GLOBAL PRICING AND LAUNCHING OF NEW DRUGS: AN ECONOMETRIC APPROACH

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The drug trade yields a specific bargaining procedure between pharmaceutical firms and countries' health agencies. The firm launch medicines in different countries to maximize global profits, therefore pricing and launching are their major strategic decisions. On the other hand, countries' health agencies implement pricing policies in order to control their pharmaceutical expenditure and to guarantee access to medicines. Among existing drug pricing policies, most countries have implemented the ERP at some point of time with the target of controlling the pharmaceutical expenditure and ensuring access to medicines, mainly in on-patent medicines.

We aim at the analysis of the trade-off between drug pricing and launching and the impact of the external reference pricing (ERP) policy on pricing and launching, based on an empirical point of view. We use data from IMS Health database on 56 new molecules launched in 20 countries and belonging to 11 therapeutic classes, during our study period, 2004-2010; more recent data than previous works. We develop a model that focuses on both matters controlling for molecules, regulation and country characteristics. In this paper we develop a two equations model. We estimate a Heckman selection model for the launch price equation and a parametric duration model for the launch delay equation.

The pricing and launching seem to be no longer related to each other. There exist differences in prices across countries but not due to the launch delay. The firms do not accept lower prices in exchange of delaying launches, even from countries applying the ERP policy, therefore, the IRP policy seems to not be effective in "pricing terms" but it does so in "launching terms". These results may yield several implications on the bargaining process. We suggest that the firms basically delay launches because countries probably cannot afford to have the product available straight from the global launch, and ultimately not having the product launched. While the firms used to delay launch to avoid spillover effects, under our study, we show that the firms may conduct a more aggressive strategy that does not allow countries to pay lower prices in exchange of experiencing longer launch delays. Under this strategy the firms would avoid the spillover effects from the ERP policy and the PT, but they would also lose profits from sales in countries where the molecule is not ultimately launched.

Regarding other country characteristics, our study shows that wealthy countries have the products available in shorter-term, but the countries that ultimately pay high relative launch prices are those that allocate large budgets to the public health and the pharmaceutical expenditure. The countries belonging to the EMA seems to enjoy shorter launch delay than the countries out of it, however, there is no significant price differences between countries under the EMA's regime and countries out of it.

JEL: I18; L2; L51; C5

1. Introduction

Pharmaceuticals are sold in a global market. This characteristic yields a specific bargaining procedure between pharmaceutical firms and countries' health agencies. On the one hand, the firm sequentially launch medicines in different countries to maximize global profits, therefore pricing and launching are their major strategic decisions. On the other hand, countries' health agencies implement pricing policies in order to control their pharmaceutical expenditure and to guarantee access to medicines. Indeed, pharmaceutical price regulation is high on policy agendas in several countries, either because countries have just reformed, intend to reform or question their practices (see Chapter 1 section 1). Among existing drug pricing policies, most countries in the industrialized world have implemented the ERP at some point of time with the target of controlling the pharmaceutical expenditure and ensuring access to medicines, mainly in on-patent medicines (see Chapter 2 section 1).

In this chapter we aim at the analysis of the trade-off between pricing and launching and the impact of the ERP policy on pricing and launching, both from an empirical point of view. We develop a model that focuses on both matters controlling for molecules, country and product characteristics. The previous literature concerning the trade-off between pricing and launching has been already discussed in detail in Chapter 1 in Section 2.3 at theoretical level and Section 2.4 from an empirical point of view. On the other hand, the previous literature concerning the impact of ERP policy has also been theoretically and empirically discussed in chapter 1 in section 2.2 and section 4.2 respectively. Moreover, additional information concerning the applying of the ERP policy have been we have developed a theoretical model that analyses the convenience of applying the ERP as a cost-containment policy on pharmaceutical expenditure instead of the CEA in Chapter 2.

In this chapter, we develop an empirical model based on two equations, a Launch Delay equation and a Launch Price equation. Our new contribution to the previous literature analysed in Chapter 1, sections 2 and 3, firstly consists in the

analysis of the database at presentation level[1], the analysis of the relative launch price[2] as endogenous variable in the LP, the study of the launch delay as a duration time variable and the analysis of the inpatients market. Additionally, we introduce simultaneously the country size and the country purchasing power as explanatory variables.

1. The Model

2.1 Methodology

We firstly estimate the launch delay and the launch price equations separately. In a second step, we estimate the system of both equations to account for the endogeneity.

We use a parametric model with right-censored data to model the launch delay of the molecule i in country j, which is defined as the time elapsed from the global launch of the molecule i and the launch occurred in country j. The analysis has been conducted using a Weibull distribution and controlling for the unobserved heterogeinity with a gamma frailty. The model selection has followed the method proposed by Kiefer (1988) (see Annex I). We estimate a right-censored model since we note that all of the drugs in our data set were launched for the first time between January 2004 and December 2010. However, not all drugs had been launched in all 23 countries by the end of our observed period. Then, our data contain right-censored observations. This estimate does not account for the use of time-varying covariates; in their place we have used the data collected in the base year[3]. Then, we have:

$$h(t,X) = \lambda p(\lambda t)^{p-1}[U]^{\theta}$$

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1 We define two products presenting the same presentation when both products belongs to the same molecule i and present the same standard units.

2 Defined later on this section.

3 For these covariates, such as the country population, the GDP, health and pharmaceutical expenditure and EMA variables, we use the data collected in the base year of the dataset (2004). To not make the model more complex we have decided to estimate the duration model without time-varying covariates. We understand that the target of these covariates is to measure certain differences in country size, wealth and expenditure, which are represented with the data collected for the base year 2004.

where

$$\lambda_{ij} = e^{X_{ij}\beta}$$

where the subindex i=molecule, j=country and X_{ij} are the covariates, β the covariates' parameters, t the time elapsed until the launch of molecule i occurs in country j, p the shape parameter[4], U a random variable and θ the variance of the frailty[5] (Jenkins, S.P., 2008; Keele, L. 2007). The covariates X_{ij} are the relative launch price at molecule level, the logarithm of the country size (population), the logarithm the public health expenditure per capita, the logarithm of the pharmaceutical expenditure per capita, the firm location, the belonging to the EMA and the therapeutic fixed-effects at ATC-1 level. These variables are defined in detail in Annex I.

We mainly focus on the effect of the launch price and the applying of the ERP policy on the launch delay. We expect that countries paying high prices experience short launch delays (see Chapter 1, sections 2.1 and 3.3.1). We also expect that the applying of the ERP is effective and countries applying this pricing policy, with the need of previous countries to which take as reference, suffer from longer delay launch (see Chapter 1 sections 2.2 and 3.3.3). To show this, we have controlled for country characteristics regarding the bargaining power of the country such as the country size and the country purchasing power (GDP) (see Chapter 1 section 3.3.4). We expect that countries with a large population and high-incomes experience short launch delays for new drugs. Other country features concern the health investment and the attitude of firms towards countries with a high public health and pharmaceutical expenditure per capita. We expect that these variables may affect negatively the launch delay, since countries with a high public health expenditure should be more worried about the availability of drugs in their market, while countries with a high pharmaceutical expenditure are willing to pay higher prices for new drugs and therefore, firms are interested in launching earlier in those countries.

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[4] The shape parameter p determines whether the hazard is increasing, decreasing, or constant over time.

[5] We can evaluate the hypothesis that $\theta = 0$ and determine whether we need to worry about unobserved heterogeneity using a likelihood ratio test.

Also, we have controlled for the firm's headquarters location. We expect that countries hosting the firm's headquarter pay higher prices. We think that hosting the firm's headquarter could generate other profits for the country (e.g. employment, incomes from taxes, etc.) (see Chapter 1, sections 2.5 and 3.3.5). Furthermore, since we have in our database countries belonging to the EMA and other countries out of it, we know that drug approval processes do not take the same time depending on the organization (the Food and Drugs Administration (FDA), the EMA, etc.) and we expect that this variable affects the launch delay (see Chapter 1 section 3.3.3)

Besides, we have also controlled for product characteristics as the strength, expected to affect positively on prices and the administration route, expecting the injectable products to be more expensive than other such as oral solid or ointment. Finally, we have controlled for the therapeutic class fixed-effects and the trend. Country fixed effects have not been included because the variable of greatest interest, that measuring the use of price controls, has little intracountry variation.

On the other hand, we use ordinary least squares with molecule-presentation-clustered standard errors to model the log of the relative launch price of product k in country j at the time t, conditional on launching. To account for unobserved molecule characteristics we also report results from a GLS (Generalized Least Squares) random effects estimator. To account for possible selection bias produced by the correlation between the propensity to launch and the launch price, we also estimate a Heckman selection model with a first-stage probit regression (Heckman, 1979). The relative launch price is defined as the price ratio between the launch price of a product k in country j at the time t, and the launch price of the product k in the country j at the global launch time o. Then, we have:

$$RP_{ijkt} = \frac{P_{ijkt}}{P_{ijk0}} = \beta_0 + \beta' Z_{ijkt} + V_{ijkt}$$

where the subindex i=molecule, j=country, k=product and t=year. Then, RP_{ijkt} is the relative launch price of, the P_{ijkt} is the launch price in country j at time t and P_{ijko} is the launch price in country j at the first global launch time 0. Then, Z_{ijkt} is the vector of explanatory variables and V_{ijkt} is the random term.

The explanatory variables in this model are: the launch delay of molecule i in country j, the squared of the launch delay, the logarithm of the GDP per capita of country j at time t, the country size (population) of country j at time t, the public heath expenditure per capita of country j at time t, the pharmaceutical expenditure per capita of country j at time t, the use of the IRP policy in country j, the firm's home country=1 if the headquarters' firm of launching the molecule i is located in country j, the belonging to the EMA=1 if the country j belongs to the EMA at time t. Also, we have included the year fixed-effects at time t. These explanatory variables are defined in more detail in Annex 1.

We focus on the effect of launch delay and the effect of the applying of the ERP policy on the relative launch price. We expect that countries suffering from launch delays pay lower relative launch prices (see Chapter 1, sections 2.1 and 3.2.1). We also expect that the applying of the ERP is effective and countries applying this pricing policy pay lower relative launch prices (see Chapter 1, sections 2.2 and 3.2.3). To show this, we have controlled for country characteristics regarding the bargaining power of the country such as the country size and the country purchasing power (GDP). We expected that large country size could obtain lower relative launch prices while high-income countries should pay higher prices for new drugs (see Chapter 1 section 3.2.4). Other country features concerns the health provision and the attitude of firms towards countries with higher public health and pharmaceutical expenditure per capita. We expect that these variables may affect positively the drug launch prices, since countries with a high public health expenditure should be more worried about the availability of drugs in their market, therefore, they will be willing to pay attractive high prices, while countries with a high pharmaceutical expenditure, since they allocate to spend on drugs, they should be willing to pay higher prices for new drugs.

Also, we have controlled for the firm's headquarters location. We expect that countries hosting the firm's headquarter pay higher prices. We understand that hosting the firm's headquarter could generate other profits for the country (e.g. employment, incomes from taxes, etc.) (see Chapter 1, sections 2.5 and 3.2.5). Finally, we have controlled for the therapeutic class fixed-effects and the trend. Country fixed effects are not included, because the variables of greatest interest, those measuring the use of price controls, have little intracountry variation.

2.2 Data

We use data from IMS Health database on 56 new molecules launched in 20 countries belongs to 11 therapeutic classes, all of them approved through the centralised procedure by the EMA, during our study period, 2004-2010. We have collected yearly inpatients and outpatient sales at ex-manufacturer price (in EUROS) and unit volume (IMS standard units)[6]. After the data were screened for internal consistency, revenue was adjusted for inflation using country-quarter specific Producer Price Indexes (PPI) available from the International Monetary Fund (IMF), with 2005 as the base year. The price per SU for each product *k* was calculated on a yearly basis as the ratio of total revenues to standard units sold[7]. Two products *k* are considered the same is they present the same quantity of SU and the same administration route. For each molecule-country providing the same product as defined above but under different packsizes[8], the volume-weighted average price was calculated for each set of products. Also, we note that the USA sales, collected at inpatient and outpatient level through different sale channels (e.g. Drugstores, Foodstores, Mail Service, etc. for inpatient sales, and Hospital, Non-Federal Hospitals, Home health care, etc. for outpatients), the volume-weighted average price were calculated for each product *k*. Besides, we note that sales from Denmark, the Netherlands and Sweden were jointly collected by IMS

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6 The IMS standard unit is a proxy for a dose for each formulation e.g. one tablet or capsule, 5ml. for liquids. The IMS price data for the US do not reflect off-invoice discounts given by manufacturers to health plans and hence are upward biased for manufacturer net revenues

7 Multiple form-3 level formulations are combined (e.g. tablets and capsules, possibly of different strength) in a given country and quarter into a single observation and defined the price as the volume-weighted average price per unit. Identical forms that were launched by different co-marketing companies were also averaged.

8 E.g. *Tablets 150MG 28* and *Tablets 150MG 56.*

(inpatient and outpatient). The relative launch price for the whole database was calculated as noted in the above subsection 2.1. In Annex I we report the variable definitions and the variable classification in Table 5.

2. Results

2.1 Launch Relative Price Equation

When we analyse the retail sales, we firstly observe that the relative launch price is conditional on launching since the IMR coefficient is statistically significant. Regarding the variables on which we focus our study, we note that the launch delay seems to have no statistically significant effect on the relative launch price. This result may indicate that the firms have prioritized to avoid the spillover effects from the IRP and the PT against the profits of some late sales at lower prices. Indeed, it seems that countries do not longer profit lower prices in exchange for having the product available with a certain delay. Furthermore, we observe that the use of IRP does not affect significantly the relative launch price. Particularly, it seems that countries applying the IRP policy do not pay lower relative launch prices than countries that do not use it. This unexpected result shows that the use of the IRP is not effective, because either there are countries that directly take the reference prices (Chapter 2 section TBA), or countries that do not apply ultimately the IRP when it is considered together with other pricing policies (see Chapter 2, section TBA), or because the firms do not sell at that price (see Chapter 2 section TBA). Furthermore, other country characteristics such as the pharmaceutical and health public expenditure per capita do seem to affect significantly the relative launch price. Indeed, as expected, countries with high pharmaceutical and public health expenditures per capita pay higher relative launch prices. Besides, the results show that countries with a high bargaining power, since they have a large population, pay lower relative launch prices in average (see Chapter 2 section TBA). As we account for unobserved molecule characteristics we also report results from a GLS random effects estimator. The results slightly change when we estimate this alternative specification. Particularly, only the country size and the public health expenditure per capita remain as

significant factors influencing the relative launch prices.

When we analyse the hospital sales, we observe that, compared to the retail market, significant results remains. Besides, in this analysis, the headquarter firm's location has a slightly significant effect on the relative launch price, as expected. Then, drugs launched by firms with their headquarters settled in the launching country, obtain lower prices than drugs launched by firms with their headquarters settled out of the launching country. Similar to the retail market, when we report the results from a GLS random effects estimator, the only significant effect that remains is the country size, the rest of variables affecting the relative launch price become insignificant. Even, the IMR does not affect significantly the relative launch price, being significant in the retail market for both specifications and in the hospital market for the OLS molecule-clustered estimate.

2.2 Launch Delay Equation

Now, we present the results arising from the analysis of the duration of the launch delay from the molecule global launch. This analysis has been conducted by the estimation of a Weibull model controlling for the unobserved heterogeinity.

In the analysis of the retail sales, the model reports a statistically significant hazard ratio slightly lower than the unity (close to the unity) for the relative launch price of the molecule. Exactly, a high relative launch prices affect negatively the probability of having the molecule launched. This unexpected result indicates that countries that experience longer launch delays pay higher prices than countries with a shorter market access. However, we should remark that the extent of this effect is negligible and ultimately we may interpret that different relative launch prices do not yield large different launch delays. Furthermore, as expected, the use of the IRP policy generates a lower probability of launch. This effect is much larger than the negative effect produced by the relative launch price. This may indicate that the firms try to avoid the spillover effects delaying launch in this type of countries. As some of the countries applying the IRP policy are potential exporter countries, this could be another reason why the firms delay launch in these countries.

Regarding other country characteristics, it is observed that larger countries suffer from longer launch delays. This unexpected result may show that the bargaining power coming from the market size is not effective to have a molecule available with a short delay. What it seems to have an important positive effect on the probability of having launched a molecule is the GDP per capita level and the belonging to the EMA. However, other indicators such as the health public or the pharmaceutical expenditure do not affect the probability of launch. Even, the firms with their headquarters settled in the launching country do not launch first in such as countries than in other.

At molecule level, the model reports statistically significant differences among different ATC-1 classes, taking the A-class as the referent category.

When we analyse the hospital sales we do not observe major changes respect the retail sales. Factors influencing the launch delay and their signs remain the same. We just may mention that the GDP per capita is now statistically significant at 10% (very close to the 5%). There is no huge change in the extent of the influence from the significant covariates. As in the analysis of retail sales, the model reports statistically significant differences at ATC-1 level.

3. Discussion

Our new contribution to the previous literature analysed in Chapter 1, sections 2 and 3, firstly consists in the analysis of the database at presentation level, the analysis of the relative launch price as endogenous variable in the LP, the study of the launch delay as a duration time variable and the analysis of the inpatients market. In this chapter we have aimed at the analysis of the trade-off between pricing and launching and the impact of the ERP policy on both pricing and launching

At this regard, we have observed that the launch delay does not significantly affect the relative launch price, however, the relative launch price does so on the launch delay, but the extent of the influence is quite low. On the other hand, the results show that the use of the IRP policy make countries experience longer launch delays but not paying lower relative launch prices. These results may yield

several implications on the bargaining process. Indeed, we may think that the firms do not want to play the game in which, countries rejects the firm's offer knowing that over the time they will obtain lower prices. Besides, we observe that the firms delay launches in countries using the IRP policy, however, these countries do not necessarily pay lower prices. This last result may indicate that the IRP policy is not effective in "pricing terms" but it does so in "launching terms". It seems that the firms do not accept lower prices in exchange of delaying launches from countries applying the IRP. These results may suggest that the firms basically delay launches because countries probably cannot afford to have the product available straight from the global launch, and ultimately not having the product launched. Different from the previous literature, where the firms used to delay launch to avoid spillover effect, under our study, we show that the firms may conduct a more aggressive strategy which does not allow countries to have the products available with a launch delay in exchange of paying lower relative launch prices. Under this strategy the firms would avoid the spillover effects from the IRP policy and the PT, but they would also lose profits from sales in countries where the molecule is not ultimately launched.

Furthermore, among other country characteristics, we observe that the bargaining power supported by the country size is effective to obtain lower prices, however, this country characteristic does not seem to be an influencing factor to experience shorter launch delays, even more, unexpectedly, countries with a large country size find lower probabilities to have a product launched. In the same line, we have observed that the GDP per capita level is not affecting the relative launch price, however, other country characteristics, more particularly affecting the pharmaceutical consumption, such as the pharmaceutical and health public expenditure per capita levels, affect positively the relative launch price. Exactly the opposite effects occur on the launch delay. The pharmaceutical and the public health expenditure do not seem to make countries experience shorter launch delays. Indeed, what is make countries to have products available on a short-term is a high level of wealth per capita. We may say that wealthy countries have the products available in short-term, but the countries that ultimately pay high relative

launch prices are those that allocate large budgets to the public health and the pharmaceutical expenditure.

On the basis of the results, the firms neither make discounts nor launch in short-term in those countries where they have settled their headquarters. Only in the hospital market we observe that countries obtain lower prices from this type of firms than from foreign companies. Furthermore, the countries belonging to the EMA enjoy shorter market access in average than the countries out of the EMA's regime.

Conclusions

The pricing and launching seem to be no longer related to each other. There exist differences in prices across countries but not due to the launch delay. The firms do not accept lower prices in exchange of delaying launches, even from countries applying the IRP policy, therefore, the IRP policy seems to not be effective in "pricing terms" but it does so in "launching terms". These results may yield several implications on the bargaining process. We suggest that the firms basically delay launches because countries probably cannot afford to have the product available straight from the global launch, and ultimately not having the product launched. While the firms used to delay launch to avoid spillover effects, under our study, we show that the firms may conduct a more aggressive strategy that does not allow countries to pay lower prices in exchange of experiencing longer launch delays. Under this strategy the firms would avoid the spillover effects from the IRP policy and the PT, but they would also lose profits from sales in countries where the molecule is not ultimately launched.

Regarding other country characteristics, our study shows that wealthy countries have the products available in shorter-term, but the countries that ultimately pay high relative launch prices are those that allocate large budgets to the public health and the pharmaceutical expenditure. The countries belonging to the EMA seems to enjoy shorter launch delay than the countries out of it, however, there is no significant price differences between countries under the EMA's regime and countries out of it.

In general, the results under the retail market and the hospital market do not show huge differences, only the firms with headquarter settled in the launching country bargain lower prices with the country concerned.

References

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Annex I

A.1. Selection of parametric model

We have followed the method proposed by Kiefer (1988). Basically, in a first step, according to the empirical density function of the endogenous variable, as shown in Figure 1, we have, in general terms, a monotonically decreasing function. Then, the more suitable models are the Weibull and Gompertz parametric models. These two models are often used with data presenting monotonically failure rates, either increasing or decreasing. Since we have not been able to observe the all variables affecting the launch delay, it is likely to have unobservable heterogeinity. The most common way to control for the unobservable heterogeinity, is based on the introduction of a parametric distribution for the random error term and thus, to estimate the parameters of the function which generates such error term. There is no a strict pattern to chose the type of this distribution. Based on the previous literature, the two distribution most used are the Gamma (Lancaster, 1992; Klein and Moeschberger, 1997) and the Inverse Gaussian (StataCorp., 2001). Then, we estimate four different parametric models. In Table 3 and 4 we show the measure of goodness of fit (AIC) and the statistical hypothesis tests of the unobserved heterogeinity. Another way to have an accurate selection model is based on the analysis of the Cox-Snell generalized residuals. Then, if the model has been correctly selected, the Cox-Snell residuals should present a form of a unit exponential function. The Cox-Snell residuals are shown in Figure 2, 3, 4 and 5 (for retail market), and Figure 6, 7, 8 and 9 (for hospital market).

Figure 1. Density Function of Delay In Months. Retail Market

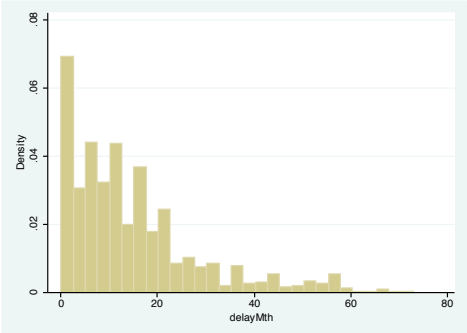

Figure 2. Density Function of Delay In Months. Hospital Market

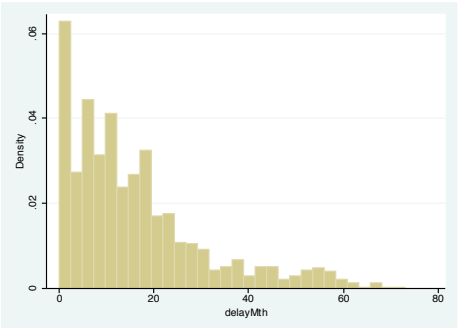

Table 3. Goodness of fit of parametric models. Unobservable Heterogeinity Contrast. Retail market

	Weibull with Gamma Heterogeinity	Weibull with Inverse Gaussian Heterogeinity	Gompertz with Gamma Heterogeinity	Gompertz with Inverse Gaussian Heterogeinity
AIC	38.14430201	38.142709	38.13897749	38.10271705
Heterogeinity (Ho= No heterogeinity)	$\overline{\chi}^2_1$ =29.32 p=0.000	$\overline{\chi}^2_1$ =26.21 p=0.000	$\overline{\chi}^2_1$ =81.28 p=0.000	$\overline{\chi}^2_1$ =8.63 p=0.002

Figure 3. Weibull, Gamma (R)

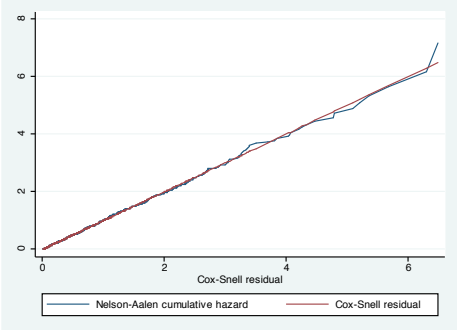

Figure 4. Weibull, Inverse Gaussian (R)

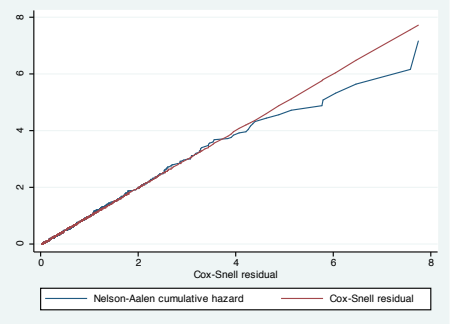

Figure 5.Gompertz, Gamma (R)

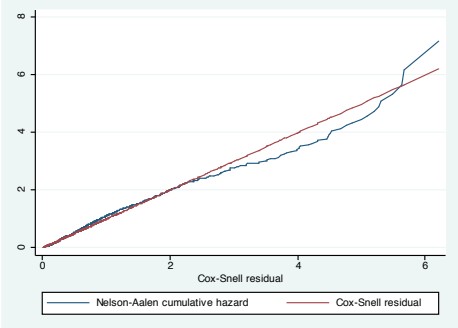

Figure 6.Gompertz, Inverse Gaussian (R)

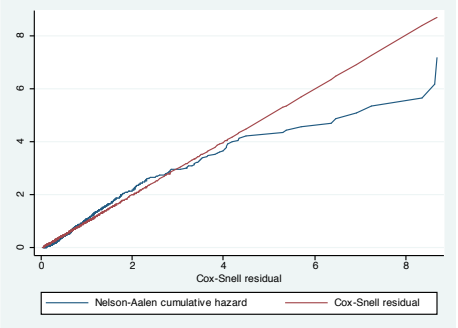

Table 4. Goodness of fit of parametric models. Unobservable Heterogeinity Contrast. Hospital sales

	Weibull with Gamma Heterogeinity	Weibull with Inverse Gaussian Heterogeinity	Gompertz with Gamma Heterogeinity	Gompertz with Inverse Gaussian Heterogeinity
AIC	37.94271225	37.94223474	37.94238153	37.90821115
Heterogeinity (Ho= No heterogeinity)	$\overline{\chi}^2_1$ =37.34 p=0.000	$\overline{\chi}^2_1$ =36.17 p=0.000	$\overline{\chi}^2_1$ =100.29 p=0.000	$\overline{\chi}^2_1$ =14.54 p=0.000

Figure 7. Weibull, Gamma (H)

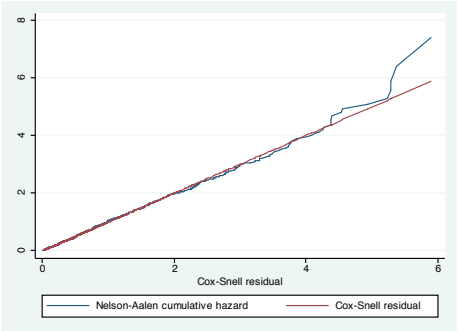

Figure 8. Weibull, Inverse Gaussian (H)

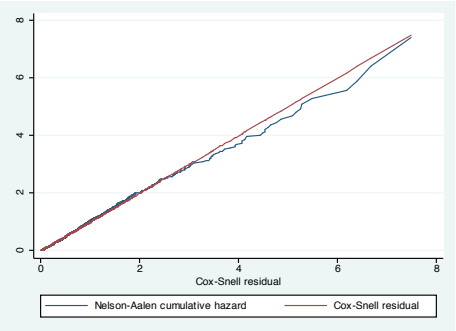

Figure 9. Gompertz, Gamma (H)

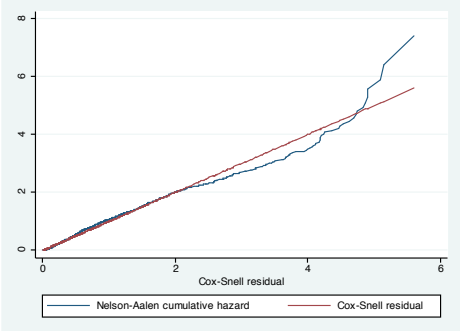

Figure 10. Gompertz, Inverse Gaussian (H)

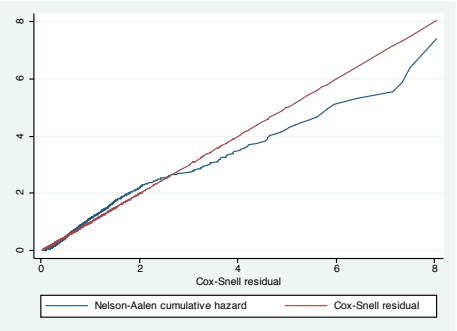

Table 1. Variables classification

Level / Time	Time Invariant	Time Variant
Molecule	- ATC fixed effects (*ATC*)	
Country	- External Reference Pricing (ERP) - Country Fixed Effect (CFE) - GDP per capita 2004 (GDP2004) - Population size 2004 (POP2004) - Pharmaceutical Expenditure per capita (HPE2004). - Public Health Expenditure per capita (PE2004). -EMA 2004 (EMA2004).	- GDP per capita (GDP). - Population size (POP) - Pharmaceutical Expenditure per capita (Exp_Pharma_pc). - Public Health Expenditure per capita (Exp_PubHealth). - EMA (EMA).
Molecule-Country	- Delay (DELAY) - Home launched (HOME)	
Molecule-Country-Presentation	-Relative price (RP)	

A.2. Variable definitions

Relative launch price: The relative launch price is the price ratio between the launch price of a product k of a molecule i in country j at the time t, and the launch price of the product k of the molecule i in the country j at the global launch time o. Both prices, numerator and denominator, are measured at the ex-manufacturer price per standard unit.

Delay: the launch window of molecule *i* in country *j* is the difference (in months) between the month in which the drug was first launched anywhere in the world and the month in which the drug was launched in the country j. The month of launch is the first month in which sales of the new drug are non-zero.

External Reference Pricing (**ERP**): A dummy variable (= 1) that indicates if the country j applies the ERP (= 1) and (= 0) otherwise.

Log GDP per Capita: Logarithm of the Gross Domestic Product (GDP) of country *j* in year *t*.

Log Population size (**POP**)**:** The population size at time *t*, measured by the natural logarithm of the number of inhabitants of country j.

Log Health Expenditure per capita (**Exp_PublicHealth_percapita**): The natural logarithm of public health expenditures per capita in country *j* at time *t*.

Log Pharmaceutical Expenditure per capita (**Exp_Pharma_percapita**): The natural logarithm of pharmaceutical expenditures per capita in country *j* at time *t*.

Log GDP per Capita (**GDP2004**): Logarithm of the Gross Domestic Product (GDP) of country *j* in year 2004.

Log Population size (**POP2004**)**:** The population size in year 2004, measured by the natural logarithm of the number of inhabitants of country j.

Log Health Expenditure per capita (**HPE2004**): The natural logarithm of public health expenditures per capita in country *j* in year 2004.

Log Pharmaceutical Expenditure per capita (**PE2004**): The natural logarithm of

pharmaceutical expenditures per capita in country *j* in year 2004.

EMA: A dummy variable that has the value 1 if a drug was launched in a country j that is part of the European Medicine Evaluation Agency's decision zone (EMA).

EMA 2004 (**EMA2004**): A dummy variable that has the value 1 if a drug was launched in a country j belongs to the EMA in 2004.

Home launched (**HOME**): A dummy variable that indicates if the company's headquarters launching the molecule *i* is located in the country of launch *j* (=1) and 0 otherwise.

ATC: Dummy variables for the therapeutic classes to which molecule *i* could belong to an ATC at level one (ATC-1). The therapeutic class A is used as referent category. The therapeutic classes included are: A- Alimentary tract and metabolism, B- Blood and blood forming organs, C- Cardiovascular system, D- Dermatologicals, G- Genito-urinary system and sex hormones, J- Antiinfectives for systematic use, L- Antineoplastic and immunomodulating agents, M- Musculo-skeletal system, N- Nervous system, R- Respiratory system, S- Sensory organs, T and V- Various.

Year Fixed Effects: A dummy variable for each year *t*.