The Growth and Welfare Effects of Vertical Separation versus Vertical Integration

Chi-Ting Chin

Department of Risk Management and Insurance, Ming Chuan University, Taiwan

Bonanno and Vickers (1988) show that vertical separation is profitable and is of interest to manufacturers collectively, as well as individually, provided that the franchise fees can be used to extract the retailers’ surplus. However, their analysis is derived within the goods market only, and hence ignores the harm caused to the community by the double marginalization. This paper develops a simple endogenous growth model with monopolistic competition, in which both structures of vertical integration and vertical separation can be described, and finds that vertical separation reduces both the balanced growth rate and the social welfare.

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1 Introduction

Since the price of goods in a non-integrated industry is higher than in an integrated industry when both upstream and downstream firms add their own price-cost margin at each stage of production, vertical separation will create a double price distortion, thereby giving rise to the phenomenon of double marginalization. Bonanno and Vickers (1988) show that vertical separation is profitable and of interest to manufacturers collectively, as well as individually, provided that franchise fees can be used to extract the retailers’ surplus. Existing studies (for example, Salinger
that are concerned with vertical separation and vertical integration are conducted in a partial equilibrium framework. To be more specific, their analysis is derived within the goods market only, and hence ignores the mutual interaction between the goods market and other markets. In spite of its being profitable for the firm under the vertical separation regime, Bonanno and Vickers (1988) do not look into the possibility that double marginalization might injure the community.

Since the late 1980s, the study of economic growth has also received a good deal of attention. Benhabib and Farmer (1994) develop the endogenous growth model with monopolistic competition. The primary doctrine of the imperfectly competitive model is that firms have monopoly power in the product market and set prices optimally in light of the demand curves. Based on a solid micro-foundation of optimizing behavior, an imperfectly competitive model provides us with greater insight than a purely competitive model. A common feature in existing studies on the endogenous growth model with imperfect competition is that they anonymously confine their analysis to the perspective of market structure. In other words, they focus on highlighting how the degree of monopoly power will govern the determination of relevant macroeconomic variables. Departing from the existing literature, this paper instead focuses on the issue from the perspective of the industrial structure. To be more specific, this paper develops a simple endogenous growth model with imperfect competition, in which both structures of vertical integration and vertical separation can be described, and finds that vertical separation reduces both the balanced growth rate and the social welfare.

Compared to the existing literature on the standard industrial organization of double marginalization, this paper has distinctive traits. First, this paper develops a simple endogenous growth model with imperfect competition, in which not only the positive long-run economic growth rate is explicitly taken into consideration, but also both structures of vertical integration and vertical separation can be described. Second, a common feature of existing studies concerning vertical separation and

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1 Under partial equilibrium, Atallah (2007) argues that vertical separation is profitable for price competition with differentiated products but unprofitable for quantity competition with homogeneous products. Hart and Tirole (1990) indicate that vertical separation reduces the degree of monopoly power and the firms’ profits. Bonanno and Vickers (1988) consider the case where the firms manufacture differentiated goods and compete directly on price.
vertical integration is that some of their behavioral functions, in particular the demand function for goods, are based on *ad hoc* specifications. The advantage of this paper is that it presents an endogenous growth model embodying a solid micro-foundation for the behavioral functions. Third, in the standard industrial organization model, the social welfare is measured by the sum of the consumer’s surplus and all firms’ profits. In our imperfectly competitive endogenous growth model, as the owner of all firms, the household receives the profits of all firms in the form of dividends. Accordingly, the social welfare can be measured by the level of the household’s lifetime utility without resorting to the sum of the consumer’s surplus and all firms’ profits.

### 2 The Model

The economy is populated by a large number of identical and infinitely-lived households. For simplicity, population is normalized to unity. The households derive utility from consumption; the lifetime utility can be specified as:

$$ U = \int_0^\infty \ln ce^{-\rho t} dt, \quad (1) $$

where \( c \) is consumption and \( \rho (>0) \) represents the constant rate of time preference.

Households use the total income that they do not consume to accumulate more capital stock, and the total income received by households is the sum of profit income, capital income, and labor income. The households thus face the following instantaneous budget constraint:

$$ \dot{k} = r k + \Pi + w - \int_0^\infty p_j c_j dj, \quad (2a) $$

where \( p_j \) denotes the price of the \( j \)th intermediate good in terms of the final good; \( c_j \) represents the quantities of the \( j \)th final good; \( k \) denotes the real capital stock; and \( \Pi, r, \) and \( w \) represent the total profit income that the household receives from the firm, the capital return rate and the real wage rate, respectively. Along the lines of the insight offered by Dixit and Stiglitz (1977), the households’ composite consumption as a CES-aggregate type for all consumption varieties can be defined
Suppose that \( \lambda_1 \) is the shadow value of the physical capital stock, and \( \lambda_2 \) is the Lagrange multiplier for equation (2b). By means of a standard procedure, we can derive the first-order conditions and then summarize the necessary conditions for optimality by using the following equations:

\[
\frac{\dot{c}}{c} = r - \rho, \\
c^{\theta}c_j^{\theta} = p_j \frac{\lambda_1}{\lambda_2}.
\]

Equation (3a) establishes the standard Keynes-Ramsey rule. Evidently, the demand function for the \( j \)th final good (i.e., equation (3b)) has a constant price elasticity \( 1/\theta \). To guarantee the existence of an equilibrium, the parameter \( \theta \) should be restricted at \( \theta \in [0,1) \). As we will show later, \( \theta \) measures the degree of monopoly of the final good firms.

### 2.1 Vertical Separation

We are now in a position to specify the non-integrated industry. There is a continuum of raw materials, \( y_j, j \in [0,1] \), which is produced by a continuum of upstream firms. All of the raw materials are sold to an independent retailer, and are then transformed into a final good to sell to households. For simplicity, assume that each of the downstream firms (retailers) transforms one unit of the raw material bought from the upstream firm into one unit of the final good at zero cost. Accordingly, the number of downstream firms and final goods is equal. To be more specific, we will deal with an economy in which there is a continuum of upstream firms (manufacturers), each of which has an exclusive relationship with a downstream firm.

We first deal with the optimal behavior of the downstream firms. Following the linear pricing assumption of De Fraja and Price (1999), the \( j \)th upstream firm sells to
the $j$th downstream firm charging a linear price $q_j$. Let $y_j$ be the level of the raw materials that the $j$th downstream firm buys from the $j$th upstream firm (the level of the intermediate goods that the $j$th downstream firm sells to the households), and $\pi'_j$ be the nominal profits of the downstream firm $j$. The maximization problem of the $j$th downstream firm can be expressed as follows:

$$\begin{align*}
\text{Max} & \quad \pi'_j = p_j c_j - q_j y_j, \\
\text{s.t.} & \quad e^o c_j = \frac{\lambda_2}{\lambda_1}, \\
& \quad y_j = c_j.
\end{align*}$$

(4a)

(4b)

(4c)

The first-order condition for the $j$th downstream firm’s profit maximization problem leads to the following profit-optimizing pricing and nominal profits:

$$\begin{align*}
p_j &= \frac{q_j}{1-\theta}, \\
\pi'_j &= \theta p_j c_j.
\end{align*}$$

(5a)

(5b)

Equation (5a) indicates that the price of the final good is positively related to the price of the raw material and the market power, and hence equation (5b) indicates that the nominal profits of the $j$th downstream firm are also positively related to the degree of monopoly power.

Substituting (5a) into (4b), the level of the final goods sold to households is given by:

$$e^o c_j = \frac{\lambda_2}{\lambda_1} = \frac{q_j}{1-\theta}.$$  

(5c)

Upstream firms rent capital and labor from perfectly competitive markets. Let $\pi''_j$ be the nominal profits of the $j$th upstream firm. By choosing the capital inputs, $k_j$, and labor inputs, $n_j$, the $j$th upstream firm maximizes its profits:

$$\begin{align*}
\text{Max} & \quad \pi''_j = q_j y_j - w n_j - r k_j, \\
\text{s.t.} & \quad y_j = B k_j^\alpha k^{1-\alpha}, \\
& \quad e^\alpha c_j = \frac{\lambda_2}{\lambda_1} = \frac{q_j}{1-\theta}.
\end{align*}$$

(6a)

(6b)

(6c)
The average economy-wide stock of capital $\bar{k}$ represents production externalities given to each upstream firm, due to a learning-by-doing mechanism proposed by Romer (1986). $B$ is the technical parameter. The first-order conditions for $k_j$ and $n_j$ are:

\[ c^e(B^{1-\alpha}k_j^{1-\alpha}n_j^{1-\alpha})^{1-\alpha}(1-\theta) \frac{\lambda_j}{\lambda_i} = rk_j, \]  
(7a)

\[ c^e(B^{1-\alpha}k_j^{1-\alpha}n_j^{1-\alpha})^{1-\alpha}(1-\alpha)(1-\theta) \frac{\lambda_j}{\lambda_i} = wn_j. \]  
(7b)

Equations (7a) and (7b) indicate that the $j$th upstream firm hires inputs until the marginal product of each input equals its market price. Both equations also reveal that the demand for each input is decreasing in the monopoly power index, $\theta$. Vertical separation leads to the double price distortion since both upstream and downstream firms add their own price-cost margin at each stage of production.

We restrict our analysis to follow a symmetric equilibrium in which $n_j = n$, $k_j = \bar{k} = k$, $p_j = p$, $\lambda_j = \lambda_i$, and $y_j = Bkn_j = Y$ for all $j \in [0,1]$. Using (7a) and (7b), we can immediately calculate that the profit, which the $j$th good producers (including upstream and downstream firms) earn, equals $\Pi_j = \pi^u_j + \pi^d_j = Y^{1-\alpha}y_j^{1-\alpha} - wn - rk = \theta(2 - \theta)Y$.

2.2 Vertical Integration

In this section we will provide a description of the integrated industry. Suppose that the $j$th upstream firm integrates its operations with those of the $j$th downstream firm. In what follows, we refer to this integrated firm as “the $j$th integrated firm”. The $j$th integrated firm rents capital and labor from perfectly competitive markets. By choosing the capital inputs, $k_j$, and labor inputs, $n_j$, the $j$th integrated firm maximizes its profits:

\[ \max_{k_j, n_j} \Pi_j = p_j y_j - wn_j - rk_j, \]  
(8a)

subject to $y_j = B^{1-\alpha}k_j^{1-\alpha}n_j^{1-\alpha}$.  
(8b)
The first-order conditions for \( j \)th firm are:

\[
e^c c_j^* = p_j \frac{\lambda_j}{\lambda_2}, \quad (8c)
\]

\[
y_j = c_j. \quad (8d)
\]

The first-order conditions for \( k_j \) and \( n_j \) are:

\[
c^e (B\tilde{k}^{ij} - \tilde{k}^{ij} \alpha(1-\theta) \frac{\lambda_j}{\lambda_2} = r k_j, \quad (9a)
\]

\[
c^e (B\tilde{k}^{ij} - \tilde{k}^{ij} (1-\alpha)(1-\Theta) \frac{\lambda_j}{\lambda_2} = w n_j. \quad (9b)
\]

Equations (9a) and (9b) indicate that the \( j \)th firm hires inputs until the marginal product of each input equals its market price. Both equations also reveal that the demand for each input is decreasing in the monopoly power index, \( \theta \).

We restrict our analysis to follow a symmetric equilibrium in which \( n_j = n \), \( k_j = \tilde{k} = k \), \( p_j = p \), \( \lambda_j = \lambda_2 \), and \( y_j = Bkn^1 = Y \) for all \( j \in [0,1] \). Using (9a) and (9b), we can immediately calculate that the profit, which the \( j \)th goods producer earns, equals \( \Pi_j = Y^c y_j^* - wn - rk = \theta Bkn^1 = \theta Y \).

## 3 Balanced Growth

The equilibrium conditions of the labor and final goods markets are:

\[
n = 1, \quad (10a)
\]

\[
\tilde{k} = Bkn^1 - c. \quad (10b)
\]

In the balanced-growth equilibrium, we can obtain the growth rates of the economy under the regimes of vertical separation and vertical integration:

\[
\bar{\gamma} = Ba(1-\Theta) - \rho, \quad (11a)
\]

\[
\gamma = Ba(1-\Theta) - \rho. \quad (11b)
\]

By comparing equation (11a) with (11b), we have:

\[
\gamma - \bar{\gamma} = -Ba(1-\Theta) \theta < 0. \quad (12)
\]

Since the price of goods in a non-integrated industry is higher than in an integrated industry, the non-integrated firm produces less output than the integrated
firm. Then, both the demand for capital and the capital return rate under the vertical separation regime are smaller than under the vertical integration regime. Consequently, the balanced growth rate under the vertical separation regime is smaller than that under the vertical integration regime.

4 Welfare Measure

Based on equation (1), in the long run, we have the following expression:

$$ U = \frac{\ln c}{\rho} + \frac{r - \rho}{\rho^2} = \frac{\ln(\rho k + \Pi + w)}{\rho} + \frac{r - \rho}{\rho^2}. $$

(13)

In the balanced-growth equilibrium, we can obtain the social welfare of the economy under the regimes of vertical separation and vertical integration:

$$ \hat{U} = \frac{\ln k}{\rho} + \frac{\ln[\rho + B(2 - \theta)\theta + B(1 - \alpha)(1 - \theta)^2]}{\rho} + \frac{B\alpha(1 - \theta) - \rho}{\rho^2}, $$

(14a)

$$ \hat{\hat{U}} = \frac{\ln k}{\rho} + \frac{\ln[\rho + B\theta + B(1 - \alpha)(1 - \theta)]}{\rho} + \frac{B\alpha(1 - \theta) - \rho}{\rho^2}. $$

(14b)

By comparing equation (14a) with (14b), we have:

$$ U - \hat{U} = \frac{1}{\rho} \ln \left\{ \frac{[\rho + B\theta(2 - \theta) + B(1 - \alpha)(1 - \theta)^2]}{[\rho + B\theta + B(1 - \alpha)(1 - \theta)]} \right\} - \frac{B\alpha(1 - \theta)}{\rho^2} > 0, $$

(15)

Equation (15) tells us that the balanced welfare under the vertical separation regime may be either larger or lower than that under the vertical integration regime. The economic intuition behind this result can be illustrated by three components: the Profit Income Effect, the Wage Rate Effect and the Growth Rate Effect. We will now describe these three components in detail:

1. The Profit Income Effect:

Given the fact that the profit of the non-integrated firm is greater than that of the integrated firm, the total profit income that the household receives from the firm under the vertical separation regime is greater than that from the firm under the vertical integration regime. The Profit Income Effect indicates that the balanced
welfare under the vertical separation regime will be larger than that under the vertical integration regime.

2. The Wage Rate Effect:

Given the fact that the non-integrated firm produces less output than the integrated firm, both the demand for labor and the wage rate under the vertical separation regime are smaller than that under the vertical integration regime. The Wage Rate Effect indicates that the balanced welfare under the vertical separation regime will be lower than that under the vertical integration regime.

3. The Growth Rate Effect:

Since the balanced growth rate under the vertical separation regime is smaller than that under the vertical integration regime, the Growth Rate Effect signifies that the balanced welfare under the vertical separation regime will be lower than that under the vertical integration regime.

From equation (15), we observe that the current consumption under the vertical separation regime is higher than that under the vertical integration regime through the Profit Income and Wage Rate Effects, and the future consumption under the vertical separation regime is lower than that under the vertical integration regime through the Growth Rate Effect. Since the sum of the Profit Income and Wage Rate Effects may be either higher or lower than the Growth Rate Effect, a numerical simulation can help us to compare the balanced welfare under the vertical integration regime with that under the vertical separation regime. In line with the literature in general, we use the following parameters: the time preference rate \( \rho = 0.05 \), technical parameter \( B = 1 \), and the capital elasticity of output \( \alpha = 0.3 \).

In Figure 1, the horizontal axis depicts the degree of monopoly power, \( \theta \), and the vertical axis represents the welfare effects between the vertical integration regime and the vertical separation regime. As indicated in Figure 1, the Growth Rate Effect is larger than the sum of the Profit Income and Wage Rate Effects, and the balanced welfare under the vertical separation regime is lower than that under the vertical integration regime. The reduction in future consumption determines the rise in current consumption, and so vertical separation reduces the social welfare.
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