, which fact shows generic competition has not been fully realized in Japanese market.

JEL Classification: L11, L51, L65
Key Words: price regulation, pharmaceutical, Japan

## 1.Introduction

Pharmaceutical price has been a central policy issue in various countries. The United States is an only country that has no formal price control among OECD countries. The increase in pharmaceuticals prices in the 1990s, however, has raised a question to introduce pharmaceutical price control. Series of proposals are presented to constrain pharmaceutical prices. European countries have long adopted pharmaceutical price control. For example, Germany introduced price control in 1989, in which the government sets maximum listed price for reimbursement purpose. Pharmaceutical price has been an issue for developing countries. Asian and African countries, currently faced with the AIDS breakout, have attempted to reduce price of AIDS treatment by encouraging new entry of generic products.

Large-scale pharmaceuticals firms are opposed to price control. Various firms and trade associations like PhRMA (Pharmaceutical Research and Manufacturers Association) and JPMA (Japan Pharmaceutical Manufacturers Association) have frequently expressed views against pharmaceutical price control. Their contentions are summarized as follows. First, pharmaceuticals are cost effective options for health care compared with services of physicians. Second, price control does not necessarily lower pharmaceutical prices. Third, price control reduces economic returns from innovative products, which prevents pharmaceutical firms from conducting research and development. These views are supported by empirical studies. For example, Lichtenberg (1996) supported the first view by showing that decline of the mortality in the U.S. is achieved by use of pharmaceuticals. He estimated that every dollar spent on pharmaceuticals is associated with a $ 4 decline in fees for hospital services. Danzon et al. (2000) supported the second view by exhibiting that pharmaceutical price level of the United States without price control is not higher than other countries with price control. They concluded that international comparisons would differ significantly by method of means (arithmetic/geometric), by sample of pharmaceuticals for comparisons. The third view is supported by anecdotal evidence that countries with price control like France, Germany, and Japan are inferior in developing innovative products to the U.S. that does not adopt price control.

In order to evaluate price control, one needs to examine how demand for an individual pharmaceutical is determined by price competition. Series of studies are conducted using U.S. data. For instance, Berndt et al. (1997) studied a relationship between price and quantity of anti-ulcer products. Ellsion et al.(1997) examined cephalosporins. However these studies are focusing on the U.S. market, and studies on other countries with price control are very limited in numbers.

Japanese pharmaceutical market could provide an interesting case study because of the following properties. First, nation-wide public health insurance has ensured almost all Japanese to access to wide range of pharmaceuticals with payment of a fraction of pharmaceutical price. Second, the government has long regulated the "official prices" of pharmaceuticals for public health insurance purposes. The government has set official prices for all products depending on brands, forms, and dosages. For products newly introduced in market, the government determines official prices based on costs including R&D expenses or a comparison with similar products. For existing products, the government regularly updates official prices using average price information on wholesale prices. Third, the government has left wholesale prices unregulated. Transactions between pharmaceutical firms and wholesalers, and those between wholesalers and hospitals/pharmacies are subject to market competition without the government intervention. Wholesale prices have declined overtime because wholesalers are engaged in price competition to increase sales. The difference between official price and wholesale price is earned by hospitals or pharmacies as its income. This difference has significantly distorted demand for pharmaceuticals. Fourth, Japanese government has reduced official price more than twenty years reflecting steadily declining wholesale prices.

Several research questions are raised on Japanese pharmaceutical price control. First question is how price control determines demand for individual pharmaceuticals. Second question is how pharmaceutical price regulation distorts demand and supply of pharmaceuticals. Third question is how income distribution is affected by the price regulations. This paper addresses the first two questions by estimating demand for pharmaceuticals. The rest of this paper consists of the following sections. Section 2 portrays institutional background and briefly explains structure of the Japanese pharmaceutical price regulation. Section 3 specifies a model for estimation. Section 4 summarizes empirical results. Section 5 provides concluding remarks.

## 2. Background

The National Health Insurance (NHI) plays a central role in Japanese medical services. First, the government determines designated physicians who can provide medical services and prescribe pharmaceuticals for the purpose of the NHI. Second, the government determines the official prices of medical services and pharmaceuticals. The NHI pays for specified fraction of medical expenses of patients, while the rest is borne by patients. For pharmaceuticals covered by the NHI, payment by patients ranges from 20 to 30 percent depending on types of the programs and status of the insured.

Pharmaceutical distribution consists of pharmaceutical firms, wholesalers, hospitals/pharmacies, and patients. Several different prices are distinguished for each stage of pharmaceutical distribution (Table 1). The price for transactions between pharmaceutical firms and wholesalers is "manufacturer's sales price ($P^M$)". The price for transactions between wholesalers and hospitals/pharmacies is "wholesale price or delivery price ($P$)". These two prices are market prices without price control. The benchmark of payment by the NHI and patients is the "official price ($\overline{P}$)." Under the NHI system, the official price of pharmaceuticals usually exceeds the wholesale price because wholesalers compete each other by lowering wholesale prices. The price difference ($\overline{P}-P$) is called as "*Yakkasa*" in Japanese and has played a significant role in pharmaceutical market. Hospitals and pharmacies can earn the price difference as their income. Because interests of physicians are sometimes directly tied to income of hospitals, physicians have strong incentive to prescribe pharmaceuticals with large price difference. On the other hand, hospitals/pharmacies demand significant discount of the whole prices. This is why wholesalers have a strong economic incentive to lower the wholesale price ($P$) to gain share.

--- Table 1. Prices and Transactions

The Japanese government is interpreted to regulate the official price of pharmaceuticals for two reasons. First, the government has attempted to reduce expenditure for pharmaceuticals. Second, the government has attempted to reduce the price difference itself. The government, however, seldom articulates the reasons behind the reduction of official prices. Instead, the government sets formula for updating the official price by equating it with wholesale price.

The government regulates the official price in a following method. For new pharmaceuticals, the official price ($\overline{P}$) has been determined either by a comparison with similar pharmaceuticals or by cost estimates including production and R&D expense. For existing pharmaceuticals, the official price has been determined by the wholesale price (*P*) as a benchmark. Because the wholesale prices differ significantly with transactions and hospitals/pharmacies, the Japanese government conducts a nation-wide survey of wholesale prices. The government updates new official price by applying the special formula to the mean wholesale price. For example, in 1992 the government adopted the formula called "reasonable zone method" as shown in (1).

$$\overline{P}_t = P_{t-1}(1+u_t) + R_t \cdot (\overline{P}_{t-1} - P_{t-1}) \qquad (1)$$

The rate of $R_t$ was initially set 0.15 in 1992 fiscal year and was scheduled to decline gradually for updates. As of 2000, $R_t$ declined to 0.02 for most pharmaceuticals. Consumption tax $u_t$ is 0.03 up to 1994, and 0.05 after 1995. The Japanese price regulations affect income of participants. The price difference is source of income for hospitals and pharmacies. Because the government allows hospital and pharmacies to earn the price difference as their income, hospitals and pharmacies demand wholesalers to lower the wholesale prices. Economic loss of wholesalers due to price competition is compensated through rebates provided by pharmaceutical firms. Thus a combination of pharmaceutical firms, wholesalers, hospitals/physicians, and the National Health Insurance has established the long-run decline of pharmaceuticals, which fact is quite unique from the experiences of other countries.

**3. Model**

The demand of pharmaceutical *h* at *t-th* period ($q_{ht}$) is specified as a function of the official price ($\overline{P}$) and the wholesale price ($P$). It is also a function of the official prices and wholesale prices of competitors ($\overline{P}^C$) and ($P^C$). Determinants other than price variables are captured by *K*.

$$q_{ht} = k_{ht}\left[\overline{P}_{ht}\right]^a (p_{ht})^b \left[\overline{P}^C_{ht}\right]^g (p_{ht}{}^C)^d \qquad (2)$$

$$q_{ht} = k_{ht}\left[\frac{\overline{P}_{ht}}{P_{ht}}\right]^a (p_{ht})^b \left[\frac{\overline{P}^C_{ht}}{P^C_{ht}}\right]^g (p_{ht}{}^C)^d \qquad (2)'$$

$q_{ht}$ : demand for *h* product at *t*-th period in "patients days".

$\overline{P}$ : official price (self) in real term

$P$ : wholesale price (self) in real tem

$\overline{P}^C$ : official price of competitors (benchmark) in real term

$P^C$ : wholesale price of competitors (benchmark) in real term

" : price elasticity with respect to the official price (self)

$ : price elasticity with respect to the wholesale price (self)

( : price elasticity with respect to the official price (benchmark)

* : price elasticity with respect to the wholesale price (benchmark)

k : Effects other than prices

The estimate of " is expected to be both positive and negative, $ is negative value. When competitors have effects on demand, ( and 0 need to have significant values. Equation (2) can be rewritten into (2)' by using the ratio of official and wholesale prices. The equation implicitly assumes that physicians behave as agents for patients as well as agents for hospitals/pharmacies. When physicians behave as agents of hospitals/pharmacies, their prescriptions depend both on the official prices and the wholesale prices. When physicians behave as agents for patients, their prescriptions do not depend on the wholesale prices but on the official prices. The expected effects are summarized in Table 2.

---- Table 2. Examples of Demand Change

By taking log, equation (2) can be transformed into (3).

$$\log q_{ht} = \log k_{ht} + a(\log \overline{P}_{ht}) + b(\log P_{ht}) + g(\log \overline{P}^C_{ht}) + d(\log P^C_{ht}) \qquad (3)$$

$$\frac{\Delta q_{ht}}{q_{ht}} = \frac{\Delta k_{ht}}{k_{ht}} + a\left(\frac{\Delta \overline{P}_{ht}}{\overline{P}_{ht}}\right) + b\left(\frac{\Delta P_{ht}}{P_{ht}}\right) + g\left(\frac{\Delta \overline{P}^C_{ht}}{\overline{P}^C_{ht}}\right) + d\left(\frac{\Delta P^C_{ht}}{P^C_{ht}}\right) \qquad (4)$$

Here k represents the effects on demand other than prices. The change in k can be decomposed into the individual effects ( :$_h$) and the time effects (<$_t$) and an error (,$_{ht}$).

$$\frac{\Delta k_{ht}}{k_{ht}} = m_h + n_t + e_{ht}$$

$$\frac{\Delta q_{ht}}{q_{ht}} = a\left(\frac{\Delta \overline{P}_{ht}}{\overline{P}_{ht}}\right) + b\left(\frac{\Delta P_{ht}}{P_{ht}}\right) + g\left(\frac{\Delta \overline{P}^C_{ht}}{\overline{P}^C_{ht}}\right) + d\left(\frac{\Delta P^C_{ht}}{P^C_{ht}}\right) + m_h + n_t + e_{ht} \qquad (5)$$

We further assume that demand for benchmark product is determined in equation (6).

$$\frac{\Delta q_{jt}^{C}}{q_{jt}^{B}} = g^{C}\left(\frac{\Delta \overline{P}_{jt}^{C}}{\overline{P}_{jt}^{C}}\right) + d^{C}\left(\frac{\Delta P_{jt}^{C}}{P_{jt}^{C}}\right) + m_{j}^{C} + n_{t} + e_{jt}^{C} \quad (6)$$

$$\left(\frac{\Delta q_{ht}}{q_{ht}} - \frac{\Delta q_{jt}^{B}}{q_{jt}^{B}}\right) = a\left(\frac{\Delta \overline{P}_{ht}}{\overline{P}_{ht}}\right) + b\left(\frac{\Delta P_{ht}}{P_{ht}}\right) + (g - g_{2})\left(\frac{\Delta \overline{P}_{Bt}}{\overline{P}_{Bt}}\right) + (d - d_{2})\left(\frac{\Delta P_{Bt}}{P_{Bt}}\right) + (m_{ht} - m_{jt}^{B}) + (e_{ht} - e_{Bt}) \quad (7)$$

For notational convenience, equation (5) is expressed as in equation (6).

$$Q_{ht} = \left(\frac{\Delta q_{ht}}{q_{ht}} - \frac{\Delta q_{jt}^{B}}{q_{jt}^{B}}\right) = \sum_{i} l_{i}\left(\frac{\Delta X_{ht}}{X_{ht}}\right) + (m_{h} - m_{j}^{Bt}) + (e_{ht} - e_{jt}) \quad (8)$$

Equation (8) is our fundamental equation for estimation. There are several drawbacks in this specification. First, this does not depend on any demand theory to derive the equation. Neither income nor insurance is explicitly introduced as a determinant of demand. Second, conditions of supply are not introduced. The pharmaceuticals are supplied by pharmaceutical firms, which constitute oligopoly in supply of particular pharmaceutical. Third, there is an endogenous relationship between the wholesale price and demand for pharmaceutical. This study uses strength of a standard usage per patient day as a unit of price and quantity.

$$Q_{ht} - \overline{Q_{h.}} = \sum_{i} l_{i}\left(\left(\frac{\Delta X_{ht}}{X_{ht}}\right) - \left(\overline{\frac{\Delta X_{h.}}{X_{h.}}}\right)\right) + (e_{ht} - e_{jt}^{C}) - (\overline{e_{h..}} - \overline{e_{j}^{B}}) \quad (9)$$

$$\overline{m}_{h} - \overline{m}_{j} = \overline{Q_{h.}} - \sum_{i} \overline{l}_{i}\left(\overline{\frac{\Delta X_{h.}}{X_{h.}}}\right) \quad (10)$$

The long bar above each variable represents the mean over time periods for each h. The fixed effects of $\overline{m}_h$ is the individual-specific effects on demand. This study estimates equation (9) by using instrumental variable method.

### 3. Data

This study uses cardiovascular pharmaceuticals. The wholesale price is not obtained directly from the sources because the data is proprietary. This study uses the data on the secondary market data listed in Kokusai Syogyo Syuppan's "*Kokusai Iyakuhin Jyoho*" (biweekly). The pharmaceuticals at the secondary market are transacted between hospitals. There are some hospitals with excess supply of pharmaceuticals. Other firms need extra pharmaceuticals with discounts. The supply and demand created the secondary market through the network of specialized wholesalers. The list prices might reflect the demand and supply of pharmaceuticals. The secondary market transacts only popular products. So not all prices are available. This study uses the price list around every

June. Sales data are taken from "Kokusai-Iyakuhin-Jyoho" for calendar year. The original data of the sale is taken from corporate hearing or from the corporate press release. Prices and sales data, however, do not have long time periods. So I choose the sample when prices and sales data are available for more than 4 consecutive years. To use only popular pharmaceuticals, sales should exceed at least once in the sample periods. In sum, 39 pharmaceuticals are identified and a part of 1985-1999 data constitutes unbalanced panel. The official prices are obtained from "Yakka-kijyun Ten-su Hayami-Hyo". To construct the unit prices for a pharmaceutical as a patient day, this study uses the standard formula, strength, and quantity. The quantity is derived as at the sales divided by the prices.

**4. Results**

a. Price Effects

Table 3 summarizes the results. Model 1 indicates that the elasticity with the official price is 0.805 (significant at 5 percent) and with the wholesale price is –1.132 (significant at 1 percent). What is obvious is that reduction of the self-wholesale price would increase demand. These results confirm that pharmaceutical firms can increase demand by lowering the wholesale price while maintaining the official price as high as possible. Also these results suggest that physicians prescribe pharmaceuticals as agents for hospitals/pharmacies instead of agents for patients.

Sample of pharmaceuticals are divided into two depending on years at market. Model 2 uses a sample of only old products and Model 3 uses that of new products. Pharmaceuticals marketed more than 12 years are classified as old products and less than 12 years are classified new. We find the significant difference in two groups. Model 2 exhibits that demand for old products are more sensitive to the decline of the wholesale price. Elasticity of self wholesale piece is –1.204, which exceed unity in absolute value. This indicates that pharmaceutical firms are engaged in fierce price competition by lowering wholesale prices. Model 3 indicates demand for pharmaceuticals are both determined by self-official price is 1.593 and self-wholesale price is -1.103. These results indicate that pharmaceutical firms have strong incentive to maintain the official prices high as possible. Because the absolute value 1.103 is lower than 1.251, pharmaceutical firms find no reason to participate in price competition by lowering wholesale prices. They can increase sales when they maintain the official price high as possible. We can conclude that price competition would occur among old products.

Model 4 uses products with generics while Model 5 uses products without generics. This study uses two criteria to divide sample into products with generic competition and without. Products with generic competition are defined as follows. First product has generics. Second the ratio of the official price with the wholesale price should be lower than 0.95. Products without generic competition are defined as they do not have generics or products whose ratio above is higher than 0.95. Products with generic competition have lower elasticity in absolute value with respect to self-wholesale price. Products with generic competition has coefficient –1.294.

This paper estimates price elasticity of the official price and wholesale price separately. Previous studies use the price difference instead (Onda and Sato, 2002, Nanbu and Shimada, 2000). Our results indicate that coefficients of the official price and wholesale price are not equal in absolute value, which fact implies that we have to estimate separately.

**b. Product Specific Effects**

A surprising result is that price variables have limited explanatory power. For example, Model 1 indicates 54.8 percent is explained by the price related variables, while 45.2 percent is not explained by them. We can infer that product specific effects might account for the remaining variation. So this study weighs the product specific effects by equation (10). Figure 1 summarizes the product specific effects. There are wide variances of product specific effects across pharmaceuticals. Upper half products above "Lipovas" are pharmaceuticals without generic competition, while lower half below "Carvisken" are those with generic competitions.

Own price effects are constructed are estimated change in demand due to the official price and wholesale price. Pharmaceuticals without generic competition have increased demand rapidly mostly by positive product specific effects. Own price effects have negative effects because the reduction of official price affects demand negatively. On the contrary, most pharmaceuticals with generic competition suffer from decrease in demand. Their product specific effects are much smaller than those of pharmaceuticals without generic competition. Still negative effects are alleviated by own price effects, which are achieved by lowering wholesale prices.

What does constitute the product specific effects? They are not time varying effects but individual varying effects. The examples of time varying effect are the technological progress, demographic structure, and therapeutic structure, all of which vary with time periods. On the other hand, the product specific effects are time invariant effects. Attributes of products including quality, efficacy, and safety are all considered to be product specific effects. Furthermore the effects of brands, monopoly power, and exclusivity also constitute product specific effects. In practice, we cannot clearly distinguish product specific effects from price effects because price variables accommodate certain information on product specific effects. For example, the government sets the official price by taking product specific characteristics into account. So we have to interpret product specific effects are those not captured by price variables.

---Figure 1

**c. Competition with Generics**

The patent system protects economic gain of pharmaceuticals. A patentee can enjoy monopoly by selling the patented product in a specified period. The patent rights protect pharmaceutical industry, because individual product is easily imitated. When patent rights are expired after the specified period, many firms would attempt to enter the market by making the same products. They are called "generic" products in pharmaceutical industry. In the United States generic products is widely used as an alternative to products that have been protected by patents. Grabowski and Vernon (1992) study the effects of the entries of generic products in 18 pharmaceuticals. They found that average price of previously patented products continues to rise, while the average price of generics has declined to 78 percent level after one year, 65 percent level after two years. The market share of the generics has increased rapidly. The increase in prices of patented pharmaceuticals is frequently criticized. Policy makers attempt to use generics to reduce pharmaceutical expenditure.

In Japanese market generics do not have a significant market share. Then what is the relationship between the price competition and entries of generics? Figure 2 shows the relationship between the years after the market introduction of a product and product specific effects. After several years, generics are introduced into the market. So the more price competition is expected, the more years have passed since the first introduction of products. In this case, there is a negative correlation between the years after the introduction and product specific effects. Figure 2 shows that the story does not hold. From 0 to 5 years, the product specific effects have rapidly declined. But after 7 years or so, this trend has been reversed to upward. Many pharmaceuticals have sustained product specific effects even after the periods of introduction of generics. This indicates that the introduction of generics does not necessarily promote price competition in Japanese market.

--- Figure 2

**5. Conclusion**

Japanese pharmaceutical market is a unique case study for pharmaceutical price control. Our estimates of pharmaceutical demand allow following interpretations. First, for old products, pharmaceutical firms can increase sales by lowering wholesale prices, while they have no incentives to maintain official prices. This is what the government assumes for the price control. Second, for new products, pharmaceutical firms benefit from larger sales by maintaining high official price as much as possible. Pharmaceutical firms cannot increase sales by lowering the wholesale price, because demand will decline in response to lower wholesale prices of competitors. Although the distinction between old and new products is important, the government does not incorporate the differences of two products. Third, however, the official price and wholesale price are not major determinants of demand. Instead, product specific effects have larger roles of demand. The product specific effects tend to decline with years of market. This trend, however, is reversed around 15 years after they were introduced into market.

**References**


Berndt, Ernst R. Linda T.Bui, David H.Lucking-Reiley and Glen L.Urban, 1997. "The Roles of Marketing, Product Quality, and Price Competition in the Growth and Compositions of the U.S. Antiulcer Drug Industry,"in Breshnahan T, and R.Gordon ed. *The Economics of New Goods,* NBEER.

Danzon, Patricia M. and Li-Wei Chao, 2000. Cross-national price difference for pharmaceuticals: how large, and why? Jounral of Health Econommics,19,159-195.

Ellison, Sara, Fisher, Iain M. Cockburn, Zvi Griliches, and Jerry A. Hausman, 1997, Characteristics of Demand for Pharmaceutical Products: An Examination of Four Cephalosporins, Rand Journal of Economics, 28(3). 426-446.

Grabowski Henry and Vernon John. 1986. "Longer Patents for Lower Imitation Barriers: The 1984 Drug Act." *American Economic Association Papers and Proceedings,* in Viscusi W,Kip, John M. Vernon, and Joseph E. Harrington. 1995. *Economics of Regulation and Antitrus 2nd ed.* MIT Press, Cambridge MA.

Lichtenberg,Frank, 1996. "The Effects of Pharmaceutical Utilizationand Innovation on Hospitalization and Mortality," *The National Bureau of Economic Research Working Paper Series,* 5418.

Kokusai Syogyo Syuppan. (biweekly) *Kokusai Iyakuhin Jyoho*.

Nanbu, Tsuruhiko and Shimada Naoki, 2000. "Iryo Kikan no Yakuzai Konyu ni okeru Kakaku Danryokusei no Suitei," in *Iryo Keizai Kenkyu*.

Onda, Mitsuko and Sato Masayo, 2002, "Yakka Kijyun to Iyakuhin-Jyuyo" in *Iryo Keizai Kenkyu,* 5-21.

Ykugyo Jihousya (annual) *Yakka-kijyun Ten-su Hayami-Hyo*.

Table 1. Pharmaceutical Transactions and Prices

Pharmaceutical Firms

↓ ……………Manufacturer's Sales Price $P^M$

Wholesaler

↓ ……………Wholesale Price $P^W$

Hospital/Pharmacy

↓ ……………Official Price $\overline{P}$

Patients

Table 2. Examples of Demand Change

| Coefficients | Change | Doctors' Incentives |
|---|---|---|
| ″>0 | Decrease in $\overline{P}$ | Decrease |
| $<0 | Decrease in $\overline{P}$ | Increase |
| (>0 | Decrease in *P* | Increase |
| *>0 | Decrease in $\overline{P}^C$ | Increase |
| 6>0 | Decrease in $P^C$ | Decrease |

**Table 3 Results of Estimation**

$$\left(\frac{\Delta q_{ht}}{q_{ht}} - \frac{\Delta q^{B}_{jt}}{q^{B}_{jt}}\right) = a\left(\frac{\Delta \overline{P}_{ht}}{\overline{P}_{ht}}\right) + b\left(\frac{\Delta P_{ht}}{P_{ht}}\right) + (g - g_2)\left(\frac{\Delta \overline{P}_{Bt}}{\overline{P}_{Bt}}\right) + (d - d_2)\left(\frac{\Delta P_{Bt}}{P_{Bt}}\right) + (m_{ht} - m^{B}_{jt}) + (e_{ht} - e_{Bt}) \quad (7)$$

is transformed into equation (10) for estimation.

| Model | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| Sample | All Products | Old Products | New Products | With Generics | Without Generics |
| Sample Number | 260 | 122 | 138 | 132 | 128 |
| Explanatory Variables | | | | | |
| Official Price $(\Delta \overline{P}_{ht} / \overline{P}_{ht})$ | 0.805** | - 0.245 | 1.593*** | 0.213 | 1.977*** |
| | (0.320) | (0.481) | (0.423) | (0.476) | (0.387) |
| Wholesale Price $(\Delta P_{ht} / P_{ht})$ | - 1.132*** | - 1.204*** | - 1.103*** | - 1.294*** | - 0.988*** |
| | (0.126) | (0.183) | (0.172) | (0.196) | (0.146) |
| Official Price of Benchmark | - 0.857** | - 0.407 | - 1.283** | - 0.339 | - 1.941*** |
| $(\Delta \overline{P}^{C}_{jt} / \overline{P}^{C}_{jt})$ | (0.374) | (0.529) | (0.521) | (0.575) | (0.434) |
| Wholesale Price of Benchmark | 1.243*** | 1.229*** | 1.251*** | 1.101*** | 1.366*** |
| $(\Delta P_{jt} / P_{jt})$ | (0.092) | (0.138) | (0.120) | (0.157) | (0.095) |
| Adj.R-Sqaured | 0.548 | 0.596 | 0.531 | 0.501 | 0.677 |
| D.W. | 1.87 | 1.68 | 1.88 | 1.91 | 1.49 |

Note: D.W. is Durbin-Watson statistic designed for panel structure.

# Figure 1 Determinants of Demand

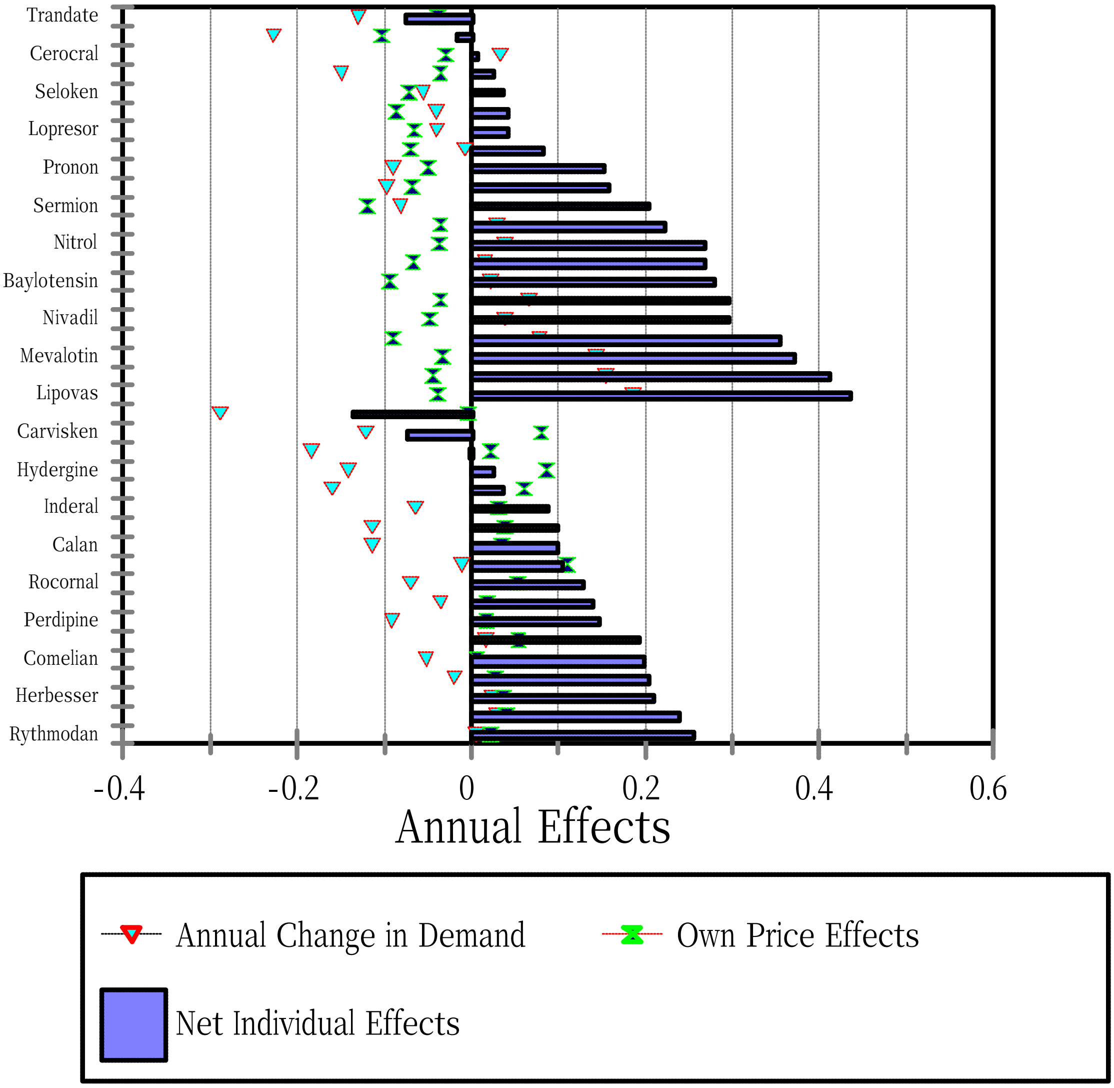

**Figure 2. Relative Product Specific**
Effects and Age of Products