PRIVATIZATION IN CLOSED AND OPEN MIXED OLIGOPOLIES

Najiba Benabess, Norwich University, Vermont, USA, nbenabes@norwich.edu

Abstract

This paper is the first to collect and organize the many past theoretical results on the predicted welfare effects of privatization in mixed oligopolies. Our review of past models demonstrates that the most critical elements in predicting the influence of privatization in mixed oligopoly are the timing of the game, and whether or not the market is open to foreign competition. In organizing these results it becomes apparent that several cases remain missing in the resulting matrix. I develop these cases and conclude that a public Stackelberg leader should never privatize while a public Cournot firm should be privatized when a domestic market is more competitive.

Keywords: Privatization, Mixed Oligopoly, Cournot model, Stackelberg model.

1. Introduction:

A large literature has developed examining mixed oligopoly models often with the object of investigating the consequences of privatization. While these models have reached somewhat contradictory predictions, the need for using theory to make predictions remains great. As the next section makes clear, the results of actual cases of privatization appear to be mixed. The characteristics of the many individual cases differ dramatically and call for the drawing of general principles based on differences in underlying market and behavioral variables.

Our review of past models demonstrates that the most critical elements in predicting the influence of privatization in mixed oligopoly are the timing of the game, and whether or not the market is open to foreign competition. Apparently, less relevant are assumptions on the exact nature of the demand and cost structure. Thus, the stylized example frequently used involves linear demand and increasing but linear marginal costs. Allowing for a downward sloping demand and convex costs does not, to date, alter the results (see for example Myles 2002 and Sepahvand 2004).

This paper is organized as follows: Section 2 briefly reviews evidence on the influence of privatization and tries to give a flavor of its variety across the World. Section 3 presents the results associated with a closed mixed oligopoly in which there are m private firms and one public firm. Section 4 presents the results associated with an open mixed oligopoly in which there are m private domestic firms and n foreign private firms and one public domestic firm; and finally, section 6 concludes this paper.

2. Experience with Privatization.

Privatization has swept both developed and developing countries with Hodge (2000) identifying more than fifty major examples from the 1980s and 1990s in the UK, Australia and New Zealand alone. Governments often make clear that the objectives in privatizing include increasing competition and efficiency with the end result of lower prices and better service for customers (Hodge 2000 P. 17-18). Yet, despite these desires, Hodge's (2000) meta-analysis shows the estimated performance effects of privatization are almost as likely to be negative as positive. These results take on particular importance in mixed oligopolies where the very purpose of the public firm has often been thought to be reducing the chances for collusion, increasing the competitiveness of the oligopoly and expanding industry output (Merrill and Schneider 1996).

From Morocco to the Arabian Gulf, the governments of the Arab world are turning to privatization to raise revenues and improve the efficiency of their enterprises and services. Privatization can bring with it an injection of foreign capital, technology and expertise, modern business methods, increased profitability and output and increased capital expenditures. Many Middle East and North African countries are committed to enhancing private sector led growth toward privatization measures and performance-based management contracts. Jordan's privatization program is one of the most successful in the region, with 33 of its targeted 40 companies privatized, including Jordan Cement Factories and Jordan Telecommunications Company; the result is an increase of $600 million in foreign investment. Performance-based management contracts in water and sanitation projects in Amman, the Gaza Strip, and the southern area of the West Bank have yielded almost immediate benefits. In Amman, results include better water quality and maintenance, sewer cleaning, and responsiveness to customer complaints. In the Gaza Strip, an independent audit rated the management contract as excellent in improving water quality and quantity. In Morocco,

Bank support has targeted development of sound institutional and legal framework for the telecommunications sector to facilitate private sector development and expand cost-efficient service to poor people, particularly in rural areas.

Privatization came later to the United States than to several other nations. Since the early 1980s, however, privatization in the United States has moved from an intellectual fringe to become a centerpiece in contemporary public policy debates. The Reagan administration began to target programs and assets for privatization early in his first term. In early 1987, the first major privatization was carried out with the sale of the government's 85 % interest in Conrail, a corporation established by Congress in 1976 to provide freight rail service in the North-east. A president's Commission on Privatization established in September 1987 proposed further efforts to increase private participation across a board range of policy areas including low-income housing, air-traffic control, the postal service, prisons, and schools. Within his first month in office, President George Bush signaled an intent to carry on the privatization initiatives, speaking out in support of market mechanisms as the vehicle for school reform and naming to his cabinet Jack Kemp, a leading advocate of enterprise zones and the sale of public housing to existing tenants .Jeffrey R. Henig (1989-1990).

Depending on its form, pace and intensity, privatization, on its own, or as an integral component of a wider policy of structural adjustment programs, is bound to have serious consequences on the society at large or on specific groups, regions, or sectors. Privatization entails redefinition of the role of the state in economic and social matters. This redefinition might bring about fundamental changes or significant contraction in the role of the state by giving way to the private sector and the roles of market forces. Apart from the main macroeconomic and developmental issues, privatization touches general and specific social issues. These include privatization effects on employment and environment; on income and wealth distribution; on levels of poverty and vulnerable groups; on compensatory and protective measures etc. All such effects form the "social balance sheet" of privatization.

3. Closed Economy

This section analyzes the effects of privatization on welfare in a closed economy.
There are three cases: *Case 1 Cournot to Cournot* determines the effects of privatization on welfare with Cournot behavior among all firms. *Case 2 Stackelberg to Cournot* presents the effect of privatization on welfare when a public Stackelberg leader becomes a private Cournot competitor, and finally *Case 3 Stackelberg to Stackelberg* presents the effect of privatization on welfare when a public Stackelberg leader becomes a private Stackelberg leader. I determine the missing cases, and finally, I compare and analyze the results. *Table A1* summarizes these cases.

Cournot to Cournot:

De Fraja & Delbono (1989) compared the resulting welfare when the public firm maximizes welfare under Cournot oligopoly and the welfare function when the public firm maximizes its own profit under Cournot oligopoly. They showed that the impact of privatization on welfare depends on the number of the domestic firms. If the domestic market has a large number of competitors, it is socially better for the public firm to privatize and maximize its own profit instead of pursuing a social goal. "With a large number of firms, in the Nash case, the public firm must produce a very high level of output, driving private profits to a very low level, and given that the public firm's marginal cost is equal to the market price, the higher consumers' surplus under the Nash Regime is not high enough to compensate the lowest private profits." De Fraja and Delbono. (1989) P.307.

Stackelberg to Cournot:

De Fraja & Delbono (1989) compared the welfare function when the public firm acts as a Stackelberg leader and maximizes the social welfare with the one when a public firm is a Cournot firm that maximizes its profit. They showed that welfare decreases with privatization.

Stackelberg to Stackelberg: Missing result.

I compare welfare functions when the government acts as a public Stackelberg leader and when it acts as a private Stackelberg leader. Previous literature has not addressed this question. The results of this case are presented next.

Public Stackelberg leader:

There is an industry composed of *m* private firms and one domestic public firm producing a homogenous good[i]. The outputs of the private firms are denoted $q_i, i = 1,.....m$ and that of the public firm by q_0.

The total output, the cost function, the demand function, the social welfare and the private and public firms profit are presented:

$$Q = q_0 + \sum_{i=1}^{m} q_i \quad (1)$$

$$C(q) = c + (1/2)kq^2 \text{ Where } k>0 \quad (2)$$

$$P = D(q_0, q_i) = a - Q; \ a > 0. \quad (3)$$

$$W = (1/2)Q^2 + pr_0 + \sum_{i=1}^{m} pr_i \quad (4)$$

$$pr_0 = q_0 P - c - (1/2)kq_0^2 \quad (5)$$

$$pr_i = q_i P - c - (1/2)kq_i^2 \quad (6)$$

The public Stackelberg leader maximizes the social welfare. It determines the best response function $q_i(q_0)$ for each follower then constructs the function $W(q_0, q_i(q_0))$ and maximizes W with respect to q_0. And finally, I substitute the expression of q_0 into the private firms' reaction functions to obtain the welfare function W. The results are presented below.

The equilibrium outputs and price are presented below:

$$q_{0\,pub}^{S} = \frac{a(2k + mk + k^2 + 1)}{\Delta} \quad (7)$$

$$q_{i\,pub}^{S} = \frac{ak(m + 1 + k)}{\Delta} \quad (8)$$

$$P_{pub}^{S} = \frac{ak(mk + 1 + 2k + m + k^2)}{\Delta} \quad (9)$$

The welfare function is presented in equation (10):

$$W_{pub}^{S} = \frac{a^2(km^2 + k^2 m + 3mk + k^2 + 2k + 1)}{2\Delta} \quad (10)$$

Where:

$$\Delta = 3k + 2mk^2 + 3mk + m^2 k + 1 + 3k^2 + k^3$$

Private Stackelberg leader:

In this section the public Stackelberg leader acts as a private Stackelberg leader and maximizes its profit with respect to q_0; $\frac{dpr_0(q_0, q_i(q_0))}{dq_0}$.

The results are presented below:

$$q_{0\,priv}^{S} = \frac{a(1 + k)}{(2 + 3k + km + k^2)} \quad (11) \qquad q_{i\,priv}^{S} = \frac{a(1 + 2k + km + k^2)}{\mathrm{B}} \quad (12)$$

$$P_{priv}^{S} = \frac{a(1 + 3k + km + 3k^2 + mk^2 + k^3)}{\mathrm{B}} \quad (13)$$

Where:

$$\mathrm{B} = (2 + 3k + km + k^2)(m + 1 + k)$$

The Optimal Welfare is presented in equation (14).

$$W_{priv}^{S} = \frac{a^2(29k^2m^2 + 3k^3m^3 + mk^5 + 4km^3 + 10mk^4 + 31km + k^2m^4 + 17m^2k^3 + 19km^2 + 32k^3m + 46mk^2 + 3k^4m^2 + 3 + 13k + 22k^2 + 18k^3 + 7k^4 + k^5 + 8m^2 + 4m)}{2B^2} \quad (14)$$

Proposition 1:

In a closed economy, when the public Stackelberg leader becomes a private Stackelberg leader, welfare can never increase.

Proof of the Proposition:

$$W_{priv}^{S} - W_{pub}^{S} = \frac{-a^2(-2.m^2k^2 + 15.k^2 + 6.k + 1 - 2.m^2k^4 - 6.m^2k^3 - 6.m^2k^2 + m^4k^2 + k^6 + 20.k^3 + 15.k^4 + 6.k^5)}{2B^2\Delta}$$

i).The maximizing difference in welfare yields $m^* = \frac{\sqrt{k(3k+3k^2+k^3+1)}}{k}$.

ii). At m^* the difference in welfare equals zero.

As an illustration, *Figure B1* shows a representative graph of the $W_{priv}^{S} - W_{pub}^{S}$ as a function of *m* when $a = 1$ and $k = 1$.

The intuition behind this proposition is that a private Stackelberg leader always produces more than any followers. The privatized leader produces where MC>P and the followers produce where P>MC. Privatizing a public Stackelberg leader causes market inefficiency, therefore avoiding privatization improves welfare.

Thus, in a closed economy, there is either a negative or no effect of privatization on welfare except for the case of Cournot to Cournot where the privatization could have positive effect when there is a large *m*. In other words, in tight oligopolies (small *m*), there is never a welfare gain from privatization.

4. Open economy

In this section, I explicitly consider a foreign competition. I assume an economy with one public domestic firm and *m* domestic private firms and *n* foreign private firms. I determine the impact of privatization on welfare in three following cases.

There are two out of three cases missing in an open economy. (Table *A1*).

Cournot to Cournot: Missing result

I compare the optimal welfare when the public firm is a Cournot player before privatization and when it becomes a private Cournot player after privatization.

Stackelberg to Cournot: Missing result

I compare the optimal welfares resulting from the case when a public Stackelberg leader maximizes welfare with the one it becomes a private Cournot competitor.

Stackelberg to Stackelberg:

Fjell and Heywood (2002) showed that privatization of a public Stackelberg leader reduces leader output, increases follower output, increases prices, and increases followers' profits. Regardless of *m* and *n*, privatization always increases profit of the leader and decreases welfare. Fjell & Heywood (2002).[1]

4.1. New results

[1] There is a modest error in Fjell and Heywood paper (2002) in the resulting social welfare of the public Stackelberg leader. But even though the expression of welfare they used was slightly wrong the result found was correct.

a. Cournot to Cournot in an open economy.

In this section, I compare the optimal resulting welfares of a public Cournot and the private Cournot.

The Equilibrium of a Public Cournot:

The public firm maximizes its welfare by choosing quantity simultaneously with the *m* domestic firms and *n* foreign firms. The equilibrium yields the following:

The public output, the domestic and the foreign outputs and the price are:

$$q_{0\,pub}^{C} = \frac{a(k+1+n)}{\Lambda} \qquad (15)$$

$$q_{i\,pub}^{C} = qf_{pub}^{C} = \frac{ak}{\Lambda} \qquad (16)$$

$$P_{pub}^{C} = \frac{ak(1+k)}{\Lambda} \qquad (17)$$

Where $\Lambda = 1 + n + 2k + km + kn + k^2$

The social welfare is presented in equation (18):

(18)

$$W_{pub}^{C} = \frac{a2(2n + 3k + 1 + 2km + 4kn + 3k2 + k3 + 2k2n + n2 + kn2 + mk3 + k2m2 + k2n2 + 4mk2 + 2k2mn + 2kmn)}{2\Lambda^{2}}$$

The equilibrium of Private Cournot

In this case, the public firm is privatized and maximizes its profit simultaneously with *m* domestic firms and *n* foreign firms.

The equilibrium public output, private and foreign firm's output and price are presented respectively in equation (19):

$$q_{0\,priv}^{C} = \frac{a}{\Omega} \qquad (19)$$

$$q_{i\,priv}^{C} = qf_{priv}^{C} = \frac{a}{\Omega} \qquad (20)$$

$$P_{priv}^{C} = \frac{a(k+1)}{\Omega} \qquad (21)$$

Where $\Omega = k + m + n + 2$

$$W_{priv}^{C} = \frac{a^2(3 + k + 4m + km + 2n + m^2 + 2mn + n^2)}{2\Omega^2} \qquad (22)$$

Where: $\Omega = k + m + n + 2$.

Proposition 2:

In an open economy, the effect of privatization on welfare is indeterminate when a public Cournot player becomes a private Cournot competitor. The effect of privatization on welfare depends on the values of m (the number of domestic firms), n (the number of foreign firms) and k (the marginal cost slope). At any given k, the higher m and n the positive is the effect of privatization on welfare.

Proof of the proposition:

Let $W_{priv}^{C} - W_{pub}^{C} = \Phi$

$$\Phi = \frac{a^2(km - 10kn + 2knm - 4n - 3k - 8kn^2 - 5k^2n^2 - 8k^2n - 3k^2 - k^3 - 5n^2 + 2mn^3k + 2nkm^2 + m^2kn^2 + 3mkn^2 - 2k^3n - 1 - 2n^3 - k^3n^3 + km^2 + n^4k)}{2\Omega^2\Lambda^2} \quad (23)$$

$\Phi = 0$ at m^*:

$$m^* = -.5(2kn + kn + k - \sqrt{(4kn^2 + 37kn^2 + 42nk^2 + 13k^3 + 8kn^3 + 20kn^2 + 20kn^2 + 4n^2k^4 + 32kn^3 + 8k^3n^4 + 16kn^3 + 12k^3n^3 + 4k^4n^4)})/(n+1)k$$

Figure B2 shows m^* as a function of n when $k=1$, $k=4$ and $k=6$. It implies that all the points that are on the locus show that the difference of the welfares is equal to zero, and the points that are inside the locus show that Φ is negative and the points that are outside the locus show that the difference of the welfares is positive.

Figure B2 also shows the effect of k on Φ. The higher the k the lower is Φ. This means the higher the slope of the marginal costs, the lower is welfare with privatization.

I observe that there is an inverse relationship between n and m. In other words, n and m do substitute for each other in determining the value of Φ. In order to keep $\Phi = 0$ the higher m the lower is n and vice- versa.

Thus, if the market is competitive (large m and n), it is socially better for the public firm to maximize its own profit instead of pursuing a social goal. With the large number of firms, the public firm must produce a very high level of output, driving private profits to a very low level; given that the public firm's marginal cost is equal to the market price, the higher consumers' surplus is not high enough to compensate the lower private firms' profits.

$q^C_{0\,pub} > q^C_{0\,priv}$

$P^C_{pub} < P^C_{priv}$

$Q^C_{pub} > Q^C_{priv}$

The public firm produces more and the private firms produce less than the individual output of an oligopolistic market when all firms are profit maximizers. As the consumers' surplus is a decreasing function of the price, consumers are better off with the nationalization and worse off with the privatization of the public firm.

b. <u>Stackelberg to Cournot in an open economy.</u>

In this section, I present and examine the effect of privatization on welfare when a public Stackelberg leader becomes a private Cournot competitor in an open economy. First, I present the outcomes resulting from a public Stackelberg leader and next I present the outcomes of a private Cournot and finally I compare the resulting welfares.

The Equilibrium of Public Stackelberg Leader

Consider an industry where one state-owned public firm is a Stackelberg leader, with m domestic private and n foreign private followers. The Stackelberg leader moves first, anticipating the reaction of the followers. The demand function and the cost function are all identical to the models above.

The equilibrium is presented in the equations below.

$$q^S_{0\,pub} = \frac{[(1+k)(1+k+2n)+km]a}{\Psi} \quad (24)$$

$$q^S_{i\,pub} = qf^S_{pub} = \frac{(m+n+k+1)ak}{\Psi} \quad (25)$$

$$P_{pub}^{S} = \frac{(1+k)(m+n+k+1)ak}{\Psi} \qquad (26)$$

Where: $\Psi = 1 + 2n + [4n + 3(m+1) + (m+n)^2]k + [3 + 2(m+n)]k^2 + k^3$

The equilibrium welfare is presented in equation (27):

$$W_{pub}^{S} = \frac{a^2(k^2m + k^2 + 2nk + 3km + kn^2 + km^2 + 2k + 2kmn + 2n + 1)}{2\Psi^2} \qquad (27)$$

Note that when *n=0* (i.e. in the absence of foreign firms), I get the result of the optimal welfare of a public Stackelberg in a closed economy with no subsidy.

The Private Cournot Equilibrium

The public firm maximizes its profit simultaneously with *m* domestic private firms and *n* foreign private firms. Solving the model yields the equilibrium:

$$q_{i\,priv}^{C} = q_{f\,priv}^{C} = q_{0\,priv}^{C} = \frac{a}{k+m+n+2} \qquad (28)$$

$$P_{priv}^{C} = \frac{a(1+k)}{k+m+n+2} \qquad (29)$$

The resulting welfare is presented below (30)

$$W_{priv}^{C} = \frac{a^2(k+2mn+mk+3+4m+2n+m^2+n^2)}{2(k+m+n+2)^2} \qquad (30)$$

Proposition 3:

In an open economy, welfare decreases when a public Stackelberg leader becomes a private Cournot competitor.

Proof of the proposition:

Let $\delta = W_{priv}^{C} - W_{pub}^{S}$.

$$\delta = \frac{-a^2(k^2n^2 + 4kn^2 + 4n + 6nk + 2k^2n + 1 + 2k + k^2 + 4n^2)}{2(k+m+n+2)^2\Psi} < 0 \qquad (31)$$

As the intuition may suggest, if the public firm is Stackelberg leader, pricing at the marginal cost is not optimal ($P_{pub}^{S} > MC$); this is because "thanks to the Stackelberg leadership, the public firm is able to move some of its production to the private producers" De Fraja and Delbono (1989). In fact it is also:

$q_{0\,pub}^{S} > q_{0\,priv}^{C}$

$P_{priv}^{C} > P_{pub}^{S}$

$Q_{pub}^{S} > Q_{priv}^{C}$

As the consumers' surplus is a decreasing function of the price, consumers are better off when a public firm is a Stackelberg leader and worse off when it is a Cournot competitor.

4.4. Comparison

In an open economy, the public firm should privatize only if it acts as a Cournot player before and after privatization and only when the market is competitive enough (large *m* and *n*).

5. Conclusion

The literature on the welfare effects of privatization in mixed oligopolies is missing three relevant cases (table *A1*) , therefore this paper fills the gap in this literature by investigating these cases. *Table A2* represents the completed table that summarizes the effects of privatization on welfare for six different cases. I observe that *two* out of six cases show a negative effect of privatization on welfare which are: i) Stackelberg to Cournot in a closed economy; ii) Stackelberg to Cournot in an open economy. Two cases out of six show non- positive effect of privatization on welfare, which are iii) Stackelberg to Stackelberg in a closed economy; and Stackelberg to Stackelberg in an open economy. And two out of six cases show indeterminate effect of privatization on welfare which are the Cournot to Cournot in both a closed and open economy.

I conclude that a public Stackelberg leader should not become a private Stackelberg leader under any examined circumstances. Whether the economy is closed or open, the social welfare decreases with privatization. In addition, a public Stackelberg leader should not become a Cournot competitor in any of the cases presented because welfare either decreases or is unaffected with privatization.
On the other hand, a public Cournot player should be privatized only when the domestic market is competitive enough because privatization increases social welfare.

Moreover, I observe that the effects of privatization on welfare in a closed economy are identical to the ones in an open economy. I conclude that the presence of foreign competition doesn't affect the qualitative influence of privatization on social welfare.

6. Appendix

Table A1: Results on the Influence of Privatization on Welfare.

Closed Economy	Open Economy
1.Cournot to Cournot: De Fraja &Delbono (1989) **+/-**	**1.Cournot to Cournot:** ?
2.Stackelberg to Cournot: De Fraja & Delbono (1989) -	**2.Stackelberg to Cournot** ?
3. Stackelberg to Stackelberg ?	**3.Stackelberg to Stackelberg** (Fjell and Heywood 2002) -*

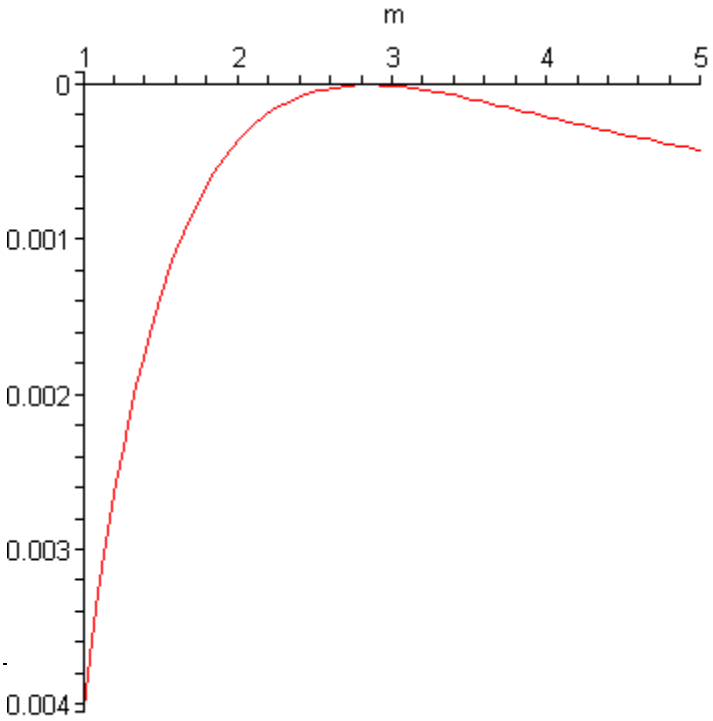
Key:
(+/-) Means that the change in welfare depends on the number of domestic firms in the market.
- Means that welfare decreases with privatization.
? Means that the result is missing and will be covered in this paper.
-* Means that the change in welfare is non- positive

Table A2 : The *completed* table represents the effects of privatization on welfare.

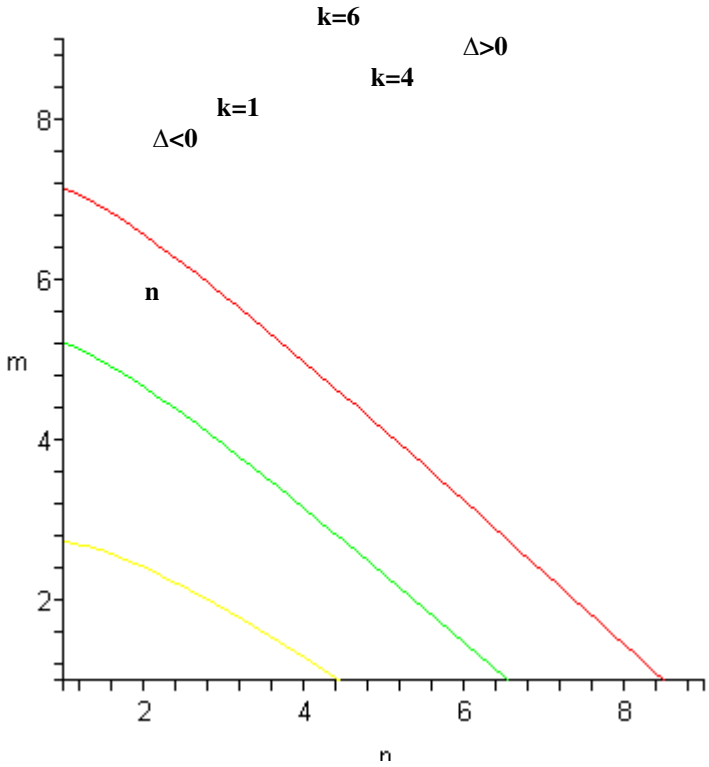
Closed Economy	Open Economy
1.Cournot to Cournot: De Fraja &Delbono (1989) **+/-**	**1.Cournot to Cournot: Benabess** +/-
2.Stackelberg to Cournot: De Fraja & Delbono (1989) -	**2.Stackelberg to Cournot Benabess** -
3. Stackelberg to Stackelberg Benabess -*	**3.Stackelberg to Stackelberg** (Fjell and Heywood 2002) -*

Key:
(+/-) Means that the change in welfare depends on the number of domestic firms in the market.
- Means that welfare decreases with privatization.
0 Means that the welfare doesn't change with privatization.
-* Means that the change in welfare is non- positive

Figure B1. Stackelberg to Stackelberg in a closed economy.
Delta (the change in welfare functions) as a function of *m* when *a=1* and *k=1*.



and k=6.


k=6
Δ>0
k=4
k=1
Δ<0
n
m
8
6
4
2
2
4
6
8
n

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