THE EFFECT OF REGULATIONS SUCH AS PRICE CONTROLS ON MEDICINE PRICES

THE CASE OF INDIA

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Abstract

This paper examines the effect of price control regulations on medicine prices in India and how different socio-economic factors influence the coordination between pharmaceutical companies in the country from March 2007 until June 2015. I focus on two specific formulations of Paracetamol. The first one, 500mg formulation of the medicine which is under regulation and the second one, the 650mg, which is not regulated. By conducting different descriptive analyses along with applying Fixed Effects regression model it is found that there are collusion practices that are influenced differently by socio-economic determinants across different regions of India. Factors such as number of pharmacists and infant mortality rate have an effect on the level of coordination as higher number of pharmacists reduce the collusion, while higher infant mortality rate increases its level. Two subsample analyses serve as a robustness check. Their results support in overall the output from the main regression model. Moreover, the study contributes to the existing literature by providing an analysis of the effect of economic factors that have prior influence over corruption. By pointing out the possible reasons for the presence of collusion, the study aims to help out policy makers in the composition of more effective policies in the future.

1. Introduction

Government interventions in the free market economy in general are a consequence of the desire the policy makers have to protect the interests of the economy and to guarantee price stability. In the past, the method used to be especially popular during war time. Several ways to stabilize prices exist – the first one is through direct price controls and the second one is by the implementation of non-price, indirect controls over diverse supporting programs, investments, and monetary policy (Quicoy et. al., 1999). Through the literature there are many evidence that price control regulations cause various concussions to the economy such as inflation or deflation that encourage companies to operate in the "grey" market. It also may result in insufficient supply or overproduction (Morton, 2001). However, in the short term, the economy could benefit by providing products on the market at their fair values, but at the same time to give new opportunities for inelastic product sectors with existing monopolies (Cheung, 1974). As price control regulations, in its nature, are against the free market principles, they are usually adopted by countries with totalitarian ruling regimes or by poor countries characterized by high levels of corruption and low legal enforcement. Therefore, specificities that supplement the tool do not give an unilateral answer to the effect the price regulations have on the economy.

Thus, price control regulation on medicine markets in particular would have rather an ambiguous effect on the prices of drugs in most of the cases than a pure positive influence. Setting a ceiling price is a popular measurement, usually adopted by the governments of the developing countries in order to deter the existing uncertainty in a given market through imposition of price cap on particular goods (Abbot, 1995). Except for health care industry, food, oil and fuel, energy and telecommunication industries are also sectors of the economy that are frequently subject to price control regulation (Morton, 2001). In general, the policy further target is a protection of the poor layers of the society. Setting ceiling prices on essential goods gives easy access to people to meet their basic necessities such as needs for food, electricity, and healthcare. In that sense, drug markets are especially vulnerable when it comes to prices.

Pharmaceutical business in general is very risky. The issues that companies operating in the industry face cannot be compared to any other industries because medicine market is directly responsible for human's life and the quality of treatment. However, besides its complex nature, control price regulation as an instrument has its positive and negative sides. On the one hand, most of the transactions conducted under such a policy take place at a price different than equilibrium price set through conventional forces of supply and demand (Morton, 2001). Thus, it may favor either consumers or producers. Based on the economic theory, the consequences

of the measure could be either surplus or shortage of medicine and according to the pure logic, companies may force themselves to penetrate the grey economy in order to avoid dead-weight losses. Furthermore, price cap leads to a distortion in the effectiveness of resource allocation (Rockoff, 2008). On the other hand, the economic theory also claims that price control regulations have a positive impact on poor layers of the society because it offers expensive items at cheaper prices for example. However, there are many more economic consequences but since they are not of primary concern in my analysis I am not going to focus on them in more details.

Overall, in case of government interventions, there will be welfare losses. The findings of many investigations show that the price controls reduce entry and investment in the long term. Results from the paper of Bhaskarabhatla et. al.[a] (2016) also demonstrate that price regulations generate unintended effects and undermine consumer welfare in the market in general. Price control regulation on pharmaceutical markets suggest that cost and quality of the drugs will be affected, because the incentives for pharmaceutical firms to engage in R&D will be altered (Kessler, 2004). Therefore, a reduction in pharmaceutical expenditures on R&D for instance, which are associated with money spend on innovative products would lead to lower profits and lower cash flows for pharmaceutical companies. Moreover, based on Kessler's research, such measures may affect prices and the use of existing drugs as well which is another evidence for the ambiguity of the effect of price regulation policy.

Bhaskarabhatla et. al. (2016) further suggests that the effect of price control regulation on the market forces companies to diversify away from it and increase the relative price of the alternative drugs' formulations in the unregulated markets. Subsequently, this leads to limited effectiveness of regulations (Bhaskarabhatla et. al.[a], 2016). My paper further deepen into the Indian pharmaceutical market as evidence for collusion among pharmaceutical companies there already exist as a result of price control regulation.

Hence, the research problem of this master thesis is: What are the factors that lead to coordination among the pharmaceutical companies across Indian states? The study tries to fill the gap in the existing literature by studying these factors that favor collusive practices in the medicine industry in India. The pharmaceutical industry in the country is one of the rapid developing ones for the last few decades. This fact additionally increases my interest in it. Analysis of the factors naturally leads to the research question of this thesis: Why companies in different regions respond differently to price control regulation?

Indian pharmaceutical distribution is defined by constrained competition, due to cartel agreements and collusion practices between the big companies in the market, which lead to high retail price margins (Bhaskarabhatla et. al.[b], 2015). The effect of regulations in different regions of the country differ due to socio-economic factors every state has. Subsequently, I explore to what extend factors as GDP, number of pharmacists, primary health centers, infant mortality rate and literacy rate contribute to the artificial increase in prices of the regulated formulations of Paracetamol during the period from March 2007 until June 2015.

The results indicate that increase in GDP decrease the collusion practices in the second and the third period investigated, but the effects are not significant. Moreover, high number of pharmacists per 1,000,000 people has negative effect on the level of coordination between companies in the third period, while increase in infant mortality rate is followed by an increase in collusion. Surprisingly, the effects of primary health centers and literacy rate were opposite to what I expect. Both factors have positive effect on collusion, except for primary health centers in the third period, however, their results appear to be not significant as well. The subsample analyses differ in their results. According to the first subsample, GDP has negative effect during the second and the third period of time and the result is significant in the second one. Number of pharmacists and primary health centers have negative effect on the price difference between regulated and unregulated formulations of Paracetamol in the third period, and both of the results are significant. However, infant mortality rate and literacy rate influence positively the collusion practices, and the two indicators are significant. In the second subsample analysis, GDP has a negative effect on price difference in the second and third period but again the effect is significant only in the second period. The effects of the rest of the indicators comply with the results from the first subsample regression results.

Hence, the underlying purpose of this study is to analyze the role of price regulations on drug market in different regions of the country. I investigate how factors are advantageous for and facilitate cartel agreements between pharmaceutical companies. I do that through exploration of a specific essential drug as Paracetamol and its price distribution around India. The study builds on the article written by Bhaskarabhatla et. al.[a] (2016), contributing to the existing literature by analyzing the factors that cause the difference in effects of price control regulations across Indian regions. It will help policy makers by suggesting a solution how to adjust price regulation policy for more effective results in the future. The remainder of this paper is organized as follows. In section 2, I present an overview of the existing literature on price control regulation and pharmaceutical market of India. Section 3 contains the hypotheses

development. Section 4, the data and methodology are analyzed. Section 5 regards the main results of the empirical analysis. Section 6 provides discussion and limitations, while section 7 concludes and provide suggestions for further research.

2. Literature review

To fully understand the principles of price controls, first, it is very important to analyze the essential foundations of market economy and the role of the price in it. The formulation of price-making is mathematically explained by Petricsko in the early 1932. The author presents the idea that based on its characteristics, every good is attributed with a value indicator. This economic value of an item is called price. The paper explains the price formulation based on the interactions of the conventional supply and demand forces. Thus, the mechanism of price-making suggests that prices should regulate themselves until the point of market equilibrium is achieved (Petricsko, 1932). The author states that as prices increase and decrease due to the desired production level, the consumption of goods also varies. Hence, the main idea expressed by Petricsko is that prices cannot change without the adjustments in production and consumption.

Thus, market under perfect competition is an effective tool to determine market price and quantity supplied, which perfectly corresponds to the effective allocation of resources. However, there is no such thing as perfect competition in practice which means that the work of market mechanism also differ from the theoretical expectations. Therefore, determinants as imperfect foresight, corruption and human factor should be taken in consideration. In this section of my study, I divide the literature review in four subsections, starting from the broadest one, explaining the economic effects of regulations and gradually narrowing the scope of the analysis to the effect of price control regulation in general and in India.

2.1 Economic effects of regulations

In the free fall economy, the supply and demand curves do not fully respond to the effects of distortion caused by the governmental price control regulation. Fixed prices for example, lead to biasness in the market equilibrium by affecting quantities produced. Heavy control over prices is introduced at the beginning of World War II. That is why most of the articles on the topic were written after the war. Besides, the economists were skeptical on the efficiency of the measure at that time, many governments not only introduced this policy but continued to exercise price control after the war was over as well (Allen, 1953).

Cheung (1974) further deepen the analysis of price control - defining it as one of the many legislative actions that interfere with private contracting in the market place. He splits the regulation into two types – direct and indirect, which are implemented to stabilize the market. He sets three conditions that need to be met in order to identify a price control action. First, the

control must fix the price or income, but exclude any kind of legislation that regulates the distribution of income among the parties in the contracts. Second, the government actions recognized as price control regulation should not involve any appropriation of proceeds to or from government. Lastly, government actions in order to control resources are not classified under price controls. The author concludes further that even though government interventions may have indirect effect on prices, those interventions are not meant to destabilize the market equilibrium (Cheung, 1974). Although, these conditions sound logical, they might by seriously doubted. To provide evidence against these conclusion I will further continue analyzing the impact of price control on market equilibrium below.

Galbraith (1952) proposes another view of price controls. He expresses the idea of a fair interaction of wages and prices. The paper develops the theory that the main market players are inclined to raise prices and wages, which would lead to overall inflation and monetary expansion. Therefore, price control regulation could serve the role of intermediary that will stabilize the interaction between the two indicators. However, this theory is constrained by the war period at that time, so under such circumstances the conventional fiscal and monetary policies are inadequate. Moreover, Hargreaves (1947) argues that a government may fix the maximum profit margin of the companies and thus, to keep the supply at the necessary level but at the same time to cut the number of intermediate retailers. However, this may result in inequality among the industry and to favor the largest retailers. Theory that is also developed by Haley in his analysis from 1950. Thus, these theories further deepen the uncertain results from price control regulation and the doubts of presence of collusion in the economies where such policies are adopted.

Nonetheless, the information available on this topic is rather limited because of the relatively low number of analyses made on this subject. However, many scholars of comparative economic systems believe that the values, cultures, and political structures of countries are that much different that attempts to generalize across national boundaries are worse than useless. Thus, what appears to work in one context is likely to be disastrous in another (Noll, 2016). This assertion on policy implication is true to great extent, however in the current paper my focus is on different states within a single country - India in that case. Noll further continues by describing regulations as a policy that intends to correct for market failures and includes in the analysis of its complexity - natural monopoly, incomplete information, and external effects that may arise. He also states that regulation may be presented as a device for protecting the population from monopoly, but at the same time it is a tool for maintaining a

cartel arrangements for a ruling elite. A matter that is observed in the case of pharmaceutical industry of India. However, the study concludes that it is unlikely price control regulation to permanently facilitate cartel.

In another study by Posner (1974), the author confirms as well that behind each scheme of regulation could be seen a market imperfection. The author also posits that regulations are imposed mainly in highly concentrated industries where the danger of collusive agreements is the greatest. Furthermore, Posner concludes that the effect of regulation such as entry control and minimum rates for example, is the same as that of cartelization where to raise prices above the competitive level is the benefit side of cartel theory. According to Posner, the value of cartelization is greater, the less elastic the demand for the industry's product is and the more costly the new entry into the industry is. A problem observed in any pharmaceutical market. To extract monopoly profits by agreeing to end competition, agents on the market charge the joint maximizing price (Poisner, 1968). An issue that I am suspicious of and can be observed between pharmaceutical firms operating in India. The paper of Peltzman et. al. (1989) analyzes the economic theory of regulation as well and further concludes that regulations served the producer interest either by creating cartels or by failing to suppress monopoly. However, as I stated earlier, my interest is in investigating different factors that cause and lead to collusive agreements in the pharmaceutical market in India, but in order to explore more thoroughly the research problem, I start with analyzing the nature of regulations in general. This will help in describing the bigger picture first, and then to narrow the scope of the analysis to the particular research focus.

2.2 Price control regulations

Most price control regimes base prices on past costs or expected costs, and prohibit the regulator from adjusting prices according to new information for a set period of time, typically 4-6 years (Jamison, 2007). According to Jamison, the initial idea of regulators was through adopting price regulation policy and allowing firms to keep for a period of time their profits to improve efficiency. Thus, the regulating body will be allowed to set regulated prices that will reflect the companies' true abilities (Jamison, 2007). Unfortunately, price cap regulation did not work out as planned and the theoretical reasons for that result are the information asymmetry, also known as principle-agent problem and moral hazard (Jamison, 2007). The author concludes that in some situations a hybrid system applying different aspects forms of regulation are crafted to form a regulatory scheme that will regulate institutional, political, and

economic situation more efficiently. At the same time, under government regulations it is very complicated the evolution of macroeconomic indicators to be identified and clearly predicted.

Bulow and Klemperer (2012) developed a model testing the consumer gains from price controls through formulas that measure consumer surplus. They tested it under different types of supply elasticity. Their results indicate that it is unlikely that consumer surplus will be enhanced by any price control, whether resources are randomly allocated or through a greater search or other rent-seeking behavior by higher-value consumers. Hargreaves, in his study from 1947, also argues that the effects of price control are influenced by the segment of goods. He suggests that efficiency of the price regulation on raw materials and final products are not equal. Another argument, developed by Gorter and Hilderbrand in 1951, is that price control is followed by a suppressed inflation. As price stability is a result of consumer cash balances, the continued increase in the balances is constrained by the limited supply, and thus grey economy develops, inflation increases, and in the end the price control system collapses. These findings give additional evidence on existence of "black" markets among the companies that adopt price control regulation. Furthermore, the shortfall of products due to the prices fixed under market equilibrium leads to problems in allocation of goods, corruption, and "black" market economy.

The paper of Hilderbrand (1952) also doubts the effect of price control regulation in stabilizing the market. He argues that there is a lack of evidence in the literature that prove that the economy would do better under price regulation than under open inflation. He further doubts the ability of a few major companies on the market to determine the level of prices and wages. The author indicates that by rising prices the demand would decline due to its elasticity. Therefore, losses will occur throughout the whole economy (Hilderbrand, 1952). Both ways, at the end, unemployment will be created. This contradicts to the primary goal of price control regulation. Inflation rate volatility will be uncertain as well under these circumstances.

However, the opposite theory that price control regulation can help in stabilizing the economy is also proposed by Galbraith's study from 1952. The author argues that the price control is justified during war time, when such a policy can actually strengthen the economy. He further proposes that suppressed inflation is preferable than an open inflation because it is more easily controlled. Additionally, he expresses the view that through controlling the prices, an economy can achieve higher levels of production and employment compared to indirect controls, which rely on an "interaction" of wages and prices. Finally, the author summarizes that the highest benefits could be achieved through using both direct and indirect price controls,

inference also made by Jamison (2007) for a hybrid form of price control regulation that can be adopted in achieving the highest benefit.

When price control regulations are regarded it is inevitable to include the political factor which has a vital role here. Usually, through taking such measures, the ruling party is trying to ensure more political support. Similar point of view is expressed by Cox in his paper from 1980. The author points out that the price controls differ across industries. However, the industries tend to violate the price ceilings, which makes the enforcement of price control necessary and at the same time costly measure. Therefore, depending on the revenues from each industry, some industries have more effective price ceilings than others (Cox, 1980). Opposite to this perception, as a tool, price controls regulation is more expensive to be adopted compared to the conventional monetary and fiscal policies. Haley (1950) even argues that the lack of serious reason for implementing price cap may result in serious problems and could even restrain one's freedom. However, the short-term success has always been preferred more than long-term consequences. Thus, the political aspect of price controls regulation further deepen the ambiguous nature of the measure.

Further issue, regarded by the literature is the market transparency under price controls. In many countries the process of regulation is not transparent because the criteria of price regulation is not fully disclosed (Hassett, 2004). In order to control the market, a complicated administrative system for cooperation between administrative and policy operations should be built and maintained. It has to be able to perform highly uncertain and diverse operations (Galbraith, 1946). However, under such conditions it would be hard to maintain market transparency.

Price floor and price ceiling are the two mechanisms that are qualified as direct price control regulation. However, as price ceiling is of main interest in the analysis, I will focus predominantly on it and its characteristics. Hence, the literature on different regulatory regimes on prices is to great extend limited. Many of the empirical studies are rather descriptive. However, in its basic form, price cap or price control regulation directly sets an end price of a product. According to King (1998), in practice, price caps tend to be more complex than simply a set price path on a single product. He adds that most companies produce multiple products and these products may be bundled together in the price cap. However, if the bundle is poorly designed, then the regulation may be subject to potential anti-competitive abuse. The paper also argues that when a price control regulation is introduced, attention is paid to the profits of the regulated firm while cost savings gained are passed on to the consumers.

Following the economic logic, Wolak (2005) argues that traditional cost-of-service price regulation has the problem that higher costs are reimbursed in higher prices, and thus this could lead to higher profits. Further, Wolak claims that by choosing a non-minimum-cost production mode, a firm may cause the price regulator to set even higher prices. Hence, the firm will earn higher profits than if it's output at minimum cost. This is an issue that is observed in the pharmaceutical market in India as well. As a main challenge for price cap regulation policy, Wolak indicates, the set of factors the regulator will impose that will force companies to produce their output at minimum cost and the resulting prices will yield them sufficient revenues to cover their costs.

In his paper, Hogendorn (2003) demonstrates how companies tacitly collude to raise prices to consumers and divide the resulting profits. Moreover, the aforementioned paper, also shows that price control regulation does not prevent collusion but may even contribute to these monopoly behavior. Throughout the paper Hogendorn demonstrates, by using electricity industry as an example, how a company could avoid political opposition in a long run perspective by colluding with other firms in order to artificially increase the prices of its services. It further demonstrates how the concept of constraint-based-collusion is not removed by introduction of price cap regulation. Shapiro (1985) shows that effect by demonstrating that two firms can achieve a collusive outcome by each licensing patents to one another at high fees. Thus, both firms reduce their output, achieving higher profits. The paper of van Koten (2006) discusses the price cap regulations as well and states similar results to those found in the existing literature that I have already discussed, namely that as a result the unbundling policy will increase the profits of the regulated companies, while causing welfare losses, which result from the presence of collusive practices.

In general, price control regulations are a very effective measure that limit inflation and guarantee the affordability of some essential goods. However, they provide only short-term solution and do not indicate the main reason for rising the prices. They may be the reason for the development of collusive practices between the players on the market. However, this matter will be analyzed throughout the current paper. It is sure that welfare losses will be created and the unemployment rate will increase.

2.3 Price control regulations – pharmaceutical market

At first glance, a certain thing that could be said about the pharmaceutical industry is that it differs from any other industry. According to Abbot (1995), the regulation of the

pharmaceutical industry is full of challenges as firms are inventive enough in avoiding those regulations. However, when it comes to price control regulations specifically in the pharmaceutical markets the literature is rather constrained.

The paper of Brekke et. al. (2009) for example, compares the effectiveness of reference pricing and price cap regulations as regulatory regimes and their relations with pharmaceutical firms. According to the authors, price cap regulation limits the pharmaceutical firms' ability to exploit market power by charging high prices. Thus, these companies may try to synthetically increase their prices through collusive agreements with their counterparts in order to utilize their actual market capacity. The ranking of the two schemes in terms of price levels is somehow ambiguous. Nevertheless, the results of the study suggest that the reference pricing scheme is more effective than price cap regulation strategy in lowering drug prices.

In the paper of Danzen et. al. (2004) authors analyze the role of pharmaceutical price regulation across 25 different countries as a contributor to delays in the launch of new drugs. These delays may cause significant losses to the pharmaceutical companies and may damage their total returns. Of course, every country has its own regulating system which means that average time delay of a release of a new drug varies across countries. Thus, the study concludes that the differences across countries reflect differences in the range of product and dosage forms and their relative weights in utilization, in addition to price differences for specific products. Furthermore, price regulation negatively affects the timing and occurrence of launch of a drug. Additionally, Danzen et. al. (2004) argues that price spillovers, due to parallel trade and external referencing, has negative influence over launch of drugs. Price cap regulations in some countries imposed due to country's per capita income may even extend launch delays.

In countries where health-care resources are scarce, effectiveness based policies alone do not maximize health benefits for population and actually may result in inefficiency and inequity (Maynard and Bloor, 2003). The two authors argue that the object of regulatory mechanisms is determined by the regulators themselves. As main objectives, the paper points out expenditure control, quality, and access. Further in their analysis, Maynard and Bloor highly doubt the real object of regulations. Whether control mechanisms ensure price and quality competition along with costs. In more depth analysis throughout the paper, the authors consider price cap regulation across Europe, summarizing that control on the drug industry itself focus mostly on price, and more recently on cost-effectiveness. The paper argues that this scheme could lead to inflation in the drug prices and reduced competition. Another effect is worsen level of transparency in the pharmaceutical industry. At the end of their study, Maynard and

Bloor suggest few measures that could enhance the pharmaceutical industry: i) widening the access to drugs, including limited drugs, will increase spending; ii) pursuit of quality; iii) incentive to use efficient treatments by low income groups, and rewarding scheme for both providers and patients; iv) price control supplemented by volume control in order to constrain general spending; v) cost-effective use of pharmaceuticals and guideline implementation. At the end, the authors infer that improvement in the pharmaceutical industry is possible, but its costs and benefits should be carefully evaluated to best fit society's scarce resources.

In another paper, Kyle (2007) examines how price regulation affect the country that imposes them along with the pharmaceutical industry itself and companies' entry strategies in such a market. The author argues that firms headquartered in countries that regulate price usually enter fewer markets than those in countries without price control. She adds also that companies avoid price-controlled markets after entering a price-controlled country. Moreover, the article provides examples that countries with stringent regulation of entry combined with relatively little price regulation have highly concentrated domestic industries. Their products are launched in more foreign markets, but are launched slowly into countries with low prices, which have price regulation. Result of price controls that relate domestic price to the prices in foreign markets is that pharmaceutical firms now have incentive to launch their products first in countries where there is freedom to set a higher price, because this will influence the price in markets with price controls (Kyle, 2007). The results from empirical analysis of Kyle (2007) suggest that drugs invented by firms in countries with price controls tend to be less successful on the global market. Therefore, firms under price cap regulation reach two fewer markets on average compared to firms that do not operate under price control regulation. The paper also infers that price controls may be used by governments as a tool of industrial policy to favor domestic firms (Kyle, 2007). This last inference could serve as evidence in support of the assertion that under price control regulation the chance for collusive practices to exist is positive.

In his paper, Vernon (2005) gives different perspective on price regulation and its relation with investment in pharmaceutical research and development. The author describes two potential ways through which price regulation may exert an influence on R&D investment. The analysis makes a comparison between firms with a high proportion of their pharmaceutical sales coming from non-U.S markets stating that they will be more exposed to price regulation than firms which sales are coming from the U.S. market. Thus, Vernon (2005) argues that the greater the proportion of firm's pharmaceutical sales coming from outside the U.S., the greater a firm's

exposure to price regulation, and the lower firm's expected returns to R&D would be. The analysis successfully demonstrates how price control regulation policy impact research and development investments in the pharmaceutical industry, and particularly in the U.S. The results from the empirical analysis conveyed by Vernon suggest that regulating pharmaceutical prices in the U.S could lead to decline in R&D intensity. Therefore, the study concludes that price regulation as a policy is likely to be the prominent factor responsible for the divergence in pharmaceutical profit margins across U.S. and non-U.S. markets. Vernon (2005) also explores, through his paper, the effect of price control regulation on social welfare. According to the results received, the policy could have a negative effect on social welfare. However, the evidence the paper provides are not sufficient for determining the net effect of price control on social welfare explicitly. Finally, the analysis concludes that even if its predictions are speculative, the results appear to be reasonable and in accordance with the economic theory. Thus, pharmaceutical price regulation influences R&D investment resulting in an expected-profit effect and a cash-flow effect (Vernon, 2005).

Similar are the results obtained by Kutyavina in her analysis from 2010. As Vernon (2005), this paper also investigates the effect of threats of price control on companies with higher fraction of U.S. sales compared to companies with mainly foreign sales and their research and development intensities. However, Kutyavina expresses additional, opposing point of view to the one demonstrated in Vernon (2005) study. The paper states that it is also possible that price control regulation may not have significant effect on R&D investments. This could be a result of circumstantial factors such as lobby, the big pharmaceutical firms have for example. Thus, they may possess inside information that could give them a competitive advantage. To investigate how companies react to price control, Kutyavina compare R&D investments of pharmaceutical companies based on their vulnerability to regulation. The empirical findings from the analysis show that pharmaceutical companies decrease their R&D efforts in the early threat (imposed at the beginning of 1993 in U.S.) of price control regulation but the effect is not the same compared to the later threat (at the beginning of 2000s). As a logical explanation following this result, Kutyavina (2010) points out the level of credibility the two different threats are consisted of. The author concludes that based on the data she has the trends from the two different threats are influenced by other factors besides price regulation (Kutyavina, 2010). Therefore, the effect of price control on R&D investment intensities should be interpreted with caution.

2.4 The Indian pharmaceutical market

Similar to USA and UK, the territory of India is comprised of different states, each of which is possessing different resources and is working under different market conditions (Kapoor, 2009). Furthermore, the country is characterized by diverse languages, cultures, and geography that differ on a regional basis. Due to their resource availability and socio-economic factors, different states vary in their economic indicators. The country is divided into 29 states, each of which has different productive potential and industrial necessities determined by the characteristics of the individual state.

When it comes to India, in first place it should be pointed out the role of the public sector, the efficiency of law and regulations across state governments across regions that lead to considerable differences (Conway and Herd, 2010). Furthermore, the paper of Conway and Herd shows that regulatory environment in India promotes viable competition. The authors find that product market regulations are much more restrictive compared to OECD countries. A few years ago, in 2013, India has adopted partial price-cap regulations for several essential medicines (Bhaskarabhatla et. al.[a], 2016). It is important to mark here that the country has been regulating its drug prices since 1970s. Based on these facts, the results from the paper of Bhaskarabhatla et. al.[b] (2016) indicate that firms coordinate in order to manipulate the ceiling price of the drugs – Metformin in the particular case. This happens in the period before regulation officially take place.

Based on the Bhadoria et. al. (2012), the Indian pharmaceutical market, along with the markets of China, Brazil and Russia is expected to become increasingly important in the upcoming decade. The economic success of the country comes as a result of mid-1980s market reforms that moved India progressively away from its former economic model towards a market-based system (Conway and Herd, 2010). According to the paper of Bhaskarabhatla et. al. (2015) Indian pharmaceutical industry plays an important role in increasing competition internationally and has been under significant pressure to recognize intellectual property rights of manufacturers in Europe and North America. Moreover, Indian pharmaceutical distribution is characterized by limited competition, resulting in high retail price margins (Bhaskarabhatla et. al., 2015). Nevertheless, Conway and Herd further indicate throughout their study that at the state level, the Product Market Regulation indicators in India confirm that cross-state differences in product market regulation are significant. Possible reason for these cross-regional differences could be the various socio-economic factors that influence economic markets differently across Indian states.

In overall, India is a country characterized by the high amount of low-income consumers, high private expenditures on health care, and a developing insurance market (Bhaskarabhatla et. al.[b], 2016). Indian pharmaceutical industry is accounted for approximately 65 percent of the production of medicines listed on the World Health Organization (WHO) Prequalified List of Medicinal Products (World Health Organization, 2015). In general, Indian consumers pay high pharmaceutical prices relative to their per capita income (Boswell, 2015). Drug prices in the country are regulated by the Drug Price Control Order (DPCO) since the 1970s. The price control mechanism in India changed from controlling profit margins in 1970s to ceilings on post-manufacturing margins in 1995 (Bhaskarabhatla et. al.[b], 2016). In order to solve the issue of high-priced drugs, the country has amended their Drug Price Control Order (DPCO). Since May, 2013, India regulates the prices of 652 formulations of 348 drugs, including Paracetamol, which is the drug analyzed throughout this study along with the effect of introduction of price cap regulation on it.

The latest DPCO policy amendments are very important for Indian pharmaceutical market. They are formulated to balance incentives for pharmaceutical firms with affordability for consumers and differ from previous DPCOs in several aspects (Bhaskarabhatla et al.[a], 2016). According to Selvaraj (2007) the DPCO delineates certain benchmark on which price control is based. These benchmarks are sales turnover, market monopoly and market competition. The policy shifted from cost-based, rate-of-return regulation to a market-based, price cap regulation. Further, the new policy was fixed at the average price of all firms with more than one-percent market share one year before the implementation of the regulation (Bhaskarabhatla et al.[a], 2016). However, while determining which drugs were to be regulated, DPCO left out several important medicines. The new amendments regulate the prices of only some of the formulations of a medicine, leaving other formulations and their fixed-dose combinations unregulated (Bhaskarabhatla et al.[a], 2016). The paper adds further that pharmaceutical firms in India have historically avoided such policies by diversifying away from the regulated medicines (Bhaskarabhatla et al.a, 2016). Nevertheless, from May, 2013, as it was already stated, India regulates the prices of 652 formulations of 348 drugs.

There is one powerful organization that dominates the Indian pharmaceutical industry. It is called the association of retail traders better known as the All India Organization of Chemists and Druggists (Bhaskarabhatla et.al., 2015). According to this paper from 2015, one of the sub-structures part of AIOCD, is the Trade Reforms Study Committee, which role is to lobby for favorable legislation, to limit entry by other stakeholders, such as doctors and

hospitals into pharmaceutical distribution. All of these aforementioned functions have underlying significance for my research. What makes AIOCD so powerful is the organization's authority to set the drug prices in the country. It also has the right to punish the companies that violate the rules (Bhaskarabhatla et. al., 2015). Furthermore, Bhaskarabhatla et. al. (2015) claim that the organization also uses trade embargos to punish AIOCD members that form parallel associations or offer price discounts. However, the paper concludes that the use of vertical restraints lead to collusive practices and even in 2014 the AIOCD threatened 30 to 40 firms with fresh embargos unless they raised trade margins on price-controlled medicines. An issue that the current paper is focused on. In general, the empirical results obtained by Bhaskarabhatla et. al. (2015) support the theoretical view that growing buyer power in conjunction with vertical restraints facilitates collusion. Furthermore, the results from the analysis point out the potential social costs in terms of lost sales due to shortage of medicines in India, particularly in the regions where sales and supply embargos are implemented. At the end, the paper concludes that entry licenses for retailers lead to territorial monopolies and relatively inelastic demand for pharmaceuticals which make it an easier context in which to collude (Bhaskarabhatla et. al., 2015).

According to Boswell (2015), despite the fact that the legislation is enacted to overthrow market failure and to increase affordability for life-saving medication, market-based price controls introduced in India have been criticized for being a threat that may drive high-quality firms out of the market. Moreover, they threat to increase drug shortages, to lower competition, and to decrease investment in the pharmaceutical sector (Boswell, 2015). All these economic concerns have been already discussed at the beginning of the analysis. But they are not the only economic consequences that may follow the imposition of price control regulations. The spread of monopoly practice among the big companies operating on Indian market is also likely to be the case. Because of the limited revenues that pharmaceutical firms can benefit from after the imposition of price cap regulation, the biggest pharmaceutical corporations in the market may look for alternative ways to benefit from the situation.

Furthermore, the empirical analysis of Bhaskarabhatla et al.[b], (2016) finds out that pharmaceutical companies in India coordinate in order to increase the price of regulated formulation in the period before regulation take place. This led to an artificial increase in the ceiling price set by the given state. Same assertion is expressed by Selvaraj (2007) paper. The analysis states that the recent policy changes have enormous implications for drug prices in India. Because of the lower percent price controlled drugs nowadays compared to 1970s, the

pharmaceutical price control policy changes have led to a phenomenal increase in the price of drugs, surpassing the general index of prices (Selvaraj, 2007).

Drug price plays a significant role in the access to medicines, particularly in low income country and it forms a substantial portion of households' spending in developing countries (Selvaraj, 2007). Selvaraj concludes that trade margins are one of the highest in the pharmaceutical industry. As evidence suggest, the high market concentration in Indian pharmaceutical industry nowadays, three to four companies together account for over 60-70 percent of the market (Selvaraj, 2007). Therefore, Selvaraj infers that consumer sovereignty does not exist on the medicine market. Furthermore, the findings of Bhaskarabhatla et. al.[b], (2016) provide evidence that there is a collusion between companies in pharmaceutical industry that leads to manipulation in ceiling prices of Metformin and thus to the synthetic increase in the prices.

Based on the existing literature, the Indian market should go a long way towards increasing competitiveness in the pharmaceutical business particularly. Hence, the current paper explores the socio-economic factors that may lead to collusion practices across pharmaceutical entities operating cross-regionally throughout India. I do that by exploring the changes in the price of regulated and unregulated versions of Paracetamol during four discrete periods on state-wise monthly data between 2007 until 2015. In this analysis, I try to fill the gap in the literature demonstrating how factors such as gross domestic product (gdp), number of pharmacists, number of primary health centers, infant mortality, and literacy rate impact the price difference between regulated and unregulated formulations of Paracetamol.

3. Hypotheses development

The paper of professor Lambsdorff (2003) studies how corruption along with collusion affect economic development. He does that by analyzing two models: first one of a corrupt agent and the second one of a corrupt principal. According to his analysis, corruption adversely affects economic development. Moreover, as a well known fact, economic development is proxied by variations in the level of GDP which is of prime concern in my work as well. Based on the empirical analysis conducted throughout this study, corruption practices may facilitate overcoming of cumbersome regulation which is an object of interest in my study also but in terms of collusive practices. Further, Lambsdorff (2003) suggests that corruption lowers the quality of the state infrastructure which in my case is the leading assertion that the current paper tends to prove – mainly that weak health infrastructure leads to higher level of collusion.

The empirical results of Lambsdorff (2003) which are in compliance with the results of Saha and Gounder (2007) indicate that the absence of corruption is positively related to GDP, and increase in the corruption leads to reduction in the productivity of capital. Lambsdorff further relates his analysis of corruption to corruption on the government level. The author concludes that corruption resulting in price increase is distorted when it bears on some goods while the prices of others are unaffected. In the same manner, the author states that under corruption, customers are charged according to their willingness to pay, discriminating with their prices between people with necessities and people that are less interested. Thus, collusive agents can seize the full rent and all deals that are mutually profitable are carried out. The paper of Saha and Gounder also indicates that corruption is the major obstacle in the process of economic development. Their empirical analysis demonstrates that developing countries suffer from higher levels of anti-competitive practices. Following all the above evidence and based on the data I have on Paracetamol for my study I come up with the inference that same practices are going on through some of the Indian states as well. Hence, to analyze this assertion I constructed the following hypothesis which I test through my empirical analysis:

Hypothesis 1: The higher the state-level GDP the lower price difference between the regulated and unregulated formulations of a medicine

To continue with I have to say that I construct the second hypothesis based on the general understanding that the high number of pharmacists operating in a given pharmaceutical entity should increase the level of transparency and will influence negatively the level of coordination between companies. According to Maynard (2003), pharmacists have substantial pharmacological knowledge and experience, which can be used to improve the efficiency of prescribing. Thus, the effect of such educational outreach by pharmacists serve in evidence of their important role, especially in the developing countries, such as India. Furthermore, the analysis of Power (2004) posits align with the earlier mentioned assertions from existing literature that all regulations of the market lead to collusion and higher prices of the goods traded. He based his analysis on observations on Irish retail pharmacy market. Power argues that independent pharmacist-owned and run pharmacies have a long-term commitment to the locality, whereas financially motivated pharmaceutical entities may not have this concern. He also expresses his concern that employees in big pharmaceutical companies may be faced with principal-agent issues.

Another analysis conducted by CUTS International (2011) investigates three different cities located in the state of Chhattisgarh in India. It gathers evidence about collusive behavior

among healthcare providers. The analysis also argues that due to collusive arrangements between providers in the public health care system and the private pharmacists, the cost of healthcare for consumers raises even more (CUTS International, 2011). Thus, the study reaches the conclusion that regulations create monopoly powers for incumbents, as it is not in the best interest of consumers. However, based on these slightly ambiguous findings from the literature and theory I come up with the second hypothesis that I analyze through the empirical part of my study:

Hypothesis 2: The high the number of pharmacists in a state the lower the number of price chnages in the regulated and unregulated formulations of a medicine

Kovacic et. al. (2009) discuss how in industries with small number of participants, companies might be expected to recognize their mutual interdependence. Therefore, one might anticipate relatively more collusive outcomes in industries with relatively fewer firms. The paper further states that a collusion between two agents on the market is likely to foster their ability to coordinate on price, output, and other dimension of competition. Company's behavior in an industry can vary from perfect competition to explicit collusion where all players on the market operate as one entity (Kovacic et. al., 2009). Of course, in the highly concentrated markets, the former observation is impossible to happen in practice. Further, the paper provides an interesting analysis of a Hospital Corporation case in U.S, where due to mergers of the big hospitals in the state of Tennessee, a danger that the largest hospitals would collude arise. The solution to the problem was a reduction in the number of major players in the pharmaceutical industry.

In another paper written by Ivaldi et. al. (2003) the authors point out that there are ways the competition to be threatened but not by single dominant companies. First one – when market concentration is high enough that firms are not considered dominant, but still are able to exert some market power. Second one is when companies threat the competition by engaging in tacit collusion. Characteristics that affect collusion are number of competitors, entry barriers, frequency of firm interactions, and market transparency (Ivaldi et. al., 2003). Therefore, an increase in the market concentration should decrease the chance for collusion among the companies in the market. Thus, based on all these inferences, I come up with the third hypothesis that:

Hypothesis 3: The greater the number of Primary Health Centers in a state the lower the number of price changes and the lower the extent of collusion

The paper of Canfield (2011) is specifically focused on the impact of corruption on education in states within India. It demonstrates the negative effect the corruption has on education and the importance of its termination. Furthermore, Canfield posits the belief that GDP growth is driven primarily by an increased incentive towards innovation and new ideas. Education and literacy are the tools that could turn this belief into reality as only educated people are able to drive innovativeness and welfare in a society. The analysis also infer that school will bring societal benefits as well – it will increase productivity, efficiency, and it will bring other positive externalities such as lower unemployment and crime rates. The empirical results of the study show negative signs of corruption outcomes across the Indian states and thus confirm the negative relation between corruption and literacy rate.

The study of Saha and Gounder (2007) analyses the issue that in countries where population is more educated and highly literate a lower level of corruption and respectively collusion is observed. The authors further develop their theory on education arguing that education helps to generate moral values against corruption. They express their point of view that if young generations are educated to adopt a moral attitudes against corruption, high fines or monitoring can be reduced while low corruption levels are perceived (Saha and Gounder, 2007). Because education brings sense of nationalism and civic duty in the citizenry, Saha and Gounder think that it will raise public awareness of human's rights and duties. Their empirical results confirmed the theory and hypotheses stated by the authors. The result suggests that in developing countries as India, increased literacy rate helps to reduce corruption. Therefore, paper infers that corruption, followed by collusion will be lower where populations are more educated and literate. Hence, based on the evidence presented above, I construct the next hypothesis:

Hypothesis 4: The higher the literacy rate in a state the lower the extent of price difference between the regulated and unregulated formulations of a medicine and lower extent of collusion

Another important factor in my analysis that I consider as vital because it serves as indicator of the level of development of the health infrastructure is the infant mortality rate. Based on the existing literature, high infant mortality rate in a state is related to low level of GDP, lower educational attainment align with bad health insurance factors (Preston, 1975). The paper of Preston is more focused on national household income and its effect on life expectancy and the associated infant mortality rate. Upadhyay and Srivastava (2015) study how macroeconomic growth is associated with reduction in infant mortality in low and middle income countries. They take under consideration the indicators of 36 developing countries,

including India. The paper develops the theory that increase in economic growth will increase the average income of individuals which will improve their quality of life. In that sense, economic growth is associated with less corruption and better access to health care services. Further, empirical results of this analysis confirm the inverse association between economic growth and infant mortality.

According to Swain et. al. (2015) more than half of the deaths of children in India are caused by diseases that could be treated with safe, essential, and child specific medicines. The analysis represents a survey of 34 essential medicines conducted in six randomly selected districts of Odisha. Odisha is the Indian state that is characterized with second highest infant mortality rate in the country. The paper concludes that the medicines for children cost high in both private and public sectors compared to the international reference price (Swain et. al., 2015). Moreover, the results indicate substantial price variation for some medicines that cost twice higher than their international reference price. One of the reasons for such an output can be closely associated with high levels of corruption and collusion practices in the particular state. Thus, to test this inference I decide to formulate the last hypothesis that I come up with, namely:

Hypothesis 5: The higher infant mortality rate and weaker health infrastructure are associated with a greater price difference between the regulated and unregulated formulations of a medicine

4. Data and methodology

4.1 Data description

In the empirical part of my analysis I examine the impact of price-control regulations across different Indian states on prices of regulated and unregulated formulations of Paracetamol, also known as Acetaminophen. I do that in order to determine the presence of collusion practices among pharmaceutical companies operating in India. However, the main goal of the study is to analyze the factors that lead to artificial increase in the prices of drugs and serve in favor of monopoly agreements. I take into consideration the case of Paracetamol – the medicine which I have data for. The reasons for choosing this drug are similar to the ones mentioned in the analysis of Bhaskarabhatla et. al.[a] (2016). First, Paracetamol is one of the most essential medicines in India. Second, its 500mg formulation has been regulated, while its close substitute, 650mg tablet is not regulated. This comparison between the two allows me to study the price variations of the formulations cross-regionally along with companies' behavior before

and after regulations in a quasi-experimental setting. Third, the drug has been already used as a representative medicine in previous studies examining the Indian pharmaceutical industry (Bennett and Yin, 2014). And lastly, I chose to explore Paracetamol, because as an essential drug, used throughout whole India, there are evidence in the literature on coordination between firms on Paracetamol prices and manipulation of the perspective ceiling prices in the medicine market of the drug. Thus, by exploring the factors that influence price differentiation of regulated and unregulated formulation of the drug I try to fill a gap in the existing literature.

Hence, I use state-level monthly data on pharmaceutical companies operating cross-regionally throughout India. Similar to Bhaskarabhatla et. al.[a] (2016) paper, in order to examine whether firms in different regions respond differently to price control regulations, I collected data from AIOCD Awacs Pvt. Ltd, pharmaceutical retailers' trade association, the All India Organization of Chemists and Druggists (AIOCD) merged with data from the official Indian government website. The type of data is panel. The data in the primary sample are disaggregated among 14 regional markets and contain a census of 143 firms. The information have been provided by AIOCD which is known as a reliable source of data, frequently cited. The good reputation of the organization should serve in support of the high quality of the data placed at disposal. Another reason why I focused my study on Paracetamol is that there are not enough data available for all other drugs that have entered price regulations.

The dataset spans the period from March 2007 until June 2015, similarly to the paper of Bhaskarabahatla et.al.[a] (2016). As in the analysis from 2016, I divide the process of price cap regulation implication in the following four periods: 1) before the public consultation for NLEM – from March 2007 to September 2009; 2) after the consultation but before the announcement of NLEM 2011 – from October 2009 to June 2011; 3) between the announcement of NLEM 2011 and the public notification of DPCO 2013 – from July 2011 to December 2012; and 4) after DPCO 2013 – from January 2013 to June 2015. According to the four different periods I create a categorical dummy variable (*Period*) for every period of time mentioned above and test how different socio-economic factors differ in their effects on price differences during different time dimensions. Hence, I estimate the changes in prices of regulated and unregulated formulations of Paracetamol relative to the three periods before and one period after the imposition of price regulation policy in India.

The data contain 30,372 observations on 14 states. It covers all delivery modes, but the analysis in particular is on tablets in each of the regional markets in India and their monthly

sales for a period of 99 months. As in Bhaskarabahatla et. al.[a] (2016) paper, data include monthly state level sales and quantity sold. As it was already mentioned earlier, the study is on two different dosage tablets of Paracetamol – those from 500mg and 650mg as the former one is the regulated formulation and the later one is not traded under regulation. Therefore, through the data all 143 companies sell these two dosage formulations. Based on Bhaskarabahatla et. al.[a] (2016), to facilitate the comparison of prices between the two formulations (500mg and 650mg) I normalize the price per 500mg tablet of Paracetamol using the formula:

$$Price\ per\ 500mg = \frac{500}{Dosage\ Strength} \times \frac{Price\ of Pack}{Number\ of\ tablets\ in\ Pack}$$

However, the data provide me with a long enough period which helps me to conduct a thorough research and explain the observations over time. I employ the Fixed Effect estimator to analyze the impact of different socio-economic factors on price differences between the regulated and unregulated formulations of the drug and in order to capture the state and time fixed effects. The full set of descriptive statistics can be seen in *Table 1* at the Annex section at the end of the paper.

4.1.1 Dependent variable

In the empirical analysis I use one dependent variable, namely the mean price difference of the unregulated and regulated formulation of Paracetamol per 500mg across different states tested through the primary sample and two other subsamples throughout the robustness check. To be more precise, the dependent variable is constructed based on the mean price of 500mg formulation subtracted from the mean price of 650mg formulation per state (*PriceDifference*). The variable is used to examine the variations caused by price regulations implied on Indian pharmaceutical market in the three periods before and the one after the price cap imposition mentioned above. Thus, I manage to follow the tendency in price changes across different regional markets more thoroughly. Hence, by measuring the changes in magnitudes, as a consequence of price control regulations, I explore how particular socio-economic factors such as GDP, number of pharmacists, number of primary health centers, infant mortality or literacy rate respond to price control regulation throughout 14 Indian states included. As a result I expect to find if different regions are affected differently and whether there are collusion practices among companies as a result of the price cap regulation imposed.

4.1.2 Independent variables

The first explanatory variable of interest is the continuous variable gross domestic product (*gdp*). It measures the values of GDP in different states across India during the period of 99 consecutive months from March 2007 until June 2015. Variations in GDP in different regions will show how the level of wealth of a particular state influences the level of collusion in this state. It is directly related to the first hypothesis I constructed. Thus, increase in the level of GDP (*gdp*) in this scenario suggests decrease in the level of collusion. As a second independent variable I employ the variable *Pharmacists* which is also a continuous variable. It measures the number of pharmacists per 1,000,000 people in a given state during a particular month. Thus, I investigate whether the high number of pharmacists working in the pharmaceutical industry will increase the transparency in that industry and thus will decrease the collusion among pharmaceutical companies. Although, the literature is a little ambiguous about the role of pharmacists, my perspective is that the higher the number of people working in the industry will lead to a better health infrastructure and less collusion.

Furthermore, I incorporate the variable (*PrimaryHealthCenters)* as a variable that measures the number of working Primary Health Centers again per 1,000,000 people in a state. In my point of view, their function should be similar to the one discussed in the previous paragraph about the number of pharmacists per 1,000,000 people employed in the industry. Therefore, the bigger the number of health centers the more transparent the industry would be and thus, the stronger the health infrastructure would be in general. As a result, the collusion practices will decrease as well because it will be harder for pharmaceutical companies to coordinate in more dynamic environment. The fourth explanatory variable employed in the analysis is the rate of literacy measured by the number of active high schools per 1,000,000 people on the territory of every state (HighSchools). The higher number of schools is related to better educated and more literate society. Hence, high literacy rate is a prerequisite for more democracy and better law enforcement as well. Therefore, it should result in more transparency and less collusion. The final explanatory variable I include is infant mortality (*InfantMortality*). As high rates of infant mortality could serve as evidence for weaker health infrastructure, it further can result in more collusion and high level of corruption in the pharmaceutical industry.

4.1.3 Control variables

Several control variables are included in my empirical analysis which may affect the relation between regulated along with unregulated formulations of Paracetamol and the price

control regulations imposed across different regional markets. Thus, I control for market concentration using Herfindahl-Hirschman index (HHI). The HHI is constructed by taking the market shares of the companies based on total sales for each month. Depending on causal effect I am studying I also include regional fixed effects and time fixed effects. Because of these fixed effects employed, as in the paper of Bhaskarabahatla et.al.[b] (2016), results cannot be explained away by state-specific time-invariant factors such as difference in demand characteristics in different regional markets, and variations over time in the prescription and usage patterns for Paracetamol that affect both 500mg and non-500mg doses. I further control for used telephone services (*TelephoneService*) which serve as a proxy for infrastructure development along with the number of proposed industrial investments (*ProposedIndustrialInvestment*) which should control for the level of industrialization across 14 states subject in this study.

4.2 Data analyses technique

The data on Paracetamol is of panel nature. Therefore, the model used to estimate the variation in prices of the two formulations of the drug is Fixed effects estimator. It also incorporates state and time fixed effects. Thus, controlling for state and month time invariant differences will prevent biasedness in the final results due to omitted time-invariant characteristics (the time-fixed individual heterogeneity). Using the Fixed effects regression, I estimate the impact of regulation on price difference (*PriceDifference*) between the regulated and unregulated formulations of Paracetamol for region *j* in month *t* using the equation:

$$\boldsymbol{y_{jt} = \alpha + \beta 1 * x1_{jt} + \beta 2 * x2_{jt} + \gamma_t + \varphi_j + u_{jt}} \qquad (1)$$

where *j* indexes states, *t* indexes month. $\boldsymbol{\alpha}$ is the constant, while $\mathbf{y_{jt}}$ is the dependent variable representing the price difference between mean prices of 500mg and 650mg formulations of Paracetamol. $\mathbf{x_{1jt}}$ represents the set of explanatory variables which test the hypotheses while $\mathbf{x_{2jt}}$ represents the set of control variables incorporated in the analysis. $\boldsymbol{\gamma_t}$ is a term controlling for month fixed effects, $\boldsymbol{\varphi_j}$ is a term controlling for state fixed effects. $\mathbf{u_{jt}}$ is the idiosyncratic time-varying error. It represents factors that change over time and affect $\mathbf{u_{jt}}$. I estimate equation (1) using the entire sample of 143 companies and 30,372 observations.

In the additional robustness check, two subsample analyses are conducted using the same model but with companies fixed effects included. In the first subsample, only companies producing both formulations of Paracetamol, namely the regulated and unregulated one are considered. In the second subsample again companies producing both formulations are included but this time only these companies that have market share bigger than 1% overall. Again, the

equation explores the impact of regulation on price difference between the regulated and unregulated formulations of Paracetamol:

$$y_{ijt} = \alpha + \beta 1 * x1_{ijt} + \beta 2 * x2_{ijt} + \gamma_t + \varphi_j + \psi_i + u_{ijt} \qquad (2)$$

where *j* indexes states, *t* indexes month and *i* indexes firms. α is the constant, while y_{jt} is the dependent variable representing the price difference between mean prices of 500mg and 650mg formulations of Paracetamol. x_{1ijt} represents the set of explanatory variables which test the hypotheses while x_{2ijt} represents the set of control variables incorporated in the analysis. γ_t is a term controlling for month fixed effects, φ_j is a term controlling for state fixed effects and ψ_i is a term controlling for companies fixed effects. u_{ijt} is the idiosyncratic time-varying error. It represents factors that change over time and affect u_{ijt}. I estimate equation (2) using a subsample of 52 companies producing both 500 mg and 650mg formulations of Paracetamol. The second subsample that I use include only 9 companies producing both formulations of Paracetamol but having a market share higher than 1% of pharmaceutical market.

5. Results

I start with *Table 2* which represents a descriptive statistics plotting the normalized price difference in the two formulations of Paracetamol among the first three periods and across the 14 states subject to the analysis. The table also shows the percentage variation difference in the prices of the drug in the discrete time spans. It is observed from the table that prices of the two formulations increase with every single period before the regulation take place. To facilitate a better comparison I form two group of states. Most shocking are the changes in prices in period 2 and period 3 in the first group of regions. It is consisted of the following states: Madhya Pradesh, Kerala, and Tamil Nadu. The prices of the different formulations of the drug in these states diverge from one another significantly, which may be a result from collusion practices going on between the pharmaceutical companies operating there.

In contrast, a gradual similar increase in the prices of the two formulations is observed throughout the second group of states. As an example I take the states Bihar, Gujarat, and Punjab, where the price shifts converge to one another. As I already stated, the brief price changes of the 500mg formulation of Paracetamol observed in the first group of states in the period before regulation could be a result of price coordination between companies that manipulate the ceiling price. From *Table 2* it can be seen that the price differences are by 17.7% in Madya Pradesh for 500mg formulation and 22% the price of 650mg formulation. The price increase in Kerala is by 23.2% for regulated formulation and 11.7% for the unregulated one.

The tendency is similar in Tamil Nadu where the 500mg formulation price increases by 11.8% in the third period compared to the second, where the price of 650mg formulation of Paracetamol increases by 12.3% in the period right before the price regulation imposition. At the same time, the differences in prices observed from the second group of states are smooth and very close between the two formulations. In Bihar, the table indicates that for 500mg formulation of Paracetamol the increase is by 11.8% from the second to the third period when for 650mg formulation it increases by 11.2%. In Gujarat, the result is slightly different. The price of the regulated formulation increases by 9.3% while the price of unregulated formulation between the second and the third time span increases by 14%. Results from Punjab are almost identical to those from Bihar. The price of the drug for 500mg formulation increases by 11.5% and by 12,7% for 650mg formulation from the second to the third period. Hence, as I already posit, to find out how and what cause the price changes across states is the main goal of this paper.

Tables 3a and *3b* represent a second descriptive analysis I conducted. In order to support the inference that there are collusion practices in the pharmaceutical market in some of the regions in India I analyze the price difference per 1mg between the 10 and 15 pack formulations of Paracetamol. The aim of conducting such an analysis is that switching from 10 to 15 pack formulation of the medicine may help producers to successfully bypass the price control measures. Here, I take in consideration the whole time duration of the data from 2007 until 2015 and compare the difference between the packs for the two dosages separately. *Table 3a* represents the price difference per 1 mg between the two packs of the regulated formulation of the medicine, the 500mg dosage. From the results received, it is obvious that the changes of prices of 10 and 15 pack are small but the most of them are in favor of 15 pack formulation.

Thereafter, *Table 3b* represents the price difference per 1 mg between the two packs of the unregulated formulation of Paracetamol – 650mg dosage. Here, the difference between the prices are bigger and more consistent compared to *Table 3a*. The output is predominantly in favor of 15 pack formulation again. Especially interesting results are those obtained for the second group of states – Bihar, Gujarat, and Punjab. Differences increase markedly in the second and third periods before the regulation imposition. Hence, the result may be explained by existing coordination between the companies operating in the market. In order to avoid the price cap regulation, firms collude between each other.

Next, I continue with the figures of the states the composed the two groups discussed earlier. They represent the price variation between the two formulations of Paracetamol among

the two groups of states and help for the better understanding of price variation tendencies. In *Figure 1a*, the normalized prices of Paracetamol for both the 500mg and 650mg formulations in Madhya Pradesh are plotted. In *Figure 1b* and *Figure 1c* the same analysis is conducted but for the other two states – Kerala and Tamil Nadu. Thus, the first three figures present the first group of states where the prices of the two formulations of Paracetamol diverge from one another in the third period before the price control regulation take place. On the figures, it can be clearly seen how the price of 500mg formulation increase in the period before regulation. These three figures serve as an example of the raise of drug prices due to a probable price coordination among the pharmaceutical companies operating on the medicine market across the Indian states.

In *Figures 2a*, *2b*, and *2c* the price variation between the two formulations of Paracetamol for the second group of states – Bihar, Gujarat, and Punjab are plotted. Opposite to what is observed in the first three figures, here the prices of 500mg and 650mg of Paracetamol converge along the whole period of time. This group of states represent an example of medicine market where collusion is less presented. The two prices increase gradually without any drastic differences among the prices of the two formulations. This effect may be explained by the lack of coordination among the pharmaceutical companies operating in these pharmaceutical markets. However, the contrast between the two groups of states is a consequence of the socio-economic factors that differ among different Indian regions.

Model 1 in *Table 4* shows the results received from the main regression analysis conducted through the four different time periods. The VIF test and correlation matrix suggest that there are no problems with multicollinearity of the variables. The dependent variable is the average price difference per pack of ten tablets of the regulated and unregulated formulations of Paracetamol. The analysis is conducted on the primary sample, where there are 143 companies producing 500mg and 650mg dosage strength of the drug. Based on the economic theory, the number of firms operating in the Indian pharmaceutical market suggest highly competitive environment and small possibility for coordination between the entities in the industry. The four different columns represent the four discrete periods regarded – the three periods before price control regulation and the period after price regulation take place.

Based on the regression analysis, it is observed that GDP has negative effect on price difference in the second and third period regarded, but the results are not significant even at 10% level. However, in the fourth period of my investigation – the period after price control regulation imposition, increase in GDP is followed by increase in price difference and the result

is significant at 10% level. According to these results, I do not have enough evidence to confirm the first hypothesis of the study that the higher GDP will lead to less collusion.

The influence of the number of pharmacists per 1,000,000 people on price difference is rather ambiguous. While the effect is positive and significant at 5% in the second period, in the subsequent third period it is negative and significant again at 5%. As it can be explained by the figures provided earlier where it is observed that the price shifts are higher in the third period right before the price control regulation take place, thus it can be supposed that the coordination is higher during the third period. Following that logic, higher number of pharmacists per 1,000,000 people should decrease the price difference between the two formulations of Paracetamol. Therefore, the result is in compliance with the second hypothesis I test and it confirms it.

However, the results for the third hypothesis tested are in contrast to the results from the second hypothesis. Although, the two hypotheses are based on a similar logic and measure the health infrastructure through similar concepts, the results are different. The effect of the number of primary health centers per 1,000,000 people are not significant, except for the fourth period. In the third period its effect is negative but not significant, while in the fourth period, the variable has positive effect on price difference and this effect is significant at 5% level. Thus, based on this inference, I cannot confirm the third hypothesis of my analysis.

Next, in *Table 4* the effect of infant mortality rate on price difference of the regulated and unregulated formulations of Paracetamol is presented. It indicates that an increase in the infant mortality leads to an increase in the coordination among companies in the industry. The result is in compliance with the fourth hypothesis but it is significant only in the first period of observations at 10% level. Thus, the fourth hypothesis can be confirmed only based on the effect in the first period representing the time before price control regulation.

The fifth hypothesis is tested on the same model. Again, the results are not significant except for the second period where number of high schools per 1,000,000 people has positive effect on price difference, and it is significant at 5% level of significance. However, the result does not give me enough evidence in support of the fifth hypothesis that high literacy rate is associated with better health infrastructure and less monopolistic practices.

Further in the paper, two subsample analyses are conducted in order to confirm the results received from the benchmark regression. For this purpose I estimate the second regression model. Hence, first subsample is composed only of companies that produce both

formulations (500mg and 650mg) of Paracetamol. Along with that company-fixed effects are also included. I do that in order to examine whether the effect of price coordination is stronger among companies producing both formulations. The dataset spans 52 firms operating across 14 Indian regions that produce regulated and unregulated formulations of the drug. Second subsample is consisted only of companies that produce both formulation of Paracetamol and have market share higher than 1%. The regression analysis includes only 9 companies working across 14 discrete regions for the whole time span of 99 months divided on 4 discrete periods. Companies' fixed effects are included as well. The small number of companies possessing higher shares of the market further intensify suspicions of collusion practices in India. As stated in the existing theory that small number of players in the market ease the collusion among companies. Both subsample analyses test again the five hypotheses tested by the benchmark regression. They are conducted in order to deepen the main results and relate them to the theory discussed in the previous sections of the study.

Table 5 shows the results of the first subsample analysis spanning the companies that produce both formulations of Paracetamol. The output imply the effect of GDP is slightly different than the results from the benchmark analysis. The effect of increase in the gross domestic product of a given state is significant except for the third period of time before price control regulation imposition. In the first and second periods, GDP has subsequently positive and negative effect on price difference and the results are significant at 1% level of significance. The effect is also positive in the fourth period and again significant at 1%, while the effect in the third period is negative, but not significant. This implies that a unit increase in GDP will lead to decrease in the price difference between the two formulations of Paracetamol. Again the same effect is valid for the second period. Thus, high GDP is associated with less collusion in the second and the third period, but the first hypothesis may be confirmed only on the result from the second period.

The results suggest further that the effect of number of pharmacists per 1,000,000 people is again ambiguous. While in the first and second period it is positive and significant at 5% and 1%, in the third period, right before regulation, the number of pharmacists has negative effect on price difference between the regulated and unregulated formulations of the drug. The result overlapped with the one from the benchmark analysis and is significant at 1% level. Following this inference, there are evidence to support the second hypothesis.

The results for primary health centers per 1,000,000 people are different than the results from the main regression analysis. Here, it is observed that an increase in the number of primary

health centers has positive effect on price difference in the first and fourth period. These results are significant at 1% level, while in the second and the third period the effects are negative. However, only the effect in the third period is significant at 5%. Similar to what I have for the number of pharmacists, in the period when coordination would be most intensive the higher number of health centers confirms the third hypothesis tested. Thus, more primary health centers are associated with more transparency in the pharmaceutical industry and stronger health infrastructure.

Results received for the effect of number of high schools are in compliance with the result from the main analysis. According to the first subsample analysis, a unit increase in the number of high schools leads to increase in the price difference among the two formulations of Paracetamol in the first three periods of time considered. Although, these results are surprising, the effects are significant at 1% level. Thus, the fourth hypothesis cannot be confirmed and the results absolutely oppose to the empirical results of Saha and Gounder (2007) who prove that higher level of education and literacy lead to less corruption and monopoly practices.

The result for infant mortality rate received from the main regression analysis is confirmed with more confidence in the subsample model. *Table 5* suggests that a unit increase in the infant mortality is associated with increase in the price difference between 500mg and 650mg of Paracetamol. These effects are significant at 1% level in the first and the second periods of the analysis. The variables has positive effect in the third period as well, but the result is insignificant. Therefore, this output confirms what hypothesis 5 posits.

However, to great extent, the results received in the second subsample analysis are overlapped with the results from the first subsample analysis. *Table 6* indicates that an increase in GDP in the second and in the third period leads to decrease in the price difference of the two formulations of Paracetamol. Nevertheless, only the result from the second time span is significant. The effect of GDP is positive in the first and the fourth period. The results are significant at 1% level of significance. Therefore, there are partial evidence in support of hypothesis 1 to be confirmed.

Next, the number of pharmacists per 1,000,000 people has positive effect on coordination in the first and second period, while this effect is negative in the third period. These results are significant at 1% level except for the first period which is significant at 10% level. The effect of the variable is negative again in the fourth time span, but this result is not

significant even at 10% level. Thus, hypothesis 2 can be confirmed based on the result from the third period.

According to the second subsample analysis, the number of primary health centers per 1,000,000 people has positive effect on price difference of the two formulations of Paracetamol in the first, second and fourth period regarded. However, only the results in the first and fourth period are significant. The effect of the variable on price difference is negative in the third period right before price control regulation take place, but this effect is not significant even at 10% level. Thus, there are no enough evidence for the third hypothesis to be confirmed.

Furthermore, the effect of number of high schools per 1,000,000 people is also in compliance with the results received in the previous two analyses. *Table 6* indicates that increase in literacy rate leads to increase in coordination between pharmaceutical companies. The results are significant at 1% level in the first two periods, while it is significant at 5% level in the third. However, there are no evidence in support of the fourth hypothesis.

Finally, *Table 6* suggest that an increase in infant mortality rate leads to increase in price difference of the regulated and unregulated formulations of Paracetamol. The effect is positive again in the first and in the second period as it was the case in the first subsample analysis. Both effects are significant at 1% and 5% level of significance. However, the effects observed in the third and fourth period are respectively positive and negative, but not significant even at 10% level. Thus, besides the weak support, the evidence from the table can confirm the fifth hypothesis of the analysis.

6. Discussion and limitations

Indian pharmaceutical market is one of the fastest growing medicine markets in the world in the last few decades (Bhadoria et. al., 2012). As India is part of the group of developing countries where the price control regulation is frequently used policy tool, it has been imposed on the drug market in the country for years. The effect of imposition of this policy provokes the interest of many scientists and economists recently. As a consequence, many studies have been conducted in order to investigate what the exact effect of price regulation is. However, the results in most of the analyses continue to be ambiguous.

The goal of this paper is to examine the socio-economic factors that favor collusion among pharmaceutical companies in India based on Paracetamol data. As evidence for such practices in the Indian drug market are already proven in the previous literature by Bhaskarabhatla et. al.[b] (2016) still there are no analyses conducted on the factors that serve in favor of such price coordination practices. This provoked my interest and I decide to explore these determinants in order to add to the knowledge that can be useful for policy makers in development of more efficient economic system and to contribute to the existing theory.

However, the results from my primary analysis indicate that my theoretical findings were only partially true. According to the empirical output I received, only two of the hypotheses I tested were confirmed. The high number of pharmacists and infant mortality rate do have the effect on collusion practices inferred from the theory developed (Saha and Gounder, 2012; Maynard, 2003). The increase in the number of pharmacists working in the pharmaceutical industry leads to less collusion and improve the health infrastructure, while an increase in the infant mortality rate is evidence for weak infrastructure and leads to more collusion among the firms operating in the sphere. However, neither the number of primary health centers, nor the high literacy rate served in support to hypotheses 3 and 4 as the empirical analyses of Kovacic (2009) and Canfield (2011) suggest. The effect of the increased number of high schools is not consistent with the findings of Saha and Gounder (2015) as well who argue in favor of exactly opposite effect the increased literacy has on corruption and coordination.

Nevertheless, the first subsample analysis I conduct reveals that these results slightly differ when only companies that produce both formulations of Paracetamol are included in the regression. In *Table 5* it can be seen that the effects are stronger and more significant compared to the effects received from the benchmark regression analysis. The first subsample analysis indicates that GDP has negative effect on price difference in the second and in the third periods.

However, it is significant only in the second period. The result is in compliance with the first hypothesis I stated. *Table 5* further confirms the negative effect the increase in the number of pharmacists has on the price difference in the third period which also gives evidence in support of second hypothesis I posited. The results also oppose to the fourth hypothesis and support the fifth one. In general, the output from the second subsample analysis of the companies that produce both formulations of Paracetamol and possess more than 1% of the market share are overlapping with the results from the primary analysis. Thus, based on the results from the three analyses it can be concluded that the socio-economic factors included in my study to serve as determinants of the level of coordination across different Indian states through the three separated periods before price control and the one after, resulted as partially effective. The regressions conducted cannot prove with absolute confidence that these are the factors that determine collusion among pharmaceutical firms in Indian medicine industry. There is a likelihood of endogeneity problem in the regression that may bias the results received.

The study has its limitations too. Similar to the paper of Bhaskarabahatla et. al.[b] (2016), the current paper main constrain is that it is based on a particular medicine – Paracetamol. The companies' market behavior may be different towards different drugs. Second, as the study is focused only on Indian market the results may not be true for other pharmaceutical markets around the world. As countries differ in their economic situation, demographic characteristics and level of development, most probably pharmaceutical markets in other countries also differ between one another. Furthermore, another limitation of the data is the lack of enough information on Paracetamol for all Indian regions. Thus, I had to restrain the analysis to 14 regions only. Moreover, the empirical analysis may suffer from model misspecification too. As there are factors such as law enforcement, market transparency or level of corruption that may have significant impact on the research but were not included due to the lack of enough information on them. Therefore, the results obtained from the regressions run are to some extend biased, and do not represent the complete situation on Indian pharmaceutical market. Furthermore, a larger dataset may be needed in order to conduct a more thorough subsample analyses as dividing the primary dataset into subsamples reduce drastically the number of observations per sample.

7. Conclusion and further research

In general, price controls regulation are used to stabilize the market and normalize the inflation. However, the analyses that have been conducted indicate the ambiguity effect the measure has on economy. The policy has its supporters who strongly defend it along with many opponents who claim against the necessity of government interventions in the free market economy that result in welfare losses and anti-competitive practices among the economic agents in the market. Interesting example of the effects from price control regulation is Indian pharmaceutical market, which is the focus of this study.

The research analyzes the effect of socio-economic factors in India on medicine prices of Paracetamol in the Indian pharmaceutical industry in the period March 2007 until June 2015. Its main goal is to determine how these factors influence coordination between pharmaceutical companies cross-regionally. The paper contributes to the existing literature by investigating the effect of these determinants on price difference between the regulated and unregulated formulations of Paracetamol in the Indian pharmaceutical market. As there are evidence in the existing literature in support of the presence of collusion between pharmaceutical companies on medicine market in India, including evidence in support of collusion on Paracetamol in particular (Bhaskarabahatla et. al.[a] (2016), a research on factors causing the collusion has not been conducted until now. However, different limitations that constrain the analysis raise a concern on the validity of its results.

Nevertheless, the results contribute to the better understanding of arising coordination between pharmaceutical companies and shed a light on the conditions that favor the presence of collusion practices among companies operating in this sphere. The research could also help policy makers to utilize, based on the results received, a better improved regulatory framework for more effective imposition of price control regulation. In their paper, Bhaskarabahatla et. al.[b] (2016) conclude that to improve regulation and to understand the behavior of pharmaceutical firms it is important to understand the strategies that companies use to avoid regulation. Thus, the current paper is focused more on the side factors that allow companies to avoid regulation and further widen the scope of knowledge in the field. Another policy implication that could help in decreasing the level of collusion between pharmaceutical companies is if price control regulation is imposed over all formulations of essential drugs. Hence, companies would not have a reason to coordinate prices, at least not for regulated medicine. Furthermore, better law enforcement along with independent judicial system can to great extend terminate the corruption and collusion practices in the economy.

The empirical results narrow the scope of companies that coordinate on the prices of Paracetamol. They add to the better understanding of conditions under which companies can collude. The most controversial results are those of the effect of GDP and literacy rate. Based on the existing literature, the high level of GDP and education are associated with better developed states, more transparency, and less corruption (Saha and Gounder, 2012; Lambsdorff, 2003). Furthermore, the study of Canfield (2011) along with the analysis of Saha and Gounder (2012) provide evidence in support of this theory. However, the empirical analysis of my paper did not confirm these findings, which makes me think that there are factors, which are more important for the better functioning of the institutions. Such factors could be the level of corruption, independency of the regulatory agents and high level of law enforcement for example. Unfortunately, there are not enough detailed data on these factors which made me exclude them from the analysis. However, the results provide support for the second and fifth hypotheses, while there are not enough evidence for the third and fourth hypotheses to be confirmed.

Finally, the analysis left a room for future research in the field. As it was mentioned in the discussion and limitations section, there are more factors that could be included in the study. The inclusion of additional factors could contribute to better understanding of the determinants of collusion among pharmaceutical companies operating in the market and their strategies for evasion of price control regulation. They will provide better understanding of the environment in general, along with additional findings that could help further the policy makers in improving more efficient policy control regulation. However, extra research is needed before this can be established. Finally, taking into consideration more drug markets around the world where it is proved that companies collude on their prices is also direction for further research.

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Appendix

Table 1: Summary statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
month	30,372	49.36	28.86	3	102
state	30,372	7.907	3.976	1	14
company	30,372	63.41	40.01	1	143
sales	30,372	1.218	5.888	2.00e-05	190.2
units	30,372	9.601	41.44	0.00100	2,254
strength	30,372	572.1	74.94	500	650
gdp	30,372	62.22	35.81	1	122
Pharmacists	30,372	44.64	25.70	1	88
PrimaryHealthCenters	30,372	32.11	18.91	1	64
InfantMortality	30,372	21.72	12.97	1	50
HighSchools	30,372	20.63	21.15	1	62
TelephoneService	30,372	60.23	35.56	1	122
IndInvest	30,372	52.68	32.85	1	109
hhi_sales	30,372	0.194	0.0783	0.0621	0.634
PriceDifference	30,372	-1.156	2.180	-18.37	8.560

Note: This table reports the descriptive statistics of information on 143 companies which sell two formulations of Paracetamol, namely 500mg or 650mg, or both formulations in the period between March 2007 and June 2015 for 14 Indian states. The main data is provided by AIOCD Awacs Pvt. Ltd.

Table 2: Descriptive statistics (Percentage difference in prices of 500mg and 650mg of Paracetamol among the first 3 periods before price control regulation

State	Price500mg			Price650mg		
Time	Period1	Period2	Period3	Period1	Period2	Period3
Andhra Pradesh	.	0.86	0.95(10.5%)	.	1.21	1.43(18.2%)
Bihar	0.76	0.85(11.8%)	0.95(11.8%)	1.06	1.16(9.4%)	1.29(11.2%)
Chattisgarh	0.69	0.80(15.9%)	0.88(10%)	1.13	1.14(0.9%)	1.30(14%)
Delhi	0.74	0.84(13.5%)	0.92(9.5%)	1.09	1.30(19.3%)	1.43(10%)
Gujarat	0.92	0.97(5.4%)	1.06(9.3%)	1.05	1.21(15.2%)	1.38(14%)
Haryana	0.89	0.78(-12.4%)	0.91(16.7%)	1.17	1.10(-5.9%)	1.40(27.3%)
Jharkhand	0.82	0.84(2.4%)	0.85(1.2%)	1.05	1.16(10.5%)	1.20(3.4%)
Kerala	0.69	0.85(23.2%)	0.89(4.7%)	1.03	1.20(16.5%)	1.34(11.7%)
Madhya Pradesh	0.63	0.79(25.4%)	0.93(17.7%)	1.08	1.27(17.6%)	1.55(22%)
Odisha	0.77	0.88(14.3%)	0.96(9.1%)	1.03	1.26(22.3%)	1.30(3.2%)
Punjab	0.77	0.78(1.3%)	0.87(11.5%)	0.96	1.10(14.6%)	1.24(12.7%)
Rajasthan	0.84	0.94(11.9%)	1.06(12.8%)	1.07	1.24(15.9%)	1.36(9.7%)
Tamil Nadu	0.72	0.85(18.1%)	0.95(11.8%)	1.03	1.22(18.4%)	1.37(12.3%)
Uttarakhand Up West	0.70	0.80(14.3%)	0.89(11.3%)	1.07	1.24(15.9%)	1.34(8.1%)
West Bengal Rest	0.73	0.82(12.3%)	0.89(8.5%)	1.04	1.18(13.5%)	1.29(9.3%)

Note: This table reports the descriptive statistics of the prices of the two formulations of the normalized Paracetamol prices for the first three discrete periods before the price control regulation imposition.

Table 3a: Descriptive statistics The difference between price per mg of 10 and 15 packs of 500mg formulation of Paracetamol

State	Price difference per mg (10 - 15 pack) – 500mg			
Time	Period 1	Period 2	Period 3	Period 4
Andhra Pradesh	.	-0.002	-0.015	-0.011
Bihar	-0.0038	-0.003	-0.03	-0.017
Delhi	0.006	0.007	-0.058	-0.033
Gujarat	0.018	-0.001	-0.025	0.006
Haryana	0.063	-0.01	-0.035	-0.04
Jharkhand	-0.0027	-0.003	-0.023	-0.009
Kerala	-0.0066	0.002	-0.018	-0.0013
Madhya Pradesh	0.0002	-0.028	-0.029	-0.009
Odisha	0.013	-0.03	-0.03	0.025
Punjab	0.011	-0.02	-0.099	-0.052
Rajasthan	0.018	0.002	-0.0003	0.022
Tamil Nadu	-0.006	-0.004	-0.029	-0.018
Uttarakhand Up West	0.005	0.01	0.002	-0.018
West Bengal Rest	-0.016	-0.003	-0.003	-0.014

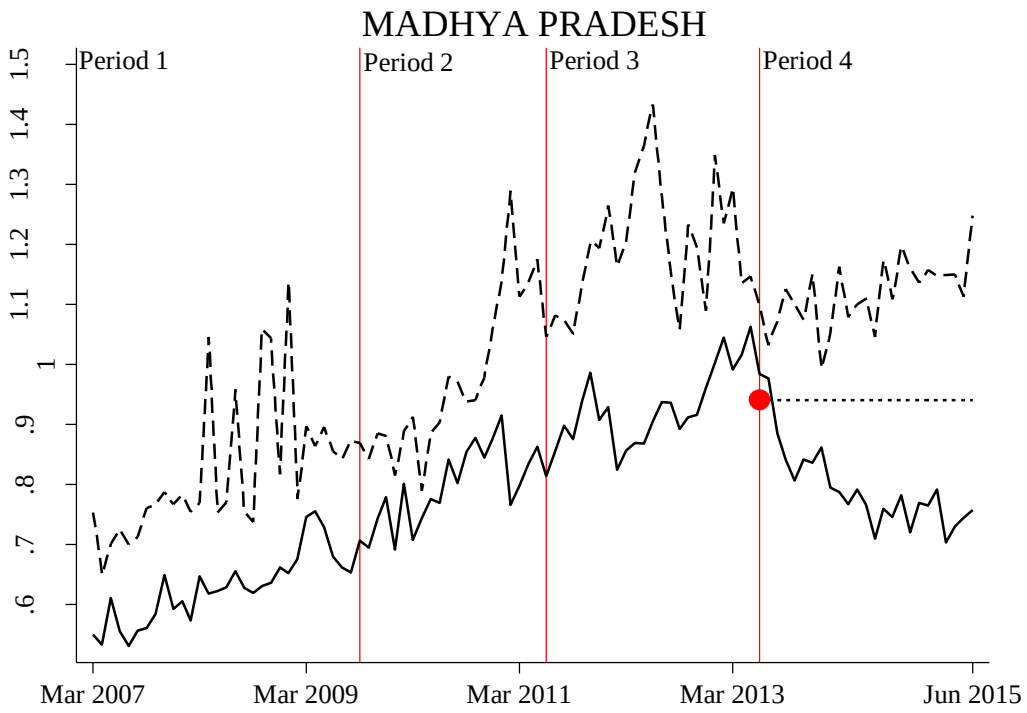
Note: This table reports the descriptive statistics of the price difference between the 10 and 15 pack of 500mg formulation of the normalized Paracetamol price per 1mg for the three discrete periods before price control regulation and one period after the imposition. The aim of the table is to show how companies switch from 10 to 15 pack of the medicine in order to avoid the regulations.

Table 3b: Descriptive statistics The difference between price per mg of 10 and 15 packs of 650mg formulation of Paracetamol

State	Price difference per mg (10 - 15 pack) – 650mg			
Time	Period 1	Period 2	Period 3	Period 4
Andhra Pradesh	.	-0.035	-0.011	-0.019
Bihar	.	-0.038	-0.027	-0.024
Delhi	.	-0.037	-0.036	-0.035
Gujarat	.	-0.042	-0.031	-0.017
Haryana	.	-0.059	-0.033	-0.057
Jharkhand	.	-0.034	-0.047	-0.031
Kerala	.	-0.037	-0.023	-0.021
Madhya Pradesh	.	-0.026	0.019	-0.016
Odisha	.	-0.016	-0.031	-0.025
Punjab	.	-0.054	-0.05	-0.028
Rajasthan	.	-0.036	-0.032	-0.023
Tamil Nadu	.	-0.036	-0.029	-0.054
Uttarakhand Up West	.	-0.038	-0.036	-0.025
West Bengal Rest	.	-0.032	-0.027	-0.015

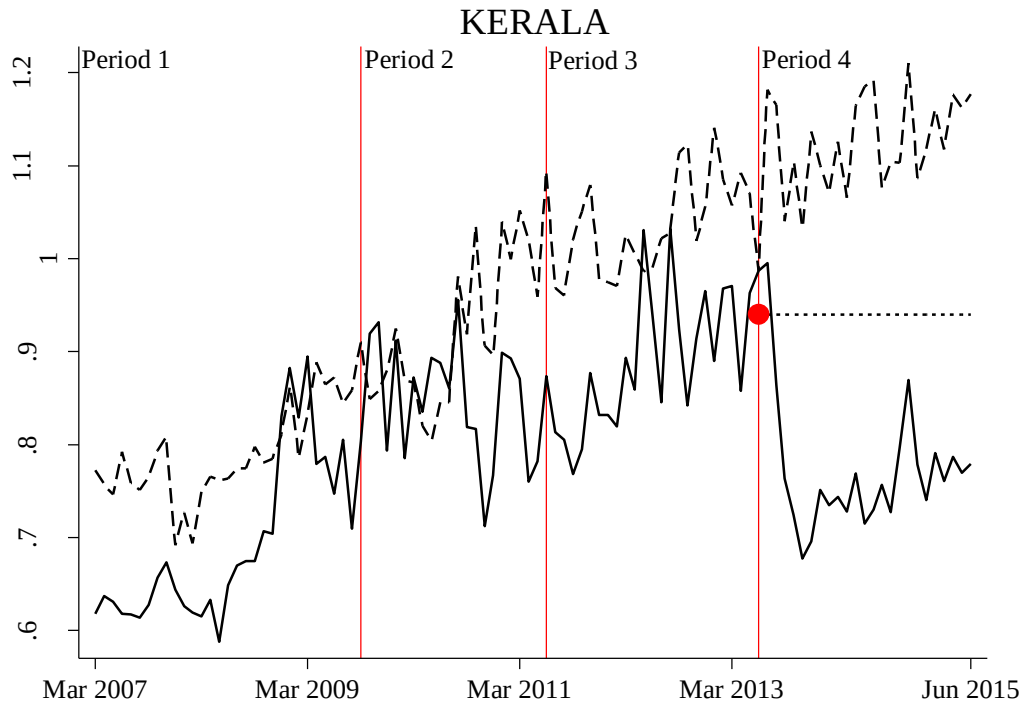
Note: This table reports the descriptive statistics of the price difference between the 10 and 15 pack of 650mg formulation of the normalized Paracetamol price per 1mg for the three discrete periods before price control regulation and one period after the imposition. The aim of the table is to show how companies switch from 10 to 15 pack of the medicine in order to avoid the regulations.

Figure 1a: The first group of states represents the tendency of price divergence between the two formulations of Paracetamol in the 4 period time as a consequence of price coordination among pharmaceutical companies in the specific region



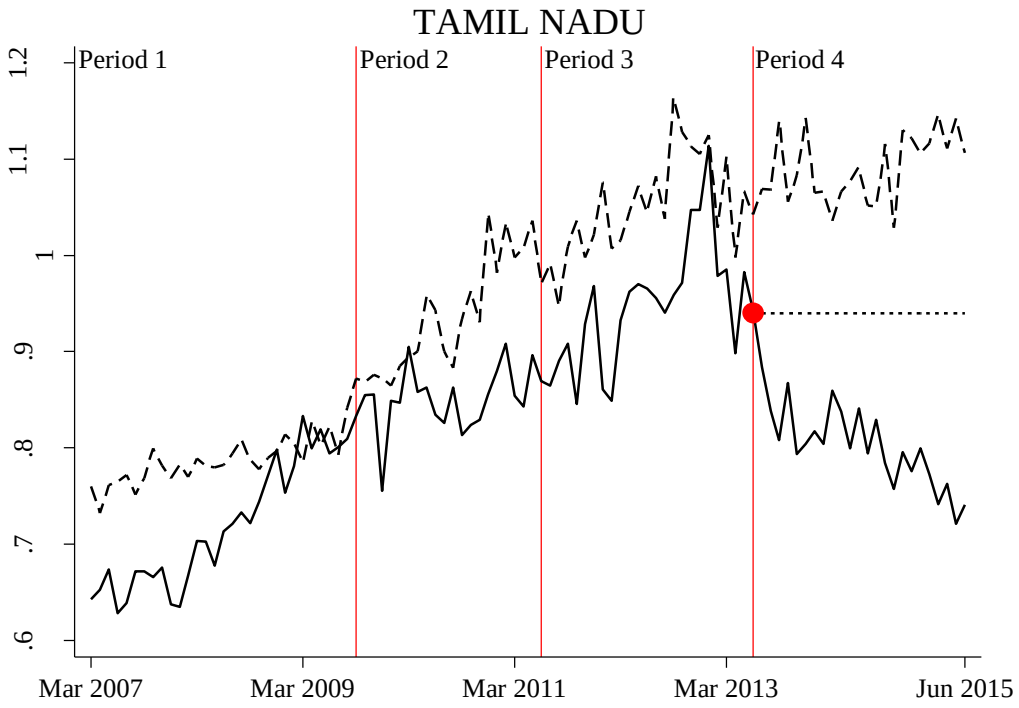
Note: This figure shows how prices of the two formulations of Paracetamol in Madhya Pradesh diverge from one another. This divergence is most vivid during the third period spanning the time right before regulation imposition. The dashed curve represents the increase in the price of 650mg formulation of Paracetamol, while the solid curve represents the increase in the price of 500mg of the drug through the period from March 2007 until June 2015.

Figure 1b: The first group of states represents the tendency of price divergence between the two formulations of Paracetamol in the 4 period time as a consequence of price coordination among pharmaceutical companies in the specific region



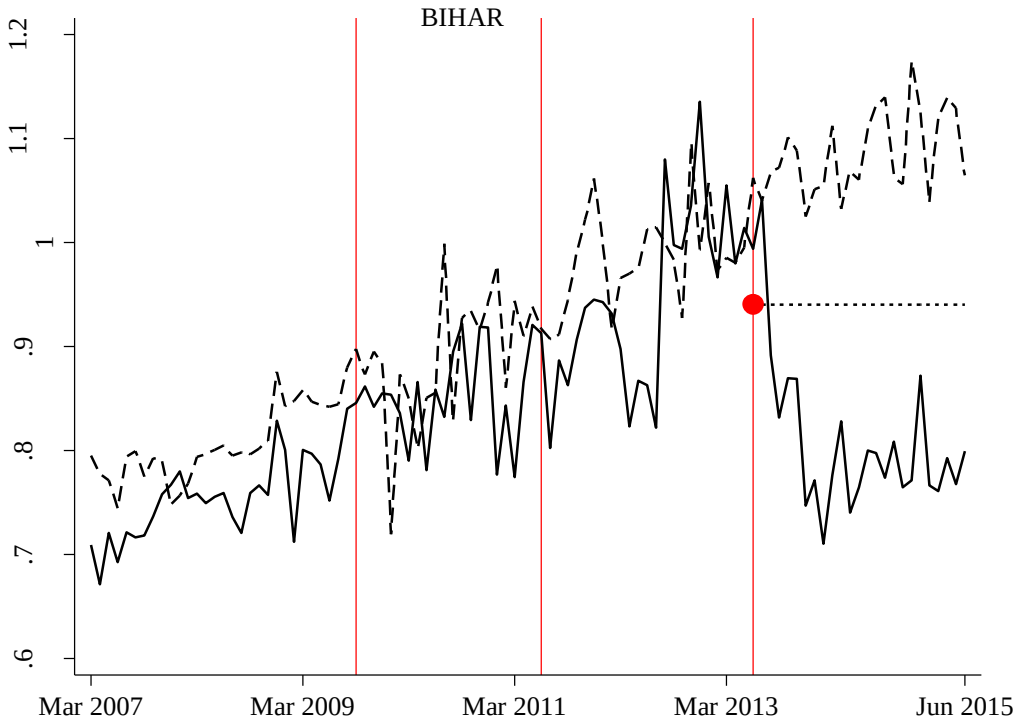
Note: Note: This figure shows how prices of the two formulations of Paracetamol in Kerala diverge from one another. This divergence is most vivid at the end of the second and in the third period spanning the time before regulation imposition. The dashed curve represents the increase in the price of 650mg formulation of Paracetamol, while the solid curve represents the increase in the price of 500mg of the drug through the period from March 2007 until June 2015.

Figure 1c: The first group of states represents the tendency of price divergence between the two formulations of Paracetamol in the 4 period time as a consequence of price coordination among pharmaceutical companies in the specific region



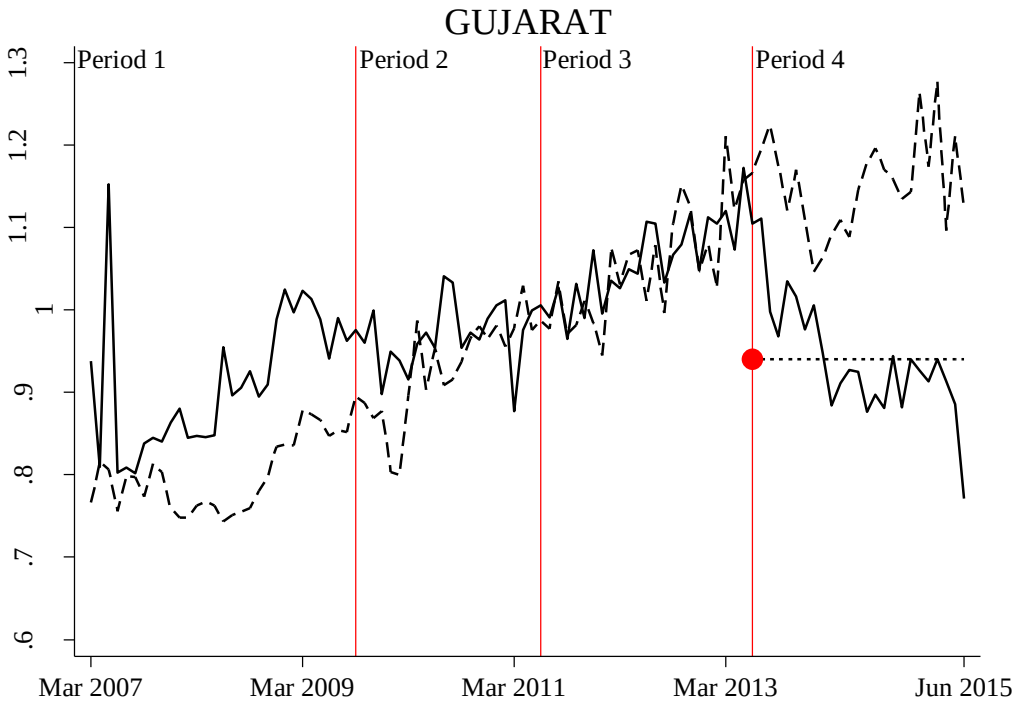
Note: Note: Note: This figure shows how prices of the two formulations of Paracetamol in Tamil Nadu diverge from one another. This divergence is most vivid during the second and the third period spanning the time right before regulation imposition. The dashed curve represents the increase in the price of 650mg formulation of Paracetamol, while the solid curve represents the increase in the price of 500mg of the drug through the period from March 2007 until June 2015.

Figure 2a: The second group of states represents the tendency of price convergence between the two formulations of Paracetamol in the 4 period time demonstrating the less collusion levels among the pharmaceutical companies



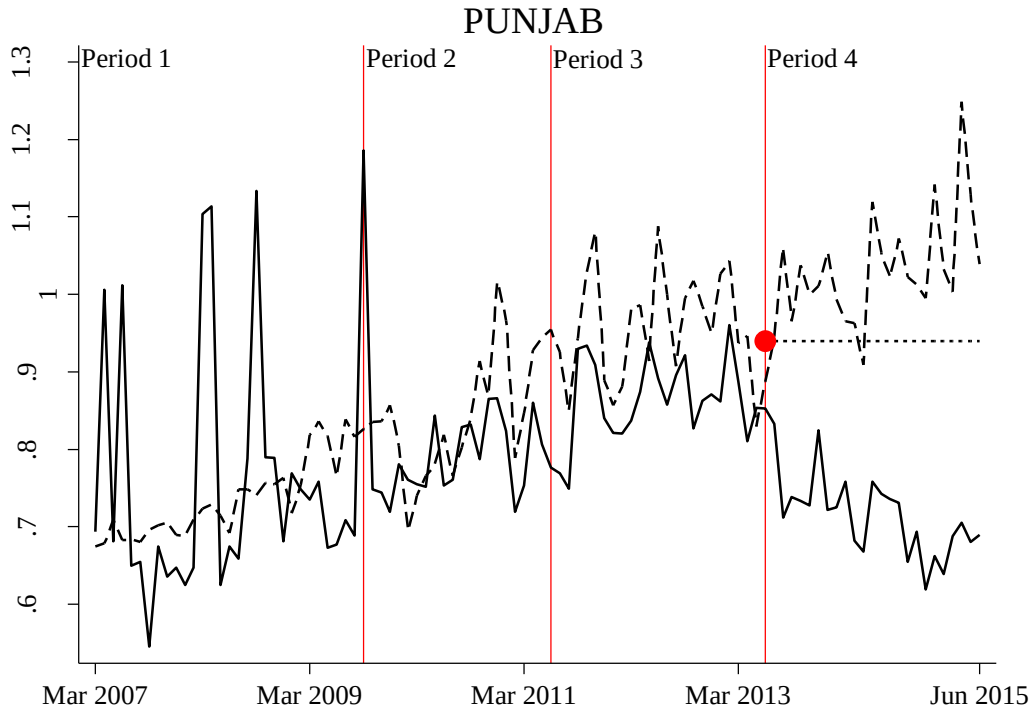
Note: This figure shows how prices of the two formulations of Paracetamol in Bihar converge to one another. It can be clearly seen that the prices of the two formulations increase together. The dashed curve represents the increase in the price of 650mg formulation of Paracetamol, while the solid curve represents the increase in the price of 500mg of the drug through the period from March 2007 until June 2015.

Figure 2b: The second group of states represents the tendency of price convergence between the two formulations of Paracetamol in the 4 period time demonstrating the less collusion levels among the pharmaceutical companies



Note: This figure shows how prices of the two formulations of Paracetamol in Gujarat converge to one another. It can be clearly seen that the prices of the two formulations increase together. The dashed curve represents the increase in the price of 650mg formulation of Paracetamol, while the solid curve represents the increase in the price of 500mg of the drug through the period from March 2007 until June 2015.

Figure 2c: The second group of states represents the tendency of price convergence between the two formulations of Paracetamol in the 4 period time demonstrating the less collusion levels among the pharmaceutical companies



Note: This figure shows how prices of the two formulations of Paracetamol in Punjab converge to one another. It can be clearly seen that the prices of the two formulations increase together. The dashed curve represents the increase in the price of 650mg formulation of Paracetamol, while the solid curve represents the increase in the price of 500mg of the drug through the period from March 2007 until June 2015.

Table 4: Results of the regression analysis of determinants of coordination practices

VARIABLES	(1) (mean) PriceDifference	(2) (mean) PriceDifference	(3) (mean) PriceDifference	(4) (mean) PriceDifference
gdp	0.093045	-0.015300	-0.001741	0.039757*
	(0.080)	(0.018)	(0.006)	(0.021)
Pharmacists per 1 mill people	0.006242	0.065238**	-0.021074**	-0.001804
	(0.010)	(0.027)	(0.008)	(0.006)
PrimaryHealthCenters per 1 mill people	0.023256	0.007927	-0.011007	0.086686**
	(0.016)	(0.024)	(0.022)	(0.044)
Infant Mortality	0.447255*	0.086128	0.047225	-0.001270
	(0.248)	(0.135)	(0.154)	(0.015)
HighSchools per 1 mill people	0.019936	0.025915**	0.006473	
	(0.019)	(0.013)	(0.016)	
TelephoneService	-0.000269	-0.011500	-0.004461	0.061134
	(0.005)	(0.009)	(0.013)	(0.058)
IndustInv	-0.006132	0.005646	-0.004540	0.002585
	(0.006)	(0.005)	(0.004)	(0.004)
hhi_sales	1.547518	-0.487446	-0.767944	-0.218368
	(1.658)	(1.927)	(2.368)	(2.048)
Constant	-19.494504**	-5.815557*	0.493011	-14.296845**
	(9.080)	(3.101)	(3.231)	(5.558)
Observations	403	278	336	329
R-squared	0.090	0.236	0.119	0.199
Number of panelid	13	14	14	14
State-month FE	Included	Included	Included	Included

Note: This table reports results from the fixed effects analysis which investigates the effects of different socio-economic factors on price difference between the regulated and unregulated formulations of Paracetamol. The price variations are studied throughout the four discrete periods described in the paper. The first three periods span the time before regulation, while the fourth period span the time after the price control regulation is imposed. The main variables of interest are of continuous nature. The main dependent variable is a continuous variable as well. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Subsample of companies producing both formulations of Paracetamol

VARIABLES	(1) (mean) PriceDifference	(2) (mean) PriceDifference	(3) (mean) PriceDifference	(4) (mean) PriceDifference
gdp	0.086923***	-0.008194**	-0.001652	0.038098***
	(0.019)	(0.004)	(0.001)	(0.005)
Pharmacists per 1 mill people	0.004468**	0.046164***	-0.018213***	-0.001795
	(0.002)	(0.006)	(0.002)	(0.001)
PrimaryHealthCenters per 1 mill people	0.022697***	-0.003572	-0.013607**	0.090930***
	(0.004)	(0.005)	(0.006)	(0.009)
Infant Mortality	0.505725***	0.089873***	0.043886	-0.001207
	(0.056)	(0.031)	(0.036)	(0.004)
HighSchools per 1 mill people	0.020628***	0.022045***	0.007989**	
	(0.004)	(0.003)	(0.004)	
TelephoneService	0.001188	-0.009869***	0.000883	0.042461***
	(0.001)	(0.002)	(0.003)	(0.014)
IndustInv	-0.005478***	0.003283***	-0.004533***	0.002792***
	(0.001)	(0.001)	(0.001)	(0.001)
hhi_sales	0.371769**	0.333800**	-0.001380	0.052769
	(0.178)	(0.158)	(0.169)	(0.155)
Constant	-21.099077***	-5.154646***	-0.026483	-13.308996***
	(2.087)	(0.720)	(0.761)	(1.365)
Observations	7,828	4,610	5,589	5,276
R-squared	0.083	0.219	0.112	0.206
Number of panelid	373	356	320	300
State-month FE	Included	Included	Included	Included

Note: This table reports results from the fixed effects analysis which investigates the effects of different socio-economic factors on price difference between the regulated and unregulated formulations of Paracetamol. The analysis includes only companies that produce both formulations of the drug. The price variations are studied throughout the four discrete periods described in the paper. The first three periods span the time before regulation, while the fourth period spans the time after the price control regulation was imposed. The main variables of interest are of continuous nature. The main dependent variable is a continuous variable as well. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Subsample of companies producing both formulations of Paracetamol but having market share > 1%

VARIABLES	(1) PriceDifference	(2) PriceDifference	(3) PriceDifference	(4) PriceDifference
gdp	0.088925***	-0.012116**	-0.001852	0.040750***
	(0.028)	(0.006)	(0.002)	(0.007)
Pharmacists per 1 mill people	0.005556*	0.058588***	-0.022244***	-0.001212
	(0.003)	(0.009)	(0.003)	(0.002)
PrimaryHealthCenters per 1 mill people	0.022713***	0.002502	-0.007943	0.088330***
	(0.006)	(0.008)	(0.008)	(0.014)
Infant Mortality	0.463763***	0.101972**	0.057418	-0.002099
	(0.086)	(0.044)	(0.053)	(0.005)
HighSchools per 1 mill people	0.020299***	0.026052***	0.011348**	
	(0.006)	(0.004)	(0.005)	
TelephoneService	-0.000013	-0.011856***	-0.004061	0.053236***
	(0.002)	(0.003)	(0.005)	(0.020)
IndustInv	-0.006308***	0.005447***	-0.003871***	0.002579**
	(0.002)	(0.002)	(0.001)	(0.001)
hhi_sales	1.552757***	-0.824892	-0.967380	-0.240908
	(0.571)	(0.652)	(0.813)	(0.676)
Constant	-19.870988***	-5.755957***	0.214471	-14.107599***
	(3.175)	(1.029)	(1.120)	(1.927)
Observations	3,134	2,188	2,604	2,572
R-squared	0.090	0.238	0.116	0.195
Number of panelid	116	125	120	123
State-month FE	Included	Included	Included	Included

Note: This table reports results from the fixed effects analysis which investigates the effects of different socio-economic factors on price difference between the regulated and unregulated formulations of Paracetamol. The analysis includes only companies that produce both formulations of the drug and possess a market share which is higher than 1% of the market. The price variations are studied throughout the four discrete periods described in the paper. The first three periods span the time before regulation, while the fourth period spans the time after the price control regulation was imposed. The main variables of interest are of continuous nature. The dependent variable is a continuous variable as well. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1