Benefit plans, insurer competition, and pharmaceutical prices: Evidence from Colombia

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Public health benefit plans must choose what services are covered with public funds. This coverage choice may affect the prices of covered services through multiple channels. First, coverage reduces out-of-pocket expenditures, making consumers less sensitive to the cost of treatment. In an environment where suppliers have market power (as is often the case with pharmaceutical drugs) this could result in higher prices. The second channel is an increase in competition among drugs listed in the benefit plan with the same therapeutic properties, which could result in lower prices. Thus, the net effect on prices is unclear and depends on consumer sensitivity to prices and the level of competition among drugs. Using a difference-in-difference strategy, I study the effect of including a pharmaceutical drug in the national benefit plan of Colombia, a country with a competitive health insurance market in which all insurance companies offer the same plan (the national benefit plan) and charge the same premium. Drug prices decreases by 14% on average after they are listed in the benefit plan and sales increase by 123%. However, if a drug faces no competition and is listed in the benefit plan its price increases. Coverage also affects the prices of unlisted services: Within a therapeutic class, the prices of drugs which are not listed in the benefit plan decrease as the market share of competing drugs listed in the benefit plan increases. I conclude with a discussion of the role of financial incentives in health care markets.

JEL: H51, I11, I13, I18, L11, L13, L51, L65

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Pharmaceutical drugs have the potential to improve health outcomes dramatically. However, they are also a major component of health expenditures and policy makers are concerned with ensuring that use of these products is cost-effective (Roberts and Reich 2011). In industrialized countries drug expenditures account for 10 to 20% of total health spending, while in low- and middle-income countries the number is between 20 and 40% (Management Sciences for Health 2012).[1] High levels of expenditure on drugs is especially worrisome because drugs are not like most goods. First, consumers often lack the necessary knowledge to understand the differences between treatment options and must rely on physicians' knowledge and recommendations of care (Arrow 1963). As a result, consumers often do not choose drugs themselves and lack the ability to assess whether a certain treatment is appropriate. Second, drug consumption can have both positive and negative externalities (e.g., preventing the spread of disease is a positive externality, while the antimicrobial resistance created by antibiotic consumption is a negative externality). Third, pharmaceutical companies are often granted temporary monopolies in order to promote the development of new drugs. This, coupled with heavy marketing, often results in a market where suppliers have market power. These special characteristics result in market failures (incomplete information, externalities, and market power) which justify government intervention in the pharmaceutical market and make pharmaceutical policy an important component of any health system. In this paper I study the effect of an increasingly popular government policy (benefit plans) in health care markets on the price and provision of pharmaceuticals.

Adopting benefit plans introduces at least two features into any health system.[2] First, such plans reduce out-of-pocket expenditures, making consumers

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[1] However, in 2000 average spending on drugs was about USD 4.40 per capita in low-income countries and about USD 396 in high-income countries (Management Sciences for Health 2012).

[2] In some countries drugs are purchased and distributed by the government, while in others private

less sensitive to the cost of treatment; in an environment where suppliers have market power this could result in higher prices (Duggan and Scott Morton 2006). Second, drugs listed in the benefit plan become closer substitutes for other listed drugs with the same therapeutical properties, which could in turn increase competition and drive prices down.[3] Thus, the net effect on prices of listing a drug in the benefit plan is unclear and depends greatly on the sensitivity of consumers to prices, cross-price elasticity among listed drugs, and the level of competition a drug faces. Furthermore, the generosity of the benefit plan could affect the price of competing treatments which are not listed in the plan. The intuition is simple: If the price of a treatment decreases after it is listed in the benefit plan then competing treatments are forced to lower prices to minimize losses in market share (regardless of whether they are listed or not).

In this article I study the case of Colombia, which has a competitive health insurance market in which all insurance companies offer the same plan (the national benefit plan) and charge the same premium. Insurance companies compete for enrollees on the basis of quality (Giedion and Uribe 2009). To maximize profits insurance companies negotiate prices with providers. This setting is similar to how Medicare Advantage works in the United States (Brown et al. 2014) and to the health systems of the Netherlands and Switzerland (Leu et al. 2009); however, as previously mentioned, insurance companies in Colombia face higher restrictions in terms of the benefits they are allowed to offer and the prices they can legally charge. Using a theoretical model, I show it is unclear whether prices will increase or decrease once a drug is listed in the

pharmacies provide medicines to public-sector patients. However, most countries have moved towards the adoption of health benefit plans that explicitly define the services to be covered with public funds, regardless of how these services are provided (Busse, Schreyögg and Gericke 2007, World Bank 2013, Giedion et al. 2014).

[3]There are at least three channels through which substitutability can increase among drugs listed in the benefit plan. First, consumers face no price differential among them (and therefore price and income are no longer barriers to access). Second, all are implicitly recommended by the government. Third, benefit plans create better-informed buyer groups (insurance companies or government experts) with higher cross-price elasticities. Additionally, benefit plans create large buyer groups which may have bargaining power and can enjoy bulk purchasing discounts. I will focus on the substitutability aspect in my theoretical model.

benefit plan. Although pharmaceutical companies can take advantage of consumers' reduced sensitivity to treatment costs, listed drugs may have a higher elasticity of substitution among them than unlisted drugs. Therefore, listing a drug induces rival companies with other listed drugs to cut prices. In turn, the drug being listed faces two effects: Price sensitivity falls, but competition from other companies rises. Ultimately, it is unclear which force will dominate and the effect on prices becomes an empirical question. Importantly, with limited competition there is only a "reduced price sensitivity" effect, leading to price increases.

I take the model to the data by implementing a difference-in-difference strategy, which exploits increases to the generosity of the benefit plan in which several drugs are added each year over a period of 6 years. First, I study the effect of listing a drug in the benefit plan and find a 14% reduction in the price paid by providers (e.g., hospitals, clinics, and private practices). Sales (measured by quantities sold to providers) increase by 123%.

An important concern when studying the effect of listing a drug in the benefit plan is that the timing of inclusion is systematic. Specifically, if the government waits for patents to expire or for a company to announce the release of a competing drug to include a drug in the benefit plan, my identification strategy would cofound the effect of these changes with the effect of listing the drug in the benefit plan. There is evidence that the timing is not completely exogenous, but I'm able to overcome this problem by exploiting a unique feature of the Colombian health care system (explained in the next paragraph). In particular, drugs that enter the benefit plan are less likely to have a generic in the years prior to the inclusion, the likelihood of having their price regulated increases steadily up to when the drug is listed, and the number of competitors increases steadily in the years prior to the inclusion of the drug.

However, three pieces of evidence support the case that the estimated coefficients reflect the causal effect of listing a drug in the benefit plan: First, although

there are changes in the market environment before a drug is listed in the benefit plan, the price and the quantities sold do not change before the drug is listed. In other words, despite these pre-treatment changes, the prices of drugs to be listed in the benefit plan exhibit parallel trends with the prices of other drugs. Second, my results are robust to controlling for these variables and for lags of these variables. Third, and most importantly, the specific regulatory environment of Colombia, in which only certain pharmaceutical forms (concentration and delivery pathway combinations) are included, allows me to overcome the endogenous timing problem. Intuitively, the timing may be endogenous at the "active component" level (the level at which the number of competitors, generics, and price regulations are relevant), but it cannot be at the pharmaceutical form level. Empirically, this amounts to using "active component by year" fixed effects, to which my results are robust.

There is heterogeneity in the treatment effect by drug characteristics and this heterogeneity follows the theory. As competition increases, the reduction in prices increases after listing a drug. Additionally, the point estimate of the effect is positive for drugs that face no competition (but not statistically significant). If there is no competition among listed drugs, then prices increase due to consumers' reduced sensitivity to treatment costs.[4] The theory also predicts lower prices once a drug is listed as the elasticity of substitution between listed and unlisted drugs decreases. I partially test this prediction by comparing prescription to over-the-counter drugs and show that the former drive the reduction in prices. Intuitively, prescription drugs require physician approval partly because consumers do not understand the therapeutic properties of the drug and are less likely to know which drugs are suitable substitutes. Since physicians are aware of which drugs are therapeutic substitutes, as well of what drugs are covered by the benefit plan, one would expect a relatively low elasticity of sub-

[4]Although it is possible these large buyer groups have some market power, the fact that prices increase in the absence of competition (when a drug is included in the benefit plan) implies that, depending on the environment, this market power may not be enough to drive down prices. In fact, in many cases the government may be worsening the insurers' bargaining power by forcing them to cover a particular drug.

stitution between listed and unlisted drugs. Finally, within a therapeutic class, the prices (paid by providers) of drugs which are *not* listed in the benefit plan decreases as the number of competing drugs listed in the benefit plan increases, as predicted by my theoretical model.

Colombia is a particularly interesting setting to study the effect of expanding the coverage of the national benefit plan for at least three reasons. First, all Colombians are entitled to the same coverage and at the same price, which restricts the ability of insurance companies to manage care. Second, the country transitioned from having less than 24% of its population covered by some form of health insurance in in 1993 to having more than 95% covered in 2013, achieving nearly universal health care (UHC); therefore, it can provide lessons for other low- and middle-income countries on the path towards UHC. Third, much of the research on institutional arrangements and their impact on drug prices, usage, and innovation has focused on the United States and other developed countries. However, most countries (as is the case with Colombia) represent a small fraction of the pharmaceutical market and therefore the institutions they put in place to provide drugs will have little, if any, repercussions in the development of new drugs. Therefore, the policy lessons from research conducted in developed countries are not easily applied to low- and middle-income countries.

This paper relates to the economic literature studying health care markets, and in particular pharmaceutical prices. The most closely related article is Duggan and Scott Morton (2010), who study a similar setting in the U.S. where the government subsidizes participation in private prescription drug plans that negotiate prices with pharmaceutical companies (Medicare Part D). They find a reduction of about 20% in prices for drugs covered by the plan, which is similar to the effect I find in Colombia. An important difference between this paper and Duggan and Scott Morton (2010) is that the benefit plan and the premium are exactly the same for all insurance companies in Colombia, unlike the U.S.

where each insurance company has some discretion over which formulary to provide and at what premium. This could potentially dampen the cross-price elasticity effect, as insurance companies are obliged to provide all the drugs in the benefit plan regardless of their price; the similarity in results suggests that competition among insurance companies can result in lower pharmaceutical prices without formularies. Additionally, I study spillover effects on other drugs that are therapeutic substitutes for drugs listed in the benefit plan.[5]

This article also relates to the literature studying how financial incentives affect physicians' care recommendations (and more generally to the agency problem). Although I do not test this directly, drug prices can only decrease if insurance companies are able to steer patients away from more expensive treatments (otherwise, including a pharmaceutical in the benefit plan would only reduce out-of-pocket expenditures, making consumers less sensitive to the cost of treatment, which in turn would result in higher prices). Previous studies have tested this directly and found evidence that physicians' behavior is affected by financial incentives.[6]

Finally, my results speak directly to the debate over the role of financial incentives in health care markets. The tension between financial incentives and quality is often a matter of controversy and some critics believe that financial incentives lead to lower quality without reducing costs (Webster 2012). Prices do decrease as a result of the financial incentives in this particular setting. Although it is still possible insurance companies are influencing providers to pre-

[5]Other relevant studies include: Duggan and Scott Morton (2006), who find that the institutional arrangement in place to procure drugs for Medicaid increases prices for drugs in which Medicaid represents a large part of the demand (this has to do with the fact that Medicaid pays the average private-sector price for each drug); Clemens and Gottlieb (2013), who find that private prices follow Medicare's lead; and Brekke, Holmas and Straume (2011), who study a cap in reimbursement rates in Norway and find that this reduces both brand-name and generic prices.

[6]For example, Clemens and Gottlieb (2014) find that an increase in Medicare payment rates to physicians results in an increase in care provision (and that the provision of elective procedures responds more to these changes). Iizuka (2012) finds that doctors in Japan, where physicians can legally profit from prescribing drugs, often fail to internalize patient costs and to prescribe cheaper generic drugs when these are available. Gruber and Owings (1996) find that obstetricians and gynecologists increase the use of cesarean delivery (which has higher reimbursement rates than normal childbirth) in places where there was a decline in fertility, and therefore in overall reimbursements.

vent certain patients from obtaining costly drugs, these results suggest drug sales increase when a drug is listed in the benefit plan and therefore the access to, and quality of, care increases. Large buyer groups, when faced with the appropriate incentives, increase competition among therapeutic alternatives, resulting in lower treatment costs. However, price reductions depend to a significant degree on whether there are substitutes (as shown by my heterogeneity results). A large insurer (public or private) may not be able to negotiate discounts in some cases.

I. Background, institutions, and incentives

A. Terminology

Because the terminology used to discuss pharmaceutical drugs is sometimes confusing, I will explain it using ibuprofen as an example. A pharmaceutical drug is "intended for use in the diagnosis, cure, mitigation, treatment, or prevention of diseases" (United States Congress 2006). In this case ibuprofen is the pharmaceutical, drug, or medication. A drug can have several market names, including brand names (such as Advil® and Motrin® for ibuprofen), and generics which are commercialized under either the "common" or "adopted" name (in this case ibuprofen) attached to the company that produces it. A generic can only be produced once the patent expires, but before there may be several brand names, as long as the originator company (which holds the patent) is willing to sell marketing rights.[7] Sometimes the same pharmaceutical company produces both a brand-name drug and a generic (e.g., in 2014 McNEIL-PPC, Inc. produced Motrin® and a generic named Ibuprofen by McNEIL®). Finally, the same brand (or generic) produced by a pharmaceutical

[7]In the particular case of ibuprofen, Boots was the originator of the drug but sold Upjohn nonexclusive marketing rights for the US. Upjohn marketed the drug as Motrin. Years later, Boots established a presence in the US and marketed the drug as Rufun®. These two companies later partnered with other companies that had experience in the OTC market to produce Nuprin® and Advil® two brand names exclusively for OTC purposes. All in all, before the patent expired there were 4 branded named drugs for ibuprofen in the US.

company can be commercialized in different concentrations and presentations. For example, Motrin® is available in the U.S. in four different concentrations: Tablets of 300, 400, 600 and 800 milligrams. Similarly, although Advil® can only be bought in tablets of 200 milligrams it comes in four different presentations: packages of 50, 100, and 200 tablets are available. In this article the unit of analysis will be a drug produced by a pharmaceutical company at a given concentration (different presentations of a drug are collapsed into a single observation). In other words, Advil® , Motrin® 300 mg, Motrin® 800 mg, and Ibuprofen by McNEIL® are different units of analysis, but packages of 50 or 100 tablets of Advil® are not. However, I take into account that all four drugs drugs contain the same chemical compound and can be used to treat the same ailments.

Each drug is associated with at least one Anatomical Therapeutic Chemical (ATC) code, which classifies drugs according to the part of the body on which they act and their therapeutic, pharmacological, and chemical properties (there are 2,094 different ATC codes in my data). Essentially, the ATC code can be used to identify the active component of a drug and suitable substitutes that can be used to treat the same ailment. I use the hierarchical structure of the ATC code to define groups such that drugs within the same group can act as substitutes for each other. I refer to this as pharmacological subgroups and they can be thought of as groups of drugs that are used to treat the same ailments but which have different chemical compounds. In total there are 629 different pharmacological subgroups in my data. For more information see http://www.whocc.no/atc/structure_and_principles/.[8]

[8]When a drug has more than one ATC code, I use the main ATC code according to the *Instituto Nacional de Vigilancia de Medicamento* (INVIMA).

B. Background

Before 1993, only 24% of the population in Colombia had some form of health insurance, with significant inequality: 47% of the highest quintile of income had health insurance but less than 5% of the lowest quintile did. In turn, access to medical services was highly unequal. More than 33% of the poorest quintile did not receive medical attention when sick in 1992, but this number was only 7% for the highest quintile of income (Gaviria 2013). Law 100 of 1993 set out to change this by introducing a universal health insurance scheme.

Since 1993 every Colombian has been entitled to a comprehensive health benefit package (known as *Plan Obligatorio de Salud* or POS). Individuals belong to one of two regimes. Those with higher income belong to the contributory regime, while individuals with lower income belong to the subsidized regime. The former is financed with a payroll tax, while the latter is financed through central government expenditures. Initially, the health packages for the contributory and the subsidized regime were different but their pharmaceutical drug coverage has been the same since the onset of the system.[9]

The system is a competitive health insurance market where individuals in both regimes get to choose an insurance company, known as *Entidades Promotoras de Salud* (health promotion entities, or EPS). The insurance companies are required to provide all the services listed in the POS. In exchange, the insurer receives an ex-ante, yearly risk-adjusted capitation payment known as the *Unidad de Pago por Capitación* or UPC.[10] As of 2013, there were 24 insurance companies providing contributory plans and 48 providing subsidized plans. Since the price and coverage of each benefit package is set by the government, insurers

[9]Originally the contributory benefit plan was more generous, but in 2008 the Constitutional Court ruled that both packages must be the same (i.e., the subsidized regime benefit package had to be expanded to include the same benefits as the contributory regime package). This process happened in stages, giving priority to the most vulnerable groups first. In October 2009, the subsidized plan was expanded to children under 12 years old, in February 2010 children under 18 were included, in November 2011 adults over 60 were included, and in July 2012 all other adults were included to the expanded plan.

[10]There is also an ex-post redistribution of resources based on the prevalence of renal chronic disease per insurer.

compete for enrollees on the basis of quality (Giedion and Uribe 2009).[11]

Cost-sharing (copayments and coinsurance rates) is the same across all insurance companies and set by the government. The exact cost-sharing structure depends on the patient's income.[12] Importantly, the copayment and the coinsurance rate is the same for all drugs in the benefit plan.

The benefit package (or POS) is determined by the Ministry of Health and has been updated several times over the years, with changes throughout the sample period. Between 1994 and 2011 the benefit plan was rarely updated. In 2008, the Constitutional Court forced the government to update the benefit plan every two years (see Appendix F for details on the process to include drugs to benefit plan).[13] When the benefit plan is updated, the yearly risk-adjusted capitation payment is not automatically adjusted. The risk-adjustment payment is based on expenditures in the previous year and is a standard formula (weighted linear regression) based on three risk factors: age groups, sex and three geographical regions.

Figure 1 shows the number of drugs that are added each year to the benefit plan. There are two types of expansion to the benefit plan. In some cases new drugs (chemical compounds) are added to the benefit plan, while in others more presentations of a given drug are added. For example, in 2012 atrovastin (ATC code C10AA05) was added to the plan in 2012. Before no drug with that active ingredient was listed. However, in 2012 only 10, 20, and 40 and mg tablets were added. In 2014, all other tablets were added. Therefore, a drug such as ATOVAROL®80 MG (produced by PROCAPS), was only added to the

[11] Furthermore, insurance companies also compete in terms of how well they can negotiate prices from providers. However, I lack the data to look at differences in prices across insurance companies.

[12] In the subsidize regime, it depends on the value of a proxy-means test. In the contributory regimen, it depends on the patients salary.

[13] See Consejo Nacional de Seguridad Social en Salud (2006*b*), Consejo Nacional de Seguridad Social en Salud (2006*a*), Consejo Nacional de Seguridad Social en Salud (2007*a*), Consejo Nacional de Seguridad Social en Salud (2007*b*), Comision de Regulacion en Salud (2009*a*), Comision de Regulacion en Salud (2009*b*), Comision de Regulacion en Salud (2010), Comision de Regulacion en Salud (2011*a*), Comision de Regulacion en Salud (2011*b*), Comision de Regulacion en Salud (2011*c*), Comision de Regulacion en Salud (2012), Ministerio de Salud y Proteccion Social (2013), Ministerio de Salud y Proteccion Social (2014), Ministerio de Salud y Proteccion Social (2015*b*).

benefit plan after 2014, yet other drugs with the same active ingredient (such as LIPITOR®20 MG by PFIZER) were already listed.

[Figure 1 about here.]

Insurance companies do not provide services directly. They pay medical providers to do this. In some cases, these providers are vertically integrated with the insurance company. There are different arrangements between providers and insurance companies, but the two most common ones are capitation contracts and fee-for-service contracts, which amount to XX% and YY% of all health services provided. Capitation contracts essentially transfer the risk to the provider. The insurer pays a fixed fee for each enrollee and in exchange the provider must cover a menu of treatment (including drugs). Under fee-for-service contracts, the insurance company and the provider agree on a set of prices for each treatment (including drugs), and the insurance company reimburses the provider for each treatment. Patients do not know which contract is being used to cover their treatment.

C. Incentives

If we assume insurance companies have no influence over the UPC or the POS, then they have at least three forms of leverage to maximize profits. First, they can change the pool of individuals they enroll. If risk-adjusted payments are a perfect predictor of health expenditure (i.e., the expected value of health expenditure is equal to the risk-adjusted payment), then insurance companies have no incentives to cream skim. However, although in theory insurers may not legally select who they insure, in practice there have been reports of slow affiliation processes and misplaced applications, which may be evidence of cream skimming (Castano and Zambrano 2006, Gómez-Suárez 2007). This type of behavior is not unique to Colombia as risk-adjusted payments are seldom perfect. For example, after risk adjustment was introduced to Medicare Advantage in

the U.S., insurance companies enrolled individuals with higher risk-adjusted payments but lower costs conditional on their risk (Brown et al. 2014). Additionally, risk-adjustment payments do not incorporate patients' preferences over care, which may result in moral hazard and adverse selection when prices and benefits are regulated (Shepard 2015), as in the case of Colombia.

Second, insurance companies can influence the treatment demanded by their enrollees. In general, the quantity of care demanded by a given patient depends not only on price, but also on physicians' recommendations of treatment as patients usually do not fully understand the difference between treatment options and must rely on physicians' knowledge and recommendations (Arrow 1963). Insurance companies can steer patients away from costly treatments by charging higher copayments or by influencing physicians' behavior. The latter option is especially attractive if copayments are fixed, as they are in Colombia. Although illegal, there have been reports of insurance companies influencing physicians' behavior in Colombia (Semana 2014). The extent to which insurance companies steer their enrollees away from or toward certain types of treatment has not been studied in Colombia, to the best of my knowledge. However, previous literature has studied how financial incentives affect physician behavior in other countries (see, for example, (Clemens and Gottlieb 2014, Iizuka 2012, Iizuka 2007, Gruber and Owings 1996)). Finally, insurance companies can negotiate lower prices with providers to reduce expenditure.

These three forms of leverage are often related. For example, an insurance company can negotiate lower prices with providers in part because they can steer enrollees away from certain treatments. In this article, I focus on the latter two forms of leverage. I assume a higher elasticity of substitution among listed drugs: In part because price (and income) barriers for consumption disappear after a drug is listed, and in part because insurance companies' are able to influence the care that their enrollees receive. The next section presents a theoretical model to formalize these ideas.

II. Theory

In this section I propose a simple model of how drug prices are set. The main goal of this model is to formalize the following intuition: If consumers are less sensitive to the cost of treatment when a drug is listed in the benefit plan but drugs within the plan are closer substitutes to one another, then it is unclear whether including a drug in the benefit plan will increase or decrease its price.

Including a drug in the benefit plan makes consumers less sensitive to the total cost of treatment as they only pay a fraction of the services listed in the benefit plan. On the other hand, the elasticity of substitution among listed drugs is higher than among non-listed drugs (within therapeutic substitutes) for at least two reasons: a) income barriers are removed and b) after a drug is listed in the benefit plan, consumers purchase drugs through insurance companies, which know what drugs are listed and the substitutability of one drug for another.

Therefore, once a drug is listed it becomes a closer substitute for other drugs that are already listed. This induces rival drug companies to cut prices. In turn, the drug being listed faces two effects: price sensitivity falls, but competition from other companies increases. With limited competition, only the first effect exists, leading to price increases.

Listing a drug in the benefit plan has an effect on the price of competing drugs. The intuition is simple: If the price of a treatment decreases after it is listed in the benefit plan, drug companies marketing competing treatments are forced to lower prices in order to minimize losses in market share.

A. Basic model

Suppose consumers derive utility from a group of pharmaceuticals that are therapeutic substitutes for each other in the following form:

$$U(Q_1, ..., Q_N) = \left(Q_A^{\frac{\eta-1}{\eta}} + Q_B^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \tag{1}$$

with

$$Q_A = \left(\sum_{i \in A} Q_i^{\frac{\rho_A - 1}{\rho_A}} \right)^{\frac{\rho_A}{\rho_A - 1}} \tag{2}$$

$$Q_B = \left(\sum_{i \in B} Q_i^{\frac{\rho_B - 1}{\rho_B}} \right)^{\frac{\rho_B}{\rho_B - 1}} \tag{3}$$

where A is the group of drugs listed in the benefit plan and B is the group of drugs not listed. I assume drugs within a group are more substitutable than drugs across groups. Additionally, drugs within the benefit plan are more substitutable for one another than drugs outside the plan: $1 < \eta < \rho_B < \rho_A$. However, consumers only have to pay a fraction λ_A of the price for listed drugs (and $\lambda_B = 1$, since consumers pay the total price of non-listed drugs).

If Y is total income, then the demand for drug i in group k is

$$Q_{i,k} = Y \left(\widehat{P_{i,k}} \right)^{-\rho_k} \widehat{P}_k^{\rho_k - \eta} \widehat{P}^{\eta - 1}, \tag{4}$$

where

$$\widehat{P_{i,k}} = \lambda_k P_{i,k} \tag{5}$$

$$\widehat{P_k} = \lambda_k P_k \tag{6}$$

$$P_k = \left(\sum_{j \in K} P_j^{1-\rho_k} \right)^{\frac{1}{1-\rho_k}} \tag{7}$$

$$\widehat{P} = \left(\lambda_A^{1-\eta} P_A^{1-\eta} + P_B^{1-\eta} \right)^{\frac{1}{1-\eta}} \tag{8}$$

$$P = \left(P_A^{1-\eta} + P_B^{1-\eta} \right)^{\frac{1}{1-\eta}} \tag{9}$$

Producers of drugs from each group (A and B) are involved in Bertrand competition (they simultaneously announce prices). The profit function of the producer of drug i is $\pi = (P_{i,k} - c)Q_{i,k}$, with $k \in \{A, B\}$. Thus the FOC is:

$$P_{i,k} = m_{i,k} c, \tag{10}$$

where c is the marginal cost (assumed to be the same across firms) and

$$m_{i,k} = \frac{\varepsilon_{i,k}}{\varepsilon_{i,k} - 1} \tag{11}$$

$$\varepsilon_{i,k} = \rho_k (1 - \widehat{S_{i,k}}) + \eta \widehat{S_{i,k}} (1 - \widehat{S_k}) + \widehat{S_k} \widehat{S_{i,k}}, \tag{12}$$

while the share of total expenditure ($\widehat{S_{i,k}}$) of drug i relative to the expenditure in group k is

$$\widehat{S_{i,k}} = \frac{P_{i,k}^{1-\rho}}{\sum_j P_{j,k}^{1-\rho}} \tag{13}$$

(14)

and the share of total expenditure in group k is

$$\widehat{S_k} = \frac{\lambda_k^{1-\eta} P_k^{1-\eta}}{\sum_k \lambda_k^{1-\eta} P_k^{1-\eta}} \tag{15}$$

(16)

This game has a unique equilibrium (Milgrom 1990). Since all firms are identical within a market k then $S_{i,k} = \frac{1}{N_k}$ and $\varepsilon_{i,k} = \rho_k \frac{N_k - 1}{N_k} + \eta \frac{1}{N_k}(1 - S_k) + S_k \frac{1}{N_k}$.

B. Comparative statics

The partial derivatives of the equilibrium prices are signed as follows (see Appendix D for details):

$$\frac{\partial P_k^*}{\partial \lambda_k} < 0 \tag{17}$$

$$\frac{\partial P_k^*}{\partial \rho_k} < 0 \tag{18}$$

$$\frac{\partial P_k^*}{\partial \eta} < 0 \tag{19}$$

$$\frac{\partial P_k^*}{\partial N_k} < 0 \tag{20}$$

$$\frac{\partial P_k^*}{\partial P_{-k}} > 0 \tag{21}$$

$$\frac{\partial P_k^*}{\partial S_{-k}} < 0 \tag{22}$$

Listing a drug in the benefit plan has two direct effects. First, it reduces λ (from $\lambda_B = 1$ to $\lambda_A < 1$). Second, it increases ρ (from ρ_B to ρ_A). Therefore, listing a drug has an ambiguous effect on prices, and whether prices increase depends on several market characteristics. With limited competition ($N_k \to 1$) ρ has no effect on prices, and listing a drug amounts to only a reduction in λ which results in higher equilibrium prices. An increase in competition (via

N_k) leads to a reduction in prices. The lower η is, the greater the reduction in prices. In other words, the lower the elasticity of substitution between listed and unlisted drugs, the greater the reduction in prices once a drug is listed. Finally, due to strategic complementarities in prices, an increase in prices in group B leads to an increase in prices in group A and viceversa. As long as listing drugs leads to a reduction in prices, this should lead to a reduction in prices for pharmaceuticals not listed in the benefit plan.

III. Data

The data for I use comes from three sources: 1) the *Sistema de Informacion de Precios de Medicamentos* (SISMED), 2) the *Instituto Nacional de Vigilancia de Medicamento* (INVIMA), the Colombian drug and food regulation agency, and 3) several pieces of legislation. For more details see Appendix E.

The final data set contains the average prices at which pharmaceutical companies sell to insurance companies and providers, as well as the total quantities sold.[14] For each drug I also have information for whether the drug is listed in the benefit plan, as well as general durg characteristics (e.g., whether its a generic, wether it can be sold OTC or not, and whether it has any price caps). The drug characteristics come from the INVIMA, as well as several pieces of legislation. The price information comes from the SISMED, a government effort to collect drug prices from pharmaceutical laboratories, wholesalers and EPS's. Several studies, including some undertaken by government agencies, have suggested the information is unreliable in some cases (Vacca, Acosta and Rodriguez 2011, Departamento Nacional de Planeacion 2012, Zapata et al. 2012) and certain drugs move in and out of the sample, resulting in an unbalanced panel. The main drawbacks of the information are the lack of standardization for different drug characteristics (e.g., units in which drugs are sold) (Vacca, Acosta and Rodriguez 2011), that transaction-level data is not pub-

[14] Providers include hospitals and clinics, but not private pharmacies.

lic (Departamento Nacional de Planeacion 2012), and under-reporting. However, transaction-level data is not needed to carry out my analysis and I take careful measures to avoid any inconsistencies in my data. The only setback is I cannot analyze how prices vary by insurance company. Additionally, the under-reporting mainly occurs for drugs with a small market share and there is no reason to believe under-reporting will change the average price observed in the data or that it is correlated with whether a drug is listed in the benefit plan or not. I take additional precautions in order to avoid inconsistencies in the data: Any drug for which the maximum price at some point in time is over 30 times the minimum price is dropped from the data set.[15]

I use information from 2007 to 2016.[16] The unit of observation is a drug produced by a company. As explained previously, ibuprofen may show up several times in my data, for example under Advil®, Motrin®, and Ibuprofen MK®. When drugs come in different presentations the price used in all of the analyses is the weighted average, by units sold, of the price per unit of product across presentations. See Appendix A for details.

A. Summary statistics

There are 27,852 unique drugs registered in Colombia during this period, with a total of 695,055 presentations. 16,225 drugs have information on prices at some point in time and 3,328 have information for all years.[17] In some cases I could not determine with certainty whether the drug was in the benefit plan or not (4.85% of data points) or some of the drug's characteristics were missing, such as whether the drug is a generic (7.48% of data points). I present summary

[15]This threshold is the 95th percentile of the maximum/minimum price distribution. The data for these drugs are dropped in the regressions; however, they are used to determine the number of competitors, whether there is any generic in the same therapeutic group, and other competition-related variables. All my results are robust to keeping these observations, as well as to dropping all observations for which the maximum price is over 10 times the minimum price, the 90th percentile of the maximum/minimum price distribution.

[16]Although some data are available for 2006, they are not used in this study because they cover less than 1% of the total number of registered drugs in the Colombia; after 2007 the coverage is over 60%.

[17]Drugs with some price information represent 1,691 ATC codes (out of 2,094) and 582 therapeutic groups (out of 629). Drugs with price information for all years represent 855 ATC codes and 403 therapeutic groups.

statistics only for those drugs that have information about their inclusion in the benefit plan and whether they are a generic (22,883) since these are the only ones included in the analysis.

Among the drugs included in the analysis, nearly half have no price information and less than 8% have price information every year. There is a positive correlation between the number of presentations a drug has and how many years have price information. Additionally, drugs for which I do not have price information are more likely to be over-the-counter (OTC) medications, less likely to be a controlled substance (i.e., generate addiction), less likely to be "essential medicines" — a special category in which drugs packages must show the generic name side by side to the brand name (with the same font size) — and less likely to be a generic. Table H.2 in Appendix B shows the difference in characteristics between drugs without any price information, those with information on prices at some points in time, and those with information for all years. Off all ATC codes (therapeutic groups): 354 (67) have no drug with any price information, 37 (4) have information for all drugs in every year, and 1,450 (543) have partial information (i.e., information for some drugs at some points in time). Pharmaceuticals with active ingredients which are no longer under any patent (and therefore have several brand-name and generic versions) often have several versions missing some information.[18]

Table 1 presents summary statistics for drugs for which I observe some prices, pooled across years. On average, the share of drugs listed in the benefit plan is 42%. There is a great deal of variation in the number of drugs in the same pharmacological subgroup (or with the same ATC code). Some drugs have no direct competitors, while others compete with 479 (277) other drugs. When we focus on drugs in the benefit plan, some pharmacological subgroups (or ATC codes) have no drug in the POS, while others have 231 (173) drugs covered by

[18]For example, over 1,000 of the drugs without price observations are due to some form of ibuprofen(213), paracetamol (371), amoxicillin (146), multivitamins (128), diclofenac (120), and loratadine (65).

the POS. Around 30% of the observations correspond to drugs that are generics and 11% of the observations correspond to drugs sold over the counter (OTC). Tables H.3 and H.4 in Appendix B show statistics only for all drugs and drugs with a maximum/minimum price ratio under 10, respectively.

[Table 1 about here.]

IV. Empirical analysis

A. Timing of inclusion in the benefit plan

In order to study the effect of including a drug in the benefit plan on its price, I use a difference-in-difference strategy comparing drugs listed in the benefit plan to other drugs before and after they enter the benefit plan. The key assumption in this analysis is commonly known as the "parallel-trend" assumption, which assumes the average change in prices in the control group (other drugs) would be the change in the absence of treatment (the counterfactual change). This assumption is usually tested by determining whether the pre-treatment trends are the same for both the control and the treatment group.[19] I test this assumption using an event-study framework described in Section IV.C. However, if the timing of the drugs' inclusion in the benefit plan coincides with other important changes to the drug or the competition it faces, then I would not be identifying the effect of the policy on the outcomes of interest. If the government includes drugs after their patents expire or a company announces the release of a competing drug, my identification strategy would pick up the effects of those changes on the drug price in addition to the effect of listing the drug in the benefit plan. In order to study this issue I estimate the following equation:

[19]This is only a suggestive test, as the identifying assumption (i.e., in the absence of treatment, the trends would remain parallel) is inherently untestable.

$$(23)\ Y_{it} = \alpha_{<-3} 1_{t-\tau_i<-3} + \sum_{j=-3, j\neq -1}^{3} \alpha_j 1_{t-\tau_i=j} + \alpha_{>3} 1_{t-\tau_i>3} + \gamma_i + \gamma_t + \varepsilon_{it},$$

where Y_{it} is the outcome of interest for drug i at time t, γ_i are drug fixed effects, γ_t are year fixed effects, and τ_i is the year drug i is included in the benefit plan (this is set to 0 for drugs that have always been listed or that are never part of the benefit plan in our sample period) and therefore $1_{t-\tau_i=j}$ is an indicator variable that is equal to one if year t is j years before/after the change. Figures 2a-2c show the estimated coefficients on the timing relative to the inclusion in the benefit plan and 95% confidence intervals for different outcomes.

[Figure 2 about here.]

The timing of inclusions is not free from suspicion of being endogenous. Drugs which enter the benefit plan are less likely to have a generic in the years prior to the inclusion, and more likely to have one after the inclusion. In addition, the likelihood of having price regulations increases steadily up to when the drug is listed in the benefit plan.[20] Finally, the number of competitors increases steadily in the years prior to the inclusion of the drug. Since the 95% confidence intervals overlap in most cases I estimate a reduced version of the previous equation to see if there are any statistically significant differences before and after the drug enters the benefit plan. In short, I estimate the following equation:

$$(24)\qquad Y_{it} = \alpha POS_{it} + \gamma_i + \gamma_t + \varepsilon_{it},$$

where POS_{it} indicates whether drug i was listed in the benefit plan at time

[20] Price regulations include price caps and reference pricing.

t. Table 2 presents the results from formally testing whether the timing of inclusion in the benefit plan is correlated with other regulatory changes. As expected these results (sign) match those presented in Figures 2a-2c.

[Table 2 about here.]

As a precaution I include as controls in all of my specifications i) whether there is a generic with the same ATC code, ii) the HH-Index at the ATC level, and iii) whether the drug is subject to any price regulation or not. All my results are robust to not including these controls. These variables may have dynamic effects which are not captured by contemporaneous controls; however, my results are also robust to controlling for a set of lags of these variables as well.

More importantly, I estimate my results including ATC by year fixed effects, which provides identification off drugs with same ATC code, in years where some are listed and some are not (at the ATC-year level there is no difference in number of competitors, generics, or price regulations). This captures the difference between doses/concentrations that are listed in the benefit plan, for a given ATC, to those that are not. The downside is that if there are spillover effects to unlisted doses/concentrations, we will capture those as part of the treatment effect of listing a drug.

B. Net effect on prices and drug sales

A difference-in-difference model is used to estimate the effect on a drug's price of including it in the POS. More specifically, I estimate the following equation:

$$\log(Price_{it}) = \alpha POS_{it} + X_{it}\beta + \gamma_i + \gamma_t + \varepsilon_{it}, \tag{25}$$

where, $Price_{it}$ is the price of drug i in year t, POS_{it} indicates whether drug i was listed in the POS at time t, X_{it} is a set of time-varying controls (whether there are generic competitors in the market, the HH-Index at the ATC level, and whether the drug is subject to reference pricing or a price cap), and γ_i and γ_t are drug and time fixed effects. α is the coefficient of interest and indicates by how much the price of a drug changes when it is listed in the POS. The coefficient is identified by drugs which enter or exit the benefit plan. Pharmaceuticals which are always in the benefit plan during the study period and those which are never in the benefit plan only inform the time fixed effects (and of course their own fixed effects). Table 3 contains the results of the model. The first column shows the results from estimating the model with the whole data set, the second column uses a balanced panel by restricting the analysis to those drugs for which I have information in every year, and the third column uses the balanced panel and includes ATC specific time trends. The fourth column drops outliers (drugs for which the maximum/minimum price ratio is over 30), while the fifth and sixth column are meant to test whether the results are robust to including ATC-Year fixed effects, and to including the set of lagged controls. Standard errors are clustered at the drug subgroup level to allow for arbitrary correlation between the prices of pharmaceutics within the same subgroup.

[Table 3 about here.]

Including a drug to the benefit plan reduces its price. In my preferred specification (column 4 in Table 3), which includes therapeutic groups' specific trends and excludes outliers, the price of a drug drops by 14% (13 log points) once it is introduced into the benefit plan. These results show even though consumers become less sensitive to the total cost of treatment once a drug is listed in the benefit plan, the competition among listed drugs ensures lower prices.[21]

[21]The results are robust to including ATC by year fixed effects, to including dynamic controls, and to restricting the sample to late entrants. All of these robustness provide evidence supporting the case that the estimated coefficients reflect the causal effect of listing a drug in the benefit plan. See Column 5, Column 6 and Table H.5 in Appendix B for details.

As expected, including a drug in the benefit, which makes it readily accessible for consumers, increases the quantities sold to insurance companies and providers by 123% (80 log points) (see Table 4). This in itself is an interesting result as insurance companies could prevent consumers from obtaining access to newly introduced drugs as an alternative mechanism for keeping expenditures low. Although insurance companies may be influencing providers to prevent certain patients (e.g., less informed ones) from obtaining certain drugs (e.g., costly ones), even if this were true, in general sales increase when a drug is listed in the benefit plan.

[Table 4 about here.]

An increase of 123% in the quantity sold by a drug may result in a change in how competitive the overall market is. Table 5 presents the results of estimating how concentration (using the HH-Index) among listed drugs changes after a drug is listed. Including a drug in the benefit plan reduces the concentration at the ATC level by 8%. This is consistent with a reduction in prices reflecting an increase in competition among listed drugs.

[Table 5 about here.]

C. Event studies

The main threat to identification is that the parallel trends assumption is not met; namely, that drugs included in the benefit plan experience a differential trend in prices prior to the change compared to drugs that were already included in the plan and those that were not. This is particularly important if the change in policy (including a drug in the benefit plan) responded to changes in demand or supply, which could result in a differential trend in prices before the change. In order to test for this I do a full event study estimating the following equation:

$$\log(Y_{it}) = \alpha_{<-3}1_{t-\tau_i<-3} + \sum_{j=-3, j\neq -1}^{3} \alpha_j 1_{t-\tau_i=j} + \alpha_{>3}1_{t-\tau_i>3} + X_{it}\beta + \gamma_i + \lambda_i \times t + \varepsilon_{it} \quad (26)$$

where Y_{it} is the outcome (price or quantity) for drug i in year t, τ_i is the year drug i is included in the benefit plan (this is set to 0 for drugs which have always been listed or which are never part of the benefit plan in our sample period) and therefore $1_{t-\tau_i=j}$ is an indicator variable equal to one if year t is j years before/after the change, and $\lambda_i \times t$ are ATC-specific time trends. The parallel trends assumption is met if $\alpha_j = 0$ for $j < 0$, and α_j when $j > 0$ shows us how the prices evolve after a drug is listed in the benefit plan. As can be seen in Figure 3a which shows the event study for prices, there are no differential trends before the policy change. Figure 3b shows the event study for quantities. As with prices, there are no differential trends before the policy change and I cannot reject the null that the coefficients are equal to each other (or to zero).

Although there are changes in the market environment before a drug is listed in the benefit plan (see Section IV.A), the price and the quantities sold do not change before the drug is listed. Price and quantity changes do not seem to be driven by changes in the market environment.

[Figure 3 about here.]

Different drugs have different numbers of leads and lags, since the year in which they enter the benefit plan is different. Therefore, the number of observations identifying each point is different. Figures G.2-G.5 in Appendix C show separate event study plots for drugs entering the benefit plan in 2012 and 2014. Finally, the parallel trend assumption also holds if we include ATC by year fixed effects (see Figures G.1a and G.1b in the Appendix).

D. *Other robustness checks*

In this section I present several robustness checks. First, I study whether a drop in prices after a drug is listed reflects a reduction in the marginal cost of production (due to economies of scale). I partially test this by splitting the sample between imported and non-imported drugs. Since Colombia represents a small share in the global market for drugs, an increase in demand in Colombia should not change the marginal cost of production for imported drugs, and therefore including an imported drug in the benefit plan should not affect its price. The price of imported drugs drops after they are listed in the benefit plan and that the difference in price drops is not statistically different between imported and locally produced drugs (see Table 6).

[Table 6 about here.]

The second check splits the samples between over-the-counter (OTC) and prescription (Rx) drugs. Intuitively, the elasticity of substitution increases more (relatively) for prescription drugs once they are listed in the benefit plan. Therefore, we should see prices falling, after a drug is included in the benefit plan, mostly for drugs which require a physician prescription. Table 7 shows the data matches this reasoning.

[Table 7 about here.]

E. *Competition and listed drugs*

An important dimension of heterogeneity is the level of competition a drug faces. As shown in section II, with limited competition ($N_k \to 1$) listing a drug should result in higher equilibrium prices. However, the level of competition is not a pre-fixed drug characteristic and may be endogenous to the timing of listing a drug (see Section IV.A). With this caveat in mind, I estimate the following equation:

$$(27)\ \log(Price_{it}) = \sum_{j=1}^{10} \alpha_j Competitors_{it}^{j} \times POS_{it} + X_{it}\beta + \gamma_i + \lambda_i \times t + \varepsilon_{it}$$

where $Competitors_{it}^{j}$ is a dummy equal to one if the number of competitors drug i faces at time t is j. $Competitors_{it}^{10}$ is equal to one if there are ten or more competitors. Figure 4 plots the α_js with 95% confidence intervals. There is a clear trend. As competition increases, the reduction in prices increases after listing a drug. As expected, the point estimate of the effect is positive for drugs which face no competition. However, the confidence intervals are large and I cannot rule out a negative price effects even for these drugs.

[Figure 4 about here.]

F. Effect on therapeutic substitutes

According to the theory the price of non-listed drugs should decrease as the market share of listed drugs increases. To test this hypothesis I estimate the following equation:

$$\log(Price_{it}) = \alpha \log(S_{it}^{POS}) + X_{it}\beta + \gamma_i + \gamma_t + \varepsilon_{it},$$

where S_{it}^{POS} is the market share of therapeutic substitutes in the benefit plan. To test whether $\frac{\partial P^{non-listed}}{\partial S^{POS}} < 0$, I estimate this equation using only drugs which are never in the benefit plan during my study period. Panel A shows the effects when using the ATC code to identify therapeutic substitutes, while panel B shows the effect when using pharmacological subgroups. Here, the point estimates are negative and statistically significant: Increasing the market share of therapeutic substitutes in the benefit plan by 1% decreases the price of drugs which are not in the benefit plan by around 15%.

[Table 8 about here.]

The estimates presented in Table 3 are the composition of two effects: The "direct effect" of including a drug in the benefit plan, and the "indirect" effect of increasing the market share of listed drugs. Table 9 attempts to decompose these effects by estimating the following equation:

$$\log(Price_{it}) = \alpha_0 POS_{it} + \alpha_1 \log(S_{it}^{POS}) + X_{it}\beta + \gamma_i + \gamma_t + \varepsilon_{it},$$

Increasing the market share of listed therapeutic substitutes by 1% has an effect of the same order of magnitude as listing the drug (Column 4).

[Table 9 about here.]

V. Conclusions

Pharmaceuticals have the potential to improve health outcomes dramatically; however, they are also a major component of health expenditures and policy makers are often concerned that usage of these products may not be cost-effective (Roberts and Reich 2011). Pharmaceutical policy dictates how drug procurement, distribution, and other supply activities are conducted within a country. The role of the government varies greatly across the world. In some countries, medications are purchased and distributed by the government, while in others private pharmacies provide medications for public-sector patients. However, most countries have moved towards the adoption of health benefit plans which explicitly define the services to be covered with public funds, regardless of how these services are provided (Busse, Schreyögg and Gericke 2007, World Bank 2013, Giedion et al. 2014). Adopting benefit plans introduces at least two features to any health system. First, it reduces out-of-pocket expenditure, making consumers less price elastic; in an environment where suppliers have market power (as is often the case with drugs and other health-related products) this could result in higher prices (Duggan and Scott Morton 2006). The second feature is an increase in competition among

listed drugs, which could in turn drive prices down. Thus, the net effect on prices is unclear and depends greatly on the incentives that these large buyer groups have to cut expenditures.

I present a theoretical model to formalize these ideas. Using a difference-in-difference strategy I study the effect of including a drug in the benefit plan and find a reduction in the price of 14% and an increase of over 123% in drug sales. However, in the absence of competition prices increase. I explore how the price of competing drugs is affected by the number of drugs in the benefit plan. The price of drugs which are not in the benefit plan decreases as the number of therapeutic substitutes in the plan increases. This is the result of the decrease in the price of drugs which are added to the benefit plan and the pressure this puts on competing drugs. On the other hand, the price of drugs which are already in the benefit plan is not affected by the number of therapeutic substitutes in the benefit plan. This could be due to the lower prices charged once a drug is listed in the benefit plan, which might reduce the scope for further price reductions via competition.

The results of this paper shed light on how different institutional arrangements affect health markets. Previous studies in the U.S. and other developed countries have shown that the incentives in place do matter and that pharmaceutical companies, physicians, and patients take them into account (Duggan and Scott Morton 2006, Duggan and Scott Morton 2010, Brekke, Holmas and Straume 2011, Clemens and Gottlieb 2013). However, this is the first paper, to the best of my knowledge, that demonstrates this in an environment where insurance companies have no discretion over the premium they can charge or the benefits they can offer. In addition, I use data from a middle-income country. This is important, as the policy lessons learned in more industrialized nations may not apply to low- and middle-income countries. For example, in the case of drugs, an institutional arrangement which results in lower prices in a middle-income country will probably not have an effect on research and innovation

since most countries represent only a small fraction of world market.

The tension between financial incentives and quality is often a matter of controversy and some critics believe that financial incentives lead to lower quality without reducing costs (Webster 2012) in health markets. The results in this paper speak directly to that controversy, showing that prices decrease without precluding access. Although it is still possible that insurance companies are influencing providers to prevent certain patients from obtaining costly drugs, these results suggest drug sales increase when a drug is listed in the benefit plan and therefore the access to, and quality of, care increases.

Recently the price of several drugs has increase in the US (The New York Times 2015*c*, The New York Times 2015*d*, The New York Times 2015*a*, The New York Times 2015*b*) due to what the press calls the "business strategy of buying old neglected drugs and turning them into high-priced "specialty drugs"". This business strategy is only possible in a market where consumers have incomplete information about possible substitutes for a given good. Large buyer groups, when faced with the right incentives, increase competition among therapeutic alternatives and reduces the price of treatment. As the The New York Times (2015*c*) puts it "...the primary check on medicine prices is large buyers - insurance companies, big hospital chains and group purchasing organizations that negotiate sizable discounts off the manufacturer's wholesale price".

REFERENCES

Arrow, Kenneth J. 1963. "Uncertainty and the welfare economics of medical care." *American Economic Review*, 53(5).

Brekke, Kurt R., Tor Helge Holmas, and Odd Rune Straume. 2011. "Reference pricing, competition, and pharmaceutical expenditures: Theory and evidence from a natural experiment." *Journal of Public Economics*, 95: 624 – 638.

Brown, Jason, Mark Duggan, Ilyana Kuziemko, and William Woolston. 2014. "How Does Risk Selection Respond to Risk Adjustment? New Evidence from

the Medicare Advantage Program." *American Economic Review*, 104(10): 3335–64.

Busse, Reinhard, Jonas Schreyögg, and Christian Gericke. 2007. "Analyzing changes in health financing arrangements in high-income countries: a comprehensive framework approach."

Castano, Ramon, and Andres Zambrano. 2006. "Biased selection within the social health insurance market in Colombia." *Health Policy*, 79(2-3): 313–324.

Clemens, Jeffrey, and Joshua D. Gottlieb. 2013. "In the Shadow of a Giant: Medicare's Influence on Private Physician Payments." National Bureau of Economic Research Working Paper 19503.

Clemens, Jeffrey, and Joshua D. Gottlieb. 2014. "Do Physicians' Financial Incentives Affect Medical Treatment and Patient Health?" *American Economic Review*, 104(4): 1320–49.

Comisión Nacional de Precios de Medicamentos . 2010. "Circular 4 de 2010."

Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos. 2011. "Circular 1 de 2011."

Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos. 2012*a*. "Circular 1 de 2012."

Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos. 2012*b*. "Circular 3 de 2012."

Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos. 2012*c*. "Circular 4 de 2012."

Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos. 2013*a*. "Circular 4 de 2013."

Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos. 2013*b*. "Circular 5 de 2013."

Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos. 2013*c*. "Circular 6 de 2013."

Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos. 2013*d*. "Circular 7 de 2013."

Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos. 2014. "Circular 1 de 2014."

Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos. 2016*a*. "Circular 1 de 2016."

Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos. 2016*b*. "Circular 4 de 2016."

Comision de Regulacion en Salud. 2009*a*. "Acuerdo 03 de 2009."

Comision de Regulacion en Salud. 2009*b*. "Acuerdo 08 de 2009."

Comision de Regulacion en Salud. 2010. "Acuerdo 17 de 2010."

Comision de Regulacion en Salud. 2011*a*. "Acuerdo 21 de 2011."

Comision de Regulacion en Salud. 2011*b*. "Acuerdo 25 de 2011."

Comision de Regulacion en Salud. 2011*c*. "Acuerdo 29 de 2011."

Comision de Regulacion en Salud. 2012. "Acuerdo 34 de 2012."

Consejo Nacional de Seguridad Social en Salud. 2006*a*. "Acuerdo 335 de 2006."

Consejo Nacional de Seguridad Social en Salud. 2006*b*. "Acuerdo 336 de 2006."

Consejo Nacional de Seguridad Social en Salud. 2007*a*. "Acuerdo 368 de 2007."

Consejo Nacional de Seguridad Social en Salud. 2007*b*. "Acuerdo 380 de 2007."

Departamento Nacional de Planeacion. 2012. "Politica Farmaceutica Nacional." In *Documentos Consejo Nacional de Política Económica y Social 155*.

Duggan, Mark, and Fiona M. Scott Morton. 2006. "The Distortionary Effects of Government Procurement: Evidence from Medicaid Prescription Drug Pur-

chasing." *The Quarterly Journal of Economics*, 121(1): 1–30.

Duggan, Mark, and Fiona Scott Morton. 2010. "The Effect of Medicare Part D on Pharmaceutical Prices and Utilization." *American Economic Review*, 100(1): 590–607.

Gaviria, Alejandro. 2013. "Exposición de motivos del Proyecto de Ley "Por el cual se redefine el Sistema General de Seguridad Social en Salud y se dictan otras disposiciones"." Ministerio de Salud y Proteccion Social.

Giedion, Úrsula, and Manuela Villar Uribe. 2009. "Colombia's Universal Health Insurance System." *Health Affairs*, 28(3): 853–863.

Giedion, Úrsula, Ignez Tristao, Liliana Escobar, Ricardo Bitrán, Oscar Cañón, Silvia Molins, Lucía Alonso, Jorge Fernández, Giota Panopoulou, Eduardo González-Pier, et al. 2014. *Health benefit plans in Latin America: a regional comparison.* Inter-American Development Bank.

Gómez-Suárez, Ronal Eduardo. 2007. "Cream-Skimming And Risk Adjustment in Colombian Health Insurance System: The Public Insurer Case." *Archivos De Economía*.

Gruber, Jonathan, and Maria Owings. 1996. "Physician Financial Incentives and Cesarean Section Delivery." *The RAND Journal of Economics*, 27(1): pp. 99–123.

Iizuka, Toshiaki. 2007. "Experts' Agency Problems: Evidence from the Prescription Drug Market in Japan." *The RAND Journal of Economics*, 38(3): pp. 844–862.

Iizuka, Toshiaki. 2012. "Physician Agency and Adoption of Generic Pharmaceuticals." *American Economic Review*, 102(6): 2826–58.

Leu, Robert E., Frans F. H. Rutten, Werner Brouwer, Pius Matter, and Christian Rutschi. 2009. "The Swiss and Dutch Health Insurance Systems: Universal Coverage and Regulated Competitive Insurance Markets." *The Commonwealth Fund*.

Management Sciences for Health. 2012. *MDS-3: Managing Access to Medicines and Health Technologies.* Arlington, VA: Management Sciences for Health.

Milgrom, Paul. 1990. "Rationalizability, Learning, and Equilibrium in Games with Strategic Complementarities." *Econometrica*, 58(6): 1255–1277.

Ministerio de Salud y Proteccion Social. 2010. "Resolucion 5229 de 2010."

Ministerio de Salud y Proteccion Social. 2011*a*. "Resolucion 1020 de 2011."

Ministerio de Salud y Proteccion Social. 2011*b*. "Resolucion 1697 de 2011."

Ministerio de Salud y Proteccion Social. 2011*c*. "Resolucion 3026 de 2011."

Ministerio de Salud y Proteccion Social. 2011*d*. "Resolucion 3470 de 2011."

Ministerio de Salud y Proteccion Social. 2011*e*. "Resolucion 4316 de 2011."

Ministerio de Salud y Proteccion Social. 2011*f*. "Resolucion 5 de 2011."

Ministerio de Salud y Proteccion Social. 2012. "Resolucion 2569 de 2012."

Ministerio de Salud y Proteccion Social. 2013. "Resolucion 5521 de 2013."

Ministerio de Salud y Proteccion Social. 2014. "Resolucion 5926 de 2014."

Ministerio de Salud y Proteccion Social. 2015*a*. "Resolucion 0718 de 2015."

Ministerio de Salud y Proteccion Social. 2015*b*. "Resolucion 5592 de 2015."

Roberts, M.J., and M.R. Reich. 2011. *Pharmaceutical Reform: A Guide to Improving Performance and Equity. World Bank Training Series*, World Bank Publications.

Semana. 2014. "Así controlan las instituciones y empresas de salud a los médicos." Visited on 11/04/2015.

Shepard, Mark. 2015. "Hospital Network Competition and Adverse Selection: Evidence from the Massachusetts Health Insurance Exchange (JOB MARKET PAPER)." Working Paper.

The New York Times. 2015*a*. "Big Price Increase for Tuberculosis Drug Is Rescinded."

The New York Times. 2015*b*. "Drug Goes From $13.50 a Tablet to $750, Overnight."

The New York Times. 2015*c*. "Fury Over Drug Price Spikes Rising, but Increases Aren't New."

The New York Times. 2015*d*. "Valeant's Drug Price Strategy Enriches It, but Infuriates Patients and Lawmakers."

United States Congress. 2006. *Federal Food, Drug, and Cosmetic Act*. Supplement 4 Title 21 Section 321.

Vacca, C, A Acosta, and I Rodriguez. 2011. "International reference prices and cost minimization analysis for the regulation of medicine prices in Colombia." *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research*, 14(5 Suppl 1): S16–S19.

Webster, Paul Christopher. 2012. "Health in Colombia: a system in crisis." *CMAJ : Canadian Medical Association Journal*, 184(6): E289–E290. PMID: 22392944 PMCID: PMC3314050.

World Bank. 2013. "Universal Health Coverage Study Series (UNICO)." Accessed: February 2016.

Zapata, Juan, Sergio Bernal, Jairo Castillo, and Katherine Garzon. 2012. "Hacia una politica integral de medicamentos biotecnologicos en Colombia." *Cuadernos de Fedesarrollo*, 39.

Figures

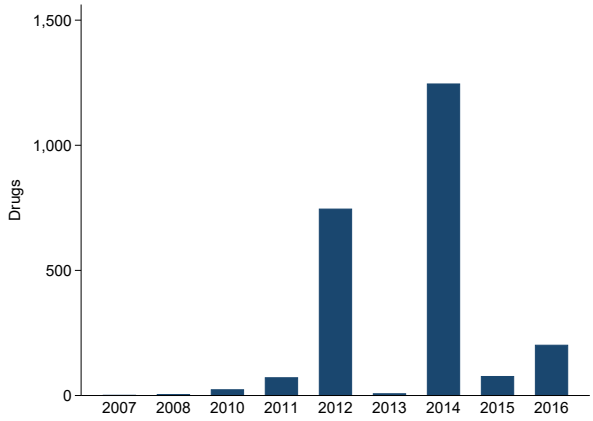
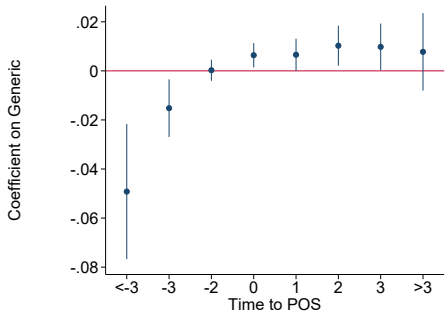


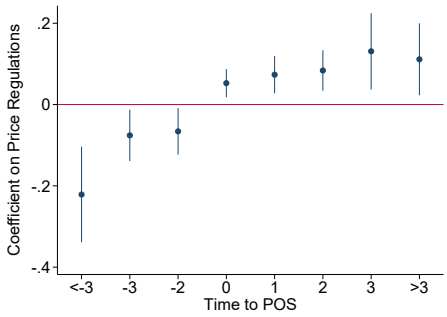
Figure 1. : Drugs added to the benefit each year.

Note: Source:Consejo Nacional de Seguridad Social en Salud (2006*b*), Consejo Nacional de Seguridad Social en Salud (2006*a*), Consejo Nacional de Seguridad Social en Salud (2007*a*), Consejo Nacional de Seguridad Social en Salud (2007*b*), Comision de Regulacion en Salud (2009*a*), Comision de Regulacion en Salud (2009*b*), Comision de Regulacion en Salud (2010), Comision de Regulacion en Salud (2011*a*), Comision de Regulacion en Salud (2011*b*), Comision de Regulacion en Salud (2011*c*), Comision de Regulacion en Salud (2012), Ministerio de Salud y Proteccion Social (2013), Ministerio de Salud y Proteccion Social (2014), Ministerio de Salud y Proteccion Social (2015*b*). *Calculations:* Author.

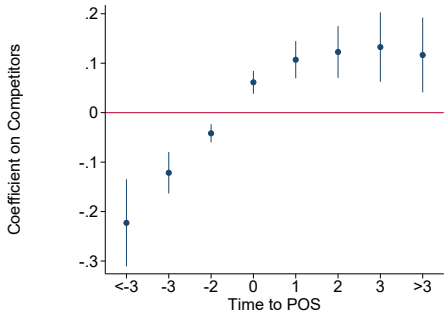
Figure 2. : Endogenous timing of inclusion



(a) Generic

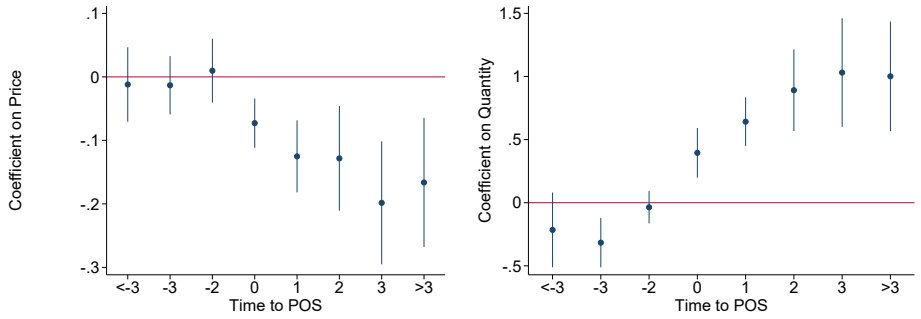


(b) Price regulation



(c) Competitors

Note: These graphs show the coefficients from leads and lags of the year of inclusion to the benefit plan from regressions which control for drug and year fixed effects. The dots represent point estimates, while the bars represent 95% confidence intervals. Panel 2a shows how the presence of generics in the market with the same ATC code changes before and after a drug is listed in the benefit plan. Panel 2b shows how price regulations changes before and after a drug is listed in the benefit plan. Panel 2c shows how the (log) number of competitors with the same ATC code changes before and after a drug is listed in the benefit plan. Data: SISMED and INVIMA. Calculations: Author.



(a) Price (b) Quantity

Figure 3. : Event studies

Note: These graphs show the coefficients from leads and lags of the year of inclusion to the benefit plan from regressions that control for drug fixed effects, ATC-specific time trends, and drops outliers from the estimation. The dots represent point estimates, while the bars represent 95% confidence intervals. Panel 3a shows the effect of including a drug in the benefit plan (POS) on its price. Panel 3b shows the effect of including a drug in the benefit plan (POS) on the quantities sold. Source: SISMED and INVIMA. Calculations: Author.

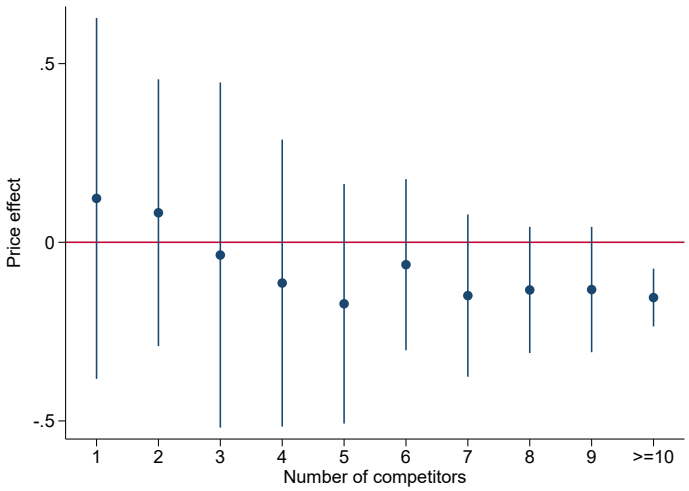


Figure 4. : The effect of competition

Note: These graphs show the coefficients from interacting the number of competitors with a dummy indicating whether the drug is listed in the benefit plan or not (the $alpha_j$s in equation 27). The regression controls for drug fixed effects, ATC-specific time trends and use a balance panel of drugs without outliers. The dots represent point estimates, while the bars represent 95% confidence intervals. Source: SISMED and INVIMA. Calculations: Author.

Tables

Table 1—: Summary statistics for drugs with some observations and a maximum/minimum price ratio under 30

	Mean	St. Dev.	Min	P10	P90	Max
POS	0.42	0.49	0	0	1	1
No. of drugs with the same ATC	41.9	45.9	1	4	92	275
No. of drugs with the same ATC in the POS	19.5	30.2	0	0	62	173
No. of drugs in the same pharmacological subgroup	102.0	95.3	1	15	217	478
No. of drugs in the same pharmacological subgroup in the POS	42.0	52.0	0	0	118	240
Generic	0.30	0.46	0	0	1	1
Essential medication (must be sold under generic name)	0.40	0.49	0	0	1	1
Controlled substance	0.023	0.15	0	0	0	1
OTC	0.11	0.31	0	0	1	1
No. of presentations	4.05	4.87	1	1	8	255
Imported	0.40	0.49	0	0	1	1
Price info every year	0.15	0.36	0	0	1	1

Note: The total number of drug-year observations is 99,411. In the POS (=1) if the drug is in the benefit plan at that point in time, for pharmaceuticals with multiple ATC codes, the number of pharmaceuticals with the same ATC code is the sum of pharmaceuticals across all ATC codes (the same applies for pharmaceuticals with the same ATC code in the POS). For pharmaceuticals with multiple pharmacological subgroups, the number of pharmaceuticals in the same subgroup is the sum of pharmaceuticals across all subgroups (the same applies for pharmaceuticals in the same pharmacological subgroup in the POS). Generic(=1) indicates if the drug is a generic, Essential Medication(=1) if the drug is labeled as "essential" and therefore the generic name must appear in the label at the same size as the brand name. Controlled substance(=1) if the drug can generate addiction and therefore its usage is heavily regulated, OTC(=1) for over-the-counter (OTC), Imported(=1) for imported drugs, and Yrs. in the market is the number of years since the introduction of the drug to Colombia in 2007, and Price info every year(=1) if there is price information for the drug every year. Source: Author's calculations based on SISMED and INVIMA data.

Table 2—: Timing and other regulatory changes

	$1_{Generic}$	Log(competitors)	$1_{Price\ regulations}$
	(1)	(2)	(3)
POS	0.029	0.21	0.18
	(0.0075)	(0.038)	(0.045)
N. of obs.	194419	194676	195710
N. of clusters (pharmacological subgroups)	609	611	615
N. of drugs	24398	24486	24509

Note: In the first column, the dependent variable is a dummy equal to one if there is at least one generic with the same ATC code. In the second column the dependent variable is the log number of competitors with the same ATC code. In the last column, the dependent variable is a dummy equal to one if the drug is subject to any price regulations (reference pricing or price caps). All regressions include drug and year fixed effects. The variable POS indicates whether a drug is listed in the plan or not. In panel A, POS changes for all drugs which are added to the benefit plan. In panel B, POS changes only for drugs which are "early entrants"(i.e., drugs which are the first of their ATC code to be listed). In panel C, POS changes only for drugs which are "late entrants"(i.e., drugs listed after other drugs with the same ATC code are already listed). Clustered standard errors, by pharmacological subgroup, are in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3—: Effect on a drug's price of including the drug to the benefit plan

	$\log(Price)$					
	(1)	(2)	(3)	(4)	(5)	(6)
POS	-0.19***	-0.15***	-0.15***	-0.13***	-0.088*	-0.12***
	(0.042)	(0.046)	(0.040)	(0.037)	(0.047)	(0.030)
N. of obs.	55579	14054	14054	13354	10608	10680
N. of clusters (pharmacological subgroups)	529	317	317	310	181	310
N. of drugs	9771	1407	1407	1337	1061	1337
Drug F.E.	Yes	Yes	Yes	Yes	Yes	Yes
ATC x Year F.E.	No	No	No	No	Yes	No
Year F.E.	Yes	Yes	No	No	No	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lagged Controls	No	No	No	No	No	Yes
Balanced panel?	No	Yes	Yes	Yes	Yes	Yes
Molecule trends?	No	No	Yes	Yes	Yes	Yes
Outliers excluded?	No	No	No	Yes	Yes	Yes

Note: The dependent variable is the (log) price at which pharmaceutical companies sell the drug to providers. The independent variable is a dummy of wether the drug is in the benefit plan. All regressions include drug specific fixed effects. The following time-varying controls are used: whether there is generic competitor in the market, the the HH-Index at the ATC level and whether the drug is subject to reference pricing or a price cap. "Lagged controls" indicates whether one and two period lags of the time-varying controls are included. "balanced panel?" indicates if only drugs for which price information is available in every year are included. "Molecule trends?" indicates whether ATC specific trends are used instead of year fixed effects. Finally, "Outliers excluded?" indicates whether drugs for which the maximum historical price is 30 times or more the minimum historical price. Clustered standard errors, by pharmacological subgroup, are in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4—: Effect of including a drug in the health plan on the quantities sold

	$\log(Q)$					
	(1)	(2)	(3)	(4)	(5)	(6)
POS	0.49***	0.56***	0.84***	0.80***	0.35**	0.57***
	(0.085)	(0.12)	(0.13)	(0.12)	(0.15)	(0.12)
N. of obs.	55579	14054	14054	13354	10608	10680
N. of clusters (pharmacological subgroups)	529	317	317	310	181	310
N. of drugs	9771	1407	1407	1337	1061	1337
Drug F.E.	Yes	Yes	Yes	Yes	Yes	Yes
ATC x Year F.E.	No	No	No	No	Yes	No
Year F.E.	Yes	Yes	No	No	No	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lagged Controls	No	No	No	No	No	Yes
Balanced panel?	No	Yes	Yes	Yes	Yes	Yes
Molecule trends?	No	No	Yes	Yes	Yes	Yes
Outliers excluded?	No	No	No	Yes	Yes	Yes

Note: The dependent variable is the total (log) quantity that pharmaceutical companies sell of the drug to providers. The independent variable is a dummy of wether the drug is in the benefit plan. All regressions include drug specific fixed effects and the following time-varying controls: whether there is generic competitor in the market, the the HH-Index at the ATC level and whether the drug is subject to reference pricing or a price cap. "balanced panel?" indicates if only drugs for which price information is available in every year are included. "Molecule trends?" indicates whether ATC specific trends are used instead of year fixed effects. Finally, "Outliers excluded?" indicates whether drugs for which the maximum historical price is 30 times or more the minimum historical price. Clustered standard errors, by pharmacological subgroup, are in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5—: Effect of including a drug in the health plan on the quantities sold

	$HH-Index$					
	(1)	(2)	(3)	(4)	(5)	(6)
POS	-0.087**	-0.067**	-0.078**	-0.078**	-0.066*	-0.069***
	(0.039)	(0.033)	(0.032)	(0.032)	(0.034)	(0.026)
N. of obs.	105648	7556	7556	7556	6167	105648
N. of clusters (pharmacological subgroups)	311	201	201	201	200	311
N. of drugs	311	201	201	201	200	311
Drug fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	No	No	No	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lagged Controls	No	No	No	No	Yes	No
Balanced panel?	No	Yes	Yes	Yes	Yes	No
Molecule trends?	No	No	Yes	Yes	Yes	Yes
Outliers excluded?	No	No	No	Yes	Yes	Yes

Note: The dependent variable is the HH-Index at the ATC level among listed drugs. The independent variable is a dummy of wether the drug is in the benefit plan. All regressions include drug specific fixed effects and the following time-varying controls: whether there is generic competitor in the market, the the HH-Index at the ATC level and whether the drug is subject to reference pricing or a price cap. "balanced panel?" indicates if only drugs for which price information is available in every year are included. "Molecule trends?" indicates whether ATC specific trends are used instead of year fixed effects. Finally, "Outliers excluded?" indicates whether drugs for which the maximum historical price is 30 times or more the minimum historical price. Clustered standard errors, by pharmacological subgroup, are in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6—: Effect of including a drug in the health plan for locally produced vs. imported drugs

Panel A: Prices				
	$\log(Price)$			
	(1)	(2)	(3)	(4)
POS	-0.13***	-0.088*	-0.12**	-0.088*
	(0.037)	(0.049)	(0.059)	(0.049)
POS × Imported				-0.037
				(0.074)
N. of obs.	13354	8134	5220	13354
N. of clusters (pharmacological subgroups)	310	232	198	310
N. of drugs	1337	814	523	1337
Drugs	All	Locally produced	Imported	All
Panel B: Quantities				
	$\log(Q)$			
	(1)	(2)	(3)	(4)
POS	0.80***	0.98***	0.57***	0.98***
	(0.12)	(0.20)	(0.18)	(0.21)
POS × Imported				-0.41
				(0.30)
N. of obs.	13354	8134	5220	13354
N. of clusters (pharmacological subgroups)	310	232	198	310
N. of drugs	1337	814	523	1337
Drugs	All	Locally produced	Imported	All

Note: All regressions include drug specific fixed effects, ATC specific time trends, and the following time-varying controls: whether there is generic competitor in the market, the the HH-Index at the ATC level and whether the drug is subject to reference pricing or a price cap. The sample is a balanced panel without outliers (drugs for which the maximum historical price is 30 times or more the minimum historical price). "Origin" indicates whether all drugs are included in the regressions, only imported drugs, or only locally produced drugs. Clustered standard errors, by pharmacological subgroup, are in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7—: Effect of including a drug in the health plan for over-the-counter (OTC) vs. prescription (Rx) drugs

Panel A: Prices				
	$\log(Price)$			
	(1)	(2)	(3)	(4)
POS	-0.13***	-0.12***	-0.19	-0.12***
	(0.037)	(0.037)	(0.13)	(0.037)
POS × OTC				-0.068
				(0.042)
N. of obs.	13354	11786	1568	13354
N. of clusters (pharmacological subgroups)	310	284		310
N. of drugs	1337	1180	157	1337
Drugs	All	rX	OTC	All
Panel B: Quantities				
	$\log(Q)$			
	(1)	(2)	(3)	(4)
POS	0.80***	0.80***	-0.61	0.80***
	(0.12)	(0.12)	(0.63)	(0.12)
POS × OTC				-1.41***
				(0.13)
N. of obs.	13354	11786	1568	13354
N. of clusters (pharmacological subgroups)	310	284		310
N. of drugs	1337	1180	157	1337
Drugs	All	rX	OTC	All

Note: All regressions include drug specific fixed effects, ATC specific time trends, and the following time-varying controls: whether there is generic competitor in the market, the the HH-Index at the ATC level and whether the drug is subject to reference pricing or a price cap. The sample is a balanced panel without outliers (drugs for which the maximum historical price is 30 times or more the minimum historical price). "Competition" indicates whether there was only one drug in the ATC group from 2007 to 2014, or were at least two drugs in the ATC group each year. Clustered standard errors, by pharmacological subgroup, are in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8—: Effect of including a drug in the benefit plan on the price of therapeutic substitutes which are not in the plan

Panel A: ATC codes

	$\log(Price)$				
	(1)	(2)	(3)	(4)	(5)
POS Market share	-0.00017	-0.0022	-0.0021	-0.0034	-0.0026
	(0.0035)	(0.0033)	(0.0032)	(0.0062)	(0.0039)

Panel B: Pharmacological subgroups

	$\log(Price)$				
	(1)	(2)	(3)	(4)	(5)
POS Market share	-0.0044	-0.0040	-0.00069	-0.0044	-0.0021
	(0.0056)	(0.0045)	(0.0054)	(0.0078)	(0.0071)

Note: All regressions include drug specific fixed effects. The following time-varying controls are used: whether there is generic competitor in the market, the the HH-Index at the ATC level and whether the drug is subject to reference pricing or a price cap. "Lagged controls" indicates whether one and two period lags of the time-varying controls are included. "Balanced panel?" indicates if only drugs for which price information is available in every year are included. "Molecule trends?" indicates whether ATC specific trends are used instead of year fixed effects. "Outliers excluded?" indicates whether drugs for which the maximum historical price is 30 times or more the minimum historical price. Clustered standard errors, by pharmacological subgroup, are in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9—: Effect on a drug's price of including the drug to the benefit plan

	log(*Price*)					
	(1)	(2)	(3)	(4)	(5)	(6)
POS	-0.16***	-0.11**	-0.12***	-0.11***	-0.11***	
	(0.043)	(0.046)	(0.040)	(0.037)	(0.030)	
POS Market share	-0.0010**	-0.0017***	-0.0019***	-0.00097***	-0.00081**	
	(0.00048)	(0.00049)	(0.00045)	(0.00035)	(0.00035)	
N. of obs.	55579	14054	14054	13354	10680	
N. of clusters	529	317	317	310	310	
N. of drugs	9771	1407	1407	1337	1337	
Year F.E.	Yes	Yes	No	No	No	
Controls	Yes	Yes	Yes	Yes	Yes	
Lagged Controls	No	No	No	No	Yes	
Balanced panel?	No	Yes	Yes	Yes	Yes	
Molecule trends?	No	No	Yes	Yes	Yes	
Outliers excluded?	No	No	No	Yes	Yes	

Note: The dependent variable is the (log) price at which pharmaceutical companies sell the drug to providers. The independent variable is a dummy of whether the drug is in the benefit plan. All regressions include drug specific fixed effects. The following time-varying controls are used: whether there is generic competitor in the market, the the HH-Index at the ATC level and whether the drug is subject to reference pricing or a price cap. "Lagged controls" indicates whether one and two period lags of the time-varying controls are included. "balanced panel?" indicates if only drugs for which price information is available in every year are included. "Molecule trends?" indicates whether ATC specific trends are used instead of year fixed effects. Finally, "Outliers excluded?" indicates whether drugs for which the maximum historical price is 30 times or more the minimum historical price. Clustered standard errors, by pharmacological subgroup, are in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Average price across presentations

As many drugs come in different presentations, the price used in all of the analyses is the weighted average, by units sold, of the price per unit of product across presentations. More formally, we have that:

$$SP = \frac{\text{Price}}{\text{Units} \times (\text{Quantity per unit})}$$
$$AP = \frac{\sum_{p \in P} (\text{SP})_p \times (\text{Quantity Sold})_p}{\sum_p (\text{Quantity Sold})_p},$$

where P is the set of presentations, SP is the standardized price (price per unit of product) for a particular presentation, and AP is the average price across presentations. Table H.1 shows the prices and quantities sold in 2014 for each presentation of Motrin 400MG® imported by Pfizer. Although only two different presentations were sold to insurance companies and providers (this does not include private pharmacies), the product comes in 17 different presentations (including medical samples). The average price in this example would be $AP = \frac{2.02 \times 335 + 1.87 \times 228}{335 + 228} = 1.96$.

[Table A.1 about here.]

Extra tables

[Table B.2 about here.]

[Table B.3 about here.]

[Table B.4 about here.]

[Table B.5 about here.]

Extra figures

[Figure C.1 about here.]

[Figure C.2 about here.]

[Figure C.3 about here.]

[Figure C.4 about here.]

[Figure C.5 about here.]

Mathematical Derivations - Model Alt

$$U(q_1, ..., q_N) = \left(q_A^{\frac{\eta-1}{\eta}} + q_B^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}$$

with

$$q_A = \left(\sum_{i \in A} q_i^{\frac{\rho_A - 1}{\rho_A}} \right)^{\frac{\rho_A}{\rho_A - 1}}$$

$$q_B = \left(\sum_{i \in B} q_i^{\frac{\rho_B - 1}{\rho_B}} \right)^{\frac{\rho_B}{\rho_B - 1}}$$

We assume $1 < \eta < \rho_A < \rho_B$.

If Y is the total income, then the demand for drug i in group k is

$$q_{i,k} = \frac{Y}{\widehat{P}} \left(\frac{\widehat{P_k}}{\widehat{P_{i,k}}} \right)^{\rho} \left(\frac{\widehat{P}}{\widehat{P_k}} \right)^{\eta}$$

or

$$q_{i,k} = Y \left(\widehat{P_{i,k}} \right)^{-\rho} \widehat{P_k}^{\rho - \eta} \widehat{P}^{\eta - 1}$$

where

$$\widehat{P_{i,k}} = \lambda_k P_{i,k}$$

$$\widehat{P_k} = \left(\sum_{j \in N_K} \widehat{P_{i,k}}^{1-\rho} \right)^{\frac{1}{1-\rho}}$$

$$\widehat{P}_k = \lambda_k \left(\sum_{j \in N_K} P_j^{1-\rho} \right)^{\frac{1}{1-\rho}}$$

$$P_k = \left(\sum_{j \in N_K} P_j^{1-\rho} \right)^{\frac{1}{1-\rho}}$$

$$\widehat{P}_k = \lambda_k P_k$$

and

$$\widehat{P} = \left(\widehat{P_A}^{1-\eta} + \widehat{P_B}^{1-\eta} \right)^{\frac{1}{1-\eta}}$$

$$\widehat{P} = \left(\lambda_A^{1-\eta} P_A^{1-\eta} + \lambda_B^{1-\eta} P_B^{1-\eta} \right)^{\frac{1}{1-\eta}}$$

$$P = \left(P_A^{1-\eta} + P_B^{1-\eta} \right)^{\frac{1}{1-\eta}}$$

In general the pirces with "hat" are the prices paid by consumers, while the prices without "hat" are the prices set by firms.

Now a firm wants to maximize:

$$\pi = (P_{i,k} - c) q_{i,k}$$

$$\pi = (P_{i,k} - c) Y \left(\widehat{P_{i,k}} \right)^{-\rho} \widehat{P}_k{}^{\rho-\eta} \widehat{P}^{\eta-1}$$

$$\pi = (\lambda_k^{-1} \widehat{P_{i,k}} - c) Y \left(\widehat{P_{i,k}} \right)^{-\rho} \widehat{P}_k{}^{\rho-\eta} \widehat{P}^{\eta-1}$$

and the FOC (with respect to $\widehat{P_{i,k}}$) implies:

$$\lambda_k^{-1} q_{i,k} + (\lambda_k^{-1} \widehat{P_{i,k}} - c) \frac{\partial q_{i,k}}{\partial \widehat{P_{i,k}}} = 0$$

$$\lambda_k^{-1} q_{i,k} + (\lambda_k^{-1} \widehat{P_{i,k}} - c) \left[-\rho \frac{q_{i,k}}{\widehat{P_{i,k}}} + (\rho - \eta) \frac{q_{i,k} \widehat{P}_i^{-\rho}}{\widehat{P}_k{}^{1-\rho}} + (\eta - 1) \frac{q_{i,k} \widehat{P}_k^{-\eta}}{\widehat{P}^{1-\eta}} \left(\frac{\widehat{P_{i,k}}}{\widehat{P}_k} \right)^{-\rho} \right] = 0$$

$$\lambda_k^{-1} + (\lambda_k^{-1} \widehat{P_{i,k}} - c) \left[-\rho \frac{1}{\widehat{P_{i,k}}} + (\rho - \eta) \frac{\widehat{P}_i^{-\rho}}{\widehat{P}_k{}^{1-\rho}} + (\eta - 1) \frac{\widehat{P}_k^{-\eta}}{\widehat{P}^{1-\eta}} \left(\frac{\widehat{P_{i,k}}}{\widehat{P}_k} \right)^{-\rho} \right] = 0$$

$$\lambda_k^{-1}\widehat{P_{i,k}} + (\lambda_k^{-1}\widehat{P_{i,k}} - c)\left[-\rho + (\rho-\eta)\frac{\widehat{P_i}^{1-\rho}}{\widehat{P_k}^{1-\rho}} + (\eta-1)\frac{\widehat{P_k}^{1-\eta}}{\widehat{P}^{1-\eta}}\frac{\widehat{P_{i,k}}^{1-\rho}}{\widehat{P_k}^{1-\rho}}\right] = 0$$

Now notice that the share of total expenditure ($\widehat{S_{i,k}}$) in variety k is

$$\widehat{S_{i,k}} = \frac{q_{i,k}P_{i,k}}{\sum_j P_{j,k}q_{j,k}} \quad \text{(D1)}$$

$$= \frac{Y\left(\widehat{P_{i,k}}\right)^{-\rho}\widehat{P_k}^{\rho-\eta}\widehat{P}^{\eta-1}P_{i,k}}{\sum_j Y\left(\widehat{P_{j,k}}\right)^{-\rho}\widehat{P_k}^{\rho-\eta}\widehat{P}^{\eta-1}P_{j,k}} \quad \text{(D2)}$$

$$= \frac{Y\left(\widehat{P_{i,k}}\right)^{-\rho}\widehat{P_k}^{\rho-\eta}\widehat{P}^{\eta-1}\lambda_k^{-1}\widehat{P_{i,k}}}{\sum_j Y\left(\widehat{P_{j,k}}\right)^{-\rho}\widehat{P_k}^{\rho-\eta}\widehat{P}^{\eta-1}\lambda_k^{-1}\widehat{P_{j,k}}} \quad \text{(D3)}$$

$$= \frac{Y\widehat{P_k}^{\rho-\eta}\widehat{P}^{\eta-1}\lambda_k^{-1}\left(\widehat{P_{i,k}}\right)^{1-\rho}}{Y\widehat{P_k}^{\rho-\eta}\widehat{P}^{\eta-1}\lambda_k^{-1}\sum_j\left(\widehat{P_{j,k}}\right)^{1-\rho}} \quad \text{(D4)}$$

$$= \frac{\widehat{P_{i,k}}^{1-\rho}}{\sum_j \widehat{P_{j,k}}^{1-\rho}} \quad \text{(D5)}$$

$$= \frac{P_{i,k}^{1-\rho}}{\sum_j P_{j,k}^{1-\rho}} \quad \text{(D6)}$$

$$= S_{i,k} \quad \text{(D7)}$$

which is the same as the share of market k that product i has ($S_{i,k}$).

The share of the total expenditure in variety k is

$$\widehat{S_k} = \frac{q_k \widehat{P_k}}{\sum_k \widehat{P_k} q_k} \tag{D8}$$

$$= \frac{Y \widehat{P_k}^{-\eta} \widehat{P}^{\eta-1} \widehat{P_k}}{\sum_k Y \widehat{P_k}^{-\eta} \widehat{P}^{\eta-1} \widehat{P_k}} \tag{D9}$$

$$= \frac{\widehat{P_k}^{1-\eta}}{\sum_k \widehat{P_k}^{1-\eta}} \tag{D10}$$

$$= \frac{\lambda_k^{1-\eta} P_k^{1-\eta}}{\sum_k \lambda_k^{1-\eta} P_k^{1-\eta}} \tag{D11}$$

(D12)

which in this case is different from the share of the total market capture by variety k

$$S_k = \frac{q_k P_k}{\sum_k P_k q_k} \tag{D13}$$

$$= \frac{Y \widehat{P_k}^{-\eta} \widehat{P}^{\eta-1} P_k}{\sum_k Y \widehat{P_k}^{-\eta} \widehat{P}^{\eta-1} P_k} \tag{D14}$$

$$= \frac{\widehat{P_k}^{-\eta} P_k}{\sum_k \widehat{P_k}^{-\eta} P_k} \tag{D15}$$

$$= \frac{\widehat{P_k}^{-\eta} \widehat{P_k} \lambda_k^{-1}}{\sum_k \widehat{P_k}^{-\eta} \widehat{P_k} \lambda_k^{-1}} \tag{D16}$$

$$= \frac{\widehat{P_k}^{1-\eta} \lambda_k^{-1}}{\sum_k \widehat{P_k}^{1-\eta} \lambda_k^{-1}} \tag{D17}$$

And therefore:

$$\widehat{P_{i,k}} \lambda_k^{-1} + (\widehat{P_{i,k}} \lambda_k^{-1} - c) \left[-\rho + (\rho - \eta) \widehat{S_{i,k}} + (\eta - 1) \widehat{S_k} \widehat{S_{i,k}} \right] = 0$$

which gives

$$P_{i,k} = m_{i,k} c$$

where

$$m_{i,k} = \frac{\varepsilon_{i,k}}{\varepsilon_{i,k} - 1}$$

and

$$\varepsilon_{i,k} = \rho + (\eta - \rho)S_{i,k} + (1 - \eta)S_k S_{i,k}$$

$$\varepsilon_{i,k} = \rho(1 - S_{i,k}) + \eta S_{i,k}(1 - S_k) + S_k S_{i,k}$$

This game has a unique equilibrium (Milgrom 1990). Since all firms are identical within a market k then $P_{i,k} = P_k$, $S_{i,k} = \frac{1}{N_k}$, and $\varepsilon_{i,k} = \rho_k \frac{N_k - 1}{N_k} + \eta \frac{1}{N_k}(1 - S_k) + S_k \frac{1}{N_k}$.

The partial derivatives of the equilibrium prices are signed as follows:

(D18)
$$\frac{\partial P_k^*}{\partial \lambda_k} = \underbrace{\underbrace{\frac{1}{(\varepsilon_{i,k} - 1)^2}}_{+} \underbrace{(\eta - 1)}_{+} \underbrace{\frac{\partial S_k}{\partial \lambda_k}}_{-} \underbrace{\frac{1}{N_k}}_{+}}_{-} < 0$$

(D19)
$$\frac{\partial P_k^*}{\partial \rho_k} = -\frac{1}{(\varepsilon_{i,k} - 1)^2} \left[N_k - 1 - \eta \frac{\partial S_k}{\partial P_k} \frac{\partial P_k^*}{\partial \rho_k} + \frac{\partial S_k}{\partial P_k} \frac{\partial P_k^*}{\partial \rho_k} \right] \frac{1}{N_k}$$

(D20)
$$= \frac{\overbrace{N_k - 1}^{+}}{\underbrace{\underbrace{(\eta - 1)\frac{\partial S_k}{\partial P_k}}_{-} - \underbrace{N_k(\varepsilon_{i,k} - 1)^2}_{+}}_{-}} < 0$$

$$\text{(D21)} \qquad \frac{\partial P_k^*}{\partial \eta} = -\frac{1}{(\varepsilon_{i,k}-1)^2}\left[(1-S_k) - \eta\frac{\partial S_k}{\partial P_k}\frac{\partial P_k^*}{\partial \eta} + \frac{\partial S_k}{\partial P_k}\frac{\partial P_k^*}{\partial \eta}\right]\frac{1}{N_k}$$

$$\text{(D22)} \qquad = \frac{\overbrace{1-S_k}^{+}}{\underbrace{(\eta-1)\frac{\partial S_k}{\partial P_k} - N_k(\varepsilon_{i,k}-1)^2}_{-}} < 0$$

$$\text{(D23)} \qquad \frac{\partial P_k^*}{\partial N_k} = \frac{1}{(\varepsilon_{i,k}-1)^2}\left[\rho_k\frac{1}{N_k^2} + \eta\left(-\frac{1}{N_k^2}(1-S_k) - \frac{1}{N_k}\frac{\partial S_k}{\partial P_k}\frac{\partial P_k^*}{\partial N_k}\right) + \frac{\partial S_k}{\partial P_k}\frac{\partial P_k^*}{\partial N_k}\frac{1}{N_k} - S_k\frac{1}{N_k^2}\right]$$

$$\text{(D24)} \qquad = \frac{1}{N_k}\frac{\overbrace{(\rho_k-\eta)}^{+} + \overbrace{(\eta-1)S_k}^{+}}{\underbrace{(\eta-1)\frac{\partial S_k}{\partial P_k} - N_k(\varepsilon_{i,k}-1)^2}_{-}} < 0$$

$$\text{(D25)} \qquad \frac{\partial P_k^*}{\partial S_{-k}} = -\frac{1}{(\varepsilon_{i,k}-1)^2}\frac{\eta-1}{N_k} < 0$$

(D26)

Using a first order Taylor approximation we have that listing a drug has an effect in prices of

$$\Delta P = \underbrace{\underbrace{\Delta\lambda}_{-}\underbrace{\frac{\partial P*}{\partial \lambda}}_{-} + \underbrace{\Delta\rho}_{+}\underbrace{\frac{\partial P*}{\partial \rho}}_{-}}_{\pm}$$

Now notice that

$$\frac{\partial \Delta P}{\partial \eta} = \underbrace{\underbrace{\underbrace{\Delta\lambda}_{-}\underbrace{\frac{\partial^2 P*}{\partial \lambda \eta}}_{+}}_{+} + \underbrace{\underbrace{\Delta\rho}_{+}\underbrace{\frac{\partial^2 P*}{\partial \rho \partial \eta}}_{-}}_{-}}_{-}$$

Data Appendix

The data for this articles comes from three sources: 1) the government *Sistema de Informacion de Precios de Medicamentos* (SISMED), 2) the *Instituto Nacional de Vigilancia de Medicamento* (INVIMA), the Colombian equivalent of the FDA in the US, and 3) several pieces of legislation.

The SISMED collects information from pharmaceutical laboratories, wholesalers, health providers, and EPS's. The government then publishes a yearly data set with (average) prices for each pharmaceutical, and total quantities. The data set is published in ready-to-use excel files after 2012. Before that is published in PDF forms. I converted those PDFs to excel. The SISMED is the source of information for prices and quantities.

The INVIMA has a record of every drug ever approved to be sold in the country. The record has information on the drug's: company, date it was first allowed to be sold in the country, presentation, ATC code, and whether is nationally produced or imported. I use the March 2017 version of this data set. The INVIMA also has information on whether the drug is a generic and if it can be sold over the counter without a prescription. However, this information is not published in a ready to use format. I web-scrapped the information from their webpage[22] and compiled it.

Finally, several pieced of legislation where manually coded. The legislation falls into three broad categories. First, the legislation that defines the benefit plan. The relevant pieces of legislation are:Consejo Nacional de Seguridad Social en Salud (2006*b*), Consejo Nacional de Seguridad Social en Salud (2006*a*),

[22] http://farmacovigilancia.invima.gov.co:8082/Consultas/consultas/consreg_encabcum.jsp

Consejo Nacional de Seguridad Social en Salud (2007*a*), Consejo Nacional de Seguridad Social en Salud (2007*b*), Comision de Regulacion en Salud (2009*a*), Comision de Regulacion en Salud (2009*b*), Comision de Regulacion en Salud (2010), Comision de Regulacion en Salud (2011*a*), Comision de Regulacion en Salud (2011*b*), Comision de Regulacion en Salud (2011*c*), Comision de Regulacion en Salud (2012), Ministerio de Salud y Proteccion Social (2013),Ministerio de Salud y Proteccion Social (2014),Ministerio de Salud y Proteccion Social (2015*b*). The second category comprises reference pricing (i.e., caps on the reimbursement insurer gets for services provided but not listed in the benefit plan). The relevant pieces of legislation are: Comisión Nacional de Precios de Medicamentos (2010), Ministerio de Salud y Proteccion Social (2010), Ministerio de Salud y Proteccion Social (2011*f*), Ministerio de Salud y Proteccion Social (2011*a*), Ministerio de Salud y Proteccion Social (2011*b*), Ministerio de Salud y Proteccion Social (2011*c*), Ministerio de Salud y Proteccion Social (2011*d*), Ministerio de Salud y Proteccion Social (2011*e*), Ministerio de Salud y Proteccion Social (2012), Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos (2013*a*), Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos (2013*b*), Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos (2013*d*). The final category encompass price caps. The relevant pieces of legislation are: Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos (2011),Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos (2012*a*),Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos (2012*b*), Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos (2012*c*), Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos (2013*a*), Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos (2013*b*), Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos (2013*c*), Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos (2013*d*), Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos (2014), Minis-

terio de Salud y Proteccion Social (2015*a*), Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos (2016*a*), Comisión Nacional de Precios de Medicamentos y Dispositivos Médicos (2016*b*).

All these data sets can be found in stata and csv format at https://mauricio-romero.com/data-and-code/.

Additional Institutional Details

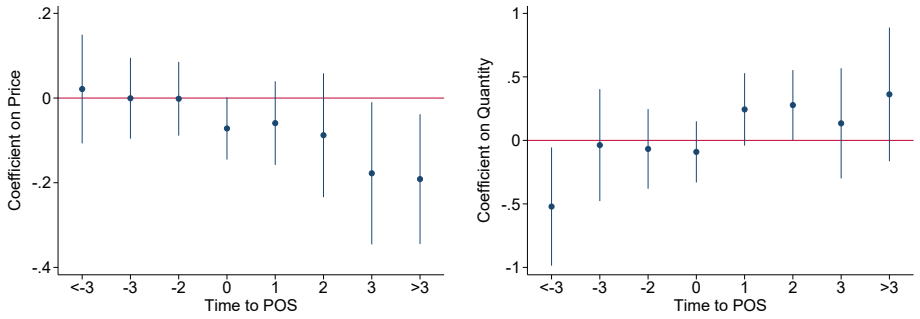
Before the health reform of 1993, Colombia had an "essential medicine" list, which had to be guaranteed to the population through the public health system at the time. In 1993, after the reform, that "essential medicine" list became the original health benefit plan. Between 1994 and 2011 the benefit plan was rarely updated. In 2008, the Constitutional Court, through sentence T 760 of 2008, forced the government to update the benefit plan every two years. The first update happened in 2011 (but effectively changed the benefit plan in 2012).[23]

The main criteria to include a drug in the benefit plan where the inclusion of drugs and technologies that were not in the benefit plan but had a large fiscal cost, since patients forced government to pay for them (directly) through judicial decisions. In addition, the 2014 reform tried to align the list of drugs included in the benefit plan with clinical practice guides promoted by the Ministry of Health. In addition, the Ministry of Health thought that insurers were pushing patients towards therapeutic alternatives that were not covered in the benefit plan (but that had a substitute that was). By doing so, they were cutting costs and forcing the government to pay for those drugs directly. Hence, the 2014 update expanded the forms of several drugs that were already in the benefit plan, and included several therapeutical alternatives. In addition, it the UPC would be calculated using the lowest price within a therapeutic category to incentives insurance companies to lower expenditure.

[23]This is why 2012, 2014, and 2016 have the largest number of drugs added to the benefit plan.

*

Figures



(a) Price (b) Quantity

Figure G.1. : Event studies with ATC-year fixed effects

Note: These graphs show the coefficients from leads and lags of the year of inclusion to the benefit plan from regressions that control for drug fixed effects, ATC by year fixed effects, and drops outliers from the estimation. The dots represent point estimates, while the bars represent 95% confidence intervals. Panel G.1a shows the effect of including a drug in the benefit plan (POS) on its price. Panel G.1b shows the effect of including a drug in the benefit plan (POS) on the quantities sold. Source: SISMED and INVIMA. Calculations: Author.

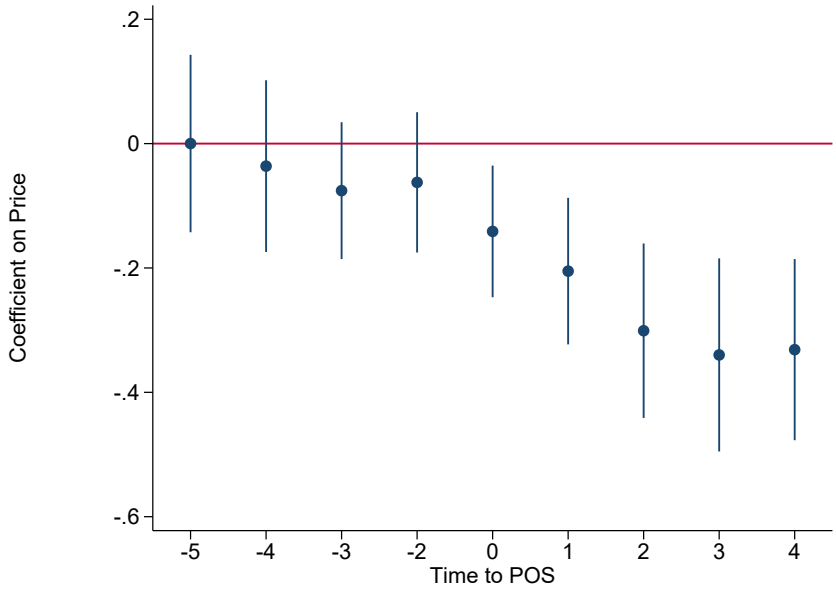


Figure G.2. : Event study for the effect of including a drug in the POS on its price for 2012 entrants

Note: The sample is restricted to drugs that enter the benefit plan in 2012 and drugs that are always in the benefit plan or are never in it. *Data:* SISMED and INVIMA. *Calculations:* Author.

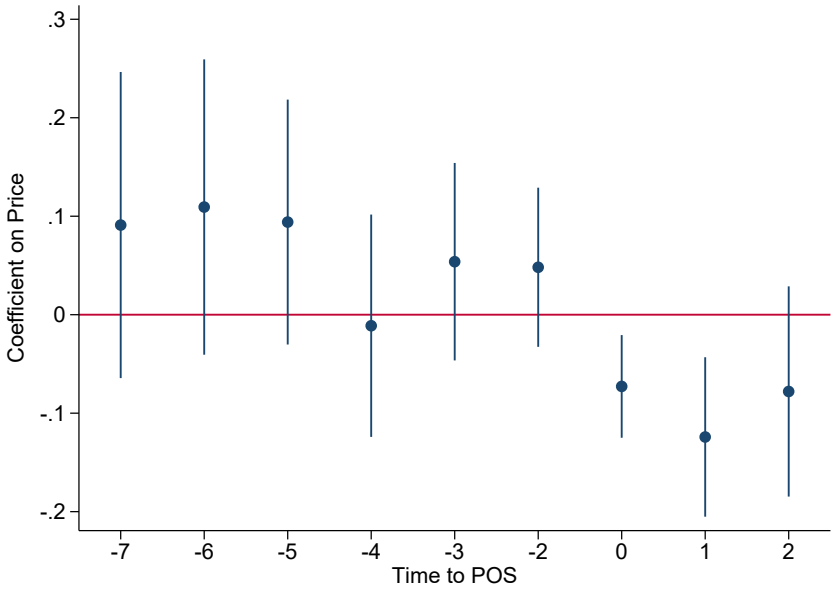


Figure G.3. : Event study for the effect of including a drug in the POS on its price for 2014 entrants

Note: The sample is restricted to drugs that enter the benefit plan in 2014 and drugs that are always in the benefit plan or are never in it. *Data:* SISMED and INVIMA. *Calculations:* Author.

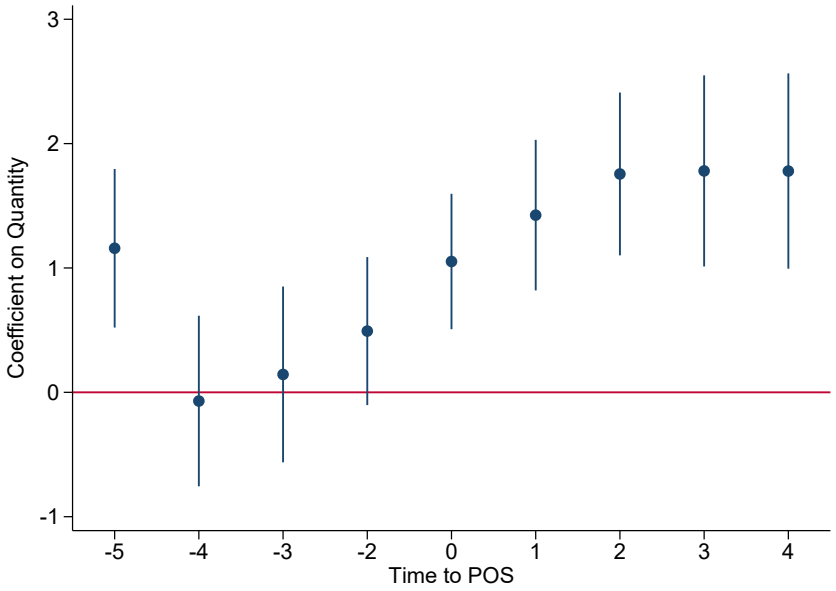


Figure G.4. : Event study for the effect of including a drug in the POS on its quantity for 2012 entrants

Note: The sample is restricted to drugs that enter the benefit plan in 2012 and drugs that are always in the benefit plan or are never in it. *Data:* SISMED and INVIMA. *Calculations:* Author.

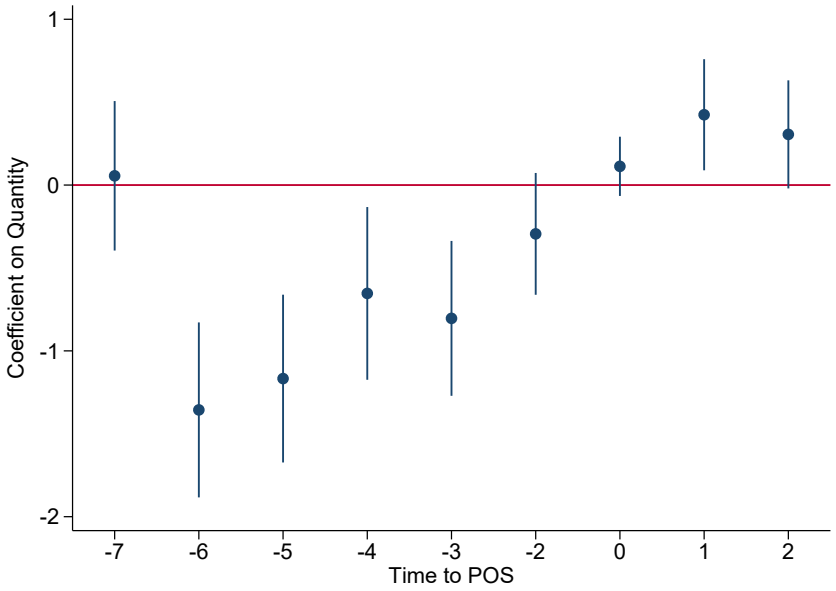


Figure G.5. : Event study for the effect of including a drug in the POS on its quantity for 2014 entrants

Note: The sample is restricted to drugs that enter the benefit plan in 2014 and drugs that are always in the benefit plan or are never in it. *Data:* SISMED and INVIMA. *Calculations:* Author.

*

Tables

Table H.1—: Different presentations for Ibuprofeno MK® and their standardized price.

Type	Units	Quantity per unit	Unit of measurement	Quantity sold	Price	Standardized price
Tablets	10	400	mg	335	8,063.10	2.02
Tablets	100	400	mg	228	74,784.67	1.87

Note:

Source: Author's calculations based on INVIMA and SISMED data for 2014.

Table H.2—: Types of drugs and availability of price information

	(1) No price observations Mean/SD	(2) Some price observations Mean/SD	(3) Annual price observations Mean/SD
Generic	0.25	0.28	0.29
	(0.43)	(0.45)	(0.45)
Essential medication (must be sold under generic name)	0.28	0.39	0.37
	(0.45)	(0.49)	(0.48)
Controlled substance	0.013	0.023	0.024
	(0.11)	(0.15)	(0.15)
OTC	0.19	0.10	0.11
	(0.39)	(0.30)	(0.31)
No. of presentations	3.04	4.17	4.48
	(3.57)	(4.91)	(4.76)
Imported	0.37	0.41	0.40
	(0.48)	(0.49)	(0.49)
Yrs. in the market	7.72	7.70	9.61
	(4.63)	(4.78)	(4.72)
Observations	12392	9611	1612

Note:

Generic(=1) indicates if the drug is a generic, Controlled substance(=1) if the drug can generate addiction and therefore its usage is heavily regulated, OTC(=1) for over-the-counter (OTC), Imported(=1) for drugs that are imported, and Yrs. in the market is the number of years since the introduction of the drug to Colombia in 2007. Source: Author's calculations based on SISMED and INVIMA data.

Table H.3—: Summary statistics for drugs with some observations with some observations and a maximum,/minimum price ratio under 30

	Mean	St. Dev.	Min	P10	P90	Max
POS	0.40	0.49	0	0	1	1
No. of drugs with the same ATC	41.8	46.1	1	4	92	275
No. of drugs with the same ATC in the POS	19.1	30.1	0	0	60	173
No. of drugs in the same pharmacological subgroup	101.9	95.3	1	14	217	478
No. of drugs in the same pharmacological subgroup in the POS	41.5	52.0	0	0	118	240
Generic	0.29	0.45	0	0	1	1
Essential medication (must be sold under generic name)	0.39	0.49	0	0	1	1
Controlled substance	0.022	0.15	0	0	0	1
OTC	0.11	0.31	0	0	1	1
No. of presentations	3.99	4.82	1	1	8	255
Imported	0.40	0.49	0	0	1	1
Price info every year	0.15	0.36	0	0	1	1

Note: The total number of drug-year observations is 94,710. In the POS (=1) if the drug is in the benefit plan at that point in time, for pharmaceuticals with multiple ATC codes, the number of pharmaceuticals with the same ATC code is the sum of pharmaceuticals across all ATC codes (the same applies for pharmaceuticals with the same ATC code in the POS). For pharmaceuticals with multiple pharmacological subgroups, the number of pharmaceuticals in the same subgroup is the sum of pharmaceuticals across all subgroups (the same applies for pharmaceuticals in the same pharmacological subgroup in the POS). Generic(=1) indicates if the drug is a generic, Essential Medication(=1) if the drug is labeled as "essential" and therefore the generic name must appear in the label at the same size as the brand name. Controlled substance(=1) if the drug can generate addiction and therefore its usage is heavily regulated, OTC(=1) for over-the-counter (OTC), Imported(=1) for drugs that are imported, and Yrs. in the market is the number of years since the introduction of the drug to Colombia in 2007, and Price info every year(=1) if there is price information for the drug every year. Source: Author's calculations based on SISMED and INVIMA data.

Table H.4—: Summary statistics for drugs with some observations and a maximum,/minimum price ratio under 10

	Mean	St. Dev.	Min	P10	P90	Max
POS	0.39	0.49	0	0	1	1
No. of drugs with the same ATC	41.8	46.6	1	4	92	275
No. of drugs with the same ATC in the POS	18.9	30.2	0	0	60	173
No. of drugs in the same pharmacological subgroup	102.0	96.2	1	14	217	478
No. of drugs in the same pharmacological subgroup in the POS	41.3	52.0	0	0	118	240
Generic	0.28	0.45	0	0	1	1
Essential medication (must be sold under generic name)	0.38	0.48	0	0	1	1
Controlled substance	0.020	0.14	0	0	0	1
OTC	0.11	0.32	0	0	1	1
No. of presentations	3.93	4.83	1	1	8	255
Imported	0.41	0.49	0	0	1	1
Price info every year	0.15	0.36	0	0	1	1

Note: The total number of drug-year observations is 89,501. In the POS (=1) if the drug is in the benefit plan at that point in time, for pharmaceuticals with multiple ATC codes, the number of pharmaceuticals with the same ATC code is the sum of pharmaceuticals across all ATC codes (the same applies for pharmaceuticals with the same ATC code in the POS). For pharmaceuticals with multiple pharmacological subgroups, the number of pharmaceuticals in the same subgroup is the sum of pharmaceuticals across all subgroups (the same applies for pharmaceuticals in the same pharmacological subgroup in the POS). Generic(=1) indicates if the drug is a generic, Essential Medication(=1) if the drug is labeled as "essential" and therefore the generic name must appear in the label at the same size as the brand name. Controlled substance(=1) if the drug can generate addiction and therefore its usage is heavily regulated, OTC(=1) for over-the-counter (OTC), Imported(=1) for drugs that are imported, and Yrs. in the market is the number of years since the introduction of the drug to Colombia in 2007, and Price info every year(=1) if there is price information for the drug every year. Source: Author's calculations based on SISMED and INVIMA data.

Table H.5—: Effect on a drug's price of including the drug to the benefit plan

	log(*Price*)					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Early entrants						
POS	-0.25***	-0.23***	-0.22***	-0.19***	-0.11	-0.16***
	(0.058)	(0.063)	(0.057)	(0.049)	(0.076)	(0.046)
N. of obs.	55579	14054	14054	13354	10608	10680
N. of clusters (pharmacological subgroups)	529	317	317	310	181	310
N. of drugs	529	317	317	310	181	310
Drug F.E.	Yes	Yes	Yes	Yes	Yes	Yes
ATC x Year F.E.	No	No	No	No	Yes	No
Year F.E.	Yes	Yes	No	No	No	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lagged Controls	No	No	No	No	No	Yes
Balanced panel?	No	Yes	Yes	Yes	Yes	Yes
Molecule trends?	No	No	Yes	Yes	Yes	Yes
Outliers excluded?	No	No	No	Yes	Yes	Yes
	log(*Price*)					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel B: Late entrants						
POS	-0.070*	-0.060	-0.048	-0.039	-0.063	-0.053
	(0.038)	(0.057)	(0.042)	(0.042)	(0.047)	(0.034)
N. of obs.	55579	14054	14054	13354	10608	10680
N. of clusters (pharmacological subgroups)	529	317	317	310	181	310
N. of drugs	529	317	317	310	181	310
Drug F.E.	Yes	Yes	Yes	Yes	Yes	Yes
ATC x Year F.E.	No	No	No	No	Yes	No
Year F.E.	Yes	Yes	No	No	No	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lagged Controls	No	No	No	No	No	Yes
Balanced panel?	No	Yes	Yes	Yes	Yes	Yes
Molecule trends?	No	No	Yes	Yes	Yes	Yes
Outliers excluded?	No	No	No	Yes	Yes	Yes

Note: The dependent variable is the (log) price at which pharmaceutical companies sell the drug to providers. The independent variable is a dummy of wether the drug is in the benefit plan. All regressions include drug specific fixed effects. The following time-varying controls are used: whether there is generic competitor in the market, the the HH-Index at the ATC level and whether the drug is subject to reference pricing or a price cap. "Lagged controls" indicates whether one and two period lags of the time-varying controls are included. "balanced panel?" indicates if only drugs for which price information is available in every year are included. "Molecule trends?" indicates whether ATC specific trends are used instead of year fixed effects. Finally, "Outliers excluded?" indicates whether drugs for which the maximum historical price is 30 times or more the minimum historical price. Clustered standard errors, by pharmacological subgroup, are in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$