THREE ESSAYS IN APPLIED MICROECONOMICS AND THEIR IMPLICATIONS FOR POLICYMAKERS

by

KYLE D. ROSS

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AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Economics
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Abstract

The first essay is on TRIPS (trade related intellectual property rights), biodiversity and North-South trade. This essay explores how true North-South trade and different IPR (intellectual property rights) regimes affect the level of biodiversity that is maintained by a Southern government. The results show that protecting farmers' rights only is the regime that will be chosen by the Southern government and that will lead to the maximum level of biodiversity. This is important for policymakers as provisions for protecting farmers' rights do not currently exist. This finding confirms previous results that did not include true North-South trade. Another result, and one that departs from existing literature, is that positive levels of biodiversity will be maintained by the Southern government if only international patent protection is implemented.

The second essay focuses on factors that affect attendance at MLS soccer matches, in particular David Beckham. The primary results in the study are that David Beckham has a very large, statistically significant effect on attendance at MLS matches. This effect is estimated as at least a sixty-five percent increase in attendance in games Beckham plays in. Other results from this study are that there are no significant effects from the months matches are played and that the only day of the week with a significant effect is Saturday (its effect is positive). The results from this study provides insight to MLS as it faces upcoming decisions about designated players, such as Beckham, and about the calendar upon which the MLS season is played.

The final essay is on moral hazard, market power and the demand for health insurance. The issue of health insurance is one of the main questions facing the U.S. government and its citizens. This essay explores the particular interaction of moral hazard and market power in the form of a duopoly in a pharmaceutical market. The results from this essay show that there are notable differences in the effects on the welfare of market participants under duopoly as compared to monopoly, such as the importance of cross-price effects that do not show up in a monopoly market.

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Approved by:

Major Professor
Yang-Ming Chang

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Table of Contents

List of Tables

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Dedication

To the three people who have done more for me than I could ever imagine I deserve:

my wife, Melissa, who has supported me and improves me every day,

my mom, Becky, who formed me into the person I am today,

my dad, Greg, from whom I learned everything about character and hard work.

Essay I

Biodiversity, Intellectual Property Rights and North-South Trade

1.1 Introduction

There have been many international agreements regarding the protection of intellectual property rights over the years. One important area that was not initially addressed, but has recently been discussed, is the protection of biological organisms. In particular the Trade-Related Intellectual Property Rights (TRIPS) Agreement of GATT included an option to protect animals and plants in Article 27 (3) b. One type of life form that is particularly relevant to intellectual property right (IPR) protection is genetically engineered plants and animals. These life forms require substantial research and development (R&D) and many argue that the discoveries need to be protected in order to continue to provide an incentive to engage in this kind of research.

However, a problem can arise from the fact that many firms go to other countries and access the flora and fauna present there to obtain ideas or information on how to better produce genetically engineered plants and animals. In this case firms can go to areas where native farmers have cultivated different seed varieties for many years. This type of cultivation is typically present in developing countries. The cultivation is predicated on free exchange of knowledge between farmers, and when firms go to draw on this knowledge they can do so without cost (Brush, 1992, p. 1619; Wood, 1998). This can cause a conflict between the farmers and the firms when there is no compensation for the farmers. There is also the problem that biodiversity can be decreased as farmers will not be able to draw on the knowledge of the firms for free due to patent protection if Article 27 (3) b of TRIPS is enforced. One concern is that this would lead to a decrease in the variety of plants worldwide (Shand, 1997; Swanson and Göschl, 2000).[1]

In their recent contribution, Droege and Soete (2001) was the first to formally incorporate the important notion of farmers' rights into a model of strategic trade policy under imperfect competition. Specifically, the authors examined the environmental issues of biological diversity by developing a North-South model where a Northern firm and a Southern firm export crop seeds to a third market. In their analysis, two different regimes of IPR protection are discussed. The first of these are international patent protections that would be similar to those enforced under Article 27 (3) b of TRIPS. The second regime discussed is farmers' rights. In this regime the native farmers are compensated for the knowledge that previously had been disseminated for free. Enforcement of these farmers' rights could potentially alleviate the aforementioned problems of knowledge exchange without compensation. Under farmers' rights, Northern firms would be required to pay fees to the Southern government in exchange for the knowledge gained from the Southern farmers.

As noted by Droege and Soete, the present policy (which is similar to only implementing patent protections, but not farmers' rights) would lead to perhaps the very outcome it is designed to prevent; the elimination or decline of biodiversity in the world. While providing interesting insight to the problem of protecting biodiversity, there are some limitations to their model setup. First, because of the assumption that the North and South export a commodity to a third market, there is no inclusion of domestic consumption (and hence consumer surplus) in the welfare maximization decision of the Southern government.[2] Consumer surplus could have very important implications for the Southern government as increasing the overall level of production

[1] Swanson and Göschl (2000) examine how intellectual property rights affect the incentive to conserve plant genetic diversity. They indicate that the current IPR system puts more emphasis on the retail end of the plant breeding industry and less on plant genetic diversity. As a consequence, the IPR system is insufficient in increasing the availability of genetic resources for the plant breeding industry.

[2] Droege and Soete call for extensions of their analysis that incorporate consumer surplus.

of just the Northern firm could have positive implications for the national welfare of the South. This could lead to higher biodiversity levels for certain situations and could also lead to a positive level of biodiversity for the case of international patent protection with or without implementation of farmers' rights. Second, by structuring the analysis with the Northern and Southern firms importing and exporting to each other's market, a more realistic picture of North-South trade can be gained. It is in response to these limitations that the present model is proposed.

We will show that the incorporation of consumer surplus into the welfare maximization problem of the Southern government in a two-way trade model significantly alters the equilibrium outcome under alternative IPR protection policies. The major results of our North-South trade model are as follows: (i) Taking into account the domestic consumption of a commodity such as crop seeds, the Southern government has an economic incentive to acknowledge international patents despite the absence of farmers' rights. (ii) Total payoff of the Northern firm is maximized when only its technological patent is protected. (iii) Under free trade without any forms of IPR regimes, biodiversity will not be maintained by the Southern government. All of these results stand in sharp contrast with the findings of Droege and Soete. (iv) The maximal levels of biodiversity and social welfare in the South are achieved by implementing farmers' rights and leaving international patents unprotected. This result is in line with the findings of Droege and Soete.

The remainder of the paper is organized as follows. Section 2 presents a simple North-South trade model to analyze environmental issues on biodiversity and IPRs. We examine the economic incentives for the Southern government to implement two independent property rights regimes (technological patents and farmers' rights), and the resulting effect on competition and biodiversity. In Section 3, we analyze the equilibrium outcomes of alternative IPR regimes and discuss policy implications of the North-South model. Section 4 concludes.

1.2 The Analytical Framework

1.2.1 Biodiversity and IPRs in North-South Trade

In order to address issues on North-South trade and further consider consumer welfare in the South, a model that has the Southern and Northern firms importing and exporting to each other's market is needed. The natural choice of an analytical framework for North-South trade is a stylized two-way trade model (Brander, 1981; Brander and Krugman, 1983). We wish to determine the conditions under which the Southern government has an incentive to maintain biodiversity in its country and to implement the protection of patents at the international level.

As in Droege and Soete (2001), we consider a three-stage game with two firms where there is one firm located in the North and one firm located in the South. These firms produce a homogeneous good, crop seeds, x_i, $i = 1,2$ for the Northern firm, and y_i, $i = 1,2$ for Southern firm. For these firms there are two cost-reducing components, a and b. The term a denotes the level of *technology* that is invested in by the Northern firm and reduces the cost of producing the seeds. Only the Northern firm is able to undertake R&D investment that lowers the cost of technology as captured by a decrease in a.[3] If patent protection for the Northern technology is chosen by the Southern government, then the Northern firm will choose l, a licensing fee, that the Southern firm must pay in order to use the technology a in its production of seeds. The term b denotes the level of *biodiversity* that is maintained by the Southern government. It too reduces

[3] We follow Chin and Grossman (1990), Žigic (1998) and Droege and Soete (2001) to assume that only the Northern firm is able to undertake R&D investment in technology.

the cost of producing seeds for the two firms.

Additionally, there is a Southern government that can choose between two different types of IPR protection: (i) the enforcement of the Northern firm's patents in developing a commercial technology and (ii) the enforcement of Southern farmers' rights in preserving the traditional cultivation methods (Droege and Soete, 2001). Specifically, it can implement patent protection for the Northern technology a. If the Southern government chooses to protect the patent on the Northern technology, then the parameter θ_1 takes on a value of 1. If international patent protection is not chosen by the Southern government, then θ_1 takes on a value of 0. The Southern government also chooses whether or not it will implement *farmers' rights* in its country. If the Southern government chooses to implement farmers' rights, then the parameter θ_2 takes on a value of 1. In this case of farmers' rights protection, the Northern firm must pay a royalty of r in order to access biodiversity b, but the Southern firm will still have free access to it. If farmers' rights are not protected then both firms will have free access to the level of b that is chosen by the Southern government. In this case θ_2 takes on a value of 0.

The structure of the three-stage game is as follows. In stage one, the Southern government chooses a property right regime combination, θ_1 and θ_2, and determines its socially welfare-maximizing levels of royalties r and biodiversity b. In the second stage, the Northern firm chooses its optimal level of technology a and it chooses licensing fee l if international patent protection is implemented by the Southern government. In the third and last stage of the three-stage game, the Northern and Southern firms adopt a Cournot strategy and simultaneously determine their outputs for both the domestic and foreign markets. The game is solved by backward induction.

1.2.2 The Sub-game Perfect Nash Equilibrium of the Three-Stage Game

We begin with the third stage where each profit-maximizing firm decides on outputs for sales in its domestic market and for export to the rival firm's market. In this stage the property rights regimes, $\{\theta_i, r, l\}$, the level of technology, a, the size of the pool of knowledge, *b*, are taken as given by the two firms. The Northern firm chooses output for the Northern market (x_1) and output for the Southern market (x_2). The Southern firm chooses output for the Northern market (y_1) and output for the Southern market (y_2). For analytical simplicity, we assume that the market demand facing each firm in the North is $p_1 = \alpha - D_1$, where $D_1 = x_1 + y_1$. Likewise, the market demand facing each firm in the South is $p_2 = \alpha - D_2$, where $D_2 = x_2 + y_2$. These assumptions imply that the size of each market is the same. Both firms faces a (constant) marginal cost of production, *c*. For our analysis we assume that $c < \alpha < (\frac{372}{137})c$. This assumption ensures first that markets are sufficiently large. It also ensures that marginal costs are not too low which helps to make investments in cost-reducing technologies necessary. Both firms also face a constant transport cost of k for the output that is exported to the foreign market.

The cost function for each firm becomes:

$$TC_1 = [c - (\delta a + b) + \theta_2 r]x_1 + [c - (\delta a + b) + \theta_2 r + k]x_2 - F \, , \tag{1}$$

$$TC_2 = [c - (\delta a + b) + \theta_1 l]y_2 + [c - (\delta a + b) + \theta_1 l + k]y_1 - F \, , \tag{2}$$

where δ reflects the degree of effectiveness of the cost-reducing technology relative to biodiversity, and F is fixed cost. As can be seen from (1) and (2), the intellectual property rights regimes chosen by the Southern government affect the cost functions of each firm. If patent protection is selected by the Southern government, then the Southern firm must pay licensing fee l to the Northern firm to use technology a. If the Southern government does not choose patent protection, then the Southern firm does not need to pay licensing fee l to the Northern firm to use technology a. If the Southern government chooses farmers' rights then the Northern firm must pay royalty r to the Southern government in order to access the pool of knowledge b. No matter the IPR regime chosen by the Southern government the Southern firm will always be able to use the pool of knowledge b.

The firms maximize their profits by choosing output for each market. Variable profits (excluding fixed costs) of the Northern and Southern firms are given respectively as

$$\pi_1 = [\alpha - (x_1 + y_1)]x_1 + [\alpha - (x_2 + y_2)]x_2 - [c - (\delta a + b) + \theta_2 r]x_1 - [c - (\delta a + b) + \theta_2 r + k]x_2 ; \qquad (3)$$

$$\pi_2 = [\alpha - (x_2 + y_2)]y_2 + [\alpha - (x_1 + y_1)]y_1 - [c - (\delta a + b) + \theta_1 l]y_2 - [c - (\delta a + b) + \theta_1 l + k]y_1 . \qquad (4)$$

Assuming that the transport cost of k is zero for analytical simplicity (and to match the analysis of Droege and Soete), we calculate the Nash equilibrium levels of outputs for each firm in each market as follows:

$$x_1^* = \frac{1}{3}(\delta a + b - c + \alpha + \theta_1 l - 2\theta_2 r) , \qquad (5)$$

$$y_1^* = \frac{1}{3}(\delta a + b - c + \alpha - 2l\theta_1 + r\theta_2) , \qquad (6)$$

$$x_2^* = \frac{1}{3}(\delta a + b - c + \alpha + \theta_1 l - 2\theta_2 r) , \qquad (7)$$

$$y_2^* = \frac{1}{3}(\delta a + b - c + \alpha - 2l\theta_1 + r\theta_2). \qquad (8)$$

As can be seen by looking at each firms' output function if b and a increase, then the output of each firm for each market increases. Also for the Northern firm, an increase in the royalty r decreases its output in each market and an increase in the licensing fee l increases its output in each market. The results for the Southern firm are the exact opposite of those for the Northern firm in terms of changes in the licensing fee and the royalty payment.

In the second stage of the game, the Northern firm chooses investment in technology a and the licensing fee l it will charge the Southern firm to use the technology. In this stage the Northern firm takes the IPR regime choices made by the Southern government as given. It also takes the pool of knowledge b and the royalty payment r as given as well. As mentioned in Droege and Soete, the licensing fee choice is contingent upon whether or not the Southern government chooses to implement international patent protection. The cost of investing in the cost-reducing technology a is assumed to be a^2.

The Northern firm maximizes its payoff, denoted as G_1, by choosing a and l. The payoff function G_1 is comprised of the Northern firm's profits, the revenues from the licensing fee $l(y_1 + y_2)$, and its cost of the technology, a^2. The maximization problem is:

$$\text{Max } G_1 = \pi_1 + \theta_1 l(y_1 + y_2) - a^2, \tag{9}$$

where π_1 is given in (3). Substituting equations (5)-(8) into G_1, we derive the first-order conditions for the Northern firm as follows:

$$\frac{\partial G_1}{\partial a} = 9a - \delta(2a\delta + 2b - 2c + 2\alpha - 5\theta_1 l + 4\theta_2 r) = 0; \tag{10}$$

$$\frac{\partial G_1}{\partial l} = \theta_1(10\alpha + 10\delta a + 10b - 10c - 20\theta_1 l - 2\theta_2 r) = 0. \tag{11}$$

To keep the analysis as simple as possible and to obtain interior solutions, we set the value of the parameter δ to $1/2$ when comparing four alternative IPR regimes.

We first examine Case 1 in which international patents and farmers' rights are implemented by the Southern government, that is, $\theta_1 = \theta_2 = 1$. Using the FOCs in (10) and (11), we calculate the equilibrium values for a and l as follows:

$$a^* = \frac{2}{7}(\alpha + b - c - r)\,; \tag{12}$$

$$l^* = \frac{2}{35}(10\alpha + 10b - 10c - 3r). \tag{13}$$

These equilibrium values indicate that an increase b increases both the equilibrium technology and licensing fee. Also, an increase in r decreases both the equilibrium technology and licensing fee.

If the Southern government chooses not to implement international patent protection then the licensing fee will be nonexistent. The technology chosen by the Northern firm is as follows:

$a^* = \frac{2}{7}(\alpha + b - c - r)$ if the Southern government implements farmers' rights;

$a^* = \frac{2}{7}(\alpha + b - c)$ if the Southern government does not implement farmers' rights.

This shows again that the larger b is, the larger the investment in technology by the Northern firm will be. Also, the larger r is the smaller a will be. For the case where farmers' rights are not implemented, a is the largest.

In the first stage of the three-stage game, the Southern government chooses the IPR regimes, as well as the level of biodiversity and the royalty the Northern firm must pay for accessing the pool of knowledge, in order to maximize the social welfare of the Southern country. The Southern government's welfare function is composed of the consumer surplus from consumption of the crop seeds, the profits of the Southern firm, and the revenue gained from the royalty fees paid by the Northern firm to gain access to the pool of knowledge maintained by the Southern government. That is, the Southern government's problem is to choose b and r that

$$\text{Max } W_2 = CS_2 + \pi_2 + \theta_2 r(x_1 + x_2) - b^2, \tag{14}$$

where $CS_2 = \int_0^{D_2} (\alpha - X)dX - p_2 D_2 = \frac{1}{2}(x_2 + y_2)^2$, π_2 is given by equation (4), and the firms' equilibrium outputs are given in (5)-(8).

Based on the FOCs for the Southern government: $\frac{\partial W_2}{\partial b} = 0$ and $\frac{\partial W_2}{\partial r} = 0$, we calculate the equilibrium levels of biodiversity and royalty per unit of output as follows:

$$b^* = 0.54(\alpha - c); \tag{15}$$

$$r^* = 0.62(\alpha - c). \tag{16}$$

Substituting the optimal values of b^* and r^* from (15) and (16) into (12) and (13), we calculate the optimal values of a^* and l^* in the second stage of the game:

$$a^* = \frac{1}{7}(2\alpha + 2b^* - 2c + 2r^*) = 0.26(\alpha - c); \tag{17}$$

$$l^* = \frac{2}{35}(10\alpha + 10b^* - 10c - 3r^*) = 0.77(\alpha - c). \tag{18}$$

Substituting equations (15)-(18) into equations (5)-(8), we determine equilibrium outputs by the firms. We further calculate the Northern firm's net payoff (variable profits net of R&D expenditures):

$$G_1^* = \pi_1^* + l_1^*(y_1^* + y_2^*) - (a^*)^2 = 0.64(\alpha - c)^2.$$

The Southern firm's profits as well as the South's consumer surplus and social welfare are calculated as follows:

$$\pi_2^* = 0.12(\alpha - c)^2;$$

$$CS_2^* = \frac{1}{2}(x_2^* + y_2^*)^2 = 0.21(\alpha - c)^2;$$

$$W_2^* = CS_2^* + \pi_2^* + r^*(x_1^* + x_2^*) = 0.54(\alpha - c)^2.$$

These results are recorded in Table 1.1.

Table 1 about here

Under the regime with double protection for both the Northern firm's technological patent and farmers' rights in the South (Case 1), we find that the Southern government's optimal level of biodiversity is strictly positive. This result is consistent with the finding of Droege and Soete that there is an incentive to maintain a positive level of biodiversity for the Southern government. To compare social welfare, it is necessary to determine the equilibrium outcomes of other IPR regimes.

1.3 Alternative IPR Regimes and their Comparisons

Having developed the analytical framework of North-South trade in Section 1.2, we find that it is straightforward to examine alternative IPR regimes when $\theta_i (i = 1, 2)$ takes on a value of 0 or 1. Our previous assumption about the relative sizes of α and c are needed for Case 2 to ensure that markets exist and that we obtain an interior solution for this case. For Case 4 the optimal level of biodiversity is $(-\frac{3}{217})(10\alpha + 41c)$. Therefore, as long as α and c are positive, the level of biodiversity for Case 4 will be 0. To save space, we summarize the equilibrium outcomes for the four different cases in Table 1.1.

For the regime under which the Southern government implement farmers' rights without enforcing international patents (Case 2), we have $\theta_1 = 0$ and $\theta_2 = 1$. In this case there is a substantial rent-shifting effect (in that there involves a transfer of income from a Northern firm to the Southern government). It is this case that provides both the maximal level of social welfare for the Southern government and ensures the highest level of biodiversity. These results confirm the analysis of Droege and Soete for the case of two-way trade. For this level of the analysis, the inclusion of consumer surplus does not affect the equilibrium chosen by the Southern government.

For the regime under which the Southern government enforces international patents and does not implement farmers' rights, we have $\theta_1 = 1$ and $\theta_2 = 0$ (Case 3 in Table 1.1). As discussed in Droege and Soete (2001), the strategic choice of the Northern firm is its R&D investment. For the Northern firm, its overall payoff (profits net of cost-reducing R&D expenditures) is highest when its technology patent is protected by the Southern government without implementing farmers' rights. The consequence is that the Northern firm becomes the only producer (i.e., a monopolist). To the Northern firm, the loss of licensing fees is more than offset by the reduction in paying royalties if there were farmers' rights. Interestingly enough, the Southern government in this case may still have an incentive to undertake investment in maintaining biodiversity. As illustrated in table 1, the equilibrium value of b is strictly positive. This finding runs counter to the model of Droege and Soete (2001), which shows that in this case biodiversity "will not be maintained by the Southern government" (p. 160).

For the regime under which the Southern government does not implement patent protection and farmers' rights, we have $\theta_1 = \theta_2 = 0$ (Case 4 in Table 1.1). This, in essence, is when there is free trade without any forms of government intervention. Unsurprisingly, this is the only case where the equilibrium level of biodiversity is 0. This points to the importance of implementing IPR protection, at least at some level, for achieving biodiversity. While various IPR protection regimes have varying outcomes, all are shown to be superior to free trade in terms of the level of biodiversity that is maintained by the Southern government. Interestingly, the level of social welfare for the South under free trade is higher than that in Case 3 (patent protection only). This finding lends credence to the idea of constraining the Southern government's choices in the interest of biodiversity (provided that farmers' rights are not an option).

Droege and Soete (2001) show that the Southern government favors only farmers' rights, and has no incentive to implement international patent protection. Quite contrary to this finding, we find that the Southern government may have an incentive to implement international patents even in the absence of farmers' rights.[4] The literature on trade-related intellectual properties (TRIPs) has examined Southern countries' incentives in the protection of international patents based on technological R&D. The condition for Southern protection of international patents is when the R&D investments are sufficiently productive to benefit Southern countries. (See, e.g., Chin and Grossman, 1990; Diwan and Rodrick, 1991; Deardorff, 1993).

Our study further shows that there is a dilemma for the Northern firm in terms of supporting farmers' rights in the South. The Northern firm's profits are the highest when only patents are enforced. But the Northern firm's profits are higher when both technological patents and farmers' rights are enforced compared to a situation where none of them are enforced. These findings contrast with those of Droege and Soete's. They find that the Northern firm's profits are highest for the case of patent protection and farmers' rights.

The importance of farmers' rights for the protection of biodiversity can be seen in the fact that farmers' rights are always biodiversity increasing. Regardless of the choice made as to whether or not to enforce international patents, biodiversity levels can be increased by implementing farmers' rights. This lends urgency to the idea that policymakers should be drafting agreements that provide for the implementation of farmers' rights.

1.4 Concluding Remarks

[4] For our Case 3, we find that social welfare in the South is positive, whereas for our Case 3, Droege and Soete (2001) find that social welfare in the South is zero.

In this paper, we have presented a stylized model of North-South trade to analyze environmental issues concerning how biodiversity decline is affected by alternative IPRs enforced by the Southern government. Our model departs from the existing literature in some important aspects. Unlike Droege and Soete (2001), who assume that both the North and South export crop seeds to a third country, we consider a two-way trade framework where the North and South export crop seeds to each other's market. Second, our model further allows for consideration of consumer welfare when the Southern government chooses IPR regimes.

We find that the choice of the Southern government when maximizing Southern social welfare is to implement farmers' rights and to not protect international patents. This regime also provides for the highest levels of biodiversity maintained by the Southern government. We also find that the South's social welfare is positive for the cases of patent protection with or without farmers' rights. These finding indicate that the Southern government has an incentive to implement patent protection.

For the case of patent protection and no farmers' rights, the Southern government does have an incentive to maintain biodiversity at a positive level. This is particularly noteworthy as Droege and Soete did not find that the Southern government had any incentive to maintain biodiversity under this regime. It is also notable that this is the regime that currently has a provision under the TRIPS agreement of GATT. These results lend credibility to the idea that the inclusion of consumer surplus has important implications for the maintenance of biodiversity by the Southern government, and provides a different result than the existing literature on this subject, both in the economic arena and non-economic arena. Further analysis will provide insight into the regime that will actually be chosen by the Southern government and thus the level of biodiversity that will be maintained by the Southern government. If the welfare maximizing regime chosen by the Southern government is a regime where biodiversity is not maximal, then that could provide motivation to draft international agreements which constrain the choice of the Southern government if it is in the best interest of the world to have maximal biodiversity.

Table 1.1 Equilibrium Results of Alternative IPR Regimes

	Case 1 **Patents and FR** $(\theta_1 = \theta_2 = 1)$	Case 2 **No Patents but FR** $(\theta_1 = 0, \theta_2 = 1)$	Case 3 **Patents but no FR** $(\theta_1 = 1, \theta_2 = 0)$	Case 4 **No IPR protection** $(\theta_1 = 0, \theta_2 = 0)$
Technology (a)	$0.26(\alpha - c)$	$0.09(\alpha - c)$	$0.34(\alpha - c)$	$0.12(\alpha - c)$
Licensing fee (l)	$0.77(\alpha - c)$	0	$0.68(\alpha - c)$	0
Biodiversity (b)	$0.54(\alpha - c)$	$1.84(\alpha - c)$	$0.20(\alpha - c)$	0
Royalty fee (r)	$0.62(\alpha - c)$	$1.02(\alpha - c)$	0	0
Northern firm's net payoff (G_1)	$0.64(\alpha - c)^2$	$0.06(\alpha - c)^2$	$0.82(\alpha - c)^2$	$0.24(\alpha - c)^2$
Southern firm's profits (π_2)	$0.12(\alpha - c)^2$	$3.39(\alpha - c)^2$	0	$0.25(\alpha - c)^2$
Southern country's Consumer surplus (CS_2)	$0.21(\alpha - c)^2$	$1.25(\alpha - c)^2$	$0.23(\alpha - c)^2$	$0.25(\alpha - c)^2$
Southern country's social welfare (W_2)	$0.54(\alpha - c)^2$	$1.84(\alpha - c)^2$	$0.20(\alpha - c)^2$	$0.50(\alpha - c)^2$

Essay II

How Posh is Becks' Salary?
And Other Issues Regarding MLS Attendance

2.1 Introduction

Major League Soccer (MLS) occupies a very unique position in the world of sports. It is the one major professional sports league in the United States that is not considered to be the best in the world. In the realm of soccer (football to non-Americans), by far the most popular sport in the world, it has the distinction of not being the most popular professional sports league in its home country. This set of circumstances poses challenges to MLS that no other professional sports league in the world faces. MLS is constantly working to promote its popularity in the United States, and at the same time to improve its reputation to the rest of the world. One of the most important tasks for MLS is to promote attendance at its league games. If this is achieved, then the popularity of MLS increases and it will be able to achieve much higher revenues. This not only occurs through increased gate receipts, but also through more lucrative television contracts as well. With increased revenues, MLS can afford to employ higher quality players, which will further enhance its reputation, and thus allow it higher revenues. This kind of virtuous cycle is (or perhaps should be) the goal of Major League Soccer.

Improving attendance at league games is almost certainly the first step for MLS in achieving its goals. The obvious question that follows concerns what MLS can do to improve attendance at its matches. This question is the subject of much debate and discussion among fans, pundits and league officials. To date there are no econometric studies addressing MLS attendance, and as such this paper will attempt to shed light on an issue that has not previously been the subject of formal statistical analysis.

One of the recent initiatives implemented by the league has been the introduction of designated players. Each MLS franchise receives one designated player slot. When a player is given the designated player tag, this essentially means that his salary is not subject to the salary cap and salary limits. This initiative is an attempt to bring in higher profile players to raise the profile of the league. David Beckham (whose wife is Victoria Beckham a.k.a. Posh Spice) is one such player brought to MLS under the designated player program. While there is no question, even to the casual observer, that Beckham's impact on attendance has been positive, it is quite difficult to quantify the impact Beckham has had on attendance. Along these lines, it is also difficult to determine whether or not Beckham has been worth the salary paid to him. This paper will attempt to answer these questions for Beckham and for one other designated player, Cuauhtemoc Blanco.

Another issue that is the subject of much debate has been the issue of when on the calendar to schedule the MLS season. Currently, MLS plays its regular season from the end of March to the end of October. The vast majority of the rest of the world plays its season from mid-August to the end of May. This means that MLS is playing the heart of its schedule during the offseason for the rest of the world. The international calendar is also set up so that players do not miss playing games for their clubs, because they are playing in international tournaments for their countries. This is not the case for MLS. MLS players are frequently absent from games for their clubs due to their commitments for their countries. MLS is unable to restrict players from leaving to play for their countries, because the games for their countries are played on dates that FIFA (the international soccer governing body) has approved. As a result, FIFA requires clubs to release players to play for their countries on these approved dates.

The fact that MLS does not schedule its season on the international calendar has been criticized by fans in the United States and soccer fans around the world. If MLS were to move to the international calendar, this would almost certainly improve its reputation and standing in the realm of the soccer world. It would ensure MLS is playing while the rest of the world is tuned in to club soccer, and it would avoid MLS having many of its top players leave to play in international tournaments.

As a league, MLS has given different reasons for maintaining its current season calendar. The primary reason is typically that MLS does not want to compete with professional and college football (of the American variety) in the fall and winter. MLS contends that attendance would suffer if fans were forced to choose between attending MLS games or football games. The underlying belief of MLS is that the current calendar will promote attendance at its games. This paper attempts to evaluate this statement, by analyzing the effects different scheduling components have on attendance. These scheduling components are the month of the year a game is played and the day of the week a game is played.

In this paper it will be shown that there are indeed significant increases in attendance at MLS games when either David Beckham or Cuauhtemoc Blanco play in the game. From these estimations, we can estimate a marginal revenue product for each of these players and compare this marginal revenue product to the salary each player is paid. Also, the only scheduling effects that have a significant impact on attendance are if a game is played in June or if a game is played on a Saturday. Both of these effects have a positive impact on attendance at MLS games. This information can be used by Major League Soccer to evaluate its scheduling policy in the future.

The rest of the paper will be organized as the following: 1) a literature review on papers regarding attendance at sporting matches, 2) a description of the models that are being estimated, 3) a description of the data used in the studies and 4) conclusions made from the results.

2.2 Literature Review

While there is not a substantial body of literature regarding MLS attendance, there is literature regarding other leagues and sports. Forrest and Simmons have written numerous papers about English football and in particular the demand for attendance at English football games. The first paper of theirs that will be discussed is "Outcome Uncertainty and Attendance Demand in Sport: The Case of English Soccer." In this paper Forrest and Simmons attempt to demonstrate a link between how uncertain the outcome of a game is and the attendance at that game by using a probability ratio. The probability ratio measures the relative chance that the home team will win versus the chance that the away team will win. The variable for the probability ratio is generated through an extended probit model using betting data and the difference between home and away attendance for a team. The variable that is generated is then put into a log-linear regression that takes the form of

$$A_i = \alpha + \gamma_1 PROBRATIO + \gamma_2 PROBRATIO^2 + \gamma_3 HOMEPOINTS + \gamma_4 AWAYPONTS \\ + \gamma_5 DIST_i + \gamma_6 DIST_i^2 + \text{month dummies} + \text{home team fixed effects} + \text{error}$$

where A_i is the log of attendance.

One of the most notable results is the coefficients on the PROBRATIO variables. An increase in the PROBRATIO indicates a higher likelihood that the home team will win, thus a decrease in the uncertainty of the outcome. The negative sign on the coefficient indicates that as uncertainty increases demand for attendance also increases. The positive sign on the $PROBRATIO^2$ does not indicate that at some point making the outcome very certain will increase attendance (Forrest and Simmons, 2002). Rather it indicates that the attendance decreases at a slower rate as PROBRATIO increases. The justification given for this is that very few observations in the data actually have a PROBRATIO that exceeds the value needed for it to increase attendance. This result provides justification that the more uncertain the outcome of a game, the higher the attendance will be at the game.

An interesting simulation of the model done by Forrest and Simmons provides an interesting result. The simulation is done by assuming that all teams are of equal strength. When this simulation is done, it is shown that attendance will actually be lower when all of the teams are of equal strength. One of the reasons given is that when the teams are of equal strength, the importance of home field advantage becomes very great and is what determines basically who wins and who loses most of the games. Given this fans become relatively disinterested in the games and thus do not attend. In fact the estimated shortfall over the course of a season of games between these perfectly matched teams would be 1.34 millions spectators (Forrest and Simmons, 2002). This importance of home field advantage is somewhat unique to soccer, and as such the results would not necessarily translate to other sports.

A second paper from Forrest and Simmons from 2006 looks at some new issues in the demand for attendance in English football. Again they use a log-linear relationship to look at the effects of different variables on the demand for attendance. The most interesting results from this paper are that fans exhibit substantial habit persistence from season to season, that fans do not appear to respond to the uncertainty of a match and that there are scheduling effects on attendance (Forrest and Simmons, 2006).

The first effect is notable in that competitive balance may not be as important as many feel, as the fact that there is habit persistence will mean that fans will continue to attend even if they feel their team does not have as much of a chance as other teams. Also, given this habit persistence, it may be more incumbent on teams to be accommodating to families in pricing their tickets. The reason for this is that if a team is able to instill the "habit" of attending the games of a particular team in children while they are young, then they will continue to attend when they are older. These types of policies can be seen in the ticket pricing of student tickets for many college athletics. Typically, student tickets are sold at a discount to regular priced tickets. While there may be other reasons for this discounting (student fee agreements, etc.), university athletic departments are willing to sell tickets more cheaply to students when their demand is more elastic. When the students graduate, then, they will be more likely to purchase tickets as an alumni, as they have developed the habit. The results from Forrest and Simmons provide empirical evidence to support these types of policies, and serve as reason for more professional teams to adopt these types of policies.

The second result is particularly notable in that it contradicts the 2002 paper from Forrest and Simmons. While they mention that this finding is consistent with some other recent findings of others, it is still striking in that it contradicts earlier work of their own. If indeed their second finding is correct, then this is another blow to those who advocate policies such as revenue sharing in order to increase the uncertainty of outcomes of games. However, if their first finding is correct this would lend support to those who advocate policies to increase the uncertainty of outcomes of games. Regardless of which is correct, given that the same group has found conflicting results, the matter is far from settled and factors that affect demand for attendance at sporting events remains an important area for future research.

The final result that there are scheduling effects is interesting for both English football specifically and for all sports in general. For English football it is interesting in that one of the main scheduling effects examined is that effects of Champions League broadcasts on the lower divisions in the English Football League. The Champions League is a cup/tournament in which the top teams from European football leagues participate. Teams from the lower divisions (the divisions looked at) never participate in the Champions League, and thus will never be broadcast as a part of it. The most interesting implication of this specifically for English football, is that the upper division Premier League may have a responsibility to compensate lower divisions as a result of the loss of revenue from the broadcast of these games as these games present a negative externality for the lower division teams (Forrest and Simmons, 2006).

As for the implications for other leagues (and for English football), the main implication is that better scheduling could allow for higher attendance and thus higher revenues. The scheduling effects of games are important for MLS in terms of considering moving to the international calendar. If there are significant effects of certain months, then that could lend weight for or against the arguments for moving to the international calendar. The effects of certain days are important as well. If weekday games cause lower attendance, this could be support for moving to the international calendar as well. This is because the season would cover more months, and allow for more weekend games by not having to squeeze games in on weekdays.

2.3 Model

The model that will be used is similar to the model used by Forrest and Simmons (2006). Both log-attendance and attendance will be regressed on the same variables. The results from the estimation using log-attendance will be used to discuss the results. This model is a bit more informative when comparing results across different clubs, as some clubs have higher average attendances than others. Therefore, a percentage change in attendance will be more accurate when estimating attendance effects for a single club. The model to be estimated using Ordinary Least Squares takes the form

$$A_i = \alpha_0 + \alpha_1 DB \text{ dummies} + \alpha_3 CB \text{ dummies} + \alpha_4 HQ_i + \alpha_5 AQ_i + \alpha_6 month \text{ dummies} + \alpha_7 day \text{ dummies}$$

where A_i = ln attendance.

The variable *DB* dummies is a set of dummy variables for David Beckham playing home, away or not in a game. Its coefficient is thus a vector of coefficients. In this case two coefficients will be estimated as one of the dummies will be dropped from the estimation. The variable *CB* dummies is a set of dummy variables for Cuauhtemoc Blanco playing home, away or not in a game. Its coefficient will also be a vector of variables with the same size as the one for David Beckham. The variables *HQ* and *AQ* are variables to control for the quality of the home team and away team respectively. The way these variables are calculated is to divide the number of points a team has earned by the league leaders and multiply this by 100. By calculating the variable this way, the relative performance of each team up to the point in the season a game is played can be seen. This is useful for MLS as a team can be in 10th place out of 15 teams, but still be very close to the league leaders. This is a result of the parity that exists in Major League Soccer. For the first five weeks of the season, an additional component is added to the calculation of the quality of the teams before multiplying by 100. This is done to control for the excitement surrounding the start of a new season, and the fact that a loss to the season may not dampen fans' enthusiasm. The additional component that is added is equal to $\frac{0.75}{n^2}$ where n is the number of the week in the season a particular game is being played.

The last two groups of variables are the scheduling effects. The variable *month* dummies is a set of dummy variables for the month of the year a game is being played. The variables included are April (including March games), May, June, July, August, September and October. The coefficient on *month* dummies will therefore contain a vector of six coefficients after one month is dropped from the estimation. The final variable *day* dummies is a set of dummy variables for the day of the week a game is being played. The variables included are Saturday, Sunday, Thursday, Wednesday, Friday and Tuesday. The coefficient on *day* dummies will thus contain five coefficients after one of the variables is dropped in the estimation.

2.4 Data

The data used in this study is for the 2008 MLS season. It was gathered from MLSnet.com. The observations that are home games for Toronto FC have been removed from the data, as there is no variability in attendance at their matches. This indicates a surplus of demand from what is supplied. As a result the attendance number does not reflect the true demand for attendance.

2.5 Results

The results obtained from the estimations are included in Table 2.1 and Table 2.2. The estimation that is discussed in this section will be for the values in Table 2.1. The results for both David Beckham and Cuauhtemoc Blanco show that each has a statistically significant positive impact on attendance whether they are playing at home or playing away. For David Beckham, the home effect is estimated to be a 65 percent increase in attendance if he is playing in a game. Beckham's effect on the road is estimated at 74 percent. This is tremendously substantial attendance effect that is replicated by no one else in the sporting world. Regardless of how one feels about Beckham's time in MLS, it is clear that David Beckham has a substantial effect in generating attendance for Major League Soccer.

The salary that David Beckham is paid by the Los Angeles Galaxy is $6.5 million per year. His overall contract is much larger than this, but the component the Galaxy are responsible for is $6.5 million. Given that Beckham is responsible for 65 percent increase in attendance at

Los Angeles home games, that corresponds to roughly 10,600 tickets per game. Over the course of 15 home games, that is an additional 159,000 tickets sold over the course of a season. Given an "average" price of $50 per ticket, this corresponds to an additional $7.95 million in extra revenue in a season for the Galaxy from ticket sales alone. This does not include extra revenue from parking, concessions, souvenirs, etc. From an investment standpoint, Beckham is clearly worth what he is being paid from the Galaxy. Beckham does not only impact revenue for the Galaxy. He also increases revenue for the other clubs in MLS by increasing attendance at their parks when the Galaxy plays away. His estimated impact of 74 percent corresponds to roughly 11,250 extra tickets sold when Beckham plays on the road at the "average" MLS club. Given an "average" price of $30 per ticket, Beckham is responsible for adding $337,500 in revenue for each club Beckham plays against on the road. Over the course of a season, this is an additional $5.06 million for the league apart from the Galaxy from ticket sales alone. These figures all point to the idea that Beckham is adding a tremendous amount to the bottom line for MLS and its franchises. The $6.5 million salary afforded Beckham seems a bargain compared to his value added.

For Cuauhtemoc Blanco the estimated effects are a 24 percent increase in attendance when playing in Chicago and a 28 percent increase in attendance when playing away from home. Blanco is being paid a $2.9 million salary for 2009 by the Chicago Fire. The added revenue for Blanco can be calculated in the same manner as was done for Beckham. Assuming an "average" price of tickets for Chicago of $30, an additional 3750 extra tickets sold per game, Blanco's added revenue for 15 home games in a year is $1.98 million per year. For the other clubs in MLS, on average, Blanco adds 4200 in attendance per game. Assuming an "average" price of $30 per ticket, Blanco adds $126,000 each time he plays away from home. This adds $1.89

million in additional revenue for MLS. While Blanco's revenue added to the Fire does not exceed his salary, his overall contribution to MLS exceeds his salary. Again, this does not include extra revenue from non-ticket items.

In terms of scheduling effects, the only things that have a statistically significant effect on attendance is if the game is played in June or if the game is played on a Saturday. Both of these results suggest that MLS can improve attendance by scheduling more games on Saturday and prevent losses to attendance by continuing to schedule games in the month of June. The playing of games on Friday also has a significant effect, but all of these games had another event going on at the same time, which most likely drove attendance meaning that playing the game on Friday was most likely not the reason for the significance of the Friday variable.

2.6 Conclusions

The results obtained from the estimation point to ways that MLS can increase their attendance. One of the main points for MLS is that right now, the primary factor that can increase attendance at MLS games is the players in the league. Very few other factors affect attendance at MLS games. The quality of the teams does not have a significant effect. No month that MLS plays in significantly decreases attendance. No day of the week significantly decreases attendance. MLS could play more games on Saturday, but most of its games are already played on Saturdays. It would also be very difficult to schedule more games in June. The month is already pretty much full. MLS seems to be at a point in its development where there is a core of fans that support the league regardless of when the game is played, or who their team is playing. What is drawing in the fans beyond this core is when notable players are playing in a game. This means that in order to increase attendance at its matches MLS needs to start signing more high profile players.

While it is unlikely that continuing to sign more and more high profile players will keep increasing attendance, it is likely that having one high profile player at each team will increase attendance. The reason for this is that both Beckham and Blanco have a significant increase in attendance on their home matches. It follows then that other teams would benefit from having at least one player like Beckham or Blanco on their squad. Currently in MLS every team does not use its designated player slot, meaning that some teams are not playing with any sort of high profile players like Beckham or Blanco. One possible action for MLS is to require clubs to use their designated player slots. This would help to increase attendance at MLS matches and raise the profile of the league. Another reason for MLS to require the use of designated player slots by all clubs is that the rest of the league benefits from one club having a designated player. This externality is not taken into account by a single club making the decision of whether or not to sign a designated player. MLS requiring the presence of a designated player would help to alleviate this externality.

The estimates for Beckham also provide an idea for how much ticket revenue MLS may lose if Beckham were to leave the league. Currently, Beckham is on loan at AC Milan in Italy. There is widespread speculation that Beckham will not return to MLS at the end of his loan deal and will want to leave for a European club. The results from this study can provide a foundation for how much MLS should demand for a transfer fee to allow Beckham to leave.

The results from this estimation also provide some insight into the current debate on when to schedule the MLS season. If MLS was to move to the international calendar, this would most likely have some negative effect on attendance as MLS would no longer play games in the month of June. This effect would be attenuated as MLS would be able to play more games on

Saturdays as the MLS season would be now be longer. MLS might also have an easier time attracting more international players, which would most likely have the effect of increasing attendance as well. Moving to the international calendar would also prevent clubs from having to play games without key players that are on international duty, which also could have the effect of improving attendance. In order to prevent the loss in revenue from a drop in attendance from not playing in June, MLS could schedule an end-of-the season cup tournament that would replace the playoffs and recapture some of the revenue.

In order to improve attendance at MLS matches, the league should focus on attracting more well-known players. One way the league could do this is to require clubs to use their designated player slots. Another is that MLS could move to the international calendar, although this might have the short-term effect of decreasing attendance by having MLS no longer play games during the month of June. In the long-run this may be what MLS has to do.

Table 2.1 Results of LN Attendance Estimation

Variable	Coefficient	Standard Error	P Value
Beck Home	0.651	0.075	0.000
Beck Away	0.737	0.077	0.000
Blanco Home	0.237	0.077	0.002
Blanco Away	0.279	0.081	0.001
Home Qual	-0.0007	0.001	0.555
Away Qual	-0.0004	0.001	0.070
Saturday	0.121	0.060	0.045
Sunday	0.055	0.072	0.443
Wednesday	-0.081	0.115	0.481
Friday	0.564	0.139	0.000
Tuesday	0.097	0.285	0.734
April	0.008	0.076	0.915
May	-0.011	0.080	0.887
June	0.142	0.077	0.066
July	-0.007	0.087	0.940
August	0.065	0.076	0.394
October	0.117	0.077	0.130
Constant	9.406	0.134	0.000

Dependent variable – ln attendance

$R^2 = 0.53$

Table 2.2 Results of Attendance Estimation

Variable	Coefficient	Standard Error	P Value
Beck Home	11641	1347	0.000
Beck Away	14981	1375	0.000
Blanco Home	2735	1366	0.047
Blanco Away	4469	1443	0.002
Home Qual	-3	20	0.891
Away Qual	-7	21	0.729
Saturday	1697	1071	0.115
Sunday	282	1285	0.827
Wednesday	-1413	2054	0.492
Friday	11873	2483	0.000
Tuesday	969	5089	0.849
April	181	1349	0.894
May	-343	1434	0.811
June	2912	1368	0.035
July	230	1555	0.883
August	788	1352	0.561
October	1744	1372	0.205
Constant	12254	2394	0.000

Dependent variable – attendance

$R^2 = 0.56$

Essay III

Do Differentiated Goods Alter Welfare Implications of Health Insurance? The Case of Heterogeneous Duopoly

3.1 Introduction

The presence of moral hazard, resulting from health insurance, in healthcare markets is a well established phenomenon in the literature. Martin Feldstein first made the argument in 1973 that consumers could realize a gain in individual consumer welfare if consumers purchased a lower level of health insurance. He argued that when covered by health insurance, consumers over consume health care because the price they face is reduced by the insurance. This overconsumption of healthcare drives prices higher. If all consumers instead consumed less healthcare than the amount chosen, consumers would be better off as prices became lower. Consumers do not do this, however, because each consumer's effect on the price is negligible compared to the aggregate, and as such do not incorporate the effect of overconsumption on price into their decision making.

Feldstein's results have driven a large amount of research devoted to the welfare effects health insurance has. Feldman and Dowd (1991) confirmed the conclusions of Feldstein. Others, notably Nyman (1999a), have argued that the loss of welfare to individuals is mitigated, but not necessarily eliminated, by the fact that one gains access to health care procedures that would be unaffordable if health insurance was not purchased. For example, if an individual needed a $350,000 heart surgery, he/she would be denied this surgery because he/she can in no way afford the procedure. Health insurance grants access to otherwise unaffordable, and unobtainable health care, and thus provides value apart from reduced financial risk. This value is ignored in most traditional welfare studies, and as a result these studies overestimate welfare losses to individual consumers. This is not an undisputed conclusion, as Nyman has gone back and forth a bit with Blomqvist (2001).

The value of health insurance and its effects on welfare is a more prescient topic than ever. For perhaps the first time in the history of the United States, there is a real drive by the President and members of the controlling party of Congress to implement some form of universal health care. Whether it is through mandated health insurance through private coverage or through a central payer system of universal health insurance is not particularly important for the scope of this paper. This paper also is in no way attempting to advocate for or against health insurance coverage for all individuals. The focus of this paper instead will be to characterize health care markets and the welfare effects of changes in health insurance levels to provide insight for policymakers as they consider major overhauls to the healthcare system in the United States.

Important aspects of the healthcare market include the nature of competition among healthcare providers and the profits these healthcare providers enjoy. These are factors that are often overlooked in traditional welfare analyses of healthcare markets and health insurance purchasing decisions. Two studies that examine the relationship and interaction of these factors are one by Gaynor et al (2000), and Wigger and Anlauf (2007). The findings and implications of these two studies will be discussed further in the literature review. Market power is an important consideration in the analysis of health insurance and its effects upon welfare. It is also particularly important in industries such as the pharmaceutical industry where individual markets for diseases or conditions are characterized by relatively few producers.

In this paper I will analyze how market power and moral hazard resulting from health insurance interact in the setting of duopolistic healthcare providers. The two differentiated goods that are produced and traded are pharmaceuticals in a market for the treatment of a disease. The main goal of the paper is to analyze how a change in the level of health insurance purchased by individual consumers affects welfare levels for participants in the market. The results from the study reveal important considerations for policymakers as they consider implementing a program of nationwide health insurance.

One of the most interesting findings is that the welfare effects of decreasing the amount of health insurance purchased depend upon the cross-price effects of the two goods in the drug market. More specifically, the effects depend upon whether or not the two goods are complements or substitutes. For the welfare of individual consumers in the market, a decrease in the level of health insurance purchased unambiguously enhances individual welfare for individuals when the two goods are substitutes. This result is consistent with the findings of the many other studies in the literature. When the two goods are complements, the effects on individual welfare are ambiguous; it depends on the relative size of two different effects. No other study incorporates cross-price effects into the analysis, and this is thus a new contribution to the literature.

In this paper, the term "individual welfare" is used to represent a consumer's expected utility rather than "consumer welfare" to avoid any confusion in terms of the groups being referred to. In some cases in law and legislation, consumer welfare implies consideration of profits for firms. Individual welfare is thus used in this paper to refer to the case where industry profits are not considered.

In terms of social welfare, which refers to the case where profits for healthcare providers in the industry are considered, the results in terms of ambiguity are reversed. For the analysis of this study, if the two goods are complements then a decrease in the level of health insurance purchased unambiguously decreases social welfare. In the case of substitutes it is not clear cut. Again it will depend on the relative sizes of two different effects.

The introduction of this paper will be followed by a literature review, an overview and description of the model used, a description of the conditions that result at market equilibrium, a description of the effects of changing the level of health insurance individuals enjoy and the conclusions of the paper.

3.2 Literature Review

The three primary studies from which the current analysis follows are the ones by Gaynor et al (2000), Vaithianathan (2006) and Wigger and Anlauf (2007). These papers all incorporate market power on the side of healthcare providers into their analysis.

The paper by Gaynor et al (2000) analyzes the distortion associated with moral hazard in a single-good healthcare market. The model in the paper incorporates an insurance industry that is competitive and a healthcare provider market that is imperfectly competitive. The primary aim of the paper is to analyze the effects on welfare for an increase in price that would be associated with an increase in market power on the side of producers. One of the key results from the study is that "a competitive insurance market will always produce a contract that leaves consumers at least as well off under lower prices as under higher prices" (Gaynor et al 2000, p. 992). In terms of the nomenclature of this paper, this result is referring to the effects of a price decrease on individual welfare. Another result from this study concerns the effect of lower prices on total social welfare. Gaynor et al find that the benefits to consumers outweigh the losses to producers. Following from this, they conclude that a decrease in price leads to an improvement in overall social welfare. One of the implications of this study is that market power does not reduce the effects of moral hazard on individual welfare (and social welfare) by increasing prices. Rather, as stated, a decrease in price has the effect of increasing individual welfare and increasing overall social welfare.

Vaithianathan (2006) examines how imperfect competition affects individual consumer welfare with a competitive health insurance market. In this paper firms in the health care markets choose the quantity of an identical good under Cournot competition. The author finds that even with imperfect competition consumers choose too much health insurance and individual welfare can be improved if all consumers were to enjoy a lower level of health insurance. Vaithianathan (2006) also finds that consumers are made better off as the healthcare market becomes more competitive.

Wigger and Anlauf (2007) further analyze the interaction of moral hazard and market power and the effects on different groups' welfare. The model used in this paper is one of competitive insurance markets and a monopoly producer of a single healthcare good. Bertrand competition is the method employed by the authors, meaning that the monopoly producer chooses the price of the good rather than quantity as in Cournot competition. In this case the healthcare good is a drug in a single market for a particular disease. Rather than focusing on price changes, the authors focus on how changes in the level of health insurance affects the welfare of individuals and the welfare of society as a whole.

The level of health insurance chosen by individuals has different implications for individual welfare and for overall social welfare. First, for individual welfare, the authors find that if individual consumers purchase less health insurance, then their welfare is enhanced. This is a result not unlike what many other authors in this area have found; consumers purchase too much health insurance. The presence of monopoly power is not enough to counteract the effects of moral hazard. The results for overall social welfare stand in contrast to the results for individual welfare. In the overall social welfare case, the authors find that if individuals consumers purchase less health insurance, then overall social welfare is decreased. In this case the losses to the monopoly producer outweigh the benefits to consumers. It is this result that can give pause to policymakers. If policymakers choose to increase the level of health insurance enjoyed by individual consumers, then they are implicitly valuing the welfare of individuals over the welfare of monopolistic producers, as society could be better off as a whole if individual consumers were covered by a lower level of health insurance.

It is primarily from where Wigger and Anlauf (2007) ends that this paper is launched. One of the limitations of their, and others', analysis is that the healthcare good is a homogeneous good. This paper will analyze the interaction of market power and moral hazard in the context of differentiated goods, meaning that cross-price effects will come into play as alluded to earlier. This is a new contribution to the existing literature as no other paper (to existing knowledge) incorporates differentiated goods (pharmaceuticals) into a theoretical model. Another limitation of the analysis of Wigger and Anlauf (2007) is that lesser degrees of market power are not considered. This paper incorporates duopolistic competition into the drug market to analyze how different levels of market power interact with moral hazard. The consideration of differentiated goods produced by two firms yields new and intriguing insights into the analysis of market power and moral hazard.

3.3 The Model

The analytical framework developed in this paper follows basically from the model of Wigger and Anlauf (2007) with the primary difference being that there are two differentiated goods in the drug market. The presence of two differentiated goods means there will be heterogeneous products (drugs) and there will be two arguments in the loss function as part of the individual's utility function.

The economy in the model is made up of a unit-measure continuum of initially identical individuals. Each individual has the potential to experience illness with probability $\pi \in (0,1)$. The probability of becoming ill is independently distributed across all individuals. If an individual becomes sick he/she can consume two differentiated drugs, denoted as *x* and *y*, to reduce his/her loss from becoming sick. Each individual has the opportunity to purchase insurance to reduce the risk of drug expenses in the event an individual becomes ill.

The expected utility for an individual is given by

$$Eu = \pi U\left[I - z - l - \lambda\left(p_x x + p_y y\right)\right] + \left(1 - \pi\right)U\left[I - z\right], \tag{1}$$

where U denotes a von Neumann-Morgenstern utility function with $U' > 0$ and $U'' < 0$, I is the individual's disposable income, z is the insurance premium, x and y are the quantities of each drug consumed in the case of illness, p_x and p_y are the respective prices of each drug and λ is the coinsurance rate. Thus, λ is the fraction of drug expenditures the individual is responsible for, and as a result $\lambda\left(p_x x + p_y y\right)$ is the out-of-pocket drug expenditures for the individual.

The loss that an individual experiences when ill is equivalent to l currency units. The loss an individual experiences from illness can be reduced by consuming the two drugs. Thus l is a function of x and y and can be written as $l = l(x,y)$. As stated by Wigger and Anlauf (2007), this loss specification rules out any ex post income effects of a change in the drug price on drug demand and, allows for only for ex post substitution effects.

The function l will be assumed to be smooth and to satisfy the following monotonicity, convexity and Inada assumptions:

$$l > 0,\ l_x < 0,\ l_y < 0,\ l_x(0) = -\infty,\ l_y(0) = -\infty,\ l_{xx} > 0,\ l_{yy} > 0.$$

These assumptions ensure an interior solution for the quantity of each drug and imply that diminishing marginal benefits to each drug's consumption in restoring an individual's health occur.

There exists a perfectly competitive insurance market which ensures that the profits to insurance companies are zero. The nature of the loss function *l* is known only to each individual. This means that the insurance contract entered into by individuals and insurers will depend only on drug expenses $\lambda(p_x x + p_y y)$ and not on the loss function *l*. The insurance premium for each individual in the economy, assuming no administrative costs, is given by

$$z = \pi(1-\lambda)(p_x x + p_y y). \tag{2}$$

Each drug is produced by one firm. These two firms together form the duopoly in the marketplace. Each firm produces drugs with a constant marginal cost of *c*. Ignoring fixed costs (they are immaterial for the pricing decision), the profit for a firm is given by
the following:

$$m_i = \pi(p_i - c)i\,,\; i = x, y\,, \tag{3}$$

as π individuals will become ill and demand drugs.

There will be four stages in the game, three of which will be solved. The sequence of events that is used is 1) individuals and insurers agree on insurance contracts and choose *z* and *λ*, 2) each firm sets the price for its drug, 3) nature chooses which individuals are ill and which individuals are healthy, and 4) individuals that have become ill choose the quantity of drugs they will consume.

3.4 The Market Equilibrium

According to game theory, backward induction will be used to determine the equilibrium that results in the economy. This means we will first solve for individuals' drug demand, then solve each duopolist's pricing decision and finally we will solve the insurance problem for each individual.

3.4.1 Drug Demand

Once nature has chosen which individuals are healthy and which individuals are sick, the healthy individuals will choose to consume no drugs. Considering equation (1) each individual that has become ill will solve the following optimization problem

$$\max_{x,y\geq 0} U\lfloor I - z - l(x,y) - \lambda(p_x x + p_y y)\rfloor$$

where z, λ, p_x and p_y are taken as given by each individual in the fourth stage as they have been determined earlier. I is assumed to be sufficiently large enough so the first-order conditions are

$$-l_i(x,y) - \lambda p_i = 0,\ i = x,y. \tag{4}$$

These first-order conditions show that the out-of-pocket price paid by an individual for each drug will equal the marginal reduction of the loss from illness that consuming an extra unit of that drug. From the first-order condition it can also be seen that the ratio of the prices for the two drugs will equal the ratio of the marginal reductions of the two drugs. By using the implicit function theorem, we can see that Equation (4) implies demand functions of the forms $x = x(\lambda p_x, \lambda p_y)$ and $y = y(\lambda p_x, \lambda p_y)$ that satisfy the following conditions:

$$x_1 = -\frac{1}{l_{xx}} \tag{5}$$

and

$$y_2 = -\frac{1}{l_{yy}}. \tag{6}$$

Given that there are no *ex post* income effects, these conditions show that x negatively depends on the out-of-pocket prices λp_x and λp_y.

3.4.2 Duopoly Pricing

At the second stage of the game each duopolist chooses its profit maximizing price p_x or p_y. Each duopolist will take the appropriate drug demand into account from Equation (4) from the fourth stage. The duopolists will thus solve

$$\max_{p_i} \; m_i = \pi(p_i - c)i(\lambda p_i, \lambda p_j) \quad i, j = x, y \text{ and } i \neq j .$$

The duopolists will take the coinsurance rate λ as given when choosing the drug prices. The first-order conditions are

$$(p_x - c)\lambda x_1 + x = 0 \tag{7}$$

and

$$(p_y - c)\lambda y_2 + y = 0 , \tag{8}$$

where $x_1 = \dfrac{\partial x}{\partial p_x}$ and $y_2 = \dfrac{\partial y}{\partial p_y}$. Clearly $p_i > c$ to ensure that firms enter into the market. Although, not necessary for production, it will be assumed that $\lambda p_i > c$. This assumption will be used in the social welfare analysis. This gives a minimum level of market power firms will have. This could also be thought of a minimum margin level firms need to entice them to undertake earlier research and development for the drugs they produce.

Equations (7) and (8) define p_x and p_y as implicit functions of the coinsurance rate λ. Implicitly differentiating these two equations gives

$$\frac{dp_x}{d\lambda} = -\frac{(p_x - c)(\lambda p_x x_{11} + x_1) + p_x x_1}{(p_x - c)\lambda^2 x_{11} + 2\lambda x_1} \tag{9}$$

and

$$\frac{dp_y}{d\lambda} = -\frac{(p_y - c)(\lambda p_y y_{22} + y_2) + p_y y_2}{(p_y - c)\lambda^2 y_{22} + 2\lambda y_2}, \tag{10}$$

where $x_{11} = \frac{\partial^2 x}{\partial p_x^2}$ and $y_{22} = \frac{\partial^2 y}{\partial p_y^2}$. In analyzing the signs of equations (9) and (10), we assume that *x* and *y* are sufficiently small. This is equivalent to assuming the demand functions are not too convex. In their analysis Wigger and Anlauf (2007) simply assume that the x and y away, implying a linear demand function. It is highly unlikely (probably impossible) that linear demand functions will result from the specifications that have been given. As a result, I will make the less restrictive assumption that the demand functions are not too convex. After this assumption is applied, it follows that both (9) and (10) are negative. It also follows that $\left(\frac{dp_i}{d\lambda} + \frac{p_i}{\lambda}\right) > 0, i = x, y$.

3.4.3 Insurance Choice

The first stage where insurance contracts are determined can now be solved. Individuals choosing their coinsurance rate take into account their demand for drugs as given by Equation (4). Each individual also takes the prices set by the duopolists as fixed. Since there are a large number of individuals, each individuals effect on the drug price is negligible and thus has no influence on the drug price. Each individual will thus solve optimization problem given by

$$\max_{0 \le \lambda \le 1} \{\pi U[I - \pi(1-\lambda)(p_x x + p_y y) - l(x(\lambda p_x, \lambda p_y), y(\lambda p_x, \lambda p_y)) - \lambda(p_x x + p_y y)]$$
$$+ (1-\pi) U[I - \pi(1-\lambda)(p_x x + p_y y)]\},$$

given the drug price p. The first-order condition that results from maximizing expected utility is given by

$$\left[\pi U_S' + (1-\pi)U_H'\right]\left[\pi\left(p_x x + p_y y\right) - \pi(1-\lambda)\left(p_x^2 x_1 + p_x p_y x_2 + p_y^2 y_2 + p_x p_y y_1\right)\right]$$
$$- \pi U_S'\left(p_x x + p_y y\right) \begin{matrix}\geq \\ = \\ \leq\end{matrix} 0 \quad \text{with} \leq 0 \text{ if } \lambda = 0, = 0 \text{ if } 0 < \lambda < 1, \text{and} \geq 0 \text{ if } \lambda = 1, \tag{11}$$

where U_S' and U_H' are the marginal utilities of income when an individual is ill and healthy, respectively.

The first-order condition describes the trade-off between the extra utility that comes from a lower insurance premium and the extra utility that comes from reduced risk. It can be shown that an individual will choose a level of insurance so that $\lambda \in (0,1)$. This will cause the first-order condition to be equal to 0. First assume an individual selects λ= 0. In this case each individual enjoys full insurance when they become ill. As a result the individual would pay nothing for drugs when he/she is ill. Under this situation the price of each drug and quantity of each drug would find no limit and there would be no equilibrium if $\lambda = 0$.

Now we can assume that $\lambda = 1$. In this case the individual is responsible for all of the expense of drugs when ill and receives no assistance from the insurer. In this case the first-order condition (8) reduces to $-\left(U_S' - U_H'\right) \geq 0$. When an individual has no insurance, this means that the marginal utility of income when ill is going to be higher than the marginal utility of income when sick, or $-\left(U_S' - U_H'\right) < 0$, which is a contradiction to the reduced (8). Therefore, an individual will choose a coinsurance rate which is less than 1.

The results from solving the three stages of the game we have solved summarize the conditions that occur at market equilibrium. The coinsurance rate that occurs at market equilibrium is $\hat{\lambda}$ and will satisfy $0 < \hat{\lambda} < 1$. The market equilibrium is also characterized by the insurance contract $(\hat{\lambda}, z(\hat{\lambda}))$, the drug prices $p_x(\hat{\lambda})$ and $p_y(\hat{\lambda})$ and the quantities of drugs

$x(\hat{\lambda}\, p_x(\hat{\lambda}), \hat{\lambda}\, p_y(\hat{\lambda}))$ and $y(\hat{\lambda}\, p_x(\hat{\lambda}), \hat{\lambda}\, p_y(\hat{\lambda}))$.

3.5 Welfare Analysis

Once the economy is at equilibrium, we can analyze how a change in the coinsurance rate λ from its equilibrium level $\hat{\lambda}$ will affect the welfare of individual consumers and society as a whole. Individual consumer welfare is concerned only with the welfare of the individuals in the economy, whereas social welfare will combine the individuals welfare with the profits the producers of drugs enjoy.

In order to analyze the changes in consumer welfare we will impose the assumption of symmetry on the loss function. When this is done, we have the following results at equilibrium

$$x = y = x^*, \tag{12}$$

$$x_1 = y_2 = x_o, \tag{13}$$

$$x_2 = y_1 = x_c, \tag{14}$$

$$\frac{dp_x}{d\lambda} = \frac{dp_y}{d\lambda} = \frac{dp^*}{d\lambda} \tag{15}$$

where $x_2 = \frac{\partial x}{\partial p_y}$, $y_1 = \frac{\partial y}{\partial p_x}$, x^* is equilibrium production for each firm, x_o is the own-price effect for each drug and x_c is the cross-price effect for each drug.

3.5.1 Individual Consumer Welfare

The effects on individual consumer welfare for a change in coinsurance can now be examined. In order to determine the effects on individual consumer welfare equation (1) will be differentiated while considering equations (2), (4), (7), (8), (11), (12), (13) and (14). The effect on individual consumer welfare of a marginal change in coinsurance, when $\lambda = \hat{\lambda}$, is

$$\left.\frac{dEu}{d\lambda}\right|_{\lambda=\hat{\lambda}} = -\pi\, T\, \frac{dp^*}{d\lambda}\left(2x^* + (1-\hat{\lambda})\,p^* x_c(\lambda p^* + c)\right), \qquad (16)$$

where $T = \left[\pi\, U_S^{'} + (1-\pi)U_H^{'}\right]$.

It follows from equation (16), that for the case of substitutes, the sign is unambiguously positive. This indicates that as the level of health insurance is decreased, due to an increase in the coinsurance rate λ, the level of welfare for an individual consumer increases. The $2x$ component represents an equivalent component to the case of the change in individual welfare for a change in health insurance for a monopoly producer. This effect is likely larger for duopoly as $2x$ represents the total market size for duopoly and x (the monopoly equivalent in the equation) is the market size for monopoly (likely smaller than the market size for duopoly). There is also the second interaction effect that adds to welfare enhancement when health insurance is lowered for the case of substitutes. This is a reflection of the presence of additional moral hazard when more firms enter the market to produce substitute drugs. The overall result is consistent with the results of Wigger and Anlauf (2007) except that the effect is likely larger in the case of duopoly. This result points to the idea that if policymakers desire to increase the welfare of individual consumers for the case of the two goods being substitutes, then increasing the level of health insurance coverage is not the policy to pursue.

In the case of complements, the interaction effect of the two goods serves to offset the welfare enhancement of a decrease in health insurance coverage. It is also possible that if this interaction effect is large enough (in absolute value) that it could outweigh the moral hazard effect and make an increase in health insurance coverage welfare increasing. This case points to the idea that there can be benefits for individual consumers' welfare for an increase in health insurance coverage if the drugs in a market are complements to one another.

The nature of the welfare effects for individual consumers for the case of complements arises from the synergies between the two drugs in the market. The increased health insurance coverage acts to stimulate consumption of both drugs that enhances utility to a different degree than the case for substitutes. This synergism in the utility function drives an increase in insurance coverage to have a welfare enhancing component to the overall effect on individual welfare.

The existence of complements in a pharmaceutical market does not have to be implausible. Many (and probably most) cases of drug markets involve drugs that are substitutes. Tylenol, Advil and Aleve are examples of substitutes in the pain relief market. There are cases where drugs may be complements. We can consider two different cases: (1) a non-prescription market, the bone loss prevention market and (2) a prescription market, the cholesterol reducing market.

In the bone loss prevention market we can consider two supplements that can be used to help prevent bone loss. These two supplements are calcium and vitamin D. A consumer can choose either calcium or vitamin D to help promote bone formation or prevent bone loss. What makes these two drugs complements is the nature of the way they work. Calcium works by being a necessary building block in bone structure and vitamin D works by promoting the absorption of calcium in the digestive tract. If a consumer chooses to use both calcium and vitamin D, the two supplements will work together and produce an exponentially greater result.

In the cholesterol reducing market, we can consider the two drugs Zetia and Zocor. Each one of these can be used individually to treat high cholesterol. Again, though, each drug works through a different mechanism. Zetia works in the digestive tract and prevents the absorption of cholesterol. Zocor is a statin drug and thus works by preventing the formation of cholesterol in the liver. Compared to being used alone, these drugs are much more effective when used in combination with each other. The effects are so strong, in fact, that there is a drug that combines the two together into one pill. This drug is Vytorin. It is not a unique pharmaceutical, but simply a combination of Zetia and Zocor. If the price of Zocor were to increase, then the cost of Vytorin would increase and lead to a decrease in the demand for Vytorin. The demand for Zetia would also fall as a result, indicating complementary goods.

The effects of a change in insurance coverage are shown to depend on the nature of the price interactions of two drugs in a market. For the case of substitutes, an increase in the level of insurance coverage is welfare decreasing, while a decrease in the level of insurance coverage is welfare enhancing. The effects of a change in insurance coverage for complements are not as clear cut as the case for substitutes. If the drugs in a market are complements, this serves to enhance welfare for an increase in insurance coverage, while it decreases welfare for a fall in insurance coverage. The welfare effects for complements work in the opposite direction of a moral hazard component that is equivalent to the change in welfare for the monopoly case. The overall effect on welfare, for the case of complements, will thus be determined by the relative sizes of the two effects.

3.5.2 Social Welfare

The effects on social welfare for a change in coinsurance can also now be examined. The way this will be done, similar to Wigger and Anlauf (2007), is to add profits from the two firms into the expected utility equation for individuals. This will be done by distributing the profits in a lump-sum manner to individuals. The expected utility function for an individual in this case will be

$$Eu = \pi U\left[I + m_x + m_y - z - l - \lambda\left(p_x x + p_y y\right)\right] + (1-\pi)U\left[y + m_x + m_y - z\right].$$

Now z, m_x and m_y can be substituted for using Equations (2) and (3), and Eu becomes

$$Eu = \pi U\left[I - \pi\, c(x+y) - (1-\pi)\lambda\left(p_x x + p_y y\right) - l\right]$$
$$+ (1-\pi)U\left[y - \pi\, c(x+y) + \pi\lambda\left(p_x x + p_y y\right)\right]. \tag{17}$$

Equation (17) will now be differentiated considering equations (4), (7), (8), (11), (12), (13) and (14). The overall effect on social welfare for a marginal change in coinsurance when $\lambda = \hat{\lambda}$ is

$$\left.\frac{dEu}{d\lambda}\right|_{\lambda=\hat{\lambda}} = \pi\, T\, \hat{\lambda}\left(\frac{dp^*}{d\lambda} + \frac{p^*}{\lambda}\right)\left(2(p^* - c)x_o - \hat{\lambda}(p^* - c)(1-\hat{\lambda})\left(\frac{p^*}{x^*}\right)x_o x_c + 2(\hat{\lambda}\, p^* - c)x_c\right) \tag{18}$$

where $T = \left[\pi\, U_S^{'} + (1-\pi)U_H^{'}\right]$.

For the case of social welfare, the effect of a change in the level of insurance coverage will depend upon whether or not the drugs are substitutes or complements. For the case of complements, the sign of the change in welfare will be unambiguously positive. The first term of equation (18), $2(p-c)x_o$, is equivalent to the result obtained under monopoly. This term is the result of the increase in profits for the firms in the industry outweighing the decrease in welfare from moral hazard. The second term from equation (18) adds to the welfare increase for complements due to the synergistic effects, similar to the results from the change in individual consumer welfare for a change in insurance levels. The third term accounts for the level of market power firms in the drug industry have. By assumption, $(\lambda p - c)$ is positive, meaning that firms have a substantial amount of market power. With this much market power, individual consumers still benefit from this when the level of insurance coverage is increased. The fact that all of the components of the welfare effect are negative means that an increase in the level of insurance leads to an increase in social welfare for the case of complements.

The results for the case of substitutes do not reveal an unambiguous change in social welfare when the level of insurance is altered. The sign of the second and third components are the opposite of the signs when the two drugs are complements. In this case the second component reduces welfare (as its equivalent did for individual consumer welfare) as moral hazard is exacerbated when there are a greater number of firms in the market. The third term of equation (18) reflects the idea that when market power is substantial enough, an increase in insurance levels adds to the reduction in social welfare for the case of substitutes. The overall change in welfare, for drugs that are substitutes, will thus depend upon whether or not the first component outweighs the second component and third component. If the cross-price components are significantly large, social welfare will increase for a decrease in insurance coverage by outweighing the losses to profits for the pharmaceutical industry. If the losses to industry profits are large enough, then social welfare will decrease for a decrease in insurance coverage. The opposite will be true for an increase in insurance coverage. If the losses to industry profits are large enough, social welfare will increase for an increase in insurance coverage, and if the cross-price components are larger, then social welfare will decrease for an increase in insurance coverage.

3.6 Conclusions

The results obtained in this paper provide new insight into the interaction of moral hazard and market power in healthcare markets. The introduction of imperfect competition in the form of duopoly with differentiated goods alters the outcome when compared to the previous literature. When differentiated goods, rather than identical goods, are produced by drug makers, cross-price effects enter into the welfare change equations for both individual consumer welfare and for social welfare. The changes cross-price-effects introduce into the welfare change equations for a change in insurance coverage provide evidence that consideration of these cross-price effects in the changes in welfare for a change in insurance coverage is important for policymakers as they consider substantial changes to the health system in the United States.

One consideration for policymakers is whether or not to make policy decisions based on the welfare of individual consumers or to include drug makers' profits in policy decisions and examine social welfare. Another important consideration for policymakers is whether or not healthcare goods are substitutes or complements. While there may be markets for each case, policymakers may have to decide which case is more widely present or if they can try and tailor policy to address the unique composition of each market.

In the case of substitutes, an increase in the level of insurance coverage decreases the level of welfare for individual consumers. This result is consistent with the results of the existing literature and confirms the results for differentiated goods that are substitutes produced under duopoly. Wigger and Anlauf (2007) also address the effects of changes in insurance coverage on drug producer profits and incorporate these effects into a change in social welfare for a change in insurance coverage. Contrary to their results , the findings in this paper show that social welfare will not always decrease for a decrease in insurance coverage. The reason the findings are different is that in the case of differentiated goods, cross-price effects present themselves in the change in social welfare equation. These cross-price effects are obviously not going to be present in the case of monopoly. The cross-price effects serve to mitigate losses to profits of drug makers, or if the cross-price effects are large enough, outweigh losses to the profits of drug makers.

The change in individual consumer welfare for the case of complementary differentiated goods incorporates a cross-price effect that alters the result for a change in insurance coverage. The cross-price effect yields a component that has the opposite sign from the moral hazard component of the change in individual consumer welfare. At the very least, this cross-price effect will attenuate the moral hazard effect. If the cross-price effect is significantly large, it will outweigh the moral hazard effect. As a result an increase in insurance coverage will yield a decrease in individual consumer welfare that is reduced or, if the cross-price component is large enough, will yield an increase in consumer welfare. The change in social welfare for the case of complements yields a result that is consistent with the existing literature. For social welfare the cross price effects possess the same sign as the industry profit component. Consequently, an increase in insurance coverage will increase social welfare and a decrease in insurance coverage will decrease social welfare.

The findings of this paper have shown the importance of the consideration of whether or not drugs are substitutes or complements for policymakers. The importance of these effects has been shown in the case of a duopoly market structure. Areas of future research to improve the information available to policymakers include expanding production in the model to more than two firms as there are cases where more then two drugs are produced in a single disease treatment market. Also, given that the sizes of different components in the changes in individual consumer welfare and social welfare is important, estimation of the sizes of these components will provide even further insight for policymakers in determining the future course of healthcare policy in the United States. Primarily, the size of the own-price effect and the size of the cross-price effect would need to be estimated. The other variables and parameters that make up the welfare change equations are relatively observable. Therefore, if the own-price and cross-price effects can be estimated, these estimations can be combined with the observed terms to determine the sign of welfare changes for changes in insurance coverage for different markets.

The future of healthcare in the United States is one of the most widely debated topics in the halls of Washington, D.C. and in the living rooms of Americans. This paper has shown for the first time that the nature of individual drug markets is important to consider when developing national healthcare policy. These differences will yield different results for the welfare of individual consumers and society as a whole when the level of insurance coverage for consumers is changed.

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