# The Determinants of Pricing in Pharmaceuticals: Are U.S. prices really so high?

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**Abstract**

This paper studies price determination in pharmaceutical markets using data for 25 countries, six years and a comprehensive list of products from the MIDAS IMS database. A key finding is that the U.S. has prices that are not significantly higher than those of countries with similar income levels, especially those that are "lightly regulated". More importantly, price differences to the US levels increase for "branded", world top-selling, or innovative products, and decrease, regardless of the level of regulation for mature or widely diffused molecules. Since prices for top-selling molecules may be easier to perceive and recollect and more important for companies, they may bias the public discussion about international price differences.

Keywords: Pharmaceutical prices. regulation.
JEL Classification: I10, I18, L18, L65

# 1 Introduction

The markets for pharmaceuticals are very different from those of other goods. In addition to the standard market forces operating in most markets, they are often regulated. Indeed, Ballance et al. (1992) survey 56 nations and find that most countries impose some form of price controls.[1] But the amount of regulation varies a great deal across countries, as they go from "substantial," to "limited," to "nonexistent." Even the form of regulation is very heterogeneous.[2]

In spite of its interest and special features, there has been no systematic empirical study of the determinants of pricing in this industry for a large set of products and countries.[3] In this paper we attempt to fill this vacuum. We study pricing in pharmaceuticals using a multicountry and multiproduct data set from the IMS MIDAS international dataset for the period 1998-2003. Our dataset encompasses a large number of countries including the top ten in terms of pharmaceutical expenditures, as well as other countries that are either smaller in size or with a lower income. The data comprise products from a large number of groups or anatomic classifications. The richness of the data allow us to study the determinant of price variation between countries, and we give special attention to both regulatory regimes and industrial structure.

Our main finding is that there is a systematic and quantitatively large division between a group of less regulated countries whose average prices are higher and a group of more regulated ones where the average price level is lower. This difference is stronger for newer, more innovative products and smaller for more mature and widely diffused ones. Moreover, even in highly regulated countries the products from their own multinationals are not more expensive, suggesting foreign multinationals are protected through some mechanism, perhaps reference pricing.

**Empirical strategy and results** Our empirical strategy introduces several innovations with respect to the previous empirical literature in the subject.

First, we estimate pricing equations by pooling the countries.[4] We are thus able

[1]There are serious theoretical reasons for the existence of non-market interventions in this industry. For example, barriers to entry in markets (R&D, advertising) limit the positive effects of competition, insurance and prescription insulates the consumer from financial consequences of decisions. Naturally, this does not mean that actual regulation is always done for efficiency reasons, rather than to shift rents from some agents to others.

[2]As Scherer (2000) notes, the instruments can be: reference pricing, product per product negotiation, price caps, rate of return regulation and formula pricing.

[3]The existing studies mostly look at small groups of chemicals for a few countries (Lu and Comanor, 1998; Danzon and Chao, 2000a, 2000b; and Ekelund and Persson, 2003).

[4]We have also estimated separate pricing equations for each country, available at:

to explore the interplay of cross-national variables and regulation in price setting. For example, by including as an explanatory variable the GDP per capita, or the ratio of health expenditures (public and private separately) to GDP, we can assess, in a very disaggregate context, whether higher prices are observed primarily in richer countries, countries with larger health sectors or more regulated ones.[5] To better understand the impact of regulation we classified the countries in our sample in two groups: one less and one more regulated (see section 3 for further details regarding the classification of countries).

Second, we exploit the panel nature of the data and control for unobserved heterogeneity at the product level. By doing so, we control for time invariant factors that affect price setting. In particular we control for "unobserved" marginal effects. However, this comes at a cost, since this reduces notably the variation of the data. In this context, we identify the effect of time-invariant variables by following a two-stage procedure.

Finally, although in our main regression we do not restrict the sample in any way, we do explore the sensitivity of our results to the restriction of the sample in several dimensions, such as: to single molecule products[6], to the number of countries where a corporation is present, or the number of countries a molecule is present, to global (as well as local) top selling molecules[7], and by therapeutical category. Exploring these dimensions allows us to assess the effects of increasing the "internationality" of the corporation or the "brandedness" of the products analyzed and the "diffusion" of molecules. The analysis of molecules which are present in all the countries controls for the effects of the sequential launch of a product in different countries. The restriction to global top selling molecules is particularly noteworthy since the weight of the U.S. in that sample is very large, and thus it is rather biased toward U.S. tastes or needs.

Let us summarize our findings on the price variation across countries, since this is one the main contributions of this paper.

A first observation is that there are large and systematic differences in prices *between* the group of low regulated countries and a group of more highly regulated ones, but the differences are not very large *within* the group of low regulated countries (among which the U.S. is the largest market). These price differences increase when the product is more

http://www.econ.upf.edu/docs/papers/downloads/1032.pdf

[5] Danzon and Furukawa (2003) show theoretically that fixed costs should be distributed across countries depending on demand elasticities, so that higher prices should be observed in richer countries. This suggests that in a multi-country study, like ours, variables with cross-country variation should be included in the regression.

[6] This has been studied, for example, by Danzon and Chao (2000a).

[7] More precisely, we restrict the sample to the top 50, 100, or 200 global (local) top selling molecules in year 2000.

innovative, or "branded" since they increase for truly global companies (those present in all the countries of our sample), or for global top selling molecules. And conversely, the differences decrease for more mature, or widely diffused products, whose active molecules are present in all the countries of our sample.

This finding can be interpreted as meaning that regulation is effective in bringing prices down, but especially so in the more innovative products, those that are produced and distributed by global companies around the world, the top selling blockbusters which disproportionately preoccupy both policy-makers and industry leaders, because of their high visibility. On the other hand, for products that are common, in the sense of produced in all countries, but not by global companies (typically more advanced in their life cycles), the effect of regulation is vanishing. Thus, competition is at least as effective as regulation in bringing prices down, when applicable. Notice, however, that competition affects less the global top selling molecules, which are often innovative and on-patent. This may bias the public discussion toward making the U.S. low regulation approach seem less effective in containing prices than it truly is.

One important note of caution in this respect has to do with the nature of our pricing data. As standard in this literature (Berndt et al., 1996; Danzon and Chao, 2000a; or Danzon and Epstein, 2008), we construct manufacturers prices from data on sales divided by standard units sold. But our data, like those of Danzon and Chao (2000a) come from IMS Health and hence as they point out: "US price data do not reflect manufacturers discounts given directly to managed care and public purchasers," and "UK data do not reflect all discounts given to pharmacists." Having the correct data would tend to lower the price differentials that we find for innovative products in less regulated countries.

Another observation is that foreign multinational companies do not experience noticeably different prices from local multinationals, even in relatively highly regulated countries. This finding suggests that even though one would expect governments to regulate more leniently their own firms, the multinationals are somehow protected. A reason for this may be that conceding a low price in one country would entail, through reference pricing, lower prices in many others.[8]

There are other results of interest in the model. Variables related to the quality of the product are strongly significant in explaining the prices. For example, older products are less expensive, and recently approved ones command a price premium. There is also evidence in the data that market forces operate in the expected way, since larger firms tend

[8]Reference pricing would act, thus, as the sort of best-price guarantee which has been criticized in the anti-trust literature (see Motta, 2004). This finding can be easily accounted by the theoretical model we present in the appendix.

to command higher prices. Also, generic products, which operate in off-patent markets (thus, probably more competitive ones) have lower prices. We also find that higher per-capita income produces higher prices in any given country, most likely derived from a lower price elasticity.[9] There is also a positive effect on prices of a higher public health expenditure to GDP. The interpretation of this finding is less straightforward. Most likely, a higher public consumption to GDP also signals a low price elasticity, relative to countries with the same income, probably derived from higher insulation of consumers from prices through health insurance (as pointed out by Duggan and Scott-Morton 2006, in a very different context). The size of this effect depends on the level of regulation, and it is smaller for more regulated countries, where public sector exerts has significant bargaining power, thus partly compensating the effect of insurance.

**Literature** The work of Danzon and Chao (2000a) is especially relevant for our purposes within the large literature on this topic. They study the effect of regulatory regimes on price setting. Their data include seven large spending countries which are classified in terms of the severity of regulation. From more to less regulated, the first group includes Italy, France and Japan were launch prices are regulated and are later revised downwards over the drug's life cycle. The second group includes UK and Germany were corporations are free to set prices at launch but prices cannot increase (freely) later on. In addition, in both countries there is some type of upper bound to prices, implemented either through a reference price (Germany) or a maximum overall rate of return (UK). The third group includes US and Canada where prices are free, and consumers' and physicians' demands appear to be more elastic. Danzon and Chao (2000a) then estimate a reduced form equation where prices depend on quality attributes of the product and on the competition characteristics of the market. Their empirical results suggest that regulation limits the beneficial effect of competition.

Using similar data, Danzon and Chao (2000b) demonstrate that the conventional view that drug prices are much higher in the US than in other countries is incorrect. The biased perception is due to the small, unrepresentative samples and to the inappropriate methods used in prior studies. In this paper we further confirm and amplify this view by showing, with a much larger database and a robust empirical strategy, that the U.S. prices are indeed in line with those of countries of similar income levels.

In a similar vein, a study by the U.S. Department of Commerce (2004) has argued

[9]This supports empirically Danzon and Furukawa's (2003, p. 534) observation that "the global joint costs should be recouped through price markups over marginal cost that differ based on income levels, assuming that income is a major determinant of "true" price elasticity. Thus, price differentials that are related to income would be consistent with both economic efficiency and equity."

that the lower (income-adjusted) prices induced by regulation in the OECD countries, with respect to the U.S., hurts consumers in the long term through the lower incentive for R&D and thus through lower discovery of life-saving drugs.[10] We have a fundamental challenge to the U.S. Department of Commerce (2004) results, since our more carefully income-adjusted prices do not show that U.S. prices are higher, in line with the results of Danzon and Chao for a smaller database.

Kyle (2007) examines the effect of price controls in the extent and timing of the launch of new drugs around the world and finds that regulation has a statistically and quantitatively important effect on pharmaceutical launches. The effect takes two forms. First, drugs invented by firms headquartered in countries that use price controls reach fewer markets and with longer delays. Second, companies delay launches into price-controlled markets, and are less likely to introduce their products in additional markets after entering a country with low prices.[11] The findings of Kyle (2007) are probably connected with our result that price differences between more and less regulated countries increase for more innovative products.

The previous evidence in this industry suggests that marginal costs are almost irrelevant in it and recommends the use of a hedonic price approach. For example, Berndt et al (1999) estimate a hedonic price equation that measures the price impact of drug attributes. Likewise, we do not attempt to estimate marginal cost effects on prices.

The effect of entry of generic products on price evolution has attracted recently a lot of attention, in part because the empirical evidence on this issue is ambiguous.[12] Our analysis shows (see section 4.5), that the impact of the number of generics depends on the therapeutical class (market) analyzed (thus explaining the diverging results of earlier literature).

The rest of the paper is structured as follows. We first present in section 2 the empirical strategy. Section 3 explains the data and the construction of the variables employed. Section 4 presents the main results from the analysis. Finally, section 5 concludes.

[10]Domínguez, Ganuza and Llobet (2009) provide a theoretical counterargument. Price controls hurt small ("me-too") innovations more than the relatively price inelastic drastic innovations, and could even induce larger investment by focusing firms on the drastic innovations.

[11]Launches into low price countries in Europe are further delayed after a regulatory change allowing parallel imports, which could potentially depress prices in high price markets. Similar effects are found by Danzon and Epstein (2008).

[12]Some authors (Grabowski and Vernon, 1992; and Caves et al., 1991) report that brand-name prices increased after the entry of generic competition, while others (Wiggins and Maness, 1994) find a reduction in brand-name prices following entry.

# 2 Econometric specification

In order to organize ideas for the empirical strategy, we constructed a model (the details can be found in the appendix) which generates a number of implications. The first one is that prices from highly regulated countries will be higher than those of less regulated countries, but the price differential of regulated countries will be smaller for products that are more mature or have a larger number of substitutes. Another implication from the model is that reference pricing can provide a measure of protection against small but highly regulating countries[13], and as a consequence large regulating countries will provide a price premium for firms headquartered in their own country, whereas small but heavily regulated countries cannot influence substantially the prices in favor of the local multinationals.

Overall, the model suggests that the price for product $i$ of firm $f$ in market $k$ and country $j$, $p^{'}_{ifkj}$, can be represented as a function of quality variables and other factors[14], summarized in the function $A^{*}_{ifkj}$. Taking this into account, we consider the following log-linear specification:

$$\log(p^{'}_{ifkjt}) = \alpha + A^{*}_{ifkjt} + v_{ifkjt}$$

where $t$ denotes time, and $v$ denotes an error term, and $\alpha$ is a parameter. We further consider that

$$A^{*}_{ifkjt} = X^{\prime}_{ifkjt}\beta + Z^{\prime}_{ij}\gamma + \eta_{ij} + \eta_{j} + d_{t}$$

where $X$ and $Z$ are vectors of respectively time-variant and time-invariant variables that potentially affect equilibrium prices, and $\beta$ and $\gamma$ are the corresponding vectors of parameters. The term $\eta_{ij}$ represents a product-country specific effect, $\eta_{j}$ is a country specific effect, and $d_{t}$ is a time specific factor. Note that the effect of $Z_{ij}$ and $\eta_{j}$ are absorbed by the product-country specific effects, $\eta_{ij}$ and, consequently, they are not directly identifiable.[15] Since we have a genuine interest in some time-invariant factors, we follow a two-stage procedure to estimate them (Mundlak, 1978). In more detail, after replacing the above expression in the log price equation, we first estimate the following *1st stage* equation:

$$\log(p^{'}_{ifkjt}) = \alpha + X^{\prime}_{ifkjt}\beta + \eta_{ij} + d_{t} + v_{ifkjt} \quad (1)$$

[13]Parallel imports can have a very similar effect as shown by Grossman and Lai (2008).

[14]These may include competitors' pricing strategies, which are not formally considered in the model

[15]Note also that $\eta_{j}$ is also not identifiable when the sample is restricted to a single country.

In a *second stage* we regress the estimate of $\eta_{ij}$, say $\hat{\eta}_{ij}$, against the time invariant factors.[16] That is, we estimate the following *2nd stage* equation:

$$\hat{\eta}_{ij} = Z'_{ij}\gamma + \eta_f + \eta_k + \eta_j + u_{ij} \tag{2}$$

where $u_{ij}$ is an error term and $\eta_k$, $\eta_f$, and $\eta_j$ control for market (or molecule), firm and country specific effects, respectively. Depending on the exact assumption about them, we follow one estimation strategy or another. For example, when we assume they are random and uncorrelated with the variables in $Z$, then a least squares estimate of the above equation identifies the parameters of the model. Alternatively, we can follow a conditional approach and use a least squares dummy variable (LSDV) estimator controlling either $\eta_k$, $\eta_f$ or $\eta_j$ or all three terms altogether. We shall explore some of these possibilities in the data.

Since the number of markets and the number of products varies across countries, we check the robustness of the results to the variation in two complementary dimensions: the number of countries in which the corporation to which the product belongs is present (for example: 1+, 10+, 20+, 25), and the number of countries in which a given molecule is present (for example: 1+, 10+, 20+, 25). We also present results when restricting the sample to single molecules, and when restricting it to products for which the molecule and the corporation is present in all the countries of the sample. Note that in the two latter cases the molecule has entered in all the countries in sample by the time of the survey. By comparing price homogeneity across countries between these two samples and other, less restrictive and less homogeneous samples, we will be able to assess the robustness of the results to the variation of the degree of diffusion of the molecules. To further assess the robustness of the analysis we present results by restricting the sample to the 200, 100, 50 TOP global selling molecules (see Table WA3 for a list and some descriptive statistics of the 50 top selling molecules in year 2000).[17] Since the U.S. (by far the largest market) is overrepresented when using this particular sample selection criterion, we also present results for the 200, 100, 50 TOP local (in any country) selling molecules. We expect these samples to be less influenced by U.S.-specific demand factors.

Regarding the estimation methods, we estimate equations (1 and 2) using a Within Groups panel data method. In the first stage, we control for time-invariant heterogeneity across products-country, while in the second we control for this heterogeneity across

[16] An alternative strategy to identify the effect of the $Z$ variables is to assume that the product specific effects ($\eta_{ij}$) are well represented by the combination of the country effects, $\eta_j$ ( and the $Z'_{ij}\gamma$ component. Note that, in this particular case, the effect of the variables in $Z$ can be identified in just one step.

[17] To give an example, the TOP 50 global selling molecules are present in an average of 21 countries, are relatively younger products and have higher prices.

molecules. In order to avoid potential endogeneity problems we follow an IV approach in the first stage and test for the endogeneity of the key potentially endogenous regressions as well for the validity of the instruments employed.

# 3 Data, variables and specification

We use a multi-country and multi-product dataset from the IMS MIDAS international database for the period 1998-2003[18]. This dataset encompasses a large number of countries including the top ten in terms of expenditure, as well as medium size and small countries (see Table 1 for a list of countries and summary statistics). It includes a large number of groups or anatomic classifications, and allows to study the price variation across countries which differ in terms of both regulatory regimes and industrial structure. Many corporations supply drugs in several of these markets that can be defined at different levels of disaggregation. In the current study we regard the 4-digit Anatomic therapeutical classification (ATC4) as a market, but it would be desirable to contrast our results using alternative levels of disaggregation.[19] Table WA1 presents the distribution of corporations depending on the number of markets supplied, and Table WA2 presents the distribution of molecule ages by countries.

The dependent variable in our analysis (see appendix A for variable definitions and Table 1 for sample statistics), called *Price*, corresponds to sales revenue divided by the number of 'standard units' sold.[20] Accordingly, when several formulations of the product co-exist in the market, this corresponds to a weighted average of the price per standard unit of all these alternative formulations. Nominal country specific quantities are converted to 2000 US $.[21] As noted in the introduction, the US and UK sales data do not reflect manufacturers discounts to all purchasers. Having the correct data would tend to

[18]Our data includes information from the $4^{th}$ quarter of each year, except for 2003, for which the information is provided for the $2^{nd}$ quarter.

[19]The ATC code was not provided in the original data supplied from IMS. Fortunately we obtained an additional sample from IMS Spain which helped us to recover the ATC for the rest of the countries. We managed to match practically all the records in sample.

[20]For IMS standard units stand for the number of standard doses sold. It is determined by taking the number of counting units sold divided by the standard unit factor which is the smallest common dose of a product form as defined by IMS HEALTH. For example, for oral solid forms the standard unit factor is one table or capsule whereas for syrup forms the standard unit factor is one teaspoon (5 ml) and for injectable forms it is one ampoule of vial.

[21]We have also used PPP conversion factors. However, since the qualitative picture we obtained is basically the same we only report results using exchange rates. The complete set of results using PPP's is available on request.

lower some of the price differentials that we find.

Marginal costs are almost irrelevant in this industry.[22] Accordingly, in our regression we use a hedonic approach and include quality and competition variables (see the appendix for a list of variables with definitions) to proxy the equilibrium price. Our controls can be classified in one of two categories: time-varying and time-invariant controls.

Our list of *time varying* or *first stage* controls includes: the firm's size in terms of sales in the country, *Firm sales*, which is constructed as total corporation sales (excluding sales of the product under analysis) in each country. Firm's size is included in log form in order to give more weight to differences in small values than in large values and it is considered potentially endogenous. The lagged average global price of the molecule (excluding the product under consideration) or *Global Price*. The variable *# generics* represents the number of generic products in each market and country. *New* is a dummy variable equal to one if the product was launched in the previous year and zero otherwise.

Among the competition variables we include the market share of the corporation in the market, *Market Share*, and its square, since we would expect that a higher market share leads to a higher prices. In order to capture differential effects between local and foreign firms we interact these variables with a *Local* dummy (to be defined more precisely later). We also construct the market share of all the national products in the market, *National Share*. All these variables could be regarded as potentially endogenous and, consequently, are instrumented in our specifications.

Following Danzon and Furukawa (2003) suggestions, in the time varying regressions we control for differences between the countries with three variables: the fraction of public and the fraction private health expenditures (the last one excluding out of pocket expenditures), both of them obtained from the WHO health database, as well as *GDPpcUSD* or GDP per capita in 2000 US $, gathered from the United Nations database. They are interacted with two levels of regulation, low and medium/high:[23] The low group includes Australia, Czech Republic, Canada, Denmark, Finland, Germany, Hungary, The Netherlands, Norway, Poland, Sweden, Switzerland, UK, and the US; alternatively, the medium/high group includes Argentina, Austria, Belgium, Brazil, Egypt, France, Italy, Japan, Greece, Portugal, Spain.[24]

[22] See, e.g. Berndt et al., 1996; Suslow, 1996; Berndt et al., 1999; and Cockburn and Anis, 2001.

[23] See Table 1 for summary statistics for all the countries. The classification was done by sending the list of countries to three experts in health and pharmaceutical economics, prior to the statistical analysis of our data. We asked them for a classification of countries in the list in three groups. In the very few cases where the classification was not unanimous (no country was ever placed in three different categories), we ranked it according to the majority view. Given the small number of countries in the most regulated category, we decided to finally group them in just two groups.

[24] Note that our classification, for the top countries, in terms of spending, is similar to that employed

Our list of *time invariant* controls starts with the *Av. firm quota*, defined as the average firm quota over the sample period in a given country. *Single Molecule* takes a value of one, if the product consists of a single molecule, and zero otherwise. *Molecule Age*, is the time elapsed since the molecule was launched to December 31, 2003. The age distribution of molecules and products is presented in Table WA2. We also include to *Censor mol. age*, which equals 1 if the product was launched before January 1, 1991 (the date from which we know the exact age information) and zero otherwise; *Censor prod. age*, which equals one for products launched before January 1, 1991 and one otherwise. We also include *# markets molecule* which counts the number of countries a given molecule is present. Therefore it can be interpreted as a proxy of diffusion of a molecule. We finally construct dummies controlling the type of firm: *Local* and *Multinational*, for respectively local-non multinational, and multinational firms (the omitted category). They are interacted with *Market Share* as well as *New*.

For the regression analysis we use log transformations of *Price*, *Firm Sales*, *Global Price Molecule Age*, and *# markets molecule* so we value more the differences in smaller than in larger values.

# 4 Results and interpretation

In this section we present the results from the empirical analysis. We begin with the pooled results for all products – in the complete as well as in some restricted subsamples – and then we proceed with the more detailed results by anatomic therapeutical group (12 groups).

In tables 2 and 3 we respectively present the result of the first and second stage regressions when pooling the information of all countries in sample. In both tables, columns labeled ALL and SINGLE MOL present respectively the all-products and single molecule first stage and second stage results. The rest of the columns in the aforementioned tables present the results when varying the number of countries a corporation is present (study of dimension C) and the number of countries the molecule is present (study of dimension M).[25] The exploration of the results in these two dimensions will help us to, firstly, check the sensitivity of the results to the sample employed, and, secondly, to better understand the underlying common characteristics of the problem. As in the previous section, in all the first stage regressions, we use a IV-FE estimator (with country x product fixed

in Danzon and Chao (2000a, 2000b).

[25]We present results when the sample is restricted to products which belong to corporation or molecules present in 1+ (all sample), 10+ (10C and 10M) or 25 countries (25C, 25M, and 25M+C). Results for other restricted samples are in line with the ones presented here and are available upon request.

effects). Alternatively, in all the second stage regression we use a LS-FE estimator (with molecule fixed effects).

## 4.1 Specification checking

All the first stage regressions have been estimated using a FE-IV estimator. We regarded as potentially endogenous the variables *National Quota*, *Firm Sales*, *Market Share* and *Market Share*$^2$ (interacted with with *Local* and *Multinational*, the omitted category). The potential endogeneity of market shares has been widely documented in many theoretical and applied studies. The endogeneity of *Firm Sales* and *National Quota* is also clear for small and not very diversified firms, and somewhat less clear for large multiproduct firms.

We use all the exogenous and predetermined regressors as instruments and, under the assumption of potential contemporaneous correlation with the error term in (1), but absence of correlation across time, lags of the potentially endogenous variables (*National Quota(-1)*, *Firm Sales(-1)*, *Market Share(-1)* and *Market Share(-1)*$^2$, the latter two interacted with *Local* and *Multinational*, the omitted category), as well as lags of *Product Share*, *Product Share*$^2$ and *HHi-local*. Regarding the validity of the instruments employed, all the specifications reported in Table 2 pass the Sargan-Hansen overidentification test and well as the Anderson canonical underidentification and the Cragg-Donald weak identification tests (not reported but available on request).[26]

## 4.2 Main results

1. The pooling strategy allows us to identify the effect of some aggregate variables, such us the fraction of public and private health expenditure and the per capita GDP. After preliminary exploration of the data we interacted these variables with the level of regulation (low and medium/high). For low regulated countries (REG1), the effect of these variables is positive and highly significant. The implied elasticity of prices to per capita GDP ranges from 0.87 to 1.45, and the elasticity to the fraction of public health expenditure is very stable ranging from 1.47 to 1.93, and, finally, the elasticity to the fraction of private health expenditure is somewhat smaller, ranging from 0.16 to 0.45. For medium and high regulated countries, both the effect of per capita GDP and the fraction of private health expenditures are larger than they are for low regulated countries. The difference seems to increase as we move in either

[26]The Anderson canonical correlation underidentification test is a LM test of whether the equation is identified, i.e., that the excluded instruments are correlated with the endogenous regressors. The Cragg-Donald Wald test the null hypothesis that the instruments are weak.

the C or the M dimensions. In contrast, the effect of the fraction of public health expenditure is consistently lower than in the case of low regulated countries. The difference ranges between practically zero for very diffuse (mature) molecules and -1 for products belonging to corporation present in all countries. These are reasonable results. The fractions of private and public health expenditures are a proxy for several variables that might have a direct impact on prices, such as: insurance, which affects positively prices, as pointed out by Duggan and Scott-Morton (2006); and bargaining power, which affects negatively prices. The insurance component may dominate for low regulated countries, whereas the bargaining element is also important in highly regulated countries.

2. The analysis of country fixed effects, as reported in Table 3 and Figure 1 for selected cases, gives us a very interesting picture of the role of the regulation. First of all, price in regulated or very regulated countries are lower than in less regulated countries, particularly lower than in the US. As we move to a more homogeneous sample in the C dimension (varying the number of countries where a given corporation is present) the price gap is more evident. Alternatively, when we move in the M dimension (varying the number of countries where a given molecule is present), the price gap gets reduced. In fact, the variance of the country effect is 27 percent lower for very diffuse molecules (1.69) than it is for product from corporation present in all countries (2.30). The differences are **also** evident when we look to the last column of Table 3 (were the sample is restricted to products of corporations and molecules present in all countries, see also Figure 1 and Table A for a summary of differences): the average country effect is -2.89, for the regulated or very regulated ones and zero for the low regulated countries.

3. Within the group of less regulated countries we can also document several interesting findings. Firstly, once we control other factors, in the overall sample or the sample of single molecules, there is little evidence than average prices are higher in the US than in other countries, since we find a majority of cases for which the country fixed effect is positive. Note that this finding is in accordance with the results in Danzon and Chao (2000b) but obtained in a more general sample both in terms of products and countries considered. Secondly, as we move in the C dimension (restricting to corporations that are present in more and more countries), all the country specific effects decrease, that is, those positive are closer to zero or change sign to negative (such as Norway or Switzerland) and those negative turn out more negative, but the average differences with respect to the US level increase. Thirdly, when we move

in the M dimension (restricting to molecules that are present in more and more countries), most of the country specific effects increase, the negative become less negative and occasionally switch to positive and the positive become larger.

4. Summarizing, the US has a relatively lower price (compared to other developed countries) for products that are "very common" (probably at a later stage in their life cycle). This is consistent with the explanation that the U.S., through the insistence in competition rather than regulation to contain prices, does well for goods where there can be competition (mostly off-patent, not quite innovative goods). On the other hand, the other (mostly European) developed countries are successful at capping the prices of patented innovative goods, whereas they are less able to contain prices for products where competition could do a good job at restraining prices in the absence of regulation.

5. To finalize we would like to stress a few cases: Canada, Germany and the UK. In the case of Canada, we detect important differences with respect to the US in the overall sample. As we restrict the sample to products from multinational the differences decrease a little. On the contrary, as we move in the diffusion dimension, price differences with Canada turn out to be higher. Once we control for other factors, price differences with respect to the U.S. for Germany and, especially for the UK are mostly positive.

**Table A. Average differential of the country effects to the US level.**

| | | CORP | MOL | C + M | TOP GLOBAL | | TOP LOCAL | |
|---|---|---|---|---|---|---|---|---|
| Regulatory group | All | 25C | 25C | 25C | T200 | T50 | T200 | T50 |
| Regulated/Very Regulated | -1.67 | -3.15 | 0.37 | -2.89 | -1.15 | -3.83 | -2.15 | -1.62 |
| id. exc. Arg, Bra, Egyp | -2.58 | -4.01 | -0.30 | -3.85 | -2.27 | -5.04 | -3.43 | -2.89 |
| Low Regulated | 1.33 | 0.13 | 1.25 | 0.00 | 1.46 | 0.06 | 0.91 | 1.35 |
| *Canada* | -3.20 | -4.45 | -0.82 | -4.38 | -3.02 | -5.90 | -4.41 | -3.81 |
| *Germany* | 0.95 | -0.18 | 0.68 | -0.47 | 0.79 | -0.17 | -0.23 | 0.61 |
| *UK* | 1.81 | 0.54 | 1.55 | 0.56 | 1.81 | 0.73 | 1.34 | 1.78 |

C + M: corporations and molecules present in 25 countries;

Top global: Top (50, 100, 200) selling molecules in sample;

Top local: sample formed by either the 50, 100, 200 top selling molecules in any country

## 4.3 Other findings

1. The effect of the global price is always positive and significant. The elasticity varies between 0.06 and 0.20, depending on the specification: it decreases when the number

of countries in which the corporation is present increases, and it increases with the diffusion of the molecule. It is also interesting to note that the absence of a global price (or global reference, which means the product is innovative) increases significantly the price (around 1/3 if we move in the C dimension, and between 0.40 and 0.7 if we move in the molecule dimension).

2. As expected, new products get a premium which increases in the two dimensions explored. Interestingly, we find that new product launches on the part of purely local innovative firms receive a larger premium than other types of (multinational) firms. As we shall illustrate in the next section (see table 6) the finding is robust to the analysis by therapeutical class.

3. Once we control for product effects, the effect of the market share of a product in its ATC4 class is positive and concave in all the regressions. Note, that the concavity is even more evident and significant for local firms. For example, in the all products regression, the implied effect of market share on prices is positive up to market shares of 0.30 (that is close to the 85 percentile) and 0.59 (above the 99 percentile) for foreign and local firms respectively.

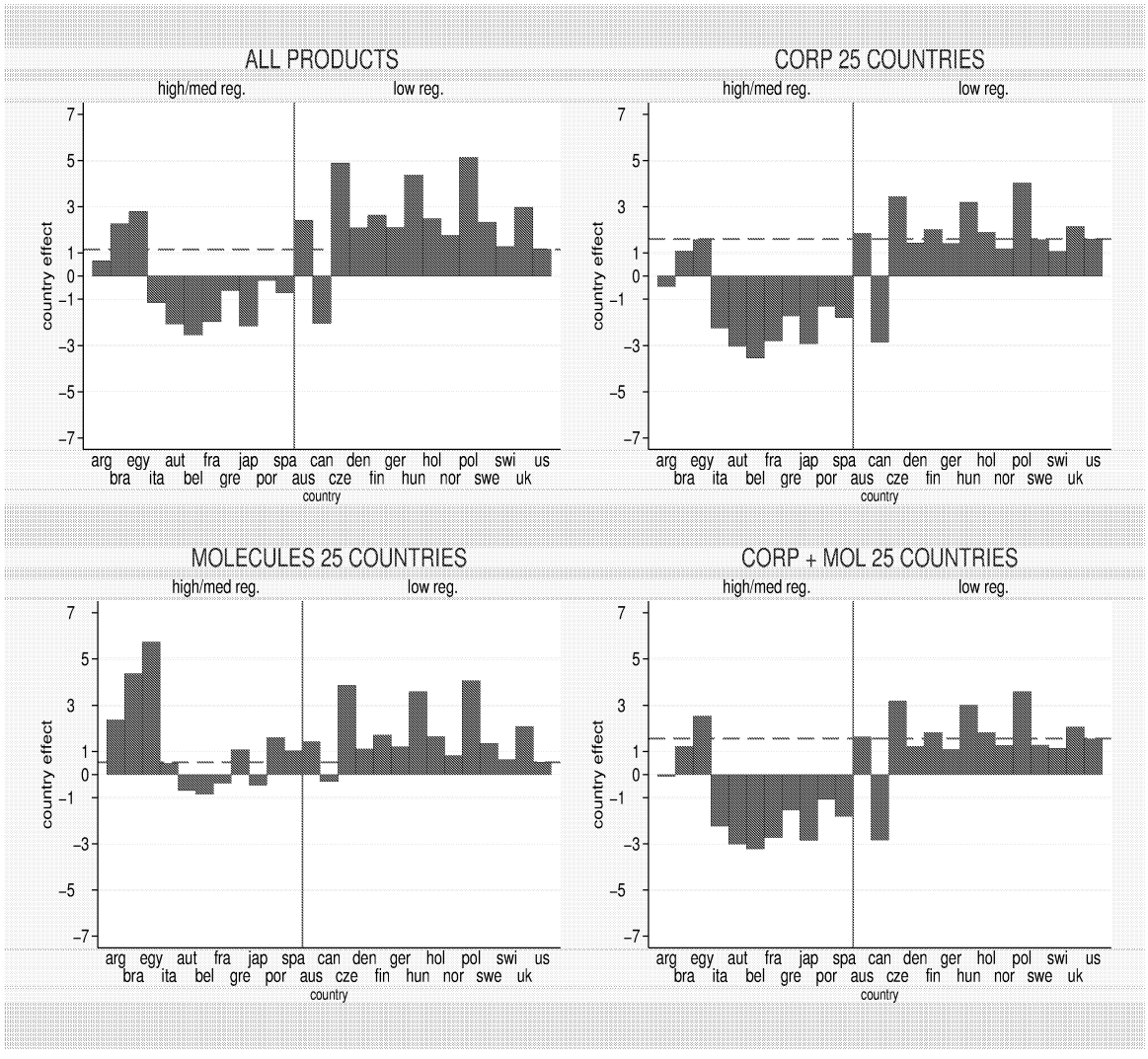
4. In contrast with some previous evidence by Danzon and Furukawa (2003, 2006) or Kyle (2007), the number of generics has a positive but small effect on prices on the global sample. As we will show in section 4.5, however, this result varies by therapeutical class, which could explain why some authors (Grabowski and Vernon, 1992; and Caves et al., 1991) report that brand-name prices increased after the entry of generic competition, while others (Wiggins and Maness, 1994) find a reduction in brand-name prices following entry.

5. In the second stage regressions, being a product from a exclusively-local corporation clearly reduces the price by approximately 16-22 per cent regardless of the dimension studied. As noted above, for the overall sample this effect is compensated by the effect of the Market Share of the corporation, when the market share is above 0.087.

6. Alternatively, being a product from a local multinational has a small positive effect on prices except when the corporation or the molecule are present in a large number of countries. In the latter case, the coefficient even turns out negative.

7. We find that on average the price for generic products is between -0.16 and -0.33 percent lower than other prices. Again, the effect is larger when the sample is restricted to products of corporation and molecules present in many countries.

Figure 1: Country effects for selected models.




note: The dashed line marks the US country effect's level.

## 4.4 Restricting the sample: TOP selling molecules

In order to illustrate the "importance" of product selection in determining some of the results that have been discussed often in the literature we present in tables 4 and 5 the result of the analysis when the sample is restricted to global and local TOP selling molecules. Since the US is the largest country in the sample, its specific demand factors dominate the sample of global TOP selling products. So in a sense, this sample is "biased" toward US "tastes" or needs. Alternatively, the sample of local TOP selling molecules reflects more precisely diversity in local demands.

All the specifications in Table 4 have been estimated by means of a FE-IV estimator using practically the same set of instruments we have used in the previous section and all but one of the columns pass the standard Sargan-Hansen test described above.[27]

With a few exceptions (the effect of *National Share* being the most relevant), the first stage results are in line with those obtained for the whole sample. The key second stage results are summarized in Figure 2, which presents the second stage country specific effects, and Table A, which summarizes the differences with respect to the US case. As it is easy to see from these tables, the average differences with respect to the U.S. for top selling global molecules (those that are the highest selling in the whole sample) turn more negative when we further restrict the sample (from top 200 to top 50). These are typically innovative products that are still in-patent (see Table WA3), those for which the low-regulation U.S. policy is at a higher disadvantage. Given their prominence, and the large negative signs, they may be dominating the public discussion, obscuring the success of the U.S. policy in restricting the prices for products at later stages of their life.

Note that when we expand the analysis considering the TOP local molecules (which captures the local idiosyncratic component and thereby are more adjusted to local demands), the differences with respect to the US are very similar, thus confirming the other results (see again Table A).

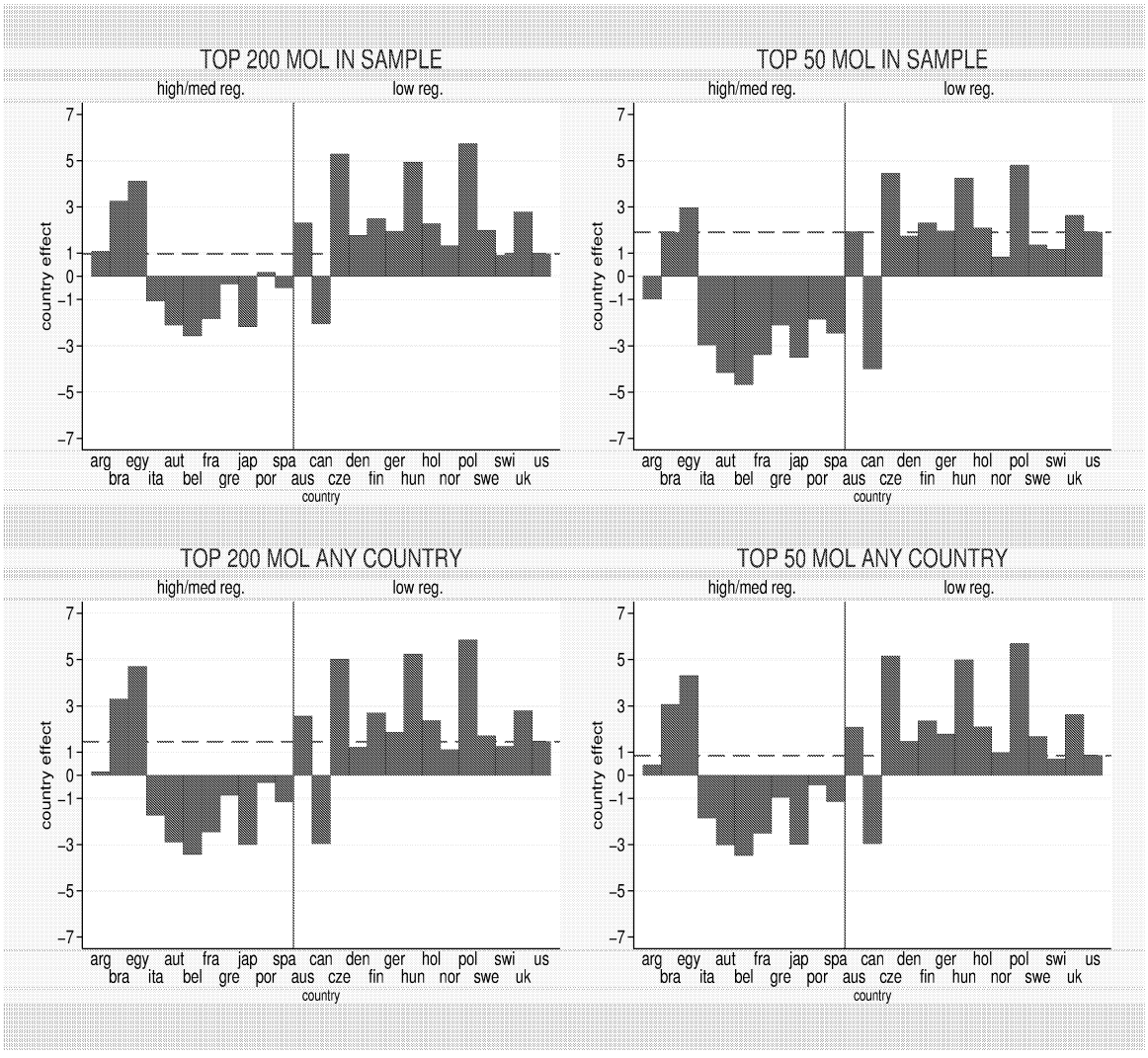
## 4.5 Results when pooling by therapeutical class

In tables 6 and 7 we present the pooled sample results of the first and second stage regressions by therapeutical class (one-digit ATC classes).[28] We only present results when the sample is not restricted in any dimension. As in the previous sections, the first stage regressions have been estimated by FE-IV using the same set of instruments. All

[27] In particular, we have removed *National Share (-1)* and added *HHi-local(-1)* to the list of instruments. See Table 4 below for the final list of instruments used in estimation.

[28] We have analyzed twelve classes: see the appendix for a list and a description of classes.

Figure 2: Country effects for selected models. TOP SELLING PRODUCTS.




note: The dashed line marks the US country effect's level.

but two of the specifications in Table 6 pass the standard Sargan-Hansen test described above. The second stage regression have also been estimated by FE-LS.

As a rule, the analysis by therapeutical class gives a very similar qualitative picture than the pooled analysis we have performed in the previous section. In the first stage regressions we obtain the following results.

1. The effect of the share of national product is in general non-significant with some important exceptions: class B and C, for which it is negative, and classes D, L and M for which it is positive.

2. Once we control for product effects, the effect of the market share of a product in its ATC4 class is positive and concave in only a few classes, L, M, N.

3. We also find that new products from exclusively local producers get a small premium for practically all therapeutical classes.

4. As found in previous studies the effect of the number of generics in the market is ambiguous since it is positive for classes A, N and R and negative for classes J, and M.

5. The results of the country level variables (public and private health expenditure consumption to GDP ratio) are mostly in line with those reported in Table 2. For the low regulated group, the elasticity of the price to the public health expenditure ranges from 1.4 (class C) to 2.86 (class H) and the elasticity of private health expenditure from 0.23 (class B) to 0.57 (class D), and the elasticity to the GDP per capita ranges from 1.16 (class H, non-significant) to 1.59 (class M). Both the effect of private health expenditure and the GDP per capita tend to be larger for more regulated countries. In contrast, the effect of public health expenditure is significantly lower.

The second stage results by therapeutical class clearly confirm that products from exclusively local firms are, other things equal, cheaper than products from multinational corporations. In contrast, we do not detect differences in any therapeutical class between local and foreign multinationals. The results for the rest of the quality variables are, as a rule, in accordance with expectations.

Results for country fixed effects (see Figure 3 for a summary) are also in line with those we discussed in the previous section. For a large number of therapeutical classes, the US is not, other things equal, the country with highest prices. In fact, average prices in low regulated countries are, in a majority of groups, higher. The estimated coefficients for

very regulated countries are negative, which implies that regulation, other things equal, reduces average prices for practically all the anatomical therapeutical classes.

# 5 Conclusions

In this paper we have investigated empirically the determinants of prices for pharmaceuticals in a large sample of countries including the top ten in terms of expenditure. We have used a more extensive database than most previous studies, and we have used a large number of controls and paid a close attention to the empirical strategy and specification.

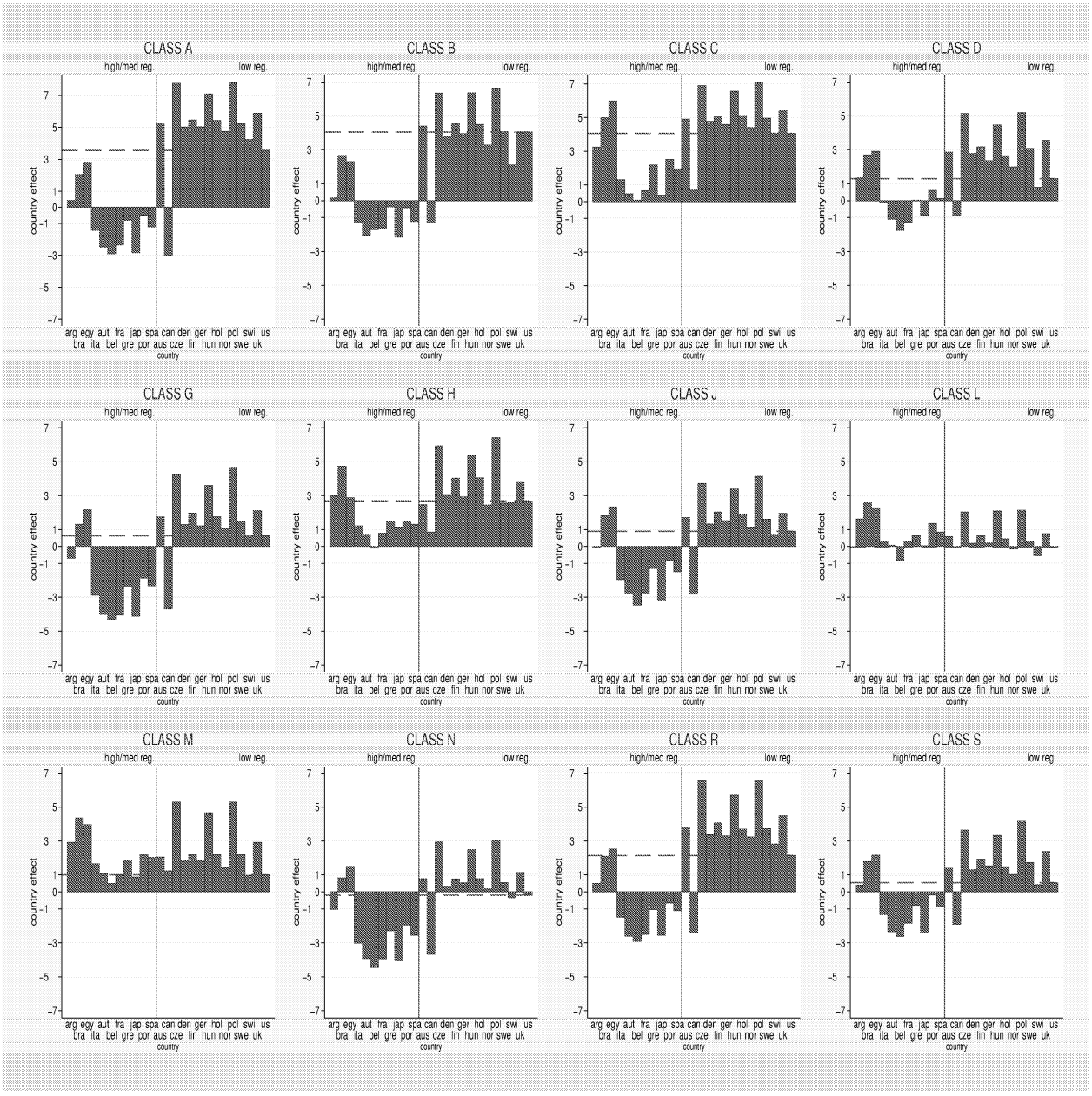
Our results do not support the view that the U.S. has higher prices than the rest of the countries in the sample.[29] First, there is a group of "lightly regulated" countries whose prices are similar or even higher to those of the U.S. In addition, for molecules available in all the countries in the sample, more mature and widely diffused, the price differences are not large, even with more highly regulated countries.

Another robust result, but somewhat contrary to conventional wisdom is that, in most countries, their own multinationals command no price premium with respect to foreign ones. Local, non-multinational firms tend to have lower prices than any multinational, and whether these multinationals are foreign or local does not affect prices in a statistically significant way. Our results, thus, do not support the view that the outcome of regulation conforms with the short-sighted best interest of local consumers. We do have evidence, on the other hand, that quality matters for prices, that firms exercise considerable market power, and that *all* multinational corporations obtain a price advantage.

In this paper we have argued that pharmaceutical prices are not obviously driven by pure rent-shifting motives from politicians. This does not mean that they are set in a way that maximizes welfare. Indeed, these prices have to balance the provision of long term incentives to innovation with the needs of present generations, something that is particularly difficult given the decentralized way in which regulations occur throughout the world. A necessary extension to the current work would be to ascertain empirically the relationship between current prices and socially efficient ones. This would, of course, require further theoretical work to determine a good benchmark (or a set of them) for socially efficient prices.

[29]This confirms and extends prior work of Danzon and Chao (2000b), and contradicts the assertions contained in the U.S. Department of Commerce report (2004).

Figure 3: Country effects by Therapeutical Class (1-digit ATC).




note: The dashed line marks the US country effect's level.

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# A Variable definition and descriptive statistics

| Variable | definition |
|---|---|
| Price | Sales revenue divided by the number of standard units sold (in logs) |
| National share | The market share of all national products in the ATC4 market |
| Market share | Market share of the corporation to which the product belongs in the ATC4 market |
| Firm sales | Firm sales in the country (in logs) |
| new | A dummy taking the value of one if the product was first observed in sample in the previous year |
| # generics | Number of identified generics in the market |
| Global Price | Previous period average global price of the molecule in US real $ |
| Global Price n.a. | A dummy taking the value of one in the absence of a global price of reference |
| Local | A dummy taking the value of one if the corporation is local non-multinational |
| Localmulti | A dummy taking the value of one if the corporation is local but multinational |
| singlemol | A dummy taking the value of one if the product is not composite |
| # markets molecule | Log of the number of markets in which a molecule is present |
| Generic | A dummy taking the value of one if the product is generic |
| Av. firm quota | Average (in sample) firm quota of the firm in a given country |
| molecule age | Time elapsed since the molecule was launched to December 31, 2003. |
| Censor mol. age | A dummy taking the value of one if the molecule was launched before January 1, 1991 |
| Censor prod. age | A dummy taking the value of one if the product was launched before January 1, 1991 |
| % Public Health exp. in GDP | Fraction of public health expenditure in GDP (source: WHO; in logs) |
| % Private Health exp. in GDP | Fraction of private health expenditure in GDP (excluding out-of-pocket exp., source: WHO; in logs) |
| GDPpcUSD | GDP per capita in 2000 US $ (source: UN, in logs) |
| REG | Level of regulation: 1 low, 2 medium/high. |
| HHi-local | The Hirsch and-Herfindähl concentration index for national firms in the ATC4 market |
| Product share in sales | Product share in firm sales |
| | THERAPEUTICAL CLASSES (one-digit ATC) |
| A | ALIMENTARY TRACT AND METABOLISM |
| B | BLOOD AND BLOOD FORMING ORGANS |
| C | CARDIOVASCULAR SYSTEM |
| D | DERMATOLOGICALS |
| G | GENITO URINARY SYSTEM AND SEX HORMONES |
| H | SYSTEMIC HORMONAL PREPARATIONS, EXCL. SEX HORMONES AND INSUL |
| J | ANTIINFECTIVES FOR SYSTEMIC USE |
| L | ANTINEOPLASTIC AND IMMUNOMODULATING AGENTS |
| M | MUSCULO-SKELETAL SYSTEM |
| N | NERVOUS SYSTEM |
| R | RESPIRATORY SYSTEM |
| S | SENSORY ORGANS |

Table 1: Descriptive Statistics

| Variables | | | Countries | | |
|---|---|---|---|---|---|
| Variable | mean | s.d. | country | mean | s.d. |
| price | 3.4875 | 2.111 | arg | .06350 | .2438 |
| National share | .3510 | .347 | bra | .05526 | .2284 |
| Firm sales | 4.1890 | 2.6 | egy | .04345 | .2038 |
| Market share | .0867 | .188 | ita | .04136 | .1991 |
| m.s. *Local | .0031 | .032 | aut | .02947 | .1691 |
| New (-1) | .1173 | .321 | bel | .02103 | .1434 |
| Global Price n.a. | .0934 | .291 | fra | .04122 | .1987 |
| Global Price(-1) | 3.1263 | 2.020 | gre | .02739 | .1632 |
| Local*new (-1) | .0380 | .192 | jap | .04092 | .1981 |
| Localmulti*new(-1) | .0130 | .113 | por | .01905 | .1367 |
| # generics | 5.0421 | 9.398 | spa | .03646 | .1874 |
| fraction pub. health(logs) | -2.8502 | .3149 | aus | .01973 | .1391 |
| fraction pri. health(logs) | -4.7825 | .9957 | can | .05403 | .2260 |
| GDP p.c. US$ | 2.7478 | .8592 | cze | .03155 | .1748 |
| Local | .3172 | .465 | den | .03930 | .1943 |
| Local multi | .1227 | .328 | fin | .01595 | .1252 |
| Molecule age | 7.9448 | .458 | ger | .12904 | .3352 |
| # Markets molecule | 2.3867 | .966 | hun | .02119 | .1440 |
| Censor mol. age | .0436 | .204 | hol | .02105 | .1435 |
| Censor prod. age | .0104 | .101 | nor | .01415 | .1181 |
| Generic | .2047 | .403 | pol | .02875 | .1671 |
| Av. firm quota | 1.6028 | 3.154 | swe | .03045 | .1718 |
| Av. firm quota$^2$ | 12.5209 | 39.2 | swi | .03293 | .1784 |

Table 2: Pooled countries results. 1st stage price equation. Country x Product fixed effects. FE-IV

| | | | | | Varying the # of countries a corporation is present | | | | Varying the # of countries a molecule is present | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ALL | | SINGLE MOL | | CORP +10C | | CORP 25C | | MOL +10C | | MOL 25C | | C+M 25C | |
| | coef | t-stat | coef | t-stat | coef | t-stat | coef | t-stat | coef | t-stat | coef | t-stat | coef | t-stat |
| National Share$^{\aleph}$ | 0.014 | 0.90 | 0.037 | 2.08 | -0.043 | -2.10 | -0.085 | -3.39 | | | 0.195 | 2.78 | -0.002 | -0.02 |
| Firm Sales$^{\aleph}$ | -0.020 | -7.33 | -0.020 | -6.71 | -0.017 | -4.99 | -0.013 | -3.16 | -0.021 | -6.26 | -0.028 | -2.29 | -0.046 | -3.13 |
| Market Share$^{\aleph}$ | 0.121 | 1.51 | 0.180 | 2.00 | 0.268 | 3.56 | 0.203 | 2.44 | 0.195 | 2.19 | 0.716 | 1.97 | 0.590 | 1.88 |
| Market Share$^2\aleph$ | -0.205 | -2.24 | -0.313 | -3.09 | -0.331 | -3.97 | -0.299 | -3.29 | -0.302 | -3.02 | -1.543 | -5.05 | -1.480 | -5.74 |
| Market Share*local | 2.203 | 7.29 | 1.964 | 5.89 | | | | | 3.335 | 5.05 | | | | |
| Market Share$^2$*local | -1.784 | -4.41 | -1.617 | -3.62 | | | | | -2.658 | -1.80 | | | | |
| New(-1) | 0.009 | 2.64 | 0.008 | 2.21 | 0.023 | 7.18 | 0.025 | 6.37 | 0.010 | 2.85 | 0.018 | 1.58 | 0.029 | 2.37 |
| Global Price n.a. | 0.366 | 33.66 | 0.385 | 31.55 | 0.292 | 23.58 | 0.324 | 20.35 | 0.410 | 30.59 | 0.706 | 9.87 | 0.536 | 7.89 |
| Global Price(-1) | 0.080 | 43.14 | 0.081 | 39.30 | 0.057 | 27.47 | 0.060 | 23.07 | 0.085 | 38.39 | 0.202 | 19.01 | 0.156 | 12.55 |
| Local*new(-1) | 0.097 | 18.89 | 0.094 | 16.31 | | | | | 0.093 | 15.18 | 0.106 | 5.20 | | |
| Localmulti*new(-1) | -0.042 | -5.65 | -0.040 | -4.79 | -0.055 | -6.27 | -0.056 | -4.43 | -0.041 | -4.81 | -0.077 | -2.66 | -0.106 | -2.19 |
| # generics(-1) | 0.001 | 4.65 | 0.001 | 3.43 | 0.001 | 2.58 | 0.001 | 1.92 | 0.001 | 3.53 | -0.002 | -1.61 | 0.001 | 0.74 |
| % Pub. health exp | 1.888 | 64.18 | 1.777 | 54.48 | 1.627 | 49.32 | 1.930 | 48.03 | 1.800 | 53.99 | 1.464 | 14.30 | 1.680 | 15.24 |
| % Priv. health exp. | 0.454 | 38.51 | 0.428 | 33.35 | 0.300 | 23.36 | 0.246 | 15.97 | 0.372 | 28.90 | 0.268 | 6.50 | 0.160 | 3.58 |
| GDPpcUSD | 1.393 | 22.46 | 1.447 | 21.25 | 0.974 | 14.65 | 0.976 | 12.03 | 1.438 | 20.78 | 1.504 | 7.14 | 0.864 | 3.87 |
| % Pub. health *High Reg. | -0.793 | -21.30 | -0.759 | -18.30 | -0.656 | -14.99 | -0.987 | -18.64 | -0.753 | -17.63 | -0.012 | -0.09 | -0.706 | -4.75 |
| % Priv. health*High Reg. | 0.133 | 7.85 | 0.140 | 7.54 | 0.281 | 14.44 | 0.387 | 16.26 | 0.223 | 11.82 | 0.329 | 5.53 | 0.428 | 6.27 |
| GDPpcUSD*High Reg. | 0.846 | 11.93 | 0.896 | 11.46 | 1.303 | 16.55 | 1.190 | 12.34 | 0.942 | 11.80 | 1.082 | 4.37 | 1.445 | 5.37 |
| intercept | 5.361 | 32.41 | 4.853 | 26.58 | 5.531 | 28.99 | 6.348 | 27.77 | 4.991 | 26.97 | 4.108 | 7.17 | 5.376 | 8.26 |
| Observations | 131506 | | 106881 | | 68916 | | 43645 | | 93012 | | 9891 | | 4766 | |
| $R^2$ within | 0.321 | | 0.311 | | 0.303 | | 0.322 | | 0.330 | | 0.391 | | 0.390 | |
| $R^2$ between | 0.017 | | 0.014 | | 0.002 | | 0.002 | | 0.016 | | 0.109 | | 0.017 | |
| $R^2$ overall | 0.017 | | 0.015 | | 0.003 | | 0.002 | | 0.017 | | 0.092 | | 0.014 | |
| $\chi^2$ | 33.2e+07 | | 2.8e+07 | | 2.9e+07 | | 2.2e+07 | | 2.8e+07 | | 2.6e+06 | | 2.4e+06 | |
| Sargan(3) | 7.85 | | 6.08 | | 6.53 | | 5.82 | | 4.01 | | 0.89 | | 0.52 | |

Notes $\aleph$: Endogenous regressors. Omitted instruments: Firm sales (-1) (Market Share(-1), Market Share$^2$(-1)) * (Local, Multinational), + Product Share(-1), Product Share(-1)$^2$, National quota (-1), HHi-local(-1). Omitted regressors: time dummies

Table 3: Pooled countries results. 2nd stage regression of the 1st stage average residual. Molecule fixed effects

| | | | | | Varying the # of countries a corporation is present | | | | Varying the # of countries a molecule is present | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ALL | | SINGLE MOL | | CORP +10C | | CORP 25C | | MOL +10C | | MOL 25C | | C+M 25C | |
| | coef | t-stat | coef | t-stat | coef | t-stat | coef | t-stat | coef | t-stat | coef | t-stat | coef | t-stat |
| Local | -0.187 | -10.50 | -0.188 | -9.69 | . | . | . | . | -0.164 | -7.58 | -0.215 | -5.87 | . | . |
| Local multinational | 0.052 | 2.38 | 0.043 | 1.84 | 0.085 | 3.04 | 0.016 | 0.44 | 0.068 | 2.64 | -0.068 | -1.48 | -0.046 | -0.70 |
| Molecule Age | -0.104 | -4.15 | -0.112 | -4.15 | -0.059 | -2.12 | -0.060 | -1.90 | -0.084 | -2.97 | -0.194 | -2.04 | -0.048 | -0.77 |
| # markets molecule | -0.036 | -0.38 | -0.025 | -0.23 | -0.061 | -0.26 | 0.085 | 0.51 | 0.205 | 0.43 | . | . | . | . |
| Censor mol. age | -0.059 | -0.89 | -0.046 | -0.67 | -0.059 | -0.68 | -0.074 | -0.58 | -0.058 | -0.74 | 0.400 | 2.56 | 0.004 | 0.02 |
| Censor prod. age | 0.054 | 0.84 | 0.068 | 0.99 | 0.064 | 0.70 | 0.111 | 0.80 | 0.021 | 0.30 | -0.254 | -0.91 | -0.072 | -0.36 |
| Generic | -0.172 | -5.88 | -0.174 | -6.08 | -0.191 | -4.50 | -0.170 | -2.88 | -0.163 | -5.06 | -0.211 | -2.37 | -0.319 | -4.38 |
| arg | -0.491 | -6.01 | -0.442 | -5.16 | -1.568 | -19.50 | -2.047 | -25.26 | -0.274 | -2.96 | 1.834 | 7.87 | -1.616 | -8.93 |
| bra | 1.101 | 13.12 | 1.202 | 13.61 | 0.055 | 0.78 | -0.505 | -6.98 | 1.434 | 16.37 | 3.835 | 20.82 | -0.327 | -2.49 |
| egy | 1.639 | 12.92 | 1.823 | 13.42 | 0.665 | 6.54 | -0.024 | -0.23 | 2.140 | 15.12 | 5.208 | 21.56 | 0.975 | 3.71 |
| ita | -2.304 | -26.96 | -2.342 | -25.98 | -3.434 | -51.09 | -3.839 | -57.54 | -2.139 | -22.87 | -0.051 | -0.24 | -3.775 | -27.81 |
| aut | -3.218 | -48.06 | -3.236 | -46.86 | -4.307 | -65.91 | -4.628 | -69.09 | -3.064 | -41.82 | -1.217 | -4.85 | -4.555 | -26.08 |
| bel | -3.696 | -48.64 | -3.714 | -46.24 | -4.761 | -69.24 | -5.133 | -71.51 | -3.562 | -42.30 | -1.365 | -5.87 | -4.772 | -26.27 |
| fra | -3.128 | -42.30 | -3.170 | -41.40 | -4.155 | -57.28 | -4.400 | -55.91 | -2.971 | -36.34 | -0.895 | -3.76 | -4.280 | -22.02 |
| gre | -1.775 | -20.45 | -1.762 | -20.53 | -2.905 | -42.12 | -3.312 | -47.04 | -1.546 | -15.92 | 0.541 | 1.69 | -3.083 | -23.40 |
| jap | -3.311 | -31.86 | -3.448 | -33.39 | -4.369 | -43.83 | -4.526 | -41.70 | -3.176 | -26.93 | -0.987 | -2.07 | -4.402 | -19.29 |
| por | -1.339 | -16.63 | -1.318 | -15.57 | -2.480 | -33.83 | -2.894 | -37.60 | -1.106 | -12.60 | 1.065 | 4.05 | -2.624 | -13.30 |
| spa | -1.882 | -22.91 | -1.890 | -22.03 | -3.004 | -40.09 | -3.380 | -42.25 | -1.686 | -18.53 | 0.491 | 1.65 | -3.360 | -24.21 |
| aus | 1.257 | 15.71 | 1.238 | 14.73 | 0.490 | 6.63 | 0.258 | 3.57 | 1.160 | 12.95 | 0.898 | 2.94 | 0.072 | 0.38 |
| can | -3.203 | -55.47 | -3.225 | -56.09 | -4.140 | -66.53 | -4.450 | -65.53 | -3.066 | -43.28 | -0.818 | -3.81 | -4.383 | -35.50 |
| cze | 3.728 | 48.30 | 3.695 | 47.41 | 2.122 | 29.30 | 1.846 | 23.10 | 3.476 | 41.37 | 3.329 | 14.94 | 1.639 | 10.56 |
| den | 0.922 | 13.30 | 0.868 | 11.77 | 0.183 | 2.20 | -0.172 | -2.19 | 0.732 | 9.70 | 0.585 | 2.88 | -0.331 | -2.74 |
| fin | 1.472 | 20.77 | 1.409 | 18.69 | 0.661 | 9.42 | 0.421 | 5.48 | 1.312 | 16.67 | 1.187 | 5.21 | 0.273 | 2.12 |
| ger | 0.946 | 14.54 | 0.951 | 13.93 | 0.134 | 2.09 | -0.182 | -2.66 | 0.812 | 11.34 | 0.680 | 4.24 | -0.468 | -4.14 |
| hun | 3.218 | 44.83 | 3.266 | 42.94 | 1.741 | 26.23 | 1.603 | 22.60 | 3.139 | 39.69 | 3.056 | 16.15 | 1.448 | 9.61 |
| hol | 1.329 | 18.56 | 1.315 | 17.63 | 0.537 | 8.07 | 0.300 | 4.41 | 1.218 | 15.41 | 1.120 | 4.62 | 0.263 | 1.48 |
| nor | 0.603 | 8.44 | 0.552 | 7.34 | -0.031 | -0.43 | -0.409 | -5.51 | 0.403 | 5.14 | 0.298 | 1.32 | -0.292 | -1.65 |
| pol | 3.973 | 53.94 | 3.939 | 52.16 | 2.511 | 36.22 | 2.424 | 30.71 | 3.857 | 47.92 | 3.536 | 11.89 | 2.040 | 8.94 |
| swe | 1.171 | 17.56 | 1.133 | 16.28 | 0.397 | 6.12 | -0.016 | -0.22 | 0.974 | 13.28 | 0.805 | 4.16 | -0.276 | -2.14 |
| swi | 0.116 | 1.35 | 0.088 | 0.97 | -0.343 | -4.51 | -0.527 | -6.87 | 0.059 | 0.63 | 0.113 | 0.37 | -0.417 | -3.28 |
| uk | 1.811 | 23.97 | 1.776 | 21.88 | 0.887 | 12.09 | 0.545 | 7.71 | 1.604 | 19.30 | 1.553 | 8.13 | 0.497 | 3.59 |
| cons | 1.158 | 3.85 | 1.228 | 3.51 | 1.692 | 2.56 | 1.597 | 3.16 | 0.219 | 0.15 | 0.526 | 0.56 | 1.548 | 2.80 |
| N | 37837 | | 30837 | | 18753 | | 11438 | | 26937 | | 2736 | | 1154 | |
| r2 w | 0.828 | | 0.827 | | 0.874 | | 0.889 | | 0.828 | | 0.780 | | 0.860 | |
| r2 b | 0.387 | | 0.321 | | 0.411 | | 0.426 | | 0.208 | | 0.051 | | 0.191 | |
| r2 o | 0.554 | | 0.564 | | 0.549 | | 0.550 | | 0.553 | | 0.620 | | 0.692 | |

t-statistics obtained from clustered (Market) standard errors.
2nd stage omitted regressors: (Av quota, Av. quota$^2$). Omitted country: US.

Table 4: Pooled countries results. 1st stage price equation. Top product analysis. Country x Product fixed effects. FE-IV

| | Top selling products in sample | | | | | | Top products for each country | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TOP 200 | | TOP 100 | | TOP 50 | | TOP 200 | | TOP 100 | | TOP 50 | |
| | coef | t-stat | coef | t-stat | coef | t-stat | coef | t-stat | coef | t-stat | coef | t-stat |
| National Share$^{\aleph}$ | -1.301 | -1.76 | -1.073 | -1.15 | 0.850 | 1.50 | 0.053 | 0.22 | 0.138 | 0.43 | 0.045 | 0.10 |
| Firm Sales$^{\aleph}$ | -0.357 | -3.77 | -0.469 | -2.65 | -0.274 | -0.90 | -0.170 | -6.44 | -0.202 | -5.22 | -0.275 | -4.46 |
| Market Share$^{\aleph}$ | 1.132 | 5.16 | 1.937 | 5.49 | 2.001 | 2.86 | 0.460 | 5.18 | 0.499 | 4.73 | 0.746 | 5.10 |
| Market Share$^2\aleph$ | -1.093 | -5.52 | -1.915 | -5.65 | -2.058 | -3.59 | -0.480 | -4.66 | -0.519 | -4.45 | -0.754 | -4.76 |
| Market Share*local | 19.582 | 4.77 | 36.648 | 3.55 | 60.362 | 1.23 | 5.098 | 7.40 | 7.013 | 5.55 | 11.820 | 6.41 |
| Market Share$^2$*local | -16.574 | -3.12 | -130.50 | -3.29 | -591.06 | -1.26 | -3.804 | -4.52 | -7.190 | -3.51 | -17.236 | -5.75 |
| New(-1) | -0.010 | -1.11 | 0.003 | 0.28 | -0.001 | -0.05 | -0.007 | -1.58 | -0.006 | -1.14 | -0.006 | -0.86 |
| Global Price n.a. | 0.737 | 20.26 | 0.769 | 12.73 | 0.852 | 6.90 | 0.447 | 28.67 | 0.567 | 28.18 | 0.715 | 25.41 |
| Global Price(-1) | 0.138 | 21.73 | 0.153 | 13.87 | 0.184 | 6.80 | 0.098 | 36.29 | 0.115 | 33.75 | 0.140 | 29.55 |
| Local*new(-1) | 0.200 | 7.01 | 0.223 | 4.18 | 0.147 | 1.96 | 0.141 | 15.55 | 0.141 | 11.94 | 0.169 | 9.25 |
| Localmulti*new(-1) | -0.004 | -0.18 | 0.003 | 0.13 | 0.005 | 0.17 | -0.035 | -3.51 | -0.038 | -3.14 | -0.039 | -2.58 |
| # generics(-1) | 0.003 | 2.30 | 0.004 | 2.39 | 0.001 | 0.29 | 0.002 | 3.81 | 0.001 | 1.70 | 0.001 | 0.55 |
| % Pub. health exp | 2.299 | 24.43 | 2.560 | 13.06 | 2.808 | 6.44 | 2.015 | 46.20 | 2.019 | 38.33 | 2.226 | 31.12 |
| % Priv. health exp. | 0.406 | 11.86 | 0.392 | 6.20 | 0.305 | 4.69 | 0.448 | 28.62 | 0.426 | 22.32 | 0.430 | 17.93 |
| GDPpcUSD | 1.541 | 8.37 | 1.407 | 4.87 | 1.694 | 4.43 | 1.827 | 19.03 | 1.891 | 16.66 | 1.919 | 13.56 |
| % Pub. health *High Reg. | -0.947 | -8.87 | -1.068 | -6.62 | -1.034 | -4.92 | -0.825 | -16.94 | -0.812 | -13.22 | -0.967 | -12.03 |
| % Priv. health*High Reg. | 0.319 | 6.83 | 0.423 | 7.16 | 0.561 | 6.58 | 0.220 | 10.94 | 0.301 | 12.78 | 0.335 | 11.44 |
| GDPpcUSD*High Reg. | 1.405 | 7.55 | 1.568 | 5.47 | 1.508 | 3.87 | 0.907 | 9.82 | 1.018 | 9.35 | 1.171 | 8.41 |
| intercept | 12.168 | 6.77 | 15.112 | 4.17 | 11.108 | 2.05 | 7.395 | 14.78 | 7.843 | 10.73 | 9.286 | 8.32 |
| Observations | 36900 | | 17322 | | 9844 | | 98503 | | 74687 | | 52219 | |
| $R^2$ within | 0.036 | | . | | 0.315 | | 0.256 | | 0.250 | | 0.200 | |
| $R^2$ between | 0.003 | | 0.002 | | 0.020 | | 0.008 | | 0.010 | | 0.006 | |
| $R^2$ overall | 0.003 | | 0.003 | | 0.024 | | 0.009 | | 0.011 | | 0.007 | |
| $\chi^2$ | 9.5e+06 | | 4.5e+06 | | 3.4e+06 | | 2.5e+07 | | 2.0e+07 | | 1.4e+07 | |
| Sargan (3) | 3.3 | | 6.1 | | 13.6 | | 4.2 | | 3.8 | | 6.9 | |

Notes $\aleph$: Endogenous regressors. Omitted instruments: Firm sales (-1) (Market Share(-1), Market Share$^2$(-1)) * (Local, Multinational) + Product Share(-1), Product Share(-1)$^2$, National quota (-1), HHi-local(-1). Omitted regressors: time dummies

Table 5: Pooled countries results. 2nd stage regression of the 1st stage average residual. Top products analysis. Molecule fixed effects

| | Top selling products in sample | | | | | | Top selling products for each country | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TOP 200 | | TOP 100 | | TOP 50 | | TOP 200 | | TOP 100 | | TOP 50 | |
| | coef | t-stat | coef | t-stat | coef | t-stat | coef | t-stat | coef | t-stat | coef | t-stat |
| Local | -1.026 | -41.85 | -1.794 | -33.95 | -2.355 | -37.24 | -1.569 | -30.34 | -1.179 | -41.19 | -1.554 | -39.39 |
| Local multinational | -0.200 | -7.21 | -0.359 | -6.11 | -0.752 | -12.83 | -0.672 | -7.91 | -0.297 | -9.75 | -0.386 | -9.93 |
| Molecule Age | -0.103 | -3.57 | -0.012 | -0.24 | 0.015 | 0.15 | -0.089 | -0.66 | -0.062 | -1.76 | -0.057 | -1.33 |
| Censor mol. age | -0.092 | -1.12 | -0.004 | -0.02 | -0.082 | -0.46 | 0.175 | 0.61 | -0.103 | -1.11 | -0.115 | -1.00 |
| Censor prod. age | 0.097 | 1.24 | 0.031 | 0.14 | 0.125 | 0.42 | -0.258 | -0.75 | 0.222 | 2.32 | 0.323 | 2.23 |
| Generic | -0.147 | -4.49 | -0.243 | -3.26 | -0.342 | -3.57 | -0.289 | -2.39 | -0.145 | -3.59 | -0.146 | -2.88 |
| arg | 0.111 | 1.04 | -1.977 | -8.44 | -2.875 | -14.76 | -1.309 | -5.74 | 0.266 | 2.08 | -0.401 | -2.14 |
| bra | 2.264 | 21.51 | 0.564 | 3.25 | -0.009 | -0.04 | 1.845 | 6.13 | 2.600 | 21.23 | 2.216 | 12.86 |
| egy | 3.130 | 21.52 | 1.656 | 8.24 | 1.058 | 5.21 | 3.253 | 10.13 | 3.686 | 23.70 | 3.454 | 16.87 |
| ita | -2.035 | -21.04 | -4.244 | -25.58 | -4.865 | -27.62 | -3.183 | -13.69 | -1.921 | -16.47 | -2.693 | -16.31 |
| aut | -3.081 | -35.76 | -5.577 | -31.83 | -6.060 | -32.48 | -4.335 | -20.26 | -3.019 | -29.02 | -3.865 | -25.59 |
| bel | -3.546 | -37.76 | -5.930 | -31.69 | -6.585 | -31.93 | -4.880 | -18.67 | -3.493 | -31.49 | -4.313 | -27.68 |
| fra | -2.811 | -30.54 | -4.972 | -31.78 | -5.282 | -30.43 | -3.907 | -13.18 | -2.639 | -23.94 | -3.349 | -21.16 |
| gre | -1.294 | -12.37 | -3.312 | -17.45 | -4.006 | -17.09 | -2.309 | -6.87 | -1.127 | -9.42 | -1.792 | -10.73 |
| jap | -3.151 | -24.99 | -4.728 | -22.00 | -5.404 | -24.10 | -4.445 | -11.98 | -3.053 | -20.84 | -3.830 | -22.40 |
| por | -0.813 | -8.30 | -3.120 | -17.27 | -3.752 | -19.66 | -1.772 | -5.53 | -0.585 | -4.96 | -1.255 | -7.62 |
| spa | -1.468 | -14.67 | -3.693 | -21.51 | -4.347 | -22.57 | -2.601 | -8.79 | -1.292 | -10.71 | -1.991 | -12.04 |
| aus | 1.329 | 13.64 | 0.268 | 1.52 | 0.015 | 0.09 | 1.099 | 3.85 | 1.316 | 11.51 | 1.226 | 7.83 |
| can | -3.019 | -47.01 | -5.266 | -42.13 | -5.897 | -39.55 | -4.408 | -17.53 | -2.937 | -37.33 | -3.803 | -39.74 |
| cze | 4.312 | 45.18 | 2.814 | 18.12 | 2.545 | 15.03 | 3.575 | 12.67 | 4.300 | 40.23 | 4.303 | 29.41 |
| den | 0.793 | 9.52 | 0.137 | 0.92 | -0.163 | -0.91 | -0.234 | -1.02 | 0.713 | 7.07 | 0.613 | 4.31 |
| fin | 1.521 | 18.42 | 0.530 | 3.84 | 0.394 | 2.41 | 1.244 | 4.98 | 1.513 | 14.67 | 1.504 | 10.82 |
| ger | 0.973 | 11.85 | 0.275 | 1.52 | 0.057 | 0.30 | 0.401 | 1.56 | 0.987 | 9.83 | 0.922 | 6.32 |
| hun | 3.957 | 45.31 | 2.543 | 15.32 | 2.344 | 15.80 | 3.786 | 13.87 | 4.082 | 39.77 | 4.142 | 28.49 |
| hol | 1.306 | 14.23 | 0.412 | 2.46 | 0.181 | 1.03 | 0.916 | 3.43 | 1.285 | 11.57 | 1.240 | 7.85 |
| nor | 0.336 | 3.86 | -0.689 | -4.00 | -1.065 | -6.32 | -0.348 | -1.14 | 0.263 | 2.56 | 0.128 | 0.88 |
| pol | 4.764 | 51.62 | 3.343 | 19.46 | 2.905 | 13.36 | 4.406 | 16.37 | 4.816 | 43.84 | 4.860 | 31.54 |
| swe | 1.018 | 12.18 | -0.221 | -1.53 | -0.543 | -3.55 | 0.258 | 0.99 | 0.943 | 9.25 | 0.826 | 5.81 |
| swi | -0.069 | -0.70 | -0.625 | -2.90 | -0.741 | -3.95 | -0.213 | -0.75 | -0.081 | -0.71 | -0.147 | -0.89 |
| uk | 1.806 | 19.99 | 0.954 | 4.75 | 0.734 | 2.93 | 1.341 | 5.23 | 1.802 | 16.51 | 1.777 | 11.86 |
| cons | 0.977 | 3.93 | 1.653 | 3.58 | 1.905 | 2.44 | 1.450 | 1.21 | 0.527 | 1.79 | 0.847 | 2.41 |
| N | 28425 | | 10779 | | 5164 | | 2997 | | 21666 | | 15237 | |
| r2 w | 0.843 | | 0.852 | | 0.865 | | 0.895 | | 0.849 | | 0.870 | |
| r2 b | 0.286 | | 0.355 | | 0.314 | | 0.083 | | 0.226 | | 0.311 | |
| r2 o | 0.598 | | 0.678 | | 0.704 | | 0.762 | | 0.605 | | 0.675 | |

t-statistics obtained from clustered (market) standard errors.
2nd stage omitted regressors: (Av. firm size, Av. firm size$^2$). Omitted country: US.

Table 6: Pooled countries results by therapeutical class. 1st stage price equation. Country x Product fixed effects. All products. FE-IV

| | Therapeutical class | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | G | H | J | L | M | N | R | S |
| | coef. | coef. | coef. | coef. | coef. | coef. | coef. | coef. | coef. | coef. | coef. | coef. |
| National Share$^{\aleph}$ | 0.039 | -0.504** | -0.249** | 0.155** | -0.082 | -0.035 | -0.065 | 0.346** | 0.419** | 0.011 | 0.003 | 0.117 |
| Firm Sales$^{\aleph}$ | -0.038** | 0.054 | -0.018** | -0.002 | -0.004 | -0.082* | -0.006 | 0.007 | -0.007 | -0.012 | -0.021* | -0.034** |
| Market Share$^{\aleph}$ | -0.835** | 1.181 | 0.107 | 0.214 | 0.186 | -2.517 | 0.364 | 1.034** | 2.404** | 0.792* | 0.236 | -0.956* |
| Market Share$^2\aleph$ | 0.917** | -0.499 | -0.010 | -0.010 | -0.066 | 2.904 | -0.468* | -1.254** | -4.012** | -0.962** | -0.164 | 0.954 |
| Market Share*local | 1.594 | 0.900 | 2.315** | 1.354 | 0.675 | 0.755 | 8.189** | -2.412 | 1.827 | 2.313 | 12.534** | 5.671** |
| Market Share$^2$*local | 0.491 | -5.251 | -1.305 | -4.754 | 0.602 | -1.983 | -11.654** | 2.451 | -12.574 | -1.393 | -4.441 | -5.415** |
| New(-1) | -0.001 | 0.043 | 0.021** | 0.003 | 0.024** | -0.003 | 0.001 | 0.016 | 0.006 | 0.009 | 0.011 | 0.002 |
| Global Price n.a. | 0.441** | 0.159 | 0.537** | 0.336** | 0.712** | 0.172 | 0.617** | 0.162* | 0.271** | 0.519** | 0.271** | 0.238** |
| Global Price(-1) | 0.134** | 0.019 | 0.165** | 0.096** | 0.156** | 0.020 | 0.095** | 0.018* | 0.047** | 0.119** | 0.096** | 0.061** |
| Local*new(-1) | 0.083** | 0.140* | 0.107** | 0.084** | 0.081** | -0.042 | 0.151** | 0.102* | 0.072** | 0.084** | 0.084** | 0.098** |
| Localmulti*new(-1) | -0.068** | -0.058 | -0.036 | -0.054 | -0.065** | -0.020 | -0.044 | -0.044 | -0.030 | 0.006 | -0.027 | -0.013 |
| # generics(-1) | 0.004** | 0.004 | 0.001 | 0.003 | 0.002 | 0.009 | -0.011** | 0.004 | -0.009** | 0.004** | 0.009** | -0.003 |
| % Pub. health exp | 2.014** | 1.673** | 1.418** | 1.924** | 2.262** | 2.863** | 2.032** | 1.501** | 1.564** | 1.401** | 1.936** | 2.007** |
| % Priv. health exp. | 0.570** | 0.264* | 0.339** | 0.571** | 0.428** | 0.431** | 0.385** | 0.228** | 0.502** | 0.366** | 0.547** | 0.447** |
| GDPpcUSD | 1.174** | 1.593* | 1.309** | 1.245** | 1.313** | 1.165 | 1.256** | 1.067** | 1.588** | 1.266** | 1.369** | 1.275** |
| % Pub. health *High Reg. | -1.236** | -1.026* | -0.597** | -0.464** | -0.876** | -1.028* | -0.831** | -0.429 | -0.407* | -0.459** | -0.933** | -0.663** |
| % Priv. health*High Reg. | -0.091* | -0.271 | 0.212** | 0.025 | 0.207** | 0.226 | 0.320** | 0.503** | 0.143 | 0.141** | -0.021 | 0.157* |
| GDPpcUSD*High Reg. | 1.187** | 0.440 | 1.169** | 0.742** | 1.236** | 0.281 | 1.108** | 0.516 | 0.146 | 1.215** | 1.074** | 0.763** |
| intercept | 4.566** | 4.071* | 3.240** | 6.076** | 6.452** | 11.588** | 7.426** | 9.206** | 5.264** | 3.929** | 4.160** | 5.417** |
| Observations | 24704 | 2091 | 17649 | 10675 | 11512 | 1779 | 11341 | 4888 | 6224 | 15840 | 14498 | 9613 |
| $R^2$ within | 0.336 | 0.115 | 0.363 | 0.358 | 0.430 | 0.246 | 0.379 | 0.174 | 0.297 | 0.324 | 0.265 | 0.319 |
| $R^2$ between | 0.003 | 0.002 | 0.065 | 0.046 | 0.027 | 0.013 | 0.036 | 0.025 | 0.025 | 0.009 | 0.023 | 0.032 |
| $R^2$ overall | 0.004 | 0.000 | 0.080 | 0.048 | 0.023 | 0.018 | 0.038 | 0.039 | 0.023 | 0.012 | 0.024 | 0.032 |
| $\chi^2$ | 4.1e+06 | 849882.4 | 4.2e+06 | 1.9e+06 | 4.7e+06 | 621790.0 | 6.7e+06 | 3.8e+06 | 1.2e+06 | 5.0e+06 | 1.6e+06 | 913326. |
| Sargan (3) | 6.42 | 9.67 | 5.88 | 8.88 | 1.80 | 12.51 | 2.14 | 2.51 | 2.95 | 4.56 | 0.53 | 3.34 |

Notes $\aleph$: Endogenous regressors. Omitted instruments: Firm sales (-1) (Market Share(-1), Market Share$^2$(-1)) * (Local, Multinational) +
Product Share(-1), Product Share(-1)$^2$, National quota (-1), HHi-local(-1) [The last two are not used in columns (25M and 25M+C]. Omitted regressors: time dummies

Table 7: Pooled countries results by Therapeutical Class. 2nd stage regression of the 1st stage average residual. Molecule fixed effects. All products

| | Therapeutical class | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | G | H | J | L | M | N | R | S |
| | coef. | coef. | coef. | coef. | coef. | coef. | coef. | coef. | coef. | coef. | coef. | coef. |
| Local | -0.302** | -0.017 | -0.127** | -0.215** | -0.221** | -0.272 | -0.168** | -0.089 | -0.143 | -0.085* | -0.158** | -0.150 |
| Local multinational | 0.035 | 0.204 | 0.086** | -0.049 | 0.024 | -0.256 | 0.059 | -0.032 | 0.008 | 0.024 | 0.105* | 0.070 |
| Molecule Age | -0.175** | -0.213 | -0.042 | -0.410** | -0.058 | -0.333 | -0.064 | -0.071 | -0.167* | 0.003 | -0.142* | -0.100 |
| # markets molecule | -0.252 | . | -1.234** | 0.949 | 0.153 | . | 0.068 | . | -0.243 | 0.268** | -0.101 | 0.160** |
| Censor mol. age | -0.190** | -2.576** | -0.211 | -0.025 | 0.102 | 1.130** | -0.128 | -0.244 | -0.214 | -0.083 | -0.049 | 0.328 |
| Censor prod. age | 0.095 | 2.633** | 0.203 | 0.136 | -0.092 | -0.908* | 0.056 | 0.029 | 0.038 | -0.054 | 0.061 | -0.076 |
| Generic | -0.168** | 0.323 | -0.261** | -0.121 | 0.021 | -0.239 | -0.011 | -0.337** | -0.213** | -0.174* | -0.409** | -0.147 |
| arg | -3.149** | -3.895** | -0.823** | 0.050 | -1.316** | 0.338 | -0.957** | 1.646** | 1.908** | -0.829** | -1.657** | -0.146 |
| bra | -1.512** | -1.395* | 0.927** | 1.396** | 0.688** | 2.059* | 0.939** | 2.605** | 3.340** | 1.019** | -0.049 | 1.250** |
| egy | -0.747** | -1.744** | 1.930** | 1.614** | 1.534** | 0.193 | 1.432** | 2.305** | 2.956** | 1.693** | 0.382 | 1.627** |
| ita | -5.015** | -5.350** | -2.766** | -1.398** | -3.505** | -1.476** | -2.841** | 0.352 | 0.646** | -2.819** | -3.631** | -1.873** |
| aut | -6.055** | -6.105** | -3.593** | -2.397** | -4.641** | -1.970** | -3.633** | 0.104 | 0.064 | -3.728** | -4.755** | -2.866** |
| bel | -6.471** | -5.756** | -3.964** | -3.039** | -4.919** | -2.768** | -4.333** | -0.781** | -0.511* | -4.250** | -5.067** | -3.161** |
| fra | -5.910** | -5.671** | -3.400** | -2.575** | -4.669** | -1.901** | -3.630** | 0.294 | 0.011 | -3.746** | -4.649** | -2.384** |
| gre | -4.383** | -4.427** | -1.872** | -1.272** | -2.953** | -1.196** | -2.187** | 0.657** | 0.846** | -2.094** | -3.188** | -1.333** |
| jap | -6.410** | -6.199** | -3.675** | -2.159** | -4.738** | -1.540** | -4.049** | 0.066 | -0.138 | -3.862** | -4.695** | -2.935** |
| por | -4.068** | -4.477** | -1.550** | -0.690* | -2.486** | -1.201* | -1.690** | 1.389** | 1.225** | -1.752** | -2.799** | -0.709* |
| spa | -4.793** | -5.281** | -2.105** | -1.166** | -2.938** | -1.373** | -2.386** | 0.881** | 1.016** | -2.365** | -3.241** | -1.403** |
| aus | 1.648** | 0.333 | 0.853** | 1.573** | 1.113** | -0.211 | 0.809** | 0.606* | 1.039** | 0.965** | 1.676** | 0.855** |
| can | -6.600** | -5.355** | -3.380** | -2.174** | -4.315** | -1.838** | -3.697** | 0.042 | 0.230 | -3.482** | -4.547** | -2.443** |
| cze | 4.220** | 2.293** | 2.848** | 3.846** | 3.648** | 3.265** | 2.825** | 2.068** | 4.281** | 3.138** | 4.414** | 3.112** |
| den | 1.459** | -0.245 | 0.711** | 1.488** | 0.672** | 0.375 | 0.431 | 0.207 | 0.834** | 0.524** | 1.232** | 0.769** |
| fin | 1.890** | 0.479 | 0.982** | 1.877** | 1.341** | 1.343** | 1.149** | 0.678** | 1.211** | 0.963** | 1.920** | 1.391** |
| ger | 1.463** | -0.107 | 0.527** | 1.064** | 0.583* | 0.247 | 0.642** | 0.232 | 0.825** | 0.726** | 1.147** | 1.000** |
| hun | 3.514** | 2.307** | 2.499** | 3.169** | 2.968** | 2.682** | 2.496** | 2.136** | 3.663** | 2.682** | 3.561** | 2.791** |
| hol | 1.860** | 0.431 | 1.060** | 1.351** | 1.125** | 1.357** | 1.030** | 0.486** | 1.181** | 0.967** | 1.550** | 0.948** |
| nor | 1.164** | -0.775 | 0.346 | 0.687* | 0.440 | -0.237 | 0.248 | -0.117 | 0.417* | 0.373** | 1.088** | 0.491 |
| pol | 4.266** | 2.572** | 3.062** | 3.885** | 4.035** | 3.733** | 3.257** | 2.167** | 4.281** | 3.238** | 4.425** | 3.621** |
| swe | 1.653** | 0.013 | 0.901** | 1.776** | 0.864** | -0.115 | 0.716** | 0.332** | 1.210** | 0.743** | 1.584** | 1.195** |
| swi | 0.669** | -1.957 | 0.021 | -0.514 | -0.011 | -0.066 | -0.178 | -0.511** | -0.037 | -0.155 | 0.677** | -0.115 |
| uk | 2.310** | -0.058 | 1.398** | 2.265** | 1.483** | 1.143** | 1.055** | 0.771** | 1.916** | 1.330** | 2.340** | 1.845** |
| cons | 3.569** | 4.052* | 4.058** | 1.294 | 0.626 | 2.678 | 0.888 | -0.029 | 1.006 | -0.196 | 2.144** | 0.536 |
| N | 7155 | 625 | 5079 | 3056 | 3164 | 486 | 3354 | 1332 | 1773 | 4625 | 4234 | 2762 |
| r2 w | 0.934 | 0.855 | 0.903 | 0.642 | 0.878 | 0.721 | 0.893 | 0.556 | 0.732 | 0.879 | 0.864 | 0.688 |
| r2 b | 0.734 | 0.514 | 0.212 | 0.504 | 0.560 | 0.092 | 0.376 | 0.000 | 0.126 | 0.616 | 0.727 | 0.441 |
| r2 o | 0.822 | 0.589 | 0.638 | 0.513 | 0.702 | 0.189 | 0.606 | 0.112 | 0.365 | 0.717 | 0.767 | 0.559 |

notes: **,* significant at 1% and 5% respectively. Clustered (Market) s.e.
2nd stage omitted regressors: (Av. firm size, Av. firm size$^2$) * (local, multinational). Omitted Country: US.

## Web Appendix

# B The model

We now develop a model that is able to explain the positive relationship of prices with quality and market shares as well as the (absence of) relationship between the origin of the company, where it sells the goods, and the price it can command. Assume that a pharmaceutical company sells monopolistically in three countries a product which it produces at constant marginal cost $c$ (the monopoly occurs because it holds a valid patent). Demands at the Low ($L$), Middle ($M$) and High ($H$) (regulation) countries are given by:

$$q_H = a - bp_H;\ q_M = A - Bp_M,\ q_L = A - Bp_L,$$

The constants $a$ and $A$ are increasing in the quality of the good. The assumption that demands in the $M$ and $L$ countries are equal is taken for notational convenience. No substantive result changes for this reason.[30]
The prices are determined through the following game. The government of the $H$ country pursues a price-control policy. It unilaterally sets the maximum price at which the company can sell the product in country $H$, $\overline{p}_H$. The firm can choose between selling in that country, in which case it must choose a price $p_H \leq \overline{p}_H$ or not to sell the good at all. In the $M$ country the regulation is of the (external) reference price type, that is, $p_M \leq \lambda p_H + (1-\lambda)\, p_L$.[31] We further assume that countries $L$, $M$ and $H$ are such that $a/b \leq A/B$, that is, the monopolistic price is higher in $L$ or $M$ than in $H$. This means that the *reference price constraint* is always binding, and $p_M = \lambda p_H + (1-\lambda)\, p_L$. If $a/b > A/B$, then the *reference price constraint* is not binding and the monopolistic prices apply in all countries.
Given that the price in unconstrained in $L$ (and assuming the absence of parallel imports that allow price discrimination across countries) the company sets the price $p_L$ equal to its monopolistic value.[32] Then

$$p_L^* = \frac{A}{2B} + \frac{c}{2}$$

In order to solve for the rest of the prices, let's assume first the company producing the good does not have headquarters at $H$. The regulator sets prices so that consumer surplus is maximized, and thus, it sets the minimum price consistent with the firm selling in $H$. Thus, the problem with the firm headquartered at $F = L$ is:

$$\begin{aligned}
&\max_p \frac{1}{2}(a-bp)\left(\frac{a}{b} - p\right) \\
&\text{subject to } \ F(p) \doteq (p-c)\,(a-bp) \\
&+(\lambda p + (1-\lambda)\, p_{I,}^* - c)\,(A - B\,(\lambda p + (1-\lambda)\, p_{I,}^*)) + \pi_{I,}^* - \pi_{MI,}^* \geq 0
\end{aligned}$$

where $\pi_L^*$ are the monopoly profits at $L$ and $\pi_{ML}^*$ is the monopoly profit of selling only at $M$ and $L$ (the prices at $L$ are obviously unaffected by whether the product is sold at $H$ or not). When selling only in $M$ and $L$ the reference price formula is irrelevant, since monopolistic prices are equal in $M$ and $L$. Thus,

$$\pi_{ML}^* - \pi_L^* = \left(A - B\left(\frac{A}{2B} + \frac{c}{2}\right)\right)\left(\frac{A}{2B} - \frac{c}{2}\right) = \frac{(A-cB)^2}{4B} = \pi_L^*$$

Notice that since the objective function is decreasing in $p$, the optimal choice of $L$'s regulator is to set the minimal price consistent with participation. Since

$$\begin{aligned}
F(p_L^*) &= (p_L^* - c)\,(a - bp_L^* + A - B\,(\lambda p_L^* + (1-\lambda)\, p_L^*)) + \pi_L^* - \pi_{ML}^* \\
&= (p_L^* - c)\,(a - bp_L^*) + (p_L^* - c)\,(A - Bp_L^*) - \pi_L^* \\
&= (p_{I,}^* - c)\,(a - bp_{I,}^*) + \pi_{I,}^* - \pi_{I,}^* \geq 0
\end{aligned}$$

and

$$F(0) = (0-c)\,(a-b0) + (\lambda 0 + (1-\lambda)\, p_{I,}^* - c)\,(A - B\,(\lambda 0 + (1-\lambda)\, p_{I,}^*)) - \pi_{I,}^* < 0$$

then there exists $p_H^*$, such that $F(p_{I,}^*) = 0$ and

$$0 < p_H^* \leq p_{I,}^*$$

and thus

$$0 < p_H^* < p_M^* = \lambda p_H^* + (1-\lambda)\, p_{I,}^* < p_{I,}^* \tag{3}$$

Moreover

$$p_H^* = \frac{K}{2(b + B\lambda^2)} - \frac{\sqrt{\tilde{K}^2 - 4(b + B\lambda^2)\left(ca + \left(c - (1-\lambda)\, p_L^*\right)\left(A - B\,(1-\lambda)\, p_L^*\right) + \pi_L^*\right)}}{2(b + B\lambda^2)}$$

where $K = a + \lambda A - 2B\lambda\,(1-\lambda)\, p_L^* + c(b + B\lambda)$. In order to gain some intuition let $c = 0$ and $B = b$. Then $p_L^* = A/2b$ and

$$\begin{aligned}
p_H^* &= \frac{\tilde{K}}{2b(1+\lambda^2)} - \frac{\sqrt{\tilde{K}^2 - 4b(1+\lambda^2)\,(1-\lambda)\, A/2b\,(A - b\,(1-\lambda)\, A/2b) + A^2/4b)}}{2b(1+\lambda^2)} \\
&= \frac{a + \lambda^2 A - \sqrt{(a + \lambda^2 A)^2 - (1+\lambda^2)\lambda^2 A^2}}{2b(1+\lambda^2)}
\end{aligned} \tag{4}$$

Table WA1. Distribution of the number of molecules of the corporations by country

| country | 1 | 2-4 | 5-9 | 10-14 | 15-20 | 21+ | Total |
|---|---|---|---|---|---|---|---|
| Argentina | 37 | 51 | 32 | 20 | 13 | 28 | 181 |
| Australia | 19 | 12 | 12 | 7 | 2 | 9 | 61 |
| Austria | 76 | 34 | 20 | 4 | 5 | 11 | 150 |
| Belgium | 19 | 32 | 21 | 7 | 2 | 8 | 89 |
| Brazil | 32 | 33 | 27 | 17 | 14 | 22 | 145 |
| Canada | 46 | 34 | 18 | 9 | 13 | 22 | 142 |
| CzechRepublic | 39 | 39 | 25 | 12 | 9 | 9 | 133 |
| Denmark | 37 | 25 | 16 | 8 | 5 | 13 | 104 |
| Egypt | 68 | 41 | 10 | 9 | 10 | 16 | 154 |
| Finland | 46 | 19 | 13 | 9 | 3 | 6 | 96 |
| France | 47 | 40 | 21 | 5 | 5 | 12 | 130 |
| Germany | 128 | 128 | 54 | 27 | 17 | 31 | 385 |
| Greece | 60 | 43 | 27 | 16 | 7 | 3 | 156 |
| Hungary | 26 | 29 | 14 | 8 | 4 | 7 | 88 |
| Italy | 59 | 73 | 37 | 18 | 5 | 9 | 201 |
| Japan | 28 | 40 | 41 | 16 | 8 | 5 | 138 |
| Nether | 17 | 26 | 14 | 7 | 1 | 13 | 78 |
| Norway | 36 | 20 | 14 | 7 | 5 | 5 | 87 |
| Poland | 57 | 37 | 24 | 11 | 10 | 6 | 145 |
| Portugal | 25 | 33 | 34 | 8 | 2 | 5 | 107 |
| Spain | 35 | 44 | 38 | 16 | 7 | 13 | 153 |
| Sweden | 44 | 38 | 15 | 9 | 6 | 12 | 124 |
| Switz | 57 | 40 | 23 | 9 | 6 | 8 | 143 |
| UK | 47 | 45 | 16 | 9 | 7 | 8 | 132 |
| US | 189 | 146 | 76 | 22 | 23 | 60 | 516 |

Table WA2. Distribution of molecule age by country

| country | 1 | 1-2 | 3-4 | 4-7 | 7-10 | 11+ | Total |
|---|---|---|---|---|---|---|---|
| Argentina | 23 | 110 | 185 | 393 | 308 | 124 | 1143 |
| Australia | 13 | 75 | 82 | 145 | 99 | 24 | 438 |
| Austria | 11 | 109 | 126 | 251 | 145 | 74 | 716 |
| Belgium | 18 | 97 | 117 | 154 | 84 | 38 | 508 |
| Brazil | 32 | 146 | 179 | 296 | 202 | 111 | 966 |
| Canada | 15 | 102 | 101 | 229 | 285 | 80 | 812 |
| CzechRepublic | 20 | 107 | 105 | 259 | 198 | 114 | 803 |
| Denmark | 15 | 81 | 93 | 230 | 168 | 66 | 653 |
| Egypt | 51 | 213 | 205 | 278 | 227 | 64 | 1,038 |
| Finland | 10 | 71 | 68 | 166 | 105 | 39 | 459 |
| France | 23 | 86 | 123 | 268 | 137 | 84 | 721 |
| Germany | 29 | 227 | 172 | 369 | 411 | 281 | 1,489 |
| Greece | 14 | 133 | 97 | 192 | 103 | 65 | 604 |
| Hungary | 9 | 93 | 90 | 184 | 122 | 52 | 550 |
| Italy | 12 | 77 | 129 | 248 | 138 | 65 | 669 |
| Japan | 4 | 82 | 106 | 151 | 136 | 51 | 530 |
| Nether | 11 | 62 | 66 | 128 | 92 | 45 | 404 |
| Norway | 6 | 73 | 84 | 132 | 67 | 26 | 388 |
| Poland | 10 | 76 | 127 | 172 | 220 | 73 | 678 |
| Portugal | 14 | 77 | 80 | 139 | 89 | 47 | 446 |
| Spain | 19 | 104 | 110 | 215 | 124 | 68 | 640 |
| Sweden | 6 | 80 | 128 | 209 | 125 | 42 | 590 |
| Switz | 4 | 98 | 141 | 276 | 229 | 80 | 828 |
| UK | 16 | 87 | 98 | 201 | 127 | 56 | 585 |
| US | 13 | 171 | 205 | 391 | 360 | 257 | 1,397 |

Table WA3. Top 50 global selling molecules

| US commercial name | molecule | global quote | # cou | launch date |
|---|---|---|---|---|
| LIPITOR | ATORVASTATIN | .05291 | 25 | jan1997 |
| PREVACID | LANSOPRAZOLE | .03255 | 20 | may1995 |
| CELEBREX | CELECOXIB | .02252 | 24 | jan1999 |
| ZYPREXA | OLANZAPINE | .01824 | 25 | oct1996 |
| FLOVENT | FLUTICASONE | .01799 | 25 | jul1991 |
| GLUCOPHAGE | METFORMIN | .01714 | 24 | apr1995 |
| VIOXX | ROFECOXIB | .01688 | 24 | may1999 |
| PRAVACHOL | PRAVASTATIN | .01562 | 17 | nov1991 |
| PROCRIT | EPOETIN ALFA | .01436 | 10 | feb1991 |
| NEURONTIN | GABAPENTIN | .01209 | 23 | feb1994 |
| RISPERDAL | RISPERIDONE | .01143 | 24 | jan1994 |
| BIAXIN | CLARITHROMYCIN | .01122 | 24 | nov1991 |
| VIAGRA | SILDENAFIL | .01114 | 25 | apr1998 |
| EFFEXOR XR | VENLAFAXINE | .01101 | 24 | mar1994 |
| FOSAMAX | ALENDRONIC ACID | .01031 | 25 | oct1995 |
| OXYCONTIN | OXYCODONE | .00978 | 17 | jan1996 |
| CELEXA | CITALOPRAM | .00970 | 23 | jul1998 |
| COZAAR | LOSARTAN | .00943 | 25 | may1995 |
| WELLBUTRIN SR | BUPROPION | .00929 | 23 | nov1996 |
| PLAVIX | CLOPIDOGREL | .00905 | 23 | feb1998 |
| ZYRTEC | CETIRIZINE | .00890 | 21 | jan1996 |
| ALLEGRA | FEXOFENADINE | .00845 | 22 | aug1996 |
| CLARITIN-D 24HR | LORATADINE/PSEUDOEPHEDRINE | .00770 | 9 | nov1994 |
| SINGULAIR | MONTELUKAST | .00757 | 25 | feb1998 |
| PREMPRO | ESTROG. SUBS./MEDROXYPROGESTERONE | .00745 | 18 | feb1995 |
| LEVAQUIN | LEVOFLOXACIN | .00738 | 23 | jan1997 |
| AVONEX | INTERFERON BETA 1A | .00728 | 21 | may1996 |
| BAYCOL | CERIVASTATIN | .00712 | 23 | dec1997 |
| ULTRAM | TRAMADOL | .00707 | 23 | mar1995 |
| CARTIA XT | DILTIAZEM | .00692 | 24 | sep1991 |
| SEREVENT | SALMETEROL | .00669 | 13 | mar1994 |
| AVANDIA | ROSIGLITAZONE | .00634 | 23 | jun1999 |
| NEUPOGEN | FILGRASTIM | .00610 | 13 | mar1991 |
| NEORAL | CICLOSPORIN | .00608 | 23 | aug1995 |
| ACTOS | PIOGLITAZONE | .00604 | 20 | jul1999 |
| ENBREL | ETANERCEPT | .00604 | 15 | nov1998 |
| XALATAN | LATANOPROST | .00602 | 25 | aug1996 |
| ARICEPT | DONEPEZIL | .00572 | 23 | jan1997 |
| COMBIVIR | LAMIVUDINE/ZIDOVUDINE | .00555 | 19 | sep1997 |
| ACCUPRIL | QUINAPRIL | .00531 | 13 | dec1991 |
| DURAGESIC | FENTANYL | .00514 | 24 | apr1991 |
| RANITIDINE | RANITIDINE | .00514 | 25 | mar1996 |
| LUPRON DEPOT-4MO. | LEUPRORELIN | .00509 | 14 | jan1996 |
| FLOMAX | TAMSULOSIN | .00491 | 22 | sep1997 |
| EVISTA | RALOXIFENE | .00490 | 24 | jan1998 |
| PROTONIX | PANTOPRAZOLE | .00490 | 24 | may2000 |
| REBETRON | INTERFERON ALFA-2B/RIBAVIRIN | .00482 | 6 | jun1998 |
| TAXOL SEMI-SYN | PACLITAXEL | .00480 | 15 | mar1996 |
| LESCOL | FLUVASTATIN | .00478 | 25 | apr1994 |
| ACIPHEX | RABEPRAZOLE | .00471 | 23 | aug1999 |

notes: US commercial name corresponds to the top selling brand. Global quota corresponds to the 2000 molecule quote in sample. # countries corresponds to number of countries the molecule is present