

KEIO UNIVERSITY
MARKET QUALITY RESEARCH PROJECT
(A 21st Century Center of Excellence Project)

KUMQRP DISCUSSION PAPER SERIES

DP2003-15

Herd Behavior, Network Externalities,
and Marginal Cost Dumping

Makoto Yano* and Fumio Dei**

Abstract

In many cases, dumping involves a large-scale demand shift from domestic products to competing foreign products that are newly introduced to the domestic market. This study demonstrates that if such a demand shift to a new product is accompanied by herd behavior and/or network externalities, the monopolistic exporter of a new product may sell at a price below the marginal cost, i.e., engage in marginal cost dumping.

* Department of Economics, Keio University
** Graduate School of Business Administration, Kobe University

Herd Behavior, Network Externalities, and Marginal Cost Dumping

Makoto Yano

Department of Economics

Keio University

myano@econ.keio.ac.jp

Fumio Dei

Graduate School of Business Administration

Kobe University

dei@kobe-u.ac.jp

Acknowledgements

We wish to thank Ron Jones, Toru Kikuchi, and Takeyoshi Ohgai for useful conversations. We gratefully acknowledge that an earlier version of this paper was presented at the First International Conference on Recent Advances in International Economics held at the City University of Hong Kong, March 11-14, 2002. This study is in parts supported by grants from the Ministry of Education, Science, Sports and Culture and from the Nomura Foundation for Social Science.

Abstract

In many cases, dumping involves a large-scale demand shift from domestic products to competing foreign products that are newly introduced to the domestic market. This study demonstrates that if such a demand shift to a new product is accompanied by herd behavior and/or network externalities, the monopolistic exporter of a new product may sell at a price below the marginal cost, i.e., engage in marginal cost dumping.

1 Introduction

In many cases, dumping involves a massive demand shift from domestic products to competing foreign products that are newly introduced to the domestic market.¹ To domestic producers, such a massive demand shift often appears to be that foreign competitors dump their products in a large quantity into the domestic market, thereby taking away the demand for domestic products. Although dumping cases very often arise in such circumstances, the role of a large-scale demand shift in dumping has not been examined in the existing literature.²

This study demonstrates that if a large-scale demand shift to a new product is accompanied by consumption externalities, it may result in “marginal

¹A list of examples is TVs, microwave ovens, portable electric typewriters, cars and textiles.

²The U.S. government’s ruling in 1971 that Japanese TVs were dumped into the U.S. market is a good example evidencing these facts. During the second half of the 1960s, a large number of U.S. consumers shifted from a black-and-white TV to a color TV. This fact is indicated by the facts (1) that the percentage of the U.S. households that owned at least one black-and-white TV decreased from 89.6 in 1963 to 64.6 in 1969 and (2) that the percentage of the households that owned at least one color TV increased from 1.7 percent in 1963 to 30.4 percent in 1969 while that which owned more than one color TV was only 0.02 in 1963 and 1.5 in 1969 (see Porter, 1983, p.480). These facts show the demand switch that took place in U.S. consumers. During the same period, (3) the share of Japanese color TVs in the U.S. market increased drastically; it was 0% in 1963, 4% in 1966, 11% in 1968 and 15% in 1969 (see Schwartzman, 1993, p.111). This together with the increase in Japanese black-and-white TV exports prompted the U.S. government’s ruling of dumping (see Ohgai, 1998).

cost dumping,” by which an exporting firm sells its product at a price below the marginal cost. As is emphasized in the literature on herd behavior and network externality, newly developed products tend to have the property that an increase in the total number of users creates external economies for individual users (Katz and Shapiro (1985)). This study builds a model in which a large-scale demand shift is accompanied by consumption externalities, encompassing both herd effects and network externalities. It demonstrates that if consumption externalities are present, a firm faces a mountain-shaped demand curve and that this gives rise to marginal cost dumping.

This study is closely related to Becker (1991). Although his study is not concerned with dumping, it demonstrates that if sufficiently strong external economies are present on the consumption side, they may result in a mountain-shaped demand curve. Our result makes a sharp contrast with Becker’s result in demonstrating that no matter how small consumption external economies are, a mountain-shaped demand curve may emerge, thereby causing marginal cost dumping.

This establishes a strong case for the emergence of marginal cost dumping in the case in which a large-scale demand shift takes place in association with the introduction of a new product. In the literature on dumping, at least three types of dumping have been examined: marginal cost dumping, average cost dumping, and price discrimination dumping. Price discrimination dumping refers to the state in which foreign producers sell their products at a price lower in the domestic market than in the foreign market (see, for example, Viner, 1923). Average cost dumping refers to the state in which they sell

their products at a price below their average cost (see, for example, Ethier, 1982, and Clarida, 1993). In the existing literature, it has been demonstrated that an exporting firm may engage in marginal cost dumping in a particular phase of its business in order to acquire gains in other phases.³ This study, in contrast, demonstrates that a firm, facing consumption externalities, may employ marginal cost dumping as a direct means of profit maximization.

In many cases in which dumping takes place in association with the introduction of a new product, the demand is influenced by both herd behaviors and network externalities, which refer to slightly different phenomena from each other. On one hand, herd effect implies external economies that are attributable to psychological and behavioral factors in consumption decisions. On the other hand, network externality refers to those that are attributable to technical properties of certain goods and services (such as telephone, some types of software, banking services, etc.), the use of which requires a development of a network of users. Both types of consumption externalities may emerge in a large-scale demand shift to a new product and in a dumping accompanied by the introduction of a new product.⁴

³Davies and McGuinness (1982) focus on uncertainty in export prices, sales maximizing firms and entry deterrence as a cause of marginal cost dumping. Gruenspecht (1988) points out that the exporters may cut prices in expectation of obtaining market experiences. Yano (1989) demonstrates that if expectations are created such that a future imposition of voluntary export restraint is likely, it drives the exporters to increase the amount of export before the restraint is actually imposed. Anderson (1992) shows this can lead to marginal cost dumping.

⁴For example, in a dumping case in which foreign producers introduce a product cheaper than competing home products, an increase in the number of users of that foreign product

The literature on herd effects and network externalities has been expanding rapidly, in particular in the field of finance.⁵ In the trade literature, however, such effects are examined by only a small number of studies, which focus on external economies that exist in telecommunications and other network technologies.⁶

In what follows, in Section 2, we introduce a model of a demand shift to a new product. In Section 3, we demonstrate that, facing consumption externalities, a firm may sell its product at a price below its marginal cost. In Section 4, we explain a process in which marginal cost dumping and price discrimination dumping (the phenomenon that a foreign producer sells at a lower price in a country to which it exports than in its own country) occur at the same time.

2 Demand Shift and Consumption Externalities

In this section, we construct a model capturing the process in which consumers switch their demands from an existing product to a newly introduced

may reduce consumers' psychological aversion against new products (herd effects) and/or enhance the use of that product by enabling sellers to build a better network of distribution services (network externalities). We build a model that covers both types of externalities.

⁵For a nice recent survey, see Bikhchandani and Sharma (2001).

⁶See Harris (1995), who initiates such a line of research, and Kikuchi and Ichikawa (2002) and Kikuchi (2003), who extend Harris's work.

product. We incorporate herd behavior and/or network externalities into that model.

Think of a market in which an existing product is sold. Call the existing product H . Assume that a single firm f introduces a new product, product F , to the market and supplies it monopolistically. For the moment, it is not necessary to specify the country origin of firm f . The total cost function is $TC = c(y)$, where y is the output of firm f . Let p be the price of product F . Firm f maximizes its profit by choosing output y and price p subject to the demand condition specified below.

Assume that an individual consumer switches his demand at the point at which he can obtain a larger consumer surplus by purchasing the new product than by sticking with the existing one; no consumer purchases both H and F at the same time. For the sake of simplicity, assume that product H is sold at a given price in the perfectly competitive fashion. An individual consumer can obtain a consumer surplus of size s_H if he buys the existing product. Let $ew(x)$ be an individual consumer's total willingness to pay for x units of product F , where e captures the level of external economies on the consumption side, representing herd effects and network externalities. Assume $w(0) = 0$, $w'(x) > 0$, and $w''(x) < 0$. When a consumer purchases x units of F , his consumer surplus is $s_F = ew(x) - px$.

Assume that there is a continuum of identical consumers the total mass of whom is equal to 1. Under this assumption, the market demand is equal to an individual consumer's demand, x .

Assume that consumption externality e non-negatively depends on the

fraction of consumers who switch their demands to F , r . It also depends on the shift parameter η that captures the strength of herd effects and network externalities. Express $e = e(r, \eta)$, and assume that $e(r, \eta) > e(r', \eta)$ for $\eta > 0$ if $r > r'$ and that $e(r, \eta) > e(r, \eta')$ for $r > 0$ if $\eta > \eta'$. Assume $e(0, \eta) = 1$, which implies that if all the consumers stay with product H (i.e., if $r = 0$), parameter η does not affect the level of consumption externalities, e . Assume, moreover, $e(r, 0) = 1$ for all r , which implies that if $\eta = 0$, there are no consumption externalities.

3 Pricing below Marginal Cost

In the above setting, it is possible that a firm is not willing to sell as much as the buyers desire to purchase at the price the firm sets. In order to incorporate this possibility into the model, denote by y the amount that firm f sells and by x the amount that the buyers desire to purchase.

Assume that if $y < x$, $100(1 - y/x)$ percent of the consumers cannot purchase product F . In that case, every consumer has an equal chance to be able to purchase F ; that is, the probability with which an individual buyer wishes and can purchase F is

$$r = y/x \leq 1. \quad (1)$$

If a consumer can actually purchase product F , his consumer surplus is $s_F = e(r, \eta)w(x) - px$. If he cannot purchase F , he has no other choice than to purchase product H and to obtain consumer surplus s_H . Thus, a consumer's

expected consumer surplus is

$$E(s) = r[e(r, \eta)w(x) - px] + (1 - r)s_H. \quad (2)$$

Assume, in this case, that an individual consumer is willing to shift his demand from H to F if the expected consumer surplus from shifting, $E(s)$, is larger than or equal to not shifting, i.e., if

$$E(s) \geq s_H. \quad (3)$$

Assume, moreover, that an individual consumer chooses his demand for x so as to maximize $E(s)$, while taking the values of r and p as given by firm f . Thus, it follows from (2) that his demand x is determined by

$$e(r, \eta)w'(x) = p. \quad (4)$$

Under these constraints, firm f 's optimization problem is to maximize its profit. That is, it chooses y , x , p and r so as to maximize

$$\pi = py - c(y) \quad (5)$$

subject to (1) through (4). That the optimal quantity is positive implies that firm f starts selling product F . As is shown below, this implies that the sale of product F starts if firm f can induce a sufficiently large number of consumers to decide to shift their demands from H to F .

In order to characterize the solution to this optimization problem, by using (1) and (4), express x as a function of y , p , and η , $x = g(y, p, \eta)$. By using this function, the constraints of optimization, (1) through (4), can be

transformed into the following form.

$$g(y, p, \eta) - y \geq 0; \quad (6)$$

$$e\left(\frac{y}{g(y, p, \eta)}, \eta\right)w(g(y, p, \eta)) - pg(y, p, \eta) \geq s_H. \quad (7)$$

Condition (6) may be called the quantity constraint, which implies that firm f can sell at most as much as the buyers demand, $x = g(y, p, \eta)$, at the price it sets, p . Condition (7) may be called the incentive constraint, which implies that firm f must guarantee each individual buyer a consumer surplus at least as much as that which the buyer can obtain by purchasing product H .

The boundary of quantity constraint (6), which we call the quantity boundary, is given by

$$e(1, \eta)w'(x) = p \quad (8)$$

and corresponds to an individual consumer's demand curve in the case in which all consumers have shifted their demands to product F , i.e., $e = e(1, \eta)$. In Figure 1, the quantity boundary is shown by curve $e(1, \eta)w'$; the region in which (6) is satisfied is on and below curve $e(1, \eta)w'$. Figure 1 depicts by curve w' an individual consumer's demand curve in the case in which no consumer has yet shifted his demand to product F , i.e., $e = e(0, \eta)$.

The boundary of incentive constraint (7), which we call the incentive boundary, can be denoted as

$$p = P(y, \eta), \quad (9)$$

which is illustrated by curve PN . The vertical intercept of this boundary, point P in Figure 1, is given by the $p = p_0$ satisfying

$$w(x(p_0)) - p_0x(p_0) = s_H, \quad (10)$$

where $x = x(p)$ is defined by $w'(x) = p$. This shows that, in Figure 1, p_0 is determined at the level at which the consumer surplus derived from demand curve w' is equal to s_H . The intersection between the quantity boundary and the incentive boundary, point N in Figure 1, is determined at the $p = p_1$ satisfying

$$e(1, \eta)w\left(x\left(\frac{p_1}{e(1, \eta)}\right)\right) - p_1x\left(\frac{p_1}{e(1, \eta)}\right) = s_H. \quad (11)$$

This shows that p_1 is determined at the level at which the consumer surplus derived from demand curve $e(1, \eta)w'$ is equal to s_H . Since $e(1, \eta) > e(0, \eta) = 1$ for $\eta > 0$, $p_1 > p_0$ if $\eta > 0$. This implies that curve PN must have an upward-sloping part if positive consumption externalities are present ($\eta > 0$).

The optimal (y, p) , denoted by (y_{opt}, p_{opt}) , is at the point at which an iso-profit curve, derived from (5), is tangent to the boundary of the feasible region, which is mountain-shaped. Firm f perceives this boundary as its demand curve. An iso-profit curve is, in general, U-shaped, and its bottom is on the marginal cost curve, $MC = c'(y)$. Moreover, the slope of an iso-profit curve is given by

$$\frac{dp}{dy} = \frac{c'(y) - p}{y}. \quad (12)$$

The fact that incentive boundary PN has an upward-sloping part implies that, as curve Π in Figure 1 shows, an iso-profit curve can be tangent to the feasible region on the upward-sloping part. In that case, as (12) shows, it is optimal for firm f to set its price p below the marginal cost. This case is shown by point (y_{opt}, p_{opt}) in Figure 1. This finding may be summarized as follows:

Proposition 1 *It is possible that the monopolistic seller of a new product*

sets its price below the marginal cost if the demand shift from the existing product to the new product creates a positive consumption externality.

In order to examine this result in detail, first, take the case in which there are no consumption externalities ($\eta = 0$). In this case, $e(r, 0) = 1$ for all r . The incentive boundary is a horizontal line through P , and the quantity boundary coincides with curve w' . This implies that if marginal cost curve MC intersects horizontal segment PM , it is optimal for firm f to set its price at p_0 and to sell an amount, \bar{y} , that is smaller than the buyers' demand \bar{x} at the price p_0 . If the marginal cost curve intersects the part of the quantity boundary below point M , it is optimal for firm f to sell as much as the buyers demand. This result may be summarized as follows:

Proposition 2 *In the case in which the market demand shifts from the existing product to a new product, it is possible for the monopolistic supplier of the new product to sell an amount smaller than that which the buyers demand, even if there are no consumption externalities.*

Recall that incentive boundary PN is a graph of $p = P(y, \eta)$. As the herd effect becomes stronger (i.e., as η becomes larger), $e(1, \eta)$ increases. This implies that p_1 increases. However, since $e(0, \eta) = 1$ stays constant, so does p_0 . This implies that, as η increases, incentive boundary PN rotates upwards around the vertical intercept, P . It may be proved that the slope of incentive boundary PN is

$$P_y(y, \eta) = \frac{(1 + \rho)x e_r w'' w'}{\rho x^2 e w'' + y e_r w'}, \quad (13)$$

where

$$\rho = \frac{xw'}{w - xw'} > 0. \quad (14)$$

Since $e(r, 0) = 1$ for all r by assumption, $e_r(r, 0) = 0$ for all r . Under the assumption that as $\eta \rightarrow 0$, $e_r(r, \eta)$ converges to $e_r(r, 0)$ uniformly over r (uniform convergence assumption), (13) implies

$$P_y(y, \eta) > 0 \text{ for all } y,$$

for any sufficiently small $\eta > 0$.⁷ Because, in this case, curve PN is upward-sloping everywhere, as shown by point (y_{opt}, p_{opt}) , the iso-profit curve tangent to curve PN , curve Π , must have a positive slope at the tangency.⁸

Proposition 3 *Provided that the assumption of uniform convergence is satisfied, no matter how small externalities are, the monopolistic seller of a new product sets its price below the marginal cost in an equilibrium in which it sells an amount smaller than that which the buyers demand.*

The results in this section are closely related to, but different in several important respects from, those of Becker (1991).

⁷For example, function $e(r, \eta) = \eta r + 1$ satisfies this condition.

⁸Yano (2001) considers the case in which herd effects appear only if all buyers shift their demands, i.e., $e(1) > e(r) = 1$ for all $r < 1$. In that case, the region in which (6) and (7) are satisfied at the same time consist of two parts. The first part is the part of curve $e(1)w'$ at or below point N . The second part is the region on and below segment PM and below curve w' . In this case, as Figure 1 illustrates, there is a large possibility with which the price is set below the marginal cost. Yano (2001) explains such a phenomenon by using a lexicographic shift of consumers' preference, when a new product is introduced.

The main result of this study is to demonstrate the possibility of marginal cost dumping, which can be attributed to the fact that a firm may face a mountain-shaped demand curve in the presence of consumption externalities. Becker demonstrates a similar possibility, although he is not concerned with dumping but with demonstrating the possibility that a firm chooses to sell less than what the buyers demand at the price at which the firm sets.

Becker (1991) demonstrates the possibility of a mountain-shaped demand curve for the case in which consumption externalities are sufficiently strong. This study, in contrast, demonstrates that no matter how small consumption externalities are, such a possibility exists if consumption externalities emerge in a large-scale demand shift to a newly introduced product.

This implies that no matter how small consumption externalities are, marginal cost dumping may occur in the case in which a foreign product is newly introduced into the domestic market. This establishes a strong case for the possibility of marginal cost dumping.

Becker (1991) demonstrates that a firm's optimal price is at the peak of a mountain-shaped demand curve, while this study demonstrates that it may appear on the upward-sloping part of such a demand curve. This difference emerges because Becker is concerned with the case in which an individual consumer's demand for a product is positively related only to the aggregate demand. This study, in contrast, is concerned with the case in which consumption externalities emerge not only from the aggregate demand, x , but also from the aggregate amount that the consumers can actually purchase, y .

4 Marginal Cost Dumping and Price Discrimination

The results in the previous section suffice in order to demonstrate the possibility of marginal cost dumping, for the above model can be interpreted as capturing the case in which a foreign exporter starts selling its product only in the home country. However, it may be of interest to examine a more standard case in which a foreign exporter sells in both its own country and the home country. In that case, as is demonstrated below, marginal cost dumping and price discrimination dumping can occur at the same time.

Think of a two-country model with countries H and F . Assume that firm f belongs to country F . That is, before firm f starts exporting product F to country H , product F is sold only in country F , and product H is sold only in country H . For the sake of simplicity, assume that product H will not be exported to country F even after firm f starts selling product F in country H . Because this implies that all the consumers in country F buy product F , it is not necessary to consider the case in which firm f sells in country F an amount y^* smaller than what country F 's consumers demand, x^* . Therefore, we may assume $x^* = y^*$. Let p^* be the price that firm f sells product F in country F .

In that case, firm f 's profit is

$$\pi = py + p^*x^* - c(y + x^*). \quad (15)$$

In country H , firm f faces the same demand constraints, (6) and (7), as in the case of the previous section, while it faces the standard demand condition

in country F , described by

$$x^* = D^*(p^*), \quad (16)$$

which is assumed to have the standard shape, as illustrated in the left-hand side panel of Figure 2. Firm f 's optimization problem is to maximize profit π , (15), subject to constraints (6), (7), and (16).

In order to solve this optimization problem, it is useful to note that, in Figure 1, the boundary of the feasible region, illustrated by the part of incentive boundary PN and quantity boundary $e(1, \eta)w'$ below point N , captures the relationship between firm f 's price, p , and the quantity that firm f can sell at that price, y . In other words, this boundary may be thought of as the demand curve that firm f faces. Because this demand curve is upward sloping between P and N , the corresponding marginal revenue curve lies above curve PN and is, in general, upward sloping. In Figure 2, this marginal revenue curve is illustrated by curve MR . In the case of the previous section, in which firm f sells only in country H , the optimal price can be determined at the intersection between the marginal cost curve, MC , and the marginal revenue curve, MR .

By using the marginal revenue curve, MR , the optimal price discrimination can be characterized in much the same manner as in the standard price discrimination. Only one difference is that the marginal revenue curve in country H is upward-sloping, because that in country F has the standard shape, as is shown by MR^* .

Firm f 's optimal strategy is determined at (y_{opt}, p_{opt}) and (x_{opt}^*, p_{opt}^*) , at which the marginal revenues are equated to the marginal cost in both

countries' markets and at which the sum of the quantities sold in the two countries is equal to firm f 's output, z_{opt} . This result may be summarized as follows.

Proposition 4 *In the case in which a new product is introduced into a country's market, marginal cost dumping may occur at the same time as price discrimination dumping if the demand shift from the existing product to the new product creates a positive consumption externality.*

References

- [1] Anderson, J., "Domino dumping, I: Competitive exporters," *American Economic Review*, 82-1, 1992, 65-83.
- [2] Becker, G., "A note on restaurant pricing and other examples of social influences on price," *Journal of Political Economy*, 99-5, 1991, 1109-1116.
- [3] Bikhchandani, S., and S. Sharma, "Herd behavior in financial markets," *IMF Staff Papers*, 47-3, 2001, 279-310.
- [4] Clarida, R., "Entry, dumping, and shakeout," *American Economic Review*, 83-1, 1993, 180-202.
- [5] Davies, S., and A. McGuinness, "Dumping at less than marginal cost," *Journal of International Economics*, 12-1/2, 1982, 169-182.
- [6] Ethier, W., "Dumping," *Journal of Political Economy*, 90-3, 1982, 487-506.

- [7] Gruenspecht, H., "Dumping and dynamic competition," *Journal of International Economics*, 25-3/4, 1988, 225-248.
- [8] Harris, R., "Trade and communication costs," *Canadian Journal of Economics*, 28-Special issue, 1995, S46-75.
- [9] Katz, M., and C. Shapiro, "Network externalities, competition, and compatibility," *American Economic Review*, 75-3, 1985, 424-440.
- [10] Kikuchi, T., "Interconnectivity of communications networks and international trade," *Canadian Journal of Economics*, 36-1, 2003, 155-167.
- [11] Kikuchi, T., and T. Ichikawa, "Congestible communications networks and international trade," *Canadian Journal of Economics*, 35-22, 2002, 331-340.
- [12] Ohgai, T., *Business History of the U.S. Consumer Electronics Industry* (in Japanese), Tokyo, Chuou Keizai Sha, 1998.
- [13] Porter, M., *Cases in Competitive Strategy*, New York, Free Press, 1983.
- [14] Schwartzman, D., *The Japanese Television Cartel: A Study Based on Matsushita v. Zenith*, Ann Arbor, University of Michigan Press, 1993.
- [15] Viner, J., *Dumping: A Problem in International Trade*, Chicago, University of Chicago Press, 1923.
- [16] Yano, M., "Voluntary export restraints and expectations: An analysis of export quotas in oligopolistic markets," *International Economic Review*, 30-4, 1989, 707-723.

- [17] Yano, M., *Applications of Microeconomics* (in Japanese, *Mikuro-Keizaigaku no Ouyou*), Tokyo, Iwanami, 2001.

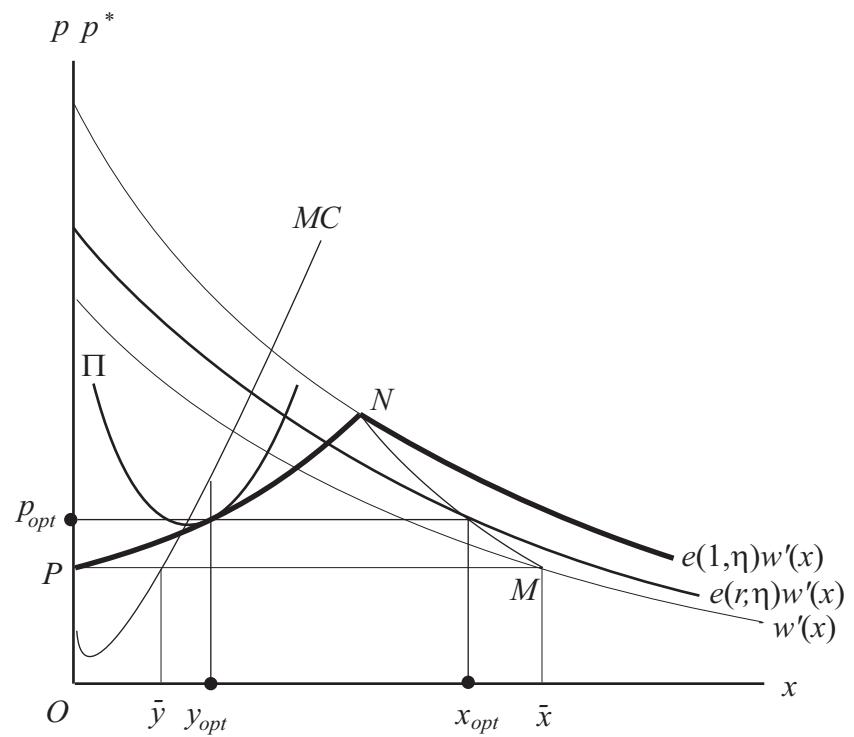


Figure 1

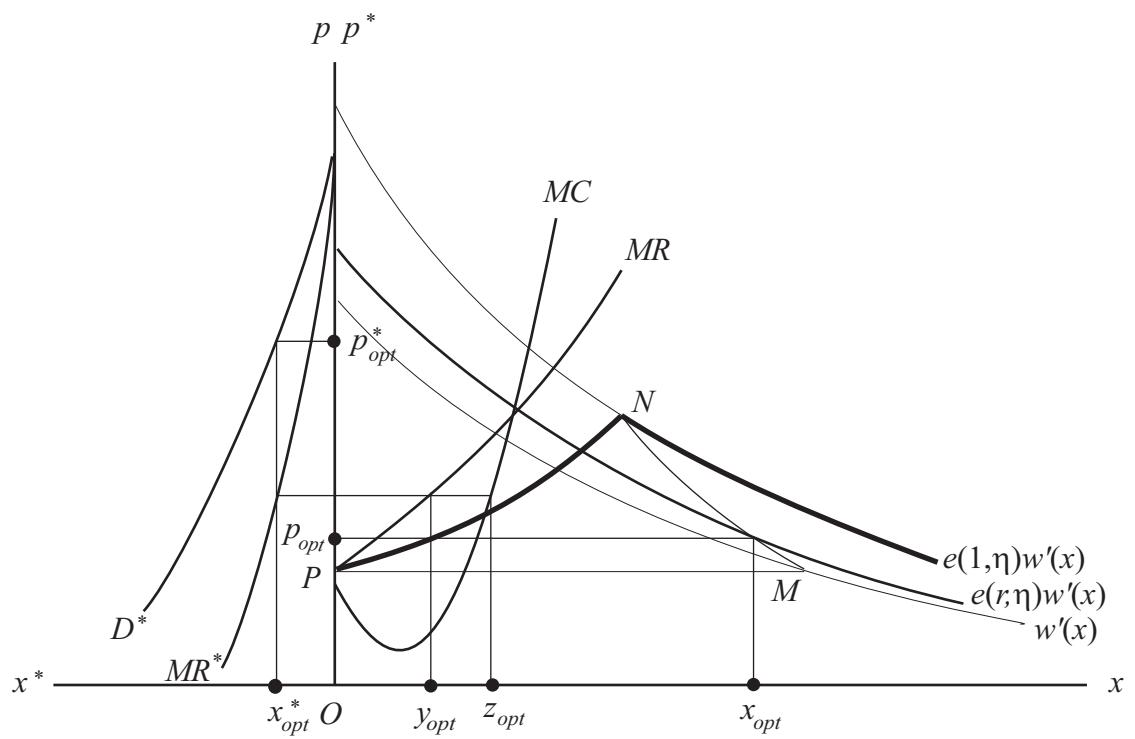


Figure 2