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Income Distribution and the Public-Private Mix in Health Care Provision: The Latin American Case

By

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Abstract

Recent literature on Latin-American countries shows that private expenses as a share of the total expenditures in health tend to be higher the lower the level of economic development of the nation. This paper explains this fact by considering a discrete choice model of product differentiation, where consumer choice is based on a price-quality tradeoff. Physicians are involved in a dual-job holding structure, working as agents in the official sector while they maximize profits in a fragmented private sector. The model -which characterizes a significant number of systems within Latin-America-, shows the linkages between consumer choice and physician behavior, and the interaction between public and private systems in the face of external macroeconomic shocks and investments in health. The paper concludes that the lack of incentives in the public sector generates a decline in health coverage. It not only reduces the quality of public services but also generates negative spillovers in the rest of the system, provoking a loss of quality in the entire health care sector. In addition, the model simulates how changes in income distribution affect the selection of quality and prices in the private sector, determining individuals= choices among different providers.

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Introduction

Recent literature on Latin American countries shows that private expenses as a share of total health expenditures tend to be higher the lower a nation=s level of economic development. This paper explains this fact by considering a discrete choice model of product differentiation, where consumer choice is based on a price-quality tradeoff. Physicians are involved in a dual job holding structure, working as agents in the official sector under a fixed wage structure while they maximize profits in a fragmented private sector. The model -- which characterizes a significant number of systems in Latin America and many other developing countries -- shows: (1) the linkages between consumer choice and physician behavior, and (2) the interaction between public and private systems in the face of external macroeconomic shocks and investments in health. The paper concludes that the lack of incentives in the public sector generates a decline in health coverage. It not only reduces the quality of public services but also generates negative spillovers in the rest of the system, provoking a loss of quality in the entire health care sector. In addition, the model simulates how changes in income distribution affect the selection of quality and prices in the private sector, determining individuals= choices among different providers.

Health care systems in Latin American and Caribbean countries exhibit many structures with different abilities -- or inabilities -- to expand health care coverage, increase health care outputs, improve health outcomes,[1] and enhance quality and efficiency. Recent efforts have sought to understand not only the characteristics of these systems, in terms of comparative public and private expenditures and outcomes within the region,[2] but also the way they are organized, the relationship and coordination among providers, and consumers= ability to find appropriate coverage.[3] This work is attempt to apply industrial organization theory to the analysis of health care markets. Industrial organization theory is important in this context because it helps explain the behavior of consumers and physicians within the prevailing incentives structure in most Latin American and Caribbean countries.

In the following pages a simple model is introduced. It contains the main features of a significant number of health care systems in Latin American and Caribbean countries. These systems are characterized by a public sector payment structure that uses fixed wages, and where physicians work as agents in the official sector at the same time that they act in the private sector as profit maximizers. The private market is deeply fragmented, and insurance mechanisms are poor or nonexistent. This structure facilitates physicians= ability to discriminate among consumers based on ability to pay. The model shows the linkages between

[1] Health care outputs are defined as those indicators that reflect the performance of the health care system in terms of services provided, such as immunization, professional birth attendance, and coverage. Health outcomes are the effects of these services plus a broad range of factors in addition to the effectiveness of the health care structure itself. Outcome measures include infant mortality, life expectancy, mortality rate for children under five.

[2] Govindaraj, Murray and Chellaraj (1995) and Suarez, Henderson, Barillas and Vieira (1995).

[3] See Inter-American Development Bank (1996) and Maceira (1996), for comparisons across countries.

consumers choice and physicians= behavior, and the interaction between public and private systems in the face of external shocks factors as macroeconomic performance and fluctuations in health care investments.

Sections one and two provide a brief discussion of the background literature and show the main differences among health care systems across the region. They also introduce the framework within which the present model is applied and describe those cases where the proposed structure holds.

In section three, the model is developed. In this model, the population of a country chooses between public and private provision, or no provision at all (home solution). The choice is based on a price-quality tradeoff. Physicians decide the characteristics of the services they provide in the private sphere of the market. They are able to set prices by discriminating among consumers according to their income, simplified in the model as Ahigh@ and Alow@ income types. The physicians also choose the quality of public services, as a function of a public price and the presence of external shocks such as budget constraints, inflation, etc.

The purpose of this paper is to define the threshold between public and private coverage by solving the model backwards. First, consumers= choices are analyzed to find the marginal patients who are indifferent to the type of services (non-formal care vs. public health care and public-private health care). Given those preferences, the physicians maximize their profits in the private sector by setting prices and quality. Finally, the physicians decide how much effort to provide in the public sector, given the public payment structure and exogenous constraints.

The analysis is completed by finding the critical values for the two extremes of the distribution: the level of income of the marginal consumer between non-formal health coverage and public coverage (Y_0), and the price paid by consumers in the private Ahigh income@ sector (p_h).

The fourth section of the paper simulates the findings of the model by considering both a uniform and a lognormal distribution of population in terms of income. The uniform distribution shows the effects of a mixed public-private health care system in terms of price and quality levels. The lognormal distribution mirrors the same results under more realistic income distributions. Then, simulations show how physicians= behavior defines population choice among different providers, as well as the importance that incentives in one area of the market have upon the others.

The last section contrasts the results obtained in the model with the conclusions found in the comparative literature on the Latin American and Caribbean health care market. The model helps to explain why patients prefer public inpatient and private outpatient care under current conditions and why private health care expenditures have been increasing as a share of total health expenditures, especially in relatively less developed countries in the region.

1. Background Discussion

Latin American and Caribbean countries vary a great deal in terms of health care indicators, as well as in health expenditures per capita. Both types of variables are highly correlated to the GDP per capita of each nation.[4] At the same time, even though there are several similarities in the structure of incentives on the supply side, strong differences in the organization of health care provision are found among countries. According to the Inter-American Development Bank (1996), and using data from Suarez et al. (1995) and Govindaraj et al. (1995), several observed empirical facts have to be taken into account in order to understand the structure of these markets[5]:

- The private health sector in Latin American and Caribbean (LAC) countries is important in the provision of health care.
- The structure of incentives in the public health sector is weak (e.g., workers are not paid according to their efforts, hospital directors are not free to fill vacant posts).
- In general, physicians work in public and private facilities at the same time.
- In 17 out of 26 countries, direct out-of-pocket payment is the main mechanism for contracting private services.
- In almost all countries, the share of population seeking inpatient services in the public sector is much higher than in the private sector. The proportions are reversed for outpatient care.
- In poorer countries, where public expenditures in health are low and there are poorer health outcomes, the private health care sector has higher shares of GDP than the public sphere.

- By 1990, four different blocks of countries could be identified in terms of organization:

* The **Contract Intensive Block** (Argentina, Chile, Uruguay) is characterized by high rates of health care coverage, where the public sector acts as provider of last resort. The private sector is organized mainly under health insurance structures. This block invests a high percentage of GDP in health, and spends relatively more than the rest of the region in terms of international dollars per capita. Health outputs and outcomes are also above regional standards.

[4] World Bank (1993); Murray, Govindaraj, and Musgrove (1994).

[5] Table 1.1. summarizes the main elements of LAC's health care systems.

* **Public Subcontractor Structure**: Brazil is the only country in the region where publicly

financed services are provided mainly by private -subcontracted- suppliers. A significant share of its population is without health care coverage, and its health care outputs and expenditures are above the region=s standards. Health insurance is developing rapidly in the private sector.

* The **Public Integrated Block** (The Bahamas, Barbados, Trinidad and Tobago, Jamaica, Costa Rica) has high levels of both health expenditures and outputs. The public sector dominates the market, while the private sector is atomistic and covers a relatively small share of the population.

* The **Segmented Block** (the rest of the countries): In this group, the public sector and the social security system (SSS) seek to provide services for a broad segment of the population. However, the effective coverage is low, and private suppliers are increasing their share of the market. In general, there is no coordination between public and SSS facilities -- with the exception in Mexico and Panama -- although both systems are financed by public funds. With the exception of Venezuela, Suriname, and the Dominican Republic -- where an increasing share of the population is covered by health insurance contracted by firms -- the private sector is highly atomistic.

The model introduced in the next section assumes the existence of a private fee-for-service atomistic market, where physicians are able to discriminate among consumers based on ability to pay. The public sector and the social security system are considered to be unified for the purpose of simplification. The structure of the model is relevant to a vast group of countries in the region, including Haiti, Guatemala, Honduras, El Salvador, Belize, Nicaragua, Peru, Bolivia, Paraguay, Ecuador, and Guyana, all of them belonging to the Segmented Block; and Costa Rica, The Bahamas, Barbados, and Trinidad and Tobago, from the Public Integrated Block.

The lack of a defined relationship in the model between the public sector and the social security system reduces its power to explain the cases of Mexico and Panama, although the general conclusions can be applied to these two nations. Introducing a health insurance base for the private sector and minor additional modifications would be necessary to extend the model to the cases of Argentina, Brazil, Chile, Colombia, and Uruguay. The health care systems of Venezuela, Suriname, Dominican Republic, and Jamaica are combinations of the present model and one that would consider health insurance in the private sector.

Although it mirrors the main features of many of LAC=s health care systems, the model does not cover several topics. First, the model does not distinguish between preventive and curative medical assistance and the resulting impact on cost-effectiveness. Second, it considers actual incentive structures, but not changes in incentive mechanisms. It is known that differences in who provides and finances health services, and in the way that payment structures are implemented affect the quality and costs of provision. While the focus on the paper is not the structure of the contracts, this would be fertile ground for future research.

2. Literature Review

In a market where quality is homogeneous among all its products, consumer choice is based on price: all consumers will buy the cheapest service offered. As soon as a higher quality product is introduced into the market, consumers= choices will differ based on their preferences for quality and their ability to pay. As a consequence, each producer will choose for his/her production the combination of price and quality that allows him/her to acheve the highest profits. The industrial organization literature includes several analysis of this issue, related mainly to discrete choice models of product differentiation (e.g., Gabszewicz and Thisse 1979, Shaked and Sutton 1982, Choi and Shin 1992, Beath and Katsoulacos 1991). The model in this paper is based on that literature. I introduce a model with vertical product differentiation,[6] where consumer choice is the result of a tradeoff between price and quality: according to their level of income, patients decide the price they will pay and the quality of service they will seek given that price.

In their article, Shaked and Sutton (1982) represent the population as uniformly distributed along a linear city such that the customer with the lowest income is located at one extreme, and the one with the highest income is found at the other end. The authors depart from a scenario where each firm, after choosing whether or not to enter the industry, offers a good with different quality. The ranking of relative qualities is known by the population. As in other linear city models, the solution is focused on the location along the income distribution of the marginal consumer, who is indifferent between each pair of different products. The marginal consumer (as defined in the industrial organization literature) stands at the threshold between the group that demands a certain combination of price-quality for the good, from a second group that pays a higher price in order to have access to better quality. Shaked and Sutton (1982) focus their analysis on the optimal number of competitors that are able to survive under these conditions.

Using the same framework, Choi and Shin (1992) analyze the case where the decision about quality is taken sequentially among two firms, such that the second firm observes the choice made by the first before deciding. In a third step, both firms define their prices.

The case introduced here has the particularity that suppliers (in this case, physicians) choose price and quality in the private sector, given a price and a quality defined in the public sector, where they also participate as agents. In addition, I compare the outputs of the

[6] Vertical product differentiation is defined in the following way: AGiven two distinct products, if they were sold at the same price, then all consumers could choose the same one (the highest quality product)@ (Shacked and Sutton 1987). The observed heterogeneity among products differentiates this kind of market from ones in which horizontal product differentiation prevails, where choices are triggered by differences in prices.

problem (public-private health care coverages) by introducing different income distributions.

The literature on health economics acknowledges the existence of dual job holding by physicians. This phenomenon is present not only in developing countries but also in developed nations. There are basically two reasons why physicians work in the public (or private) sector as employees and at the same time have their own practice. The first is the assurance of a basic wage (generally fixed) at the first job at the same time they obtain additional income through complementary efforts in their private practice. This argument is supported by research about the shape of the physicians= supply curve (Eastaugh 1992, McGuire and Pauly 1991, among others).

The second reason for dual job holding is the positive spillovers obtained by such practice. By working in a hospital, physicians have the opportunity to Ahunt@ patients who can ask for additional private care, due to reputation or self-referrals. In addition, hospital networks facilitate cross referrals among doctors. Chawla (1996) analyzes dual job holding by introducing a model of time allocation among practices. That study focuses on the generation of spillovers across jobs and subsequent time allocation, which are tested for the Indian case.

Finally, Glazer and McGuire (1993) study specific issues related to dual jobs in health care markets. The article introduces the case where the insurer (possibly the government) pays a fee for each procedure, and allows the doctor to charge a supplementary fee, a practice known as balance billing. Given this structure, physicians are able to discriminate among patients based on price and quality. The authors conclude that when price discrimination is permitted, and under certain conditions for fee determination, quality is set at a higher level for all patients, and not only for the ones who pay the supplementary price.

This finding is extremely important for policy design. As will be shown in this paper, similar effects can be found in the Latin American context, although these are limited given the different style of public-private payment mechanisms. In Latin America, spillovers in quality are found only by changes in public quality, which are independent of the fee policy. However, simulations for different income parameters allow us to recognize the effects of changes in prices and quality according to alternative income distributions.

3. An Explanatory Model

3.1. Structure

The Government, through its health authority, defines the payment structure in the public sector as a fixed wage for all physicians, independent of the number of services provided. No reward is given due to improvements in productivity and there is no relation with outputs.

Given that structure, and considering external shocks -- such as changes in general

prices and public budgetary constraints -- physicians set the quality of public services through their effort level (q_u). Once the quality in the public sector is defined, physicians, as private profit maximizers, decide the price and quality they will charge in the private sector. Finally, consumers choose whether they will ask for health care or not. If they do, they will select according to their preferences between public and private provision. The model is solved backwards. First, consumers' choices are analyzed, and three consumers are identified. They are the ones who are indifferent in choosing among different types of services. Once these marginal consumers are found, health care markets can be partitioned among providers. Then physicians decide the price and the quality they will offer in the private sector, given the public quality, which is defined by the public sector payment structure and external factors.

3.2. Assumptions

The model uses the following assumptions for simplicity:

A1- Each consumer buys, at most, one unit of health care. It rules out the possibilityof over-consumption beyond the first unit. The results can be extended to relax this assumption without substantively altering the conclusions (see Appendix 1.a.).

A2- Health care services are effective with certainty.

A3- Physicians discriminate between two groups of patients, charging high prices to one group and low prices to another. It is known that physicians in atomistic markets are able to discriminate prices according to patients' characteristics. For simplicity, it is assumed that there are just two groups of patients distinguished by their income level. There is an income threshold, Y_h, which separates the two groups of consumers. As physicians maximize their profits in the private sector, price discrimination is the strategy they follow, given that they know income level Y_h.

A4- Physicians maximize profits in the private sector by splitting monopoly profits, such that$p^i = p_m/n$, where n is the number of physicians (see Appendix 1.b.).

3.3. Consumer Choice

Consumers' preferences are defined according to the utility function

$$U(Y, k) = q_k (Y - p_k) \qquad (1)$$

where q_k : is the quality of services in sector k, and is positively associated with effort;
p_k : is the price of services in sector k;
Y : is the consumer's income level;

and k = u public sector provision;
l private sector, low-price provision;
h private sector, high-price provision;
0 no consumption.

Consumers are indifferent between goods k and k-1 if

$$U(Y, k) = U(Y, k-1)$$

which results in

$$q_k (Y - p_k) = q_{k-1} (Y - p_{k-1})$$

Interest is focused on three specific consumers. They are the ones who are indifferent between the consumption of health care from different sources.

The first marginal consumer is indifferent between consuming public health services, with price p_u (exogenous to the model) and quality q_u, and not consuming at all in health care facilities, with associated quality q_0 and price p_0. This consumer will have an income level of Y_0. The choices are represented by:

$$q_0 (Y - p_0) = q_u (Y - p_u) \quad (2)$$

The second marginal consumer is the one whose preferences are:

$$q_l (Y - p_l) = q_u (Y - p_u) \quad (3)$$

The consumer with income Y_l will be indifferent between consuming health care in the low-price private sector, with quality q_l and paying p_l, or receiving lower quality care, q_u, associated with a lower price, p_u, in the public sector. Finally, there is a third consumer who is indifferent between the Ahigh income@ private sector and the public sector. His/her preferences are represented by:

$$q_l (Y - p_h) = q_u (Y - p_u) \quad (4)$$

Note that in equation 4, the first term has q_l because the private consumers of both types will receive the same quality of care although the lower income consumer will pay less than the high income consumer. That is why there is no possibility of a consumer choosing between low and high-priced private care; physicians are the ones who discriminate among patients.[7]

Figure 1 shows the distribution of these indifference points. Consumers are ordered on the horizontal axis according to income level, and the resulting utilities are shown on the vertical axis. The intersections between U (Y, u) and U (Y , 0), and U (Y , L) and U (Y , H), respectively, show the indifferent consumers defined by (2), (3), and (4), named Y_0, Y_L , and Y_H , along the income axis.

Figure 2 shows the distribution of consumers between providers given a lognormal density function f (Y) and considering the marginal consumers already found. The distribution indicates the existence of a higher concentration of consumers in low and medium ranges of income, as well as a smaller population with high income levels. People located between 0 and Y_0 will receive no professional provision, while consumers between Y_0 and infinity do demand health care services, distributed between public health care -- from Y_0 to Y_l, private low price health care -- from Y_l and Y_h , and private high-price health care -- from Y_h on.

Section 4 will show the results of simulating the model, not only under a uniform distribution, which arises from the equations presented in this section, but also under a lognormal distribution. In that case, several means and standard deviations are considered, representing different income distributions. A higher mean is associated with a higher GDP per capita, while greater standard deviations represent less equitable societies. Before turning to the simulation, however, it is useful to analyze the structure of the model so as to better understand how behavior in the different segments affects outcomes.

3.4. Physicians Behavior and the Private Sector. Strategy in the Private Low-price Sector.

Sections 3.4 and 3.5 will study consumer choice between public and private low health care, based on physicians' behavior. That is, the behavior of the physicians in terms of quality and price will determine the marginal consumer (in terms of income). The point at which this choice is made is the focus of this paper. Section 3.6.1 and 3.6.2 explain the choices available to consumers at the extremes of the income distribution (out of the health care system and private high income).

Physicians play a double role in the provision of health care in LAC countries. They

[7] Compare with some other systems where consumers self select by choosing cheaper or more expensive health care plans.

Figure 1

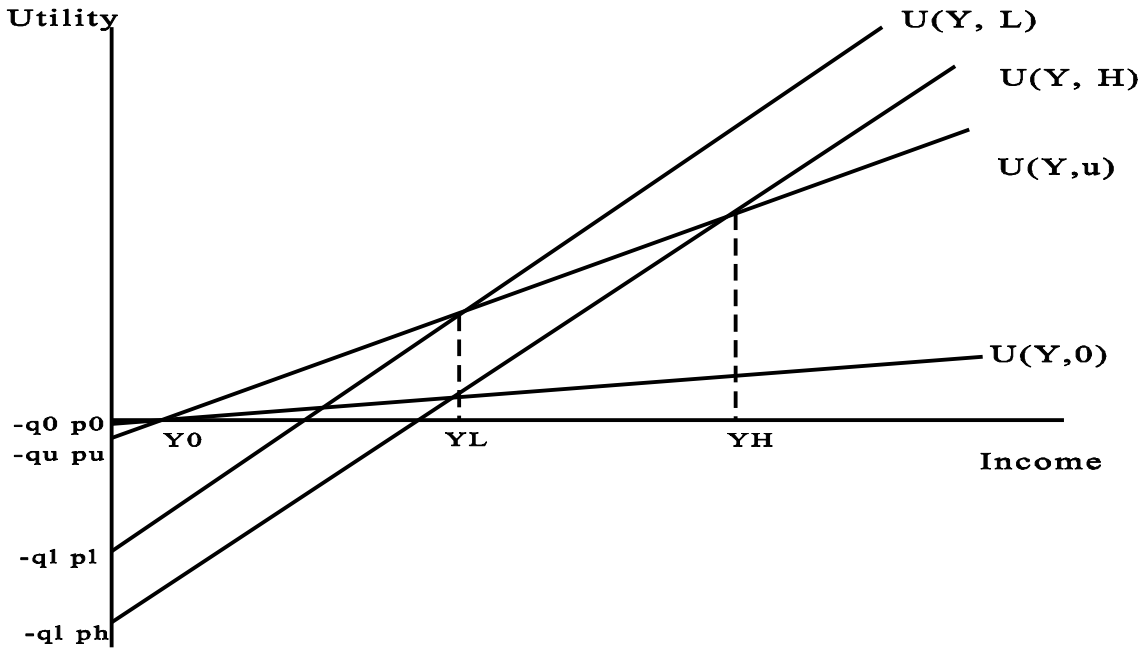
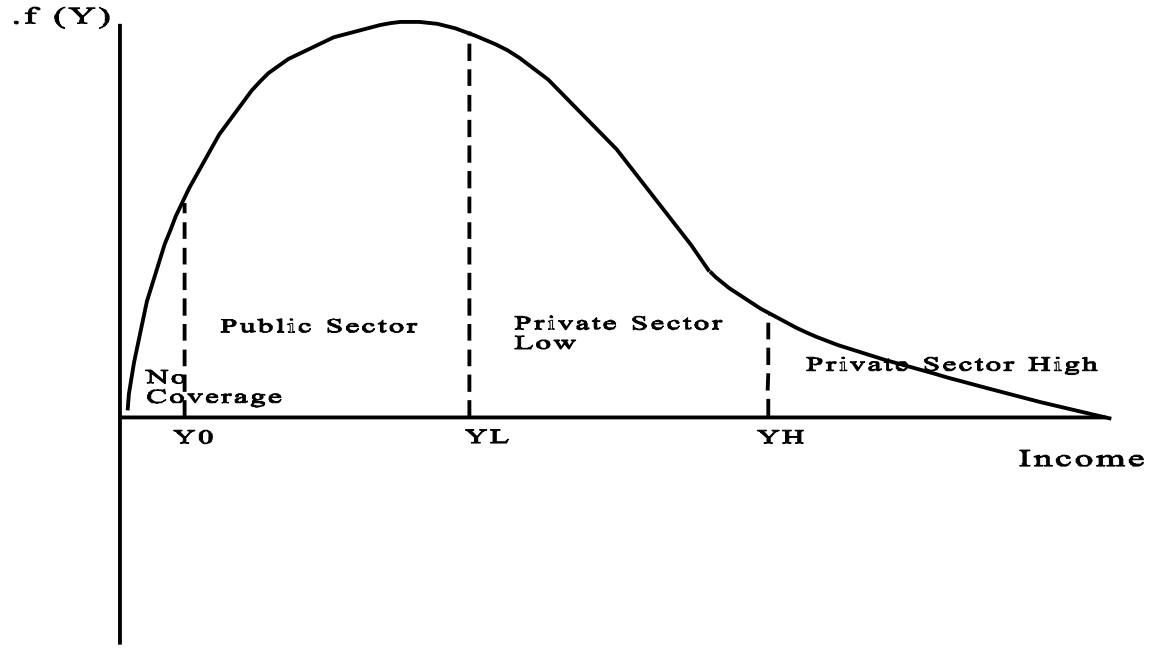


Figure 2



supply services for a fixed payment in the public sector and they provide services in the

private sector of the market, not only in their own clinics and offices, but also in public facilities. Accordingly, the quality in public and private facilities, as well as the prices charged in the private sector, are linked to each other.

Given consumers' choices, physicians in the private low-price sector select the price and quality they will offer in this range of the market.

Physicians will maximize a profit function

$$p_l = (p_l - q_l)\,(Y_h - Y_l) \qquad (5)$$

where the unit cost of producing a quality q_l is normalized to one. For simplicity, a uniform income distribution is assumed, but this assumption is relaxed in the following section.

Y_h is assumed to be fixed, and reflects the known threshold between high and low-income consumers. On the other hand, Y_l depends on price and quality decisions in the public and private low-price sectors. Given (3), Y_l will be:

$$Y_l = \frac{(\,p_l\,q_l - p_u\,q_u^*\,)}{(\,q_l - q_u^*\,)} \qquad (6)$$

where q_l and p_l : are chosen by physicians in this stage,
q_u : is chosen by physicians in the public sector, and
p_u : is exogenous.

Replacing (6) into (5) and taking first order conditions, the physicians' strategy in equilibrium for the private low income sector $[p_l^*(q_u^*\, p_u)\,,\, q_l(q_u^*,\, p_u)]$ is given by

$$p_l^*(q_u^*, p_u, q_l^*) = \frac{1}{2}\left[\, Y_h\left(\frac{q_l^* - q_u^*}{q_l^*}\right) + \left(\, p_u\,\frac{q_u^*}{q_l^*} - q_l^*\right)\right] \qquad (7)$$

and

$$q_l^*(q_u^*, p_u, p_l^*) = q_u^* + \sqrt{\frac{(\,p_l^* - p_u)\,q_u^*(\,p_l^* - q_u^*\,)}{Y_h - p_l^*}} \qquad (8)$$

Equation (7) shows the optimal price

in the private low sector, evaluated at the optimal private and public quality. This price is an average of two factors. The first is the product of the upper bound customer=s income (Y_h) multiplied by the increment of quality in the private low sector. This product can be seen as the amount of quality added to the system by the private sector. The second factor is the difference between the dissatisfaction with public provision (seen as the relation q_u/q_l), valued in terms of the public price, and the cost of receiving private quality. This factor can be seen as the opportunity for a markup that consumers will accept.

This price equation is similar to the ones found in the literature on market structures in general. Price is a function of the marginal cost (of higher quality) and of the markup (defined by the consumer=s willingness to pay for higher quality).

Equation (8) also has a straightforward interpretation. The quality provided by private health care is equal to the public quality at the optimal level plus an additional factor, which is positive. This formulation ensures the existence of a private sector. In addition, this factor is a function of three elements: the reference effort level (q_u), the monetary earnings per unit of quality supplied ($p_l - p_u$), and the maximum level of the markup ($p_l^* - q_u^*$) when, in the margin, $q_u = q_l$.

These three factors are weighted by the available income after health care expenditures of the richest patient, which is in the denominator of equation (8). To some extent, the denominator is a measure of demand. Two explanations can be suggested. The first is that the effort of physicians in the private sector is inversely related to the units of health care to be provided. This explanation follows the argument of a tradeoff between income and effort supported by the literature. An alternative view is that higher market power allows physicians to reduce their costs (quality). As the model considers a private sector behaving monopolistically, the inverse relationship between quality and a measure of demand is a signal of market power.

Given the characteristics of equations (7) and (8) , it is not possible to obtain definite analytical solutions by substituting one into the other.[8] However, by total differentiation, it is feasible to define how q_l and p_l react to changes in q_u. Results show[9] that changes in public quality affect private quality positively and private prices negatively. Simulations in Section

[8] Second order conditions to ensure the presence of local maxima were performed and are included in Appendix 2. These conditions require known specific relations between endogenous and exogenous variables that can be found by simulating the model. Section 4 shows the results of simulations by using both uniform and lognormal distributions. The results were replaced in the second order condition, confirming that the Hessian is negative definite.

[9] See Appendix 3.

4 show that this condition holds in all cases.

Equations (7) and (8) introduce the solution of the model as a result of the interaction between consumers and physicians in the private sector, subject to the quality decision in the public sphere. The price-quality tradeoff between public and private low-price sectors will define the income level of the consumer who will be indifferent between the two types of services.

3.5. Public Sector

The last step considers the choice of effort that physicians make in the public sector in order to maximize their profits. This decision incorporates the solution reached in the prior steps. In all possible cases, given the payment structure in the public sector, the solution for q_u is trivial: q_u=0. This can be seen by looking at the solution to maximizing the following profit function:

$$p_u = w - q_u \left(Y_l \left[p_u, q_u, p_l^{*}, q_l^{*} \right] - Y_0\right) \qquad (9)$$

where w is the fixed wage paid by the health authority, independent of the level of quality and the number of patients in the public sector.

However, there are several restrictions on doctors' decisions in the public sphere of the market. They are associated mainly with two factors:

(1) solidarity or moral effects in provision such that physicians provide a certain minimum quality of service, which can be introduced by a lower bound, m; and

(2) a control/monitoring constraint, x, which can be defined as a function of exogenous variables such as budgetary reductions, inflation, etc. External shocks could reduce the effectiveness of monitoring physicians and hence result in lower quality services. A possible function for this relationship is:

$$q_u = \begin{cases} m, & if \quad x > x^{*} \\ f[g(x)], & if \quad x < x^{*} \end{cases} \qquad (10)$$

where $g(x) = e^{-x}$, and $q_u = sg(x)$, with s a constant rate of controlling effectiveness.

As it was mentioned before, the signs $\partial q_l/\partial q_u$ and $\partial p_l/\partial q_u$ are tied to the value of the parameters.

3.6. Population Located at the Extremes of the Distribution

Even when the Y_1 (public-private) threshold constitutes the main issue under analysis, two other additional aspects have to be considered. They are: (1) the threshold between the population supplied by the public sector those without coverage (Y_0); and (2) the price defined in the private high income sector.

3.6.1. Population Outside the System

Y_0 is obtained from equation (2):

$$q_0 (Y - p_0) = q_u (Y - p_u)$$

and assuming p_0 to be close to zero,

$$Y_0 = \frac{q_u \; p_u}{q_u - q_0}$$

(11)

where the variation of Y_0 in terms of q_u is given by:

$$\frac{\partial Y_0}{\partial q_u} = \frac{p_u (q_u - q_0) - q_u p_u}{(q_u - q_0)^2}$$

$$\frac{\partial Y_0}{\partial q_u} = \frac{- q_u p_u}{(q_u - q_0)^2} < 0 \qquad (12)$$

The higher the quality in the public sector the lower the threshold between those outside of the system and public provision, thus increasing the share of population that receives health care in the formal sector.

3.6.2. Private Sector High-price

On the other extreme of the distribution, and according to equation (4), the price decision is the following:

$$q_l\,(Y_h - p_h) = q_u\,(Y_h - p_u)$$

which, in terms of p_h is:

$$p_h^* = \left[\frac{q_l^* - q_u^*}{q_l^*}\right] Y_h + \left(\frac{q_u^*}{q_i^*}\right) p_u \qquad (13)$$

where the first term on the right side reflects the income effect weighted by differences in quality, while the second term shows the substitution effect in terms of the ratio of service quality between public and private services. By substituting (7) and (8) in (13), the solution for p_h can be expressed as a function of q_u.

4. Simulations and Results

The analytical results obtained in section 3 and in Appendixes 2 and 3 show that under certain conditions, improvements in public quality positively affect private quality and negatively affect private prices. According to the model, physicians in the public sector define the level of quality in public facilities based on altruistic behavior and the ability of the public financier to monitor their efforts, which are negatively associated with external factors such as budgetary constraints. Public quality-s direct and indirect effects on private quality and private prices act in opposite directions (see Appendix 3), such that the net effect depends on the magnitude of the variables. This section is devoted to showing how these effects interact, by simulating the conditions introduced in the model. The model, as noted before, considers the consumers uniformly distributed along the income ladder. This assumption makes it easier to understand the relationship between dependent and exogenous variables, net of distributional effects. However, the inclusion of different scenarios in terms of income distribution may help understand the impact of equity on the provision of health care services.

Therefore, the simulations were performed for two different scenarios, which belong to alternative demand functions. Each of them refers to two main income distributions. The first belongs to the case introduced in section 3, the uniform distribution, such that the physicians' profit function to be maximized takes the form:

$$p_l = (p_l - cq_l)\,(Y_h - Y_l) \qquad (5)$$

where $(Y_h - Y_l)$ is the demand of a population that has uniformly distributed income.

The second function replaces the uniform demand function to allow different densities for each level of income. In order to replicate the distribution introduced in Figure 2, a lognormal form was used for simulation purposes:

$$p_l = (p_l - c\,q_l) \int_{Y_l}^{Y_h} f(p_u, q_u, m, s)$$

(14)

where s is positively related to the level of inequity in the distribution of income and μ is a measure of average income per capita. In both cases,

$$Y_l = \frac{(p_l\,q_l - p_u\,q_u)}{(q_l - q_u)} \qquad (6)$$

4.1. Uniform Distribution

The simulations performed for the model under the uniform income distribution show that increasing quality in public sector services has positive spillovers on private sector quality, confirming that direct effects more than offset indirect effects through private prices. The need to differentiate products between the public and private sectors, and the almost zero price that patients pay for public services, push up the quality in private facilities when public performance improves. This trend was found for different levels of public prices (Chart 4.1. right). However, private quality seems to improve by progressively smaller increments as

public quality improves.

The effects on private prices due to changes in public quality (Chart 4.1. left) are not homogeneous, depending on the levels of q_u. Even when in all cases there is a negative correlation between the two variables when direct effects offset indirect ones, if the quality in the public sector is low, the change in private price is negative and stronger than at higher levels of public quality. A possible explanation for that difference in price reaction is that at low levels of public performance patients perceive poor enough public quality to prefer paying higher prices to get relatively better quality. Therefore, at low levels of public performance, quality differences prevail over price differences from the patients' point of view. As long as the quality in public provision becomes better, the profitability in the private sector falls.

At the same time, public prices (assumed here to be transportation costs or low fees in public facilities) affect the relationship between public quality and private price in the expected way: given identical changes in public quality, the lower p_u the sooner is the fall in private prices. Considering the price-quality tradeoff between public and private facilities, the lower the price in public facilities, the higher the patients= acceptance of lower quality in public services in regard to pushing the private market to be more competitive with the public sector.

The structure of constraints in the public sector, the obtained results show that higher levels of public deficit and budget cuts in health care provoke looser control over public outputs, thereby reducing the quality of public provision. This in turn reduces the incentive to raise quality in the private sector, because physicians will receive private patients with minimum additional effort. As a result, the social health status falls as a whole.

Likewise, the more physicians identify with social needs the more the performance of the entire health care sector improves, not only in the public segment but also in the private one. This linkage explains the tradeoff between social preferences and profit goals in the physicians' function. The altruistic motive, reflected by the lower bound *m* in public quality, raises the quality of the private sector, reducing doctors' private profit (Table 4.1. and Chart 4.2. right).

The income of the marginal consumer located between the public sector and the private low-price sector, Y_l, is defined as the result of prices and qualities in both, the public and private systems (equation 6). Chart 4.2. (left) shows that Y_l moves up the income ladder as soon as quality in the public sector improves, which means higher demand for health care in public facilities. This movement in the public-private threshold suggests that the influence of q_u on consumers= choice of quality among systems prevails over the price reduction in the private low-price sector. However, the marginal change in the threshold is not proportional to the rise in public quality. Such change is sensitive to the level of prices in public provision. At lower levels of public quality, the response is higher when public prices are higher. On the other hand, the marginal variation in Y_l due to changes in public prices diminishes in relative terms when public facilities offer higher quality. To sum up, even when the choice of

provision seems to be driven by quality, the magnitude of the change in the public-private threshold is determined by a price effect. Table 4.1. shows the transition as percentage of the private low-price sector-s coverage, and for different levels of Y_h.

At the limit, if q_u is high enough, price and quality in the private low-price sector tend slowly to converge, leaving zero profits to the private provision in this segment of the market. Therefore, no incentives would be offered to supply private services, Y_l would match Y_h, and the public sector would supply the entire range of population between Y_0 and Y_h. This picture might represent the case of the *Public Integrated Block* of countries described in section 1. There, public provision covers a large percentage of the population, leaving private provision to a small group of high-income consumers.

Charts 4.1. and 4.2.
File: unisoc.wk4
Location: P1348...X1428
Position: vertical

Table 4.1.
File: unisoc.wk4
Location: P1429...X1460
Position: Vertical

4.2.Lognormal Distribution

The lognormal distribution analysis is introduced in order to look in depth at the relationship between income distribution and the public-private mix in health care provision. The choice of the lognormal distribution is based on its similarities to the allocation of income among a country=s population: it suggests a significantly lower share of people with higher levels of income, at the same time that the majority of the population is concentrated in low and middle-low income segments. As is shown in this section, the country income level, as well as its distribution affect in how changes in public quality and prices influence private health care. Therefore, not only the distribution of consumers among systems but also the level of private profits are subject to distributional characteristics, thus affecting the impact of any publicquality enhancement.

As in the case of the uniform distribution, the simulations were performed for a set of public prices and qualities and for different levels of Y_h. In addition, three different means and standard deviations were taken into account. The mean is seen as the GDP per capita of the country, such that higher µ mirrors (on average) a richer nation. The standard deviation represents the degree of inequality in income distribution, where s grows with inequality.[10]

The simulations comprised a group of nine different Asocieties@ in terms of income distribution, each one for every level of Y_h, and a set of sixty-five combinations of prices and qualities in the public sector. Iterative exercises were performed to find the maximum solution for each combination, given that the endogenous variables q_l and p_l are present in Y_l, one of the extremes of the integral (equation 14). A selection of the results is presented in Charts 4.3. - 4.6. and in tables 4.2 and 4.3.

Chart 4.3. (left) shows private price and quality reactions to public quality for four income distributions. The reactions are defined at a high level of Y_h, which is the upper bound of the demand in the low-price market. Obviously, higher means are associated with higher price levels. However, changes in private price, as a consequence of increments in public quality, are associated with the standard deviation: societies with more equitable distributions observe lower prices in the private sector as a response to increments of public quality,while in the high sigma cases the prices go up in response to the same public quality behavior.

In other words, and based on (A.1) in Appendix 3, when a society is more equitable the quality effect on prices (indirect effect) is stronger that the pure price effect. When societies are less equitable, the segmentation in health care provision among systems is stronger, allowing physicians to charge more for their services in the private sector.

[10] Given the characteristics of the lognormal distribution, no analytical results can be found for q_u and p_u without numerical experimentation.

In terms of private quality reactions to public improvements in provision (Chart 4.3. right), simulations suggest that direct effects always offset indirect effects through prices as was observed in the uniform distribution case. Therefore, rises in public quality enhance private quality for any income distribution. In all cases, the impact diminishes in magnitude when public quality goes up (decreasing spillovers). However, simulations show that richer societies (higher μ) are more responsive to changes in public quality than are poor ones, and that the degree of inequity reduces such impact across systems.

Results are not the same when we analyze the same reactions for a lower Y_h (Chart 4.4.). A lower level of Y_h represents a smaller demand in the low-price market for any μ and s. It represents a measure of market size, as was defined in equation (8). The simulations show that in this case, the net result of direct and indirect effects on prices varies according to the level of income inequality. Price is relatively less responsive to public quality and in general follows the opposite direction, as it was seen in the case with population distributed uniformly.[11] In addition, even when richer societies are still charged with higher prices, standard deviations are linked with two different phenomena: at low income levels, the price behavior replicates the one discussed before. However, at relative higher μ more egalitarian societies are charged higher than less equitable ones. A possible explanation is that the smaller size of the market pushes physicians to price private services higher in more equitable cases, where it is more probable to capture patients.

At low levels of Y_h (Chart 4.4., right), the private quality reaction to public quality is the one expected (positive), and the quality gap among services is smaller than in the high Y_h case. However, the private quality response is relatively stronger in this case, which shows that when markets are smaller, suppliers have more incentives to differentiate their products from the ones provided in the public system. This response was observed in section 3, when optimum private quality conditions were analyzed (equation 8)-.

Chart 4.5. (left) shows how the observed private responses to public behavior affect the outcomes of the health care system. In all cases, the threshold between public and private coverage rises with public quality. In line with the reactions discussed before, in more equitable societies, where private prices decrease with public quality, the threshold=s reaction is small, and it is stronger when the reaction of private prices is the opposite. The conclusion is that even when there is a tradeoff between costs and performance of health care services, the quality affects more consumers= preferences than prices, which matches the results observed under the uniform distribution. At smaller market sizes -- smaller Y_h -- the public-private threshold shows a positive trend in reaction to public quality (Chart 4.5., left), although the cost-quality tradeoff is ambiguous at low levels of public quality.

[11] Private price reactions to public quality appear to be more insensitive in this case than in the prior ones. Even when this is true relative to a higher Y_h case, these results are probably influenced by the iteratively method used to solve the model.

Charts 4.3 / 4.4.
File: LGN-T2.wk4
Location: AA1...AK70
Position: Vertical

Charts 4.5 / 4.6.
File: LGN-T2.wk4
Location: AA71...AK140
Position: Vertical

Table 4.2.(a), (b) and (c).
File: LGN-T11.wk4
Location: B1...AE37
Position: Horizontal

Table 4.3.
File: LGN-T11.wk4
Location: AH1...AR47
Position: Vertical

Finally, relatively poorer societies are associated with lower levels of physicians' profits (Chart 4.5., right), which decrease with increments in public quality. This drop is even more drastic at smaller market sizes (Chart 4.6., right), resembling the uniform distribution example. Here an interesting issue arises: in countries with lower demand, the cutoff in profits is given by the dispersion in income distribution rather than by the mean, such that more equitable societies give more profits to physicians, who choose the price-quality combination to supply according to the average income. This explanation completes the analysis of private price reactions to public quality introduced in Chart 4.3.

A more detailed look at the effects of income distribution on health care outputs is introduced in tables 4.2.(a), (b), and (c), and Table 4.3. These tables summarize the main outcomes of the model for different combinations of income distribution, demand size, and public quality and prices. The first two tables amplify the information already shown, confirming the analysis introduced before within a wider range of values for the parameters, while Table 4.3. displays a range of gaps in price and quality among services for a set of income distributions and market sizes.

As analyzed throughout the paper, different price and quality responses in the private sector reflect different tradeoffs that suppliers take into account to maximize their participation in the private low-price system. Therefore, the private sector market share is the result of the interaction of public incentives, physicians' responses, and consumers' choices under different levels and distributions of national income. Table 4.2.(c) shows the private low- price share of the market by income distribution when public quality changes, and for different levels of public prices. The table reinforces the hypothesis in the first section of this paper: lower quality in the public sector provokes a shift of consumers toward private facilities. In addition, poor and small-sized societies tend to develop a higher private share in the coverage of health care services, while rich and bigger ones show the opposite trend. Finally, the degree of income inequality negatively affects the development of the private low-price sector.

5.Conclusions

The paper shows the outcome of decisions taken by consumers and physicians under the conditions prevailing in a significant number of Latin American and Caribbean countries. It demonstrates how fixed payment rules in the public sector and physicians' double jobs affect the performance of health services in these countries, as well as the distribution of patients among different types of providers. Based on a simple price-quality tradeoff in health care services, doctors maximize their profits in every area in which they act, conditioned by external shocks and the income distribution of the population, and subject to their willingness to behave altruistically toward the population's needs.

The paper also supports two of the main observations presented in the literature: first, countries with greater budget constraints in the health sector generate lower quality outputs

in the public sector, leaving increasing proportions of the population without coverage -- in the left side of the income distribution -- and, by default, creating an atomistic and broadened private sector that covers many consumers' needs.

Second, the model shows why consumers prefer outpatient supply in the private sector rather than in the public facilities, while the reverse is identified for inpatient care: Given that inpatient care is more expensive than outpatient attention, it is easier for consumers to trade better quality for higher price in the inpatient case. This effect is further amplified by price discrimination in private sector provision.

It has also been shown that high quality in the public sector not only increases health care coverage and improves provision in public facilities, but also produces positive spillovers for consumers of private services, in terms of quality and prices in the low-price range of provision. In sum, improvements in public quality raise the entire social health status.

An additional argument that follows from the model is that in designing doctors' contracts in the public sector in order to improve performance, one must not only look into the structure of public sector compensation, but also consider the linkages between the two types of providers, as well as enforcement mechanisms that take into account the several markets where physicians perform.

Appendix 1.a. Analysis of Assumption 1

According to Assumption 1, each person consumes at most one unit of health care. However, the same structure can be used if instead of only one, N units of health care are received and paid per consumer in the private sector.

Let us assume that ex-ante the marginal consumer between the public sector and the private *low* market remains the same:

$$q_u (Y - p_u) = q_l (Y - p_l)$$

but, ex-post, each patient receives (is induced to consume) N units of health care.

Then, physicians maximize:

$$p_l = (p_l - q_l) N (Y_h - Y_l),$$

where $Y_l = \dfrac{(p_l q_l - p_u q_u)}{(q_l - q_u)}$

The resulting quality and price -- which means the signal to consumers -- remain the

$$p_l^i = N \frac{p_m}{n}$$

same. Therefore, patients will not change their behavior, and physicians' profits will be:

where n is the number of doctors in the market and p_m is the monopoly profit.

The remaining question is whether patients, under these supply characteristics, learn from experience. The answer is yes. If price and quality do not change in the public sector, patients, as soon as they understand that they were oversupplied by a private doctor, will switch their doctor next time, although still within the private sector. However, and according to Dranove (1988), it is Nash equilibrium for every physician to replicate the same conduct, such that the consumers will face the same situation whoever their provider is.

Appendix 1.b. Analysis of Assumption 4

$$p_l^i = N \frac{p_m}{n}$$

According to Assumption 4,

i= 1...n, number of physicians, which means that the monopoly profit is distributed among the number of suppliers.

One reason to support the assumption is to consider that there is a perfect spatial distribution of patients and doctors, and each physician obtains his/her share of the monopoly profits. A more general argument is that it is Nash equilibrium for physicians to act as monopolists.

The structure of the model shows that physicians in the private low-price sector offer $q_l > q_u$; otherwise there would be no private market -- people would not pay more to receive the same product. At the same time they set $p_l > q_l$; otherwise there would be no incentive to provide private services. These two rules define the existence of a private market, where

$$p_l = q_l + q_l.e$$

with e being the markup in the private sector in terms of quality of the service. Then,

$$p_l = q_l (1 + e)$$

$$p_l = q_l (1 + ? /?)$$

where ? = 0 if perfect competition,
= 1 if monopoly, and
? is the price elasticity of demand.

The question is why physicians do not act Aa la Bertrand@, reducing e such that it is Nash equilibrium to charge competitive prices. They know that the market is not perfect in terms of spatial differentiation, but also due to reasons such as trust, willingness to keep a family doctor, etc. These elements generate a particular type of product differentiation. Because of them, physicians know that these differences allow them to charge prices higher than marginal cost where the only stable limit is the monopoly price, letting doctors charge according to their patients' elasticity of demand.

Appendix 2: Second Order Conditions

Sufficient conditions for a local maximum are that $\partial^2 p_l / \partial p_l^2 < 0$, $\partial^2 p_l / \partial q_l^2 < 0$, and $\partial^2 p_l / \partial p_l \partial q_l > 0$.

$$\frac{\partial^2 p_l}{\partial p_l^2} = -\frac{2 q_l}{q_l - q_u} < 0$$

Given that $p_l > q_l > q_u$,

$$\frac{\partial^2 p_l}{\partial q_l^2} = \left(\frac{q_u (p_u - p_l)}{(q_l - q_u)^2} \right) + \frac{q_u (p_l - p_u)}{(q_l - q_u)^3} * [(q_l - p_l) + (q_u - p_l)]$$

and
this can be expressed as:

$$\frac{\partial^2 p_l}{\partial q_l^2} = A + B * [C + D]$$

As A<0, B>0, C<0, and D<0, this implies that $\partial^2 p_l / \partial q_l^2 < 0$.

$$\frac{\partial^2 p}{\partial q_l \, p_l} = \frac{\partial^2 p}{\partial p_l \, q_l} = \frac{q_l^2 + q_u [2 (p_l - q_l) - p_u]}{(q_l - q_u)^2} > 0$$

On the other hand,
if $p_l - 2q_l > 0$.

Finally, and according to the simulations introduced in section 4,

$$\frac{\partial^2 p_l}{\partial p_l^2} \frac{\partial^2 p_l}{\partial q_l^2} - \left(\frac{\partial^2 p_l}{\partial q_l \, p_l} \right)^2 = 4 q_l q_u (p_l - p_u)(p_l - q_u) - [q_l^2 + q_u (2 p_l - 2 q_l - p_u)]^2 \ll 0$$

Appendix 3: Reaction of Private Alow@ Price and Quality to Changes in Public Quality.

$$\frac{\partial q_l}{\partial q_u} = 1 + \frac{1}{2}\left[\frac{(p_l - p_u)(Y_h - p_l)}{q_u(p_l - q_u)}\right]^2 (p_l - 2q_u) > 0$$

Given that:

if ($p_l > 2q_u$) holds, and

$$\frac{\partial q_l}{\partial p_l} = \frac{1}{2}\left[\frac{(p_l - p_u)q_u(p_l - q_u)}{Y_h - p_l}\right]^{-\frac{1}{2}} * \left[\frac{q_u(2p_l - p_u - q_u)(Y_h - p_l) + (p_l - p_u)q_u(p_l - q_u)}{(Y_h - p_l)^2}\right] >$$

$$\frac{\partial p_l}{\partial q_u} = -\frac{(Y_h - p_u)}{q_l} < 0$$

and

$$\frac{\partial p_l}{\partial q_l} = \frac{(Y_h - p_u)q_u}{q_l^2} > 0$$

then, the effects of changes of public quality on private variables can be analyzed through:

$$\frac{dq_l}{dq_u} = \frac{\partial q_l}{\partial q_u} + \frac{\partial q_l}{\partial p_l} * \frac{\partial p_l}{\partial q_u}$$

(A1)

$$\frac{dp_l}{dq_u} = \frac{\partial p_l}{\partial q_u} + \frac{\partial p_l}{\partial q_l} * \frac{\partial q_l}{\partial q_u}$$

(A2)

Equations (A1) and (A2) show the direct and indirect effects of public quality on both private quality and price. In the first case (A1), public quality effects on private quality depend on the values of the parameters. The direct effect -- first term on the right-hand side -- is positive, while the effect through prices is negative. Simulations introduced in section 4 show that the direct effect is dominant, such that higher public quality is positively tied to private quality. In the second case (A2) we also observe a direct effect, in this case negative, and a indirect effect through private quality, which is positive (given the condition defined for the second order condition that $p_l > 2q_l$). Again, simulations show that the former overcompensates the latter, being that the net effect of public quality on private prices is negative.

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