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Abstract

This paper shows that distribution-channel competition among firms have significant effects on macroeconomic equilibrium under nominal wage rigidity. We consider competition on variety of brands, product quality and retail service.

First, distribution channel competition implies real-wage rigidity, or in some cases even procyclical real wages, with respect to economic fluctuation caused by nominal demand shocks. Moreover, Employment is more sensitive to nominal demand shocks in an economy with distribution-channel competition than without it, even though real wages are sticky.

Second, we examine international difference in the industrial organization of distribution channels. It is shown that the different behavior of sectoral employment between Japan and European countries may stem from the difference between Japanese manufacturer-controlled distribution and European retailer-controlled one.

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1. Introduction

In everyday life, we buy goods from retail stores. However, it is rarely the case that we buy only goods from them. There are various kinds of accompanying services such as providing product information, delivery, wrapping, and repair services. Location, and amenity of their stores are also important retail service, making shopping easy and pleasant. Moreover, the product quality and the range of product lines itself are a kind of services which are very important for us, since we want products being just right for us. In other words, retail stores are competing each other intensely with various aspects of retail services, as well as their price.

Despite its apparent importance, mainstream macroeconomics has consistently neglected the distribution (*i.e.,* wholesale, retail, and transportation) sector. By assuming a one-good economy, macroeconomics effectively rules out its existence. Goods are assumed to be sold by manufacturers themselves, and there are no competition with respect to distribution-channel services. In fact, macroeconomics goes to the other extreme: using the concept of value-added, macroeconomists consider the distribution sector as mimicking the manufacturing counterpart. It is assumed to produce "distribution services" having no connection with goods they sell, and sell the services to consumers independently of goods.[1] From this assumption, there is no special need for examining distribution channels separately.

The distribution sector was once called the "Dark Continent" of the economy.[2] Since then, there has been a large literature on the nature of distribution-channel competition, so that it is not a dark continent any more in microeconomics and international trade.[3] However, it is still profoundly a dark continent in macroeconomics, and the consequence of competition in distribution channels on macroeconomic variables are relatively unexplored.

The purpose of this paper is to fill this large gap between theory and reality. In

[1]Actually, a similar presumption is found in the treatment of the distribution sector in the System of National Accounts.

[2]This characterization of distribution channels was often found in the marketing literature.

[3]See Tirole [10].

particular, we will show that the negligence of macroeconomics with respect to distribution channel competition is by no means benign, and we gain considerable macroeconomic insights by explicitly considering competition among firms in distribution channels.

In this paper, in order to highlight its effect in well-known setting, we examine distribution channel competition in an economy where nominal wages are exogenous as in the textbook Keynesian macroeconomics. We have two purposes. The first one is to show that, if competition in distribution channels is properly taken into account, real wages become more sticky than otherwise, and in some cases they become procyclical, to the change in nominal demand. Moreover, employment is more sensitive to nominal demand change in this economy than in the case of no distribution-channel competition, even though real wages are sticky.

The apparent rigidity of real wages over business cycle has been a paradox of macroeconomics since Keynes' General Theory. If one assumes decreasing returns to scale and no technologicial shocks, marginal product of labor and the real wage must increase when the level of output is decreased. However, what we observe in reality is that real wages are insensitive to changes in output. Table 1 summarizes the correlation between the real wage and the economic activity in ten OECD countries between 1971 and 1991. It shows no cyclicality in many countries, and the United States, Japan, and France exhibit procyclicality rather than counter-cyclicality.

The introduction of product variety, product quality and distribution-channel services eases the shackles of decreasing returns to scale in output production. It should be noted here that what consumers consume is the product-quality-service mix, rather than the product itself. Therefore, confronting decreasing demand, the firm can adjust the level of service and quality as well as the level of output. Moreover, firms can also adjust the variety of their product line. Even though service provision and quality maintenance also involve decreasing returns to scale, the overall degree of decreasing returns is much more moderated through the adjustment of variety, quality and service than otherwise.

The second purpose of this paper is to explain international difference in the behavior of retail and manufacturing employment. Table 2 exhibits a wide difference among countries in the relative magnitude of retail employment to manufacturing employment. Retail employment in most European countries has almost the same magnitude of fluctuation as manufacturing employment, while Japanese retail employment is substantially more stable

than manufacturing employment. The United States is in-between of the two extremes. Figures 1-1 to 1-4 shows the change in employment in manufacturing and retail sectors in the United States, Japan, France and Germany.

In this paper, we argue that the differing behavior of sectoral employment in these countries can be traced to the difference in the industrial organization of distribution channels. Specifically, we show that the retailer-controlled channel structure often found in European countries leads to lower product quality and its rigidity over economic fluctuations, making retail activity compensate them. Thus, retail activity and its employment are high and very sensitive to demand fluctuations. On the contrary, the manufacturer-controlled channel structure found in Japan implies lower level of retail service and its rigidity, so that the manufacturer has to compensate it by higher product quality and making the quality sensitive to economic conditions. (Here, quality must be understood in a broad sense to be including advertisement and other promotional activities conducted by manufacturers.) This means manufacturing employment is highly sensitive to demand change, while retail employment is relatively insensitive to the change.

The organization of this paper is as follows. In Section 2, we set up an macroeconomic model with distribution channel competition. In order to focus our attention on the effect of distribution channel competition on real wages and employment, we assume firms are vertically integrated. We consider two types of distribution-channel competition, variety competition in Section 3 and quality-and-service competition in Section 4. In Section 5, we consider the case in which firms are not vertically integrated, and examine the two modes of distribution channel organization. Section 6 contains concluding remarks.

2. Distribution-Channel Competition

In order to clarify the effect of distribution-channel competition on macroeconomic behavior of prices and quantities, we start from the well-known imperfectly competitive macroeconomic model based on product differentiation (Spence [7], Dixit and Stiglitz [3]) and the quantity theory of money (Weitzman [11] and Blanchard and Kiyotaki [2]). We consider mostly the case of the exogenous money wage. Although the exogenous money wage assumption is not satisfactory from the theoretical viewpoint, it is the simplest way to produce monetary non-neutrality. Since our aim is not to examine price/wage

rigidity *per se*, but rather to analyze the effect of distribution-channel competition on macroeconomic variables under nominal rigidity, this procedure is justified.

Into this simple static macroeconomic model, we introduce two kinds of stylized non-price competition in the distribution channel. We analyse them in the following sections one by one.

The first type of non-price competition can be called *variety competition.* At the retail level, firms are competing with one another not only by the price of their products, but also the variety of their product lines. To offer the product suited to the consumer is the best strategy to win the heart of the consumer and to get a high profit. However, since to produce many different products results in high costs, firms are obliged to offer a limited variety to the consumer.

The second type of non-price competition is *quality-and-service competition.* As it is well-known, firms can differentiate themselves in not only product characteristics but also product quality. In addition, we often observe the effort of firms to differentiate themselves by offering various service accompanying products they sell. In this situation, firms can be considered as offering a composite good, that is, the product-quality-service mix. To position their product-quality-service mix in the market is an important strategic decision of firms engaging in distribution-channel competition.

In this paper, we assume that the manufacturer determines quality and the retailer offers service. Quality and service here are broadly defined, including various means of non-price competition. Moreover, service and quality are often very close substitutes of each other. For example, higher product quality means higher reliability and less operational failure, reducing the need of repair service.

In order to examine the effect of these distribution-channel competition on macroeconomic equilibrium, especially on employment fluctuations, we concentrate our attention on the case of vertically-integrated firms in Sections 3 and 4. Thus, firms considered here are producers doing retail operation by themselves. The case of independent retailers and manufacturers will be discussed in Section 5.

2.1. Household Preference and Demand Structure

Let us consider the representative household. The demand structure is the same as other imperfectly competitive model based on the Dixit-Stiglitz type product differentiation

except for introduction of product quality and accompanying service.

There are N types of products in this economy. The representative household is assumed to obtain utility from consumption of the "product-quality-service mix" D_i^* of the i-th product. The household also enjoys utility from holding real balances M^D/P^*, where M^D is the demand for money of the household, and P^* is the price level appropriately defined later in this section. The household gets disutility from labor.

The household's utility U is then

$$U = \phi V^{\alpha} \left(\frac{M^D}{P^*}\right)^{1-\alpha} - \frac{1}{1+\mu}\left(L^S\right)^{1+\mu};\ 0 < \alpha < 1;\ \mu > 0 \tag{2.1}$$

where V is the sub-utility from consumption of the composite goods of the product-quality-service mixes:

$$V = N\left[\frac{1}{N}\sum (D_i^*)^{\frac{k-1}{k}}\right]^{\frac{k}{k-1}};\ k > 1 \tag{2.2}$$

in which $\phi = \alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)}$ is a normalization factor.

This is the standard assumption about the household preferences in the imperfectly competitive economy *except that* the household's utility depend on the composite good D_i^* of the physical product i's quantity D_i, its quality q_i and its accompanying service s_i:

$$D_i^* = q_i s_i D_i \tag{2.3}$$

We hereafter call D_i^* quality-and-service-adjusted quantity of the product.

This formulation of the product-quality-service mix assumes that both the quality and the service are consumption-augmenting. For example, repair service can be considered as of this type, since it prolongs the life of the product. Product information may also be considered as the consumption-augmenting service. Moreover, durability is one measure of product quality, which is fitted in this consumption-augmenting framework.[4] The major assumption implicit in this framework is that the product, quality and service are jointly offered by the firm and that the firm does not charge price for its service and quality separately.[5]

[4]This type of formulation is found in the model of durability (see, for example, Swan [9]).

[5]Whether the firm can charge price for its service and quality depends on the cost of doing so. Much of retail service involves consumer externality, such as good ambiance of shopping, friendly clerks, and so on. Some of service, such as repair and delivery service can be charged, but firms may choose to offer

The household maximizes U with respect to the budget constraint

$$\sum_{i=1}^{N} p_i D_i + M^D = WL^S + \Pi + M$$

where p_i is the price of the i-th physical product, W is the wage rate, Π is the dividends from firm, and M is the initial money holding.

It is well-known that the above utility function generates the following quality-and-service-adjusted demand functions and labor supply function under the assumption of monetary equilibrium:

$$D_i^* = q_i s_i D_i = \left[\frac{\alpha}{(1-\alpha)N}\right]\left(\frac{p_i^*}{P^*}\right)^{-k}\frac{M}{P^*} = \left(\frac{p_i^*}{P^*}\right)^{-k}\frac{\overline{Y^*}}{N}, \tag{2.4}$$

where $\overline{Y^*}$ is the aggregate demand for quality-and-service-adjusted products such that

$$\overline{Y^*} \equiv \frac{\sum p_i^* D_i^*}{P^*} = \frac{\alpha}{1-\alpha}\frac{M}{P^*}, \tag{2.5}$$

and

$$L^S = \left(\frac{W}{P^*}\right)^{\frac{1}{\mu}}. \tag{2.6}$$

Here p_i^* is the quality-and-service-adjusted price of the i-th product such that

$$p_i^* = \frac{p_i}{q_i s_i} \tag{2.7}$$

and the price level is defined as follows:

$$P^* \equiv \left[\frac{1}{N}\sum (p_i^*)^{1-k}\right]^{\frac{1}{1-k}}. \tag{2.8}$$

2.2. Technological Conditions of Firms

As other imperfectly competitive macroeconomic models, we assume symmetric firms. The j-th firm is producing n_j products and supplying service s_i accompanying with the i-th product of quality q_i. The firm's technology is represented by the following required-labor functions.

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them free or for token fee rather than collecting charges to cover costs, if the cost of collecting charges is large compared with the revenue from it.

Manufacturing. First, in order to produce the i-th product, the firm has to employ a fixed amount of labor

$$F^M$$

to make operation possible. Moreover, in order to produce the i-th product of quality q_i the firm has to employ

$$L_i^q = \frac{1}{1+\varepsilon} q_i^{1+\varepsilon};\ \varepsilon > 0$$

labor. The assumption $\varepsilon > 0$ implies increasing costs in the quality maintenance. An increase in quality induces more than proportional increase in the required labor input. These two costs constitute fixed costs at the firm in production process.

In addition, it has to employ

$$L_i^M = \frac{1}{1+\gamma} D_i^{1+\gamma} q_i^{1+\eta};\ \gamma > 0;\ 1+\eta > 0 \tag{2.9}$$

for producing the physical quantity D_i of quality q_i. Note that the marginal production cost MC_i depends on not only quantity but also quality

$$MC_i = W D_i^{\gamma} q_i^{1+\eta}.$$

The parametric assumption that $1+\eta \geq 0$ implies that marginal cost is increasing in quality.

$$\frac{dMC_i}{dq_i} = (1+\eta)\, W D_i^{\gamma} q_i^{\eta} > 0.$$

Finally we assume that $\gamma > \eta$, which is necessary for the existence of the otimum quality for the firm.

Retailing. Second, in order to set up retail operation for the i-th product the firm has to employ a fixed amount of labor

$$F^R$$

to make retail operation possible.[6] In addition, it has to employ

$$L_i^R = \frac{1}{1+\theta} s_i^{1+\theta};\ \theta > 0 \tag{2.10}$$

[6]Here we assume that F^R does not depend on the number of products. However, one may argue that there is an economy of scope making F^R become smaller as the number of products increases. We will take up this issue later.

to offer the service s_i. The assumption $\theta > 0$ implies increasing costs in providing service.

We assume symmetry here, so that the fixed cost and the functional form of required labor is the same among products.

3. Variety Competition and Real Wage Rigidity

Let us first consider the effect of variety competition on macroeconomic equilibrium. *To concentrate on variety competition, we ignore service and quality differentiation altogether and to set* $L_i^R \equiv 0$ *and* $L_i^q \equiv 0$ *throughout this section.* Since there is no quality or service competition, we have $p_i = p_i^*$ by definition. To avoid heavy notation, we use the price of the physical product p_i in place of the quality-and-service-adjusted price p_i^*.

3.1. Vertically-Integrated Firms' Decision

Suppose that there are J firms in this economy. Consider the j-th firm producing n_j different products. We hereafter call products as *brands*. By definition, the total number of brands N satisfies $N = \sum_{k=1}^{J} n_k$. In order to make notation as simple as possible, j-th firm's brands are assumed to be in the range from $\sum_{k=1}^{j-1} n_k + 1$ to $\sum_{k=1}^{j-1} n_k + n_j$.

We decompose the firm's decision in two steps. That is, the firm determines the number of brands in the first step, and then, given the number of brands, it determines its optimal price for each brand in the second step. Throughout these steps, the other firms's choice on price and variety is taken as given. Then, the firm's decision can be analysed backward as usual.

Second step: Price choice. In the second step, given the number of brands, the firm maximizes its profit with respect to its price.

$$\max_{p_i} \ \pi_i \quad \text{where} \quad i = \sum_{k=1}^{j-1} n_k + 1, ..., \sum_{k=1}^{j-1} n_k + n_j$$

Here, π_i is the profit of the brand i such that

$$\pi_i = p_i D_i - W\left(L_i^M + F^R + F^M\right).$$

The optimal price is then determined by the first-order condition,[7] such that

[7] It immediately follows the profit function such that

$$\pi_i = p_i^{1-k}\frac{K}{N} - \frac{W}{1+\gamma}\left(p_i^{-k}\frac{K}{N}\right)^{1+\gamma} - W\left(F^R + F^M\right).$$

$$p_i = p_j \equiv \left[\frac{kW}{k-1}\left(\frac{K}{n_j + N_{-j}}\right)^{\gamma}\right]^{\frac{1}{1+k\gamma}} \tag{3.1}$$

where

$$K = (P^*)^k \overline{Y} \quad \text{and} \quad N_{-j} = \sum_{k \neq j} n_k.$$

From (3.1), it is clear that the price of brand i is the same p_j defined above for all i's (brands) because of symmetry. This symmetry substantially reduces the complexity of the following analysis.

First step: Variety choice. Taking account of the symmetry, we substitute the pricing rule (3.1) to get the firm j's first-step profit function for brand i, which is the same function π_j of the number of brands n_j and the common price p_j for all brands:

$$\pi_i = \pi_j \equiv R_j - C_j - W\left(F^R + F^M\right)$$

where R_j is the revenue

$$R_j = p_j^{1-k}\frac{K}{n_j + N_{-j}},$$

and C_j is the variable cost

$$C_j = \frac{W}{1+\gamma}\left(p_j^{-k}\frac{K}{n_j + N_{-j}}\right)^{1+\gamma}.$$

The firm maximizes the total profit Π_j which is the sum of all brand profits, with respect to the number of brands. To make analysis simple, we treat the number of brands, n_j, as a real number, instead of a natural number.

$$\max_{n_j} \ \Pi_j(n_j) \ \text{ where } \Pi_j(n_j) = n_j \pi_j$$

The first-order condition[8] is then[9]

$$[R_j - C_j] - n_j\left[\frac{R_j - (1+\gamma)C_j}{n_j + N_{-j}}\right] = W\left(F^R + F^M\right) \tag{3.2}$$

The above equation determining the optimal number of brands has intuitive explanation. On the one hand, the right-hand side of (3.2) is the cost of introducing an additional

[8]It can be shown that the profit function is concave in n_j. Thus, the second-order condition is satisfied.

[9]Here we can utilize the envelope relation such that $\frac{d\pi_j}{dn_j} = \frac{\partial \pi_j}{\partial p_j}\frac{dp_j}{dn_j} + \frac{\partial p_j}{\partial n_j} = \frac{\partial \pi_j}{\partial n_j}$.

brand. Since the firm incur fixed costs in both production and distribution channel in the form of set-up labor, the "unit" cost of an additional brand is $W\left(F^R + F^M\right)$. On the other hand, the left-hand side is the "unit" revenue from introducing an additional brand. Here, we must consider two offsetting effects of an additional brand.

First, there is a profit increase that an additional brand brings in, which is in the first bracket of the left-hand side of (3.2). Second, however, we have to take into account adverse effects of an additional brand on the existing brands. This is represented by the terms in the second bracket of the left-hand side of (3.2). Since there are $N_{-j}+n_j$ brands in the economy and they are symmetric, the loss of sales is evenly shared by all brands. The marginal loss of revenues is $R_j/(n_j + N_{-j})$. Since marginal cost is increasing, the marginal loss of sales induces $(1+\gamma)\, C_j/(n_j + N_{-j})$ reduction of costs. The overall loss in profits is the number of existing brands times difference between marginal decrease in revenue and marginal decrease in cost.

It should be noted here that there is pecuniary externality in the brand determination. An additional brand introduced by the firm increases only this firm's profit, while the adverse effect of the introduction is shared by all firms.

Taking account of $N = n_j + N_{-j}$ in rewriting (3.2), we have the following "variety rule" for the firm

$$\frac{N-n_j}{N}\left(\frac{p_j^{1-k}K}{N}\right) - \frac{N-(1+\gamma)\, n_j}{(1+\gamma)\, N} W \left(\frac{p_j^{-k}K}{N}\right)^{1+\gamma} = W\left(F^R + F^M\right) \tag{3.3}$$

3.2. Real Wage Rigidity in Flexible-Wage Macroeconomic Equilibrium

To understand the nature of equilibrium in the economy with variety competition, it is worthwhile to first consider the case of wage flexibility. We examine symmetric marcroeconomic equilibrium throughout this paper. This economy is in equilibrium if and only if firms maximize their profits and all markets are equilibrium.

The first requirement of symmetric macroeconomic equilibrium is that firms' behavior satisfy price rules and variety rules, and their prices and their number of brands are the same. The price rule (3.1) of individual firms under symmetric equilibrium condition ($p_i = P$, $n_j = N/J$) yields

$$\frac{W}{P} = \frac{k-1}{k} Y^{-\gamma}, \tag{3.4}$$

where Y is the average brand production

$$Y \equiv \frac{\overline{Y}}{N}, \tag{3.5}$$

while the variety rule (3.3) is reduced to

$$\left(1 - J^{-1}\right) Y - \frac{1 - (1+\gamma) J^{-1}}{(1+\gamma)} \frac{W}{P} (Y)^{1+\gamma} = \frac{W}{P} \left(F^R + F^M\right), \tag{3.6}$$

The second requirement is that all markets are in equilibrium. Since the money market is assumed to be in equilibrium in deriving the demand and supply functions of the household and imperfectly competitive producers always supply the quantity demanded, the remaining market which must be in equilibrium is labor market.

The labor supply is determined by (2.6), and the labor demand is the sum of all firms' labor demand. Thus, we have

$$\left(\frac{W}{P}\right)^{\frac{1}{\mu}} = N \left\{ \frac{1}{1+\gamma} [Y]^{1+\gamma} + \left(F^R + F^M\right) \right\}. \tag{3.7}$$

The equations (3.4), (3.6), and (3.7) completely determine the real wage W/P, the average brand production Y, and the number of brands N.

This economy has a distinctive *recursive* structure. First, firms' equilibrium conditions (3.4) and (3.6) determine the real wage W/P and the average brand production Y. Then, given W/P and Y, the number of brands N and thus total employment is determined by (3.7). The fact that the real wage is determined in the equilibrium condition of firms is remarkable, since this means labor supply conditions do not influence the real wage.[10]

The reason we get the independence of the real wage from labor market conditions is traced to the fact that the equilibrium conditions of price and variety, (3.4) and (3.6), do not depend on the total scale of production in the economy, that is, the total number of brands in the economy, N. This can be explained in the following way.

[10]It is worthwhile to clarify the difference of the variety competition model and the efficiency wage model (see for example, Solow [8]), which also implies real wage rigidity. In the efficiency wage model, the labor productivity depends on the level of the firm's real wage. Then, there is the optimal level of the real wage for the firm. The firm wants to keep the optimal real wage, and even if there are the unemployed willing to work for less than the optimal wage, the firm does not want to hire them.

In contrast, in the economy with variety competition, there is no "optimal real wage" for the individual firm, as (3.1) and (3.2) clearly show. However, in equilibrium, the real wage is determined along with the average brand production by price choice and variety choice. This difference induces a profound difference in the behavior of macroeconomic variables under nominal wage rigidity, which will be discussed later.

In the labor market, increasing disutility of labor causes increasing scarcity of labor, which in turn induces a higher real wage. If there is only one type of products, an increase in production necessarily induces a higher real wage, and equilibrium would be determined at the level where marginal revenue from increasing production is just balanced by its marginal cost, which is the real wage. However, if there is variety choice, the firm does not have to increase one brand's production to increase its profit. The firm may choose to introduce a new brand. Since under our assumption (1) the cost of introducing a new brand is constant and (2) the mark-up rate is constant and does not depend on the number of brands the firm has, we have constant returns to scale with respect to variety as an economy as a whole. This makes marginal conditions determining price and variety become independent of scale.

3.3. Macroeconomic Equilibrium under Nominal-Wage Rigidity.

Let us now consider the case of nominal wage rigidity. We replace the labor supply function with exogenous wage assumption: $W = fixed$. Obviously, in order to make analysis interesting, the fixed wage must be sufficiently high to induce unemployment. We assume the existence of unemployment throughout this sub-section.

First, since the firms' equilibrium conditions (3.4) and (3.6) are not affected by the change from wage flexibility to wage rigidity, the real wage and the average brand production are still determined by these two equations. Thus, the real wage is *completely rigid* even under nominal wage rigidity.

Next, consider the determination of total output. From (2.5) and (3.5) and taking account of the fact that we have made the quality and service fixed to unity, we have

$$NY = \frac{\alpha}{1-\alpha}\frac{M}{P},$$

which is the equation determining the number of brands N, and the average brand production Y. From this we have

$$NY = \frac{\alpha}{1-\alpha}\frac{M}{W}\frac{W}{P}. \tag{3.8}$$

Since the real wage W/P and the average brand production Y are determined by (3.4) and (3.6), the aggregate demand equation (3.8) shows that a decrease in the money supply M induces a proportionate decrease in the number of brands N. Thus, the nominal

wage rigidity in the economy with variety competition implies employment is sensitive to the change in aggregate demand, that is, the money supply in our economy. Thus, the real wage rigidity does not imply employment is unchanged, in contrast with the textbook neoclassical macroeconomic model in which constant real wage means constant employment.

Thus, we have the following proposition.

PROPOSITION 1 (Real Rigidity and Fluctuations). *Real wages are completely rigid in the economy with variety competition. However, real wage rigidity does not imply constant employment. If nominal wages are also rigid, a reduction in money supply results in reduction in employment.*

In should be noted that completely rigidity of real wages is the result of the model's property that (1) the fixed cost of introducing a new brand is constant and (2) the mark-up rate is constant and does not depend on the number of brands, as explained earlier. One might argue that the fixed retail cost F^R is decreasing with number of brands, since there is an economy of scope in retailing. Then, we have a procyclical real wage rather than the rigid one. However, if the mark-up rate is decreasing with the number of brands, then we get a counter-cyclical real wage. However, the basic point of real wage rigidity holds true: the movement of real wages is much more moderated with variety competition than without it.

Another important feature of the economy with variety competition is incidence of unemployment.

PROPOSITION 2 (Burden of Unemployment). *Under nominal wage rigidity, a decrease in total output and employment takes the form of disappearance of a particular brand in the economy with variety competition. Thus, the "burden" of unemployment is disproportionately born by a particular group of workers who happened to engage in the production of the disappeared brand. The conditions of the other groups do not change even if aggregate demand decreases.*

This proposition concurs the everyday observation of economic life. In the economic hardship, some groups disproportionately suffer from downward movement of the economy

than the other group. However, we cannot analyse the issue of burden of unemployment further under our assumption of the representative household, so that we will leave it for future research.

Finally, let us compare magnitude of employment fluctuation between the economy with variety competition and the economy without it. Figure 2 depicts the difference between the two economies.

In this figure of the $(W/P,\ NY)$ plane, AD depicts (3.8). For given nominal wage W and money supply M, an increase in real wage W/P implies a decrease in the price level P. This in turn increases aggregate demand M/P, and consequently, the employment is increased. Thus, we have upward sloping AD.

In this figure, suppose that the money supply is reduced. This means an upward shift in AD, since for given level of real wage it reduces output. In the economy with variety competition, the real wage does not change, so that the economy moves on the flat "Brand # Choice" Line in this figure to the lower equilibrium employment.

In this figure, we juxtapose the case without variety competition. Suppose that the number of brands, N, is fixed so that there is no variety competition. In this case, the economy moves on the marginal labor-productivity curve of brand production. In Figure 4, the "No Brand # Choice" Curve depicts this downward-sloping marginal labor-productivity curve. Thus, a decrease in money supply decreases output and employment, but at the same time the real wage increases. This means a decrease in price under the assumption of fixed nominal wage, which reduces the original adverse impact of reduced money supply.

Thus we have

PROPOSITION 3 (Magnitude of Fluctuation). *Under nominal wage rigidity, the effect of an decrease in money supply is larger in the economy with variety competition, than in the economy without variety competition.*

Here, the rigidity of the real wage prevents the counteracting effect of price reduction from being materialized. Consequently, the reduction in output and employment is larger in the economy with variety competition than in the economy without it.

4. Quality-and-Service Competition and Possibility of Procyclical Real Wages

In this section, we consider competition on quality and service. *To concentrate on quality and service, we assume that the firm produces only one product (brand) in this section.* Thus, the number of firms is N and it is equal to the number of brands in this section.

4.1. Vertically-Integrated Firms' Decision.

The firm determines its product price p_i, the product quality q_i and accompanying service s_i. Then, through (2.7), the quality-and-service-adjusted price p_i^* is determined. These four variables are such that if three of them are determined, then the rest is also determined. It turns out to be easy to analyse the economy in terms of the quality-and-service-adjusted price p_i^* (and corresponding quality-and-service-adjusted quantity D_i^*), the quality q_i and the service s_i, rather than the price p_i of the physical product (and corresponding physical quantity D_i), the quality q_i and the service s_i. We formulate the firm's problem in this way.

The firm's problem is

$$\max_{p_i^*, q_i, s_i} \pi_i \text{ where } \pi_i = p_i^* D_i^* - W\left(L_i^R + L_i^q + L_i^M + F^R + F^M\right)$$

In order to facilitate the analysis of this and the next section, it is worthwhile to express π_i explicitly as a function of p_i^*, q_i, and s_i :

$$\pi_i = p_i^* D_i^* - W\left(\frac{1}{1+\gamma}(D_i^*)^{1+\gamma} q_i^{\eta-\gamma} s_i^{-1-\gamma} + \frac{1}{1+\varepsilon} q_i^{1+\varepsilon} + \frac{1}{1+\theta} s_i^{1+\theta} + F^M + F^R\right), \quad (4.1)$$

where

$$D_i^* = \left(\frac{p_i^*}{P^*}\right)^{-k} Y^*,$$

in which Y^* is the average quality-and-service-adjusted product demand such that

$$Y^* = \frac{\overline{Y^*}}{N}.$$

To avoid heavy notation, we use logarithmic expression if appropriate. Then, it can be shown that the optimum s_i satisfies

$$\ln s_i = \frac{1+\gamma}{2+\theta+\gamma} \ln D_i^* - \frac{\gamma-\eta}{2+\theta+\gamma} \ln q_i, \quad (4.2)$$

while the optimum q_i is

$$\ln q_i = \frac{1}{1+\gamma+\varepsilon-\eta}\ln\frac{\gamma-\eta}{1+\gamma} + \frac{1+\gamma}{1+\gamma+\varepsilon-\eta}\ln D_i^* - \frac{1+\gamma}{1+\gamma+\varepsilon-\eta}\ln s_i. \tag{4.3}$$

The optimal p_i^* is determined by

$$\ln\frac{p_i^*}{P^*} = \frac{1}{1+k\gamma}\left[\ln\frac{k}{k-1} + \ln\frac{W}{P^*} - (\gamma-\eta)\ln q_i - (1+\gamma)\ln s_i + \gamma\ln Y^*\right] \tag{4.4}$$

Here it is important to notice that (4.2) and (4.3) show that an increase in the quality-and-service-adjusted demand is accompanied by an increase in the level of quality and service. This can be explained in the following way.

Suppose that the demand for the quality-and-service-adjusted product, D_i^*, increases. Then, the firm could increase the production of physical products, keeping the level of quality and service unchanged. However, this is not optimal, since the physical production is subject to decreasing returns to scale. The best strategy is then a part of the demand increase is satisfied by the increase in the physical quantity, and the rest is satisfied by an increase in the level of service and quality. The exact proportion depends on the relative magnitude of increasing marginal cost in physical production, quality maintenance and service provision.

It should be also noted that the service and the quality are substitutes in (4.2) and (4.3). An increase in the service *ceteris paribus* reduces the quality and *vice versa*. This is a direct consequence of our assumption that the service and quality are both consumption-augmenting.

4.2. Macroeconomic Equilibrium under Nominal-Wage Rigidity

Let us now compare the economy with quality-and-service competition with the one without it. Suppose that the both economies is in the same equilibrium. Then, consider a decrease in the money supply M.

Figure 3 depicts the difference between the two economies in the $(W/P^*,\ Y^*)$ plane. Since the aggregate demand equation in the case of quality-and-service competition

$$NY^* = \frac{\alpha}{1-\alpha}\frac{M}{W}\frac{W}{P^*} \tag{4.5}$$

is the same as (3.8) with p and Y being replaced by p^* and Y^*, a decrease in M is represented by the shift from AD to AD'.

On the one hand, PM_{Fixed} is the product market equilibrium curve determined by (4.4) with symmetric equilibrium conditions ($p_i^* = P^*$, $q_i = q$ and $s_i = s$) *under the condition that q and s are fixed at their equilibrium value before the decrease in the money supply*, which is

$$\ln \frac{W}{P^*} = -\ln \frac{k}{k-1} - \gamma \ln Y^* + (\gamma - \eta) \ln \overline{q} + (1+\gamma) \ln \overline{s} \tag{4.6}$$

On the other hand, PM_{Flexible} is the product market equilibrium curve determined by (4.2), (4.3) and (4.4) with symmetric equilibrium conditions ($p_i^* = P^*$, $q_i = q$ and $s_i = s$) *under the condition that q and s are optimally determined by firms,* such that

$$\begin{aligned} \ln \tfrac{W}{P^*} &= -\ln \tfrac{k}{k-1} + (\gamma - \eta)(1+\theta) A \ln \tfrac{\gamma - \eta}{1+\gamma} \\ &\quad - \{(\theta\gamma\varepsilon + \eta\theta + \eta) - (1 + \gamma + \varepsilon)\} A \ln Y^* \end{aligned} \tag{4.7}$$

where

$$A = \{(1+\gamma)(1+\varepsilon) + (1+\theta)(1+\varepsilon) + (1+\theta)(\gamma - \eta)\}^{-1} > 0.$$

PM_{Fixed} is downward sloping, reflecting the fact that to accommodate an increase in demand Y^* must be accompanied by an decrease in real wage W/P^* in order to have firms in equilibrium. If

$$\theta\gamma\varepsilon + \eta\theta + \eta > 1 + \gamma + \varepsilon, \tag{4.8}$$

then PM_{Flexible} is also downward-sloping.[11] However, PM_{Flexible} is flatter than PM_{Fixed},

[11] From (4.2), (4.3) and (4.4) we get

$$\ln s = -(\gamma - \eta) A \ln \frac{\gamma - \eta}{1+\gamma} + (1+\gamma)(1+\varepsilon) A \ln Y^*,$$

$$\ln q = (2 + \theta + \gamma) A \ln \frac{\gamma - \eta}{1+\gamma} + (1+\gamma)(1+\theta) A \ln Y^*,$$

and

$$\ln \frac{W}{P^*} = -\ln \frac{k}{k-1} + (\gamma - \eta) \ln q + (1+\gamma) \ln s - \gamma \ln Y^*$$

Solving the above three equations for $\ln W/P^*$ and $\ln Y^*$, we have

$$\begin{aligned} \ln \tfrac{W}{P^*} &= -\ln \tfrac{k}{k-1} + (\gamma - \eta)(1+\theta) A \ln \tfrac{\gamma - \eta}{1+\gamma} \\ &\quad - \left[\gamma - \left\{(\gamma - \eta)(1+\gamma)(1+\theta) + (1+\gamma)^2 (1+\varepsilon)\right\} A\right] \ln Y^* \end{aligned}$$

Rearrange terms, we have (4.7). From the above expression, it is evident that the coefficient of $\ln Y^*$ is smaller than γ in (4.7) so long as (4.8) is satisfied.

reflecting the fact that the firm can adjust quality and service level to reduce cost in the case of flexible quality and service. Therefore, the required reduction in real wage W/P^* is smaller in the flexible case than in the fixed case, while the reduction in the service-adjusted quantity is larger.

Moreover, there is no *a priori* reason to assume (4.8). If instead we have

$$\theta\gamma\varepsilon + \eta\theta + \eta < 1 + \gamma + \varepsilon,$$

then we have the upward-sloping PM_{Flexible}. In this case, we get real wages declining alongside with demand decline.[12] Therefore, if the concavity θ of the service-provision cost function and the degree η of marginal cost increase due to quality increase are not large, then we have procyclical real wages. For example, this is the case if $\theta = \gamma = \varepsilon = 1$ and $\eta = 0.6$.

In the above discussion, it is evident that the quality-and-service adjusted quantity Y^* becomes more sensitive to the change in nominal demand. Next, consider the change in employment. It can be shown that the production-related manufacturing employment L^M is only dependent on the level of the nominal aggregate demand and independent of the level of service and quality:[13]

$$\ln L^M = -\ln(1+\gamma) - \ln\frac{k}{k-1} + \ln\frac{\alpha}{1-\alpha} - \ln N - \ln W + \ln M. \tag{4.9}$$

Therefore, the effect of money-supply decline in the manufacturing employment is the same between the flexible and fixed quality-and-service cases. However, the quality q and the service s decline in the flexible case as the quality-and-service adjusted quantity Y^* decreases. This implies employment in quality maintenance and in service provision

[12] Solving (4.5) and (4.7) for $\ln Y^*$ and $\ln(W/P^*)$ we have

$$(1+\theta)(1+\varepsilon)(1+\gamma)A\ln Y^* = const. + \ln M$$

and

$$\{(1+\gamma+\varepsilon) - (\theta\gamma\varepsilon + \eta\theta + \eta)\}A\ln(W/P^*) = const. + \ln M.$$

[13] Substitute (4.7) into (4.5) we get

$$\begin{aligned}&(1+\gamma)\ln Y^* - (\gamma-\eta)\ln q - (1+\gamma)\ln s\\ &= -\ln N + \ln\tfrac{\alpha}{1-\alpha} + \ln M - \ln W - \ln\tfrac{k}{k-1}.\end{aligned}$$

Note that the left-hand-side is $\ln L^M + \ln(1+\gamma)$. Then, it is straightforward to get (4.9).

decline, while there is no change in the fixed quality-and-service case by definition. Thus, the overall effect of money-supply decline on employment is larger in the flexible case than the fixed case.

From the above discussion, we immediately get

PROPOSITION 4 (Procyclical Real Wage). *Under the fixed nominal wage, a reduction in employment due to a reduction in the money supply is larger in the economy with quality-and-service competition than in the economy without it. In addition, real wage is more sticky with quality-and-service competition than without it. Moreover, if* $\theta\gamma\varepsilon + \eta\theta + \eta < 1 + \gamma + \varepsilon$, *we have a procyclical real wage.*

From the discussion of this section, it is evident that this PROPOSITION depends on the following two qualitative properties of this economy. First, the household's satisfaction depends on the product-quality-service mix. Second, the firm can reduce their cost by properly choosing the product-quality-service mix for given satisfaction level of consumers. Since both seem quite reasonable, we are likely to have real wage rigidity in the case of non-price competition.

5. Industrial Organization of Distribution Channels and Sectoral Employment

5.1. Distribution-Channel Organization

We have been examined the behavior of real wages and employment in the economy with distribution-channel competition, under the assumption of vertically integrated firms. However, in reality such vertical integration is rather rare. Various reasons to prevent vertical integration of manufacturing and retailing have been discussed extensively in the literature (see Tirole [10]).

Although it may not be profitable to integrate vertically, the manufacturer and the retailer may achieve the same result as in the vertically-integrated case through various pricing schemes and contracts (Tirole [10, Ch. 4]). In fact, in an economy with variety competition, the retailer and manufacturer can achieve the same resource allocation through resale price maintenance by the manufacturer or non-linear purchasing price

scheme of the retailer in our framework of certainty. Therefore, if the distribution-channel competition is only through variety competition, then the result of Section 2 still holds true.

The same is true in the case of quantity-and-service competition so long as moral hazard problems do not exist or are only on one side if exist. Again, there are non-linear pricing schemes to alleviate the problems altogether. Thus, it is always possible to get efficient allocation if either service of the retailer or the product quality of the manufacturer is not controllable by the other party, but not both.

However, if there is a bilateral moral hazard problem, that is, *both* the service of retailer is not controllable by the manufacturer *and* at the same time the product quality is not controllable by the retailer, there is no practical and widely-accepted way of pricing schemes and contracts to remedy possible inefficiency due to this bilateral moral hazard.[14] We consider this bilateral moral hazard case of quality-and-service competition in this section, and examine the effect of particular industrial organizations observed in the real economy on macroeconomic equilibrium.

In the world economy, there exist two distinctive types of industrial organization in retailing. They are different with respect to which side of the distribution channel has an upper hand on the other side.

5.1.1. Retailer-controlled channel with bidding by suppliers and costly quality control

The first type is the distribution channel where the retailer has an upper hand over the manufacturer. In some parts of Europe and the United States, there are large retail companies operating various retail chains with many private brands.[15] The retailer determines specifications of products they sell, and procures them from the lowest bidder among manufacturers. The retailers determines various services accompanying their

[14]It is possible to remedy the problem by introducing the third party called *marginal source*, but it is not viable because of the possibility of collusion between the retailer and the manufacturer. See Holmström [4].

[15]For example, in Denmark, there are two large retail companies operating retail chains of various sizes. *Dansk Supermarked* has *Bilka* (large), *Føtex* (medium), and *Netto* (small) chains to serve various segments of the retail market, while *FDB* operates *OBS* and *A-Z* (large), *Brugsen* (medium-to-small) and *Lokal Brusgen* (small).

products.

However, the retailer cannot control the quality of products directly. If there is no quality control by the retailer, the quality will eventually go down and it hurts the retailer. In order to control the quality, the retailer has to institute costly inspection mechanism. The retailer may persuade suppliers to invest in expensive machines which produce more reliable products, by incurring a part of the investment cost. Such costs of maintaining quality are additional costs which are not present in the case of vertically-integrated firms.

5.1.2. Manufacturer-controlled channel with resale price maintenance

The second type is the distribution channel in which the manufacturer has an upper hand over the retailer. A typical example is found in Japan, which is often called *Keiretsu* distribution (exclusive distribution).[16] In the Keiretsu distribution, the manufacturer virtually determines the price of final sales (*de facto* resale price maintenance). However, manufacturers cannot control the level of the retailer's service directly, since service is unobservable for the firm. In effect, the margin between the retail price and the wholesale price becomes the instrument to control the level of retail service.[17]

We consider the effect of the difference between these two types of distribution channels on the behavior of employment fluctuations. We show that the *sensitivity* (or more precisely, the elasticity) of the real wage W/P^* and the quality-and-service adjusted quantity

[16]A historical background may help the reader to understand the development of the *Keiretsu* system as an attempt by the manufacturer to cope with inefficient distribution channels. Just after the devastation of the Second World War, the Japanese retail market was still underdeveloped. Poor retailing skills of retailers caused a serious trouble for manufacturers, and the quality of service was considered to be inadequate. In order to overcome various marketing problems due to unskilled retailing, manufacturers established *Keiretsu* distribution channels in various markets, in which only a sole retailer was given the right to deal one type of products in a certain area. Thus, there is no intra-brand competition. The Keiretsu distribution channel was characterized by active commitment of the manufacturer to support Keiretsu retailers. There was no franchise fee. On the contrary, the manufacturer usually incurred substantial training and financial costs on behalf of its Keiretsu retailers.

[17]In reality, both types of industrial organization exist in different distribution channels in the same economy. Moreover, both types even exist in the same industry: for example, in the distribution of TVs, videos, and CD players in Denmark, *Bang and Olufsen*, the high-end product manufacturer, has a distinctive manufacturer-controlled distribution channel, although the majority can be characterized as retailer-oriented. Usually, high-quality products often have a manufacturer-oriented distribution, while bulk-products are traded through a retailer-oriented one.

Y^* in response to the change in the money supply is the same in both retailer-controlled and manufacturer-controlled cases as in the vertical integration, although the *level* of the real wage and employment is different due to inefficiency stemmed from bilateral moral hazard problems. Thus, the result of the vertically-integrated case still holds with respect to the sensitivity of the real wage and the quality-and-service adjust quantity. However, the difference in the distribution-channel organization produces significantly different behavior in *sectoral employment*: the relative stability or volatility of retail sector employment compared with manufacturing employment profoundly depends on the nature of the distribution-channel organization.

5.2. Retailer-Oriented Economy

Let us first consider the economy in which the distribution channel is controlled by the retailer, which we hereafter call the retailer-oriented economy. In the retailer-oriented economy, the retailer announces the product specification and the purchase quantity, and then solicits bidding from manufacturers. It then buys the products from the lowest bidder. In order to control quality, it incurs an additional quality-maintenance cost. For simplicity, we assume that the additional cost is proportional to the fixed cost of quality in manufacturing such that

$$L_i^{q'} = \lambda L_i^q = \lambda \frac{1}{1+\varepsilon} q_i^{1+\varepsilon}.$$

Incurring this cost, the retailer can control the quality of products.

5.2.1. Manufacturer

In this procurement procedure, the manufacturer determines what price it can bid for the contract of the product quantity X_i with quality q_i. If the manufacturer's bidding price is z_i, its profit is

$$\pi_i^M = z_i X_i - W\left[\frac{1}{1+\gamma}(X_i)^{1+\gamma} q_i^{1+\eta} + \frac{1}{1+\varepsilon} q_i^{1+\varepsilon}\right] - WF^M.$$

Assuming homogeneous manufacturers, the manufacturer's bidding price z_i therefore satisfies

$$z_i X_i - W\left[\frac{1}{1+\gamma}(X_i)^{1+\gamma} q_i^{1+\eta} + \frac{1}{1+\varepsilon} q_i^{1+\varepsilon}\right] - WF^M = H, \tag{5.1}$$

where H is the outside opportunity for the manufacturer.

5.2.2. Retailer

The retailer's profit is

$$\pi_i^R = p_i^* D_i^* \left(p_i^*\right) - z_i X_i - W\left[\frac{1}{1+\theta} s_i^{1+\theta} + \lambda \frac{1}{1+\varepsilon} q_i^{1+\varepsilon} + F^R\right]$$

Substituting (5.1) into the above profit function, we have

$$\begin{aligned} \pi_i^R = p_i^* D_i^* - W\left[\tfrac{1}{1+\gamma}\left(D_i^*\right)^{1+\gamma} q_i^{\eta-\gamma} s_i^{-1-\gamma} + \tfrac{1+\lambda}{1+\varepsilon} q_i^{1+\varepsilon} + \tfrac{1}{1+\theta} s_i^{1+\theta}\right] \\ -W\left(F^M + F^R\right) - H. \end{aligned} \tag{5.2}$$

Comparing (4.1) and (5.2), we know that the first-order conditions are exactly same as the vertical-integration case except that (4.3) is replaced by

$$\ln q_i = \frac{1}{1+\gamma+\varepsilon-\eta} \ln \frac{\gamma-\eta}{(1+\gamma)(1+\lambda)} + \frac{1+\gamma}{1+\gamma+\varepsilon-\eta} \ln D_i^* - \frac{1+\gamma}{1+\gamma+\varepsilon-\eta} \ln s_i. \tag{5.3}$$

Then, it straightforward (see Appendix) to show that equilibrium physical output (production of physical products) satisfies

$$\ln Y_{retail} = \ln Y_{integrated} + \frac{1+\eta}{(1+\gamma)(1+\varepsilon)} \ln(1+\lambda). \tag{5.4}$$

and equilibrium quality can be shown to satisfy

$$\ln q_{retail} = \ln q_{integrated} - \frac{1}{1+\varepsilon} \ln(1+\lambda)$$

while the service level is the same between the two economies.

$$\ln s_{retail} = \ln s_{integrated}.$$

The quality level is lower in the retailer-oriented economy than in the vertically-integrated case as expected, and in order to compensate the low quality level, the level of physical output is higher. Since there is no source of inefficiency in service in the retailer-oriented economy, the service level is the same between the two economies. However, it is straightforward to show that the percentage effect of the money supply decline on the real wage and the quality-and-service adjusted quantity is the same in the retailer-oriented economy as in the vertically-integrated economy.

5.3. Manufacturer-oriented Economy.

Let us now consider the manufacturer-oriented economy, in which the manufacturer controls the distribution channel through resale price maintenance. The manufacturer determines both the resale price p_i, and the guaranteed margin m_i (thus the wholesale price is $p_i - m_i$).

5.3.1. Retailer.

The retailer's profit can be written as

$$\pi_i^R \equiv m_i D_i - W L_i^R - W F^R = \left[\frac{m_i}{q_i}\right]\left(\frac{p_i}{q_i}\right)^{-k} \frac{K}{N} s_i^{k-1} - \frac{W}{1+\theta} s_i^{1+\theta} - W F^R$$

The retailer maximizes its profit with respect to service s_i. The optimum service is determined by

$$(k-1)\left[\frac{m_i}{q_i}\right]\left(\frac{p_i}{q_i}\right)^{-k} \frac{K}{N} s_i^{k-2} = W s_i^{\theta}.$$

The second-order condition of optimality is satisfied if

$$\theta - k + 2 > 0, \tag{5.5}$$

which we will assume throughout this section. Consequently, the manufacturer can determine the level of the service s_i by specifying the resale pace p_i, the quality q_i and the margin m_i. Moreover, the above condition implies

$$\frac{W}{k-1} s_i^{1+\theta} = m_i D_i \tag{5.6}$$

This equation shows that the retail margin, which is the revenue of the retailer, is the principal measure to control the service level of the retailer.[18]

5.3.2. Manufacturer.

Using (5.6), we can rewrite the manufacturer's profit such that

[18]This is consistent with many anecdotal evidences found in the Japanese distribution system. For example, a high retail margin has been described as the principal tool for over-the-counter drug manufacturers to woo retailers to sell their products (see Itoh, M. (1995), *Distribution Changes Japan,* Tokyo: Kodansha, (in Japanese)).

$$\pi_i^M \equiv p_i^* D_i^* - W\left[\frac{1}{1+\gamma}(D_i^*)^{1+\gamma} q_i^{\eta-\gamma} s_i^{-1-\gamma} + \frac{1}{1+\varepsilon} q_i^{1+\varepsilon} + \frac{1}{k-1} s_i^{1+\theta}\right] - WF^M \quad (5.7)$$

The manufacturer maximizes its profit with respect to the price p_i of physical products, the quality q_i, and the margin m_i. Since the quality-and-service-adjusted price is $p_i^* = p_i/(s_i q_i)$ and p_i, q_i and m_i determine service s_i, maximizing the profit with respect to $(p_i,\ q_i,\ m_i)$ is equivalent to maximizing the profit with respect to $(p_i^*,\ q_i,\ s_i)$. We use the latter formulation.

Comparing (5.7) with (4.1) reveals that the only difference is the cost of service.[19] Thus, we have, instead of (4.2)

$$\ln s_i = \frac{1+\gamma}{2+\theta+\gamma}\ln D_i^* - \frac{\gamma-\eta}{2+\theta+\gamma}\ln q_i - \frac{1}{2+\theta+\gamma}\ln\frac{1+\theta}{k-1} \quad (5.8)$$

The macroeconomic equilibrium then satisfies the following properties (see Appendix).

$$\ln Y_{manu} = \ln Y_{integrated}$$

$$\ln q_{manu} = \ln q_{integrated}$$

$$\ln s_{manu} = \ln s_{integrated} - \frac{1}{1+\theta}\ln\frac{1+\theta}{k-1}$$

Since the source of inefficiency in service provision, the equilibrium service is lower than the vertically integrated case. Physical output and quality are the same in the manufacturer-oriented economy as in the vertically integrated economy.

Like the retailer-oriented economy, the manufacturer-oriented economy and the vertically integrated economy differ from each other on the level, but the sensitivity to nominal shocks is the same between the two economies.

5.4. Behavior of Sectoral Employment

Let us now compare the behavior of sectoral employment between the retailer-oriented economy and manufacturer-oriented one.

First, it can be shown that the employment engaged in producing physical goods is determined by

$$L^M = \left(\frac{k-1}{k}\right)\left(\frac{\alpha}{1-\alpha}\right)\frac{1}{1+\gamma}\frac{1}{NW}M, \quad (5.9)$$

[19]Fixed costs are also different, but it does not matter in our model since the number of brands for a firm is fixed to unity.

regardless of whether the regime is vertical integration, retailer-oriented, or manufacturer-oriented. This relation (5.9) holds so long as the firm optimizes its supply of physical products. Thus, the difference lies in fixed employment and employment engaged in quality control and service provision.

Retailer-oriented Economy. In the case of retailer-oriented economy, we have

$$L^q_{retail} = \frac{\gamma - \eta}{1+\varepsilon}\frac{1}{1+\lambda}L^M,$$

which is the employment for quality maintenance in manufacturing. Thus, total manufacturing employment $\overline{L^M}$ in the retailer-oriented economy is

$$\overline{L^M_{retail}} = F^M + L^M + L^q_{retail} = F^M + \left(1 + \frac{\gamma - \eta}{1+\varepsilon}\frac{1}{1+\lambda}\right)L^M. \tag{5.10}$$

Next, the retailer employs for service provision

$$L^R_{retail} = \frac{1+\gamma}{1+\theta}L^M. \tag{5.11}$$

In addition, there is additional employment for quality maintenance on the side of retailers, which is

$$L^{q'}_{retail} = \lambda L^q = \frac{\gamma - \eta}{1+\varepsilon}\frac{\lambda}{1+\lambda}L^M.$$

Therefore, the total retailing employment $\overline{L^R}$ is

$$\overline{L^R_{retail}} = F^R + L^R_{retail} + L^{q'}_{retail} = F^R + \left(\frac{1+\gamma}{1+\theta} + \frac{(\gamma-\eta)\lambda}{(1+\varepsilon)(1+\lambda)}\right)L^M. \tag{5.12}$$

Manufacturer-oriented Economy. The manufacturer-oriented economy is different from the vertically-integrated economy only in the determination of service. In particular, employment for quality maintenance is

$$L^q = \frac{\gamma - \eta}{1+\varepsilon}L^M, \tag{5.13}$$

which is the same as in the vertically integrated case. Thus, the total manufacturing employment $\overline{L^M}$ is

$$\overline{L^M_{manu}} = F^M + L^M + L^q_{manu} = F^M + \left(1 + \frac{\gamma - \eta}{1+\varepsilon}\right)L^M. \tag{5.14}$$

As for the retailing employment, employment for service competition is smaller than the vertically integrated case. We have

$$L^R = \frac{(k-1)(1+\gamma)}{(1+\theta)^2} L^M. \tag{5.15}$$

Consequently, the total retailing employment $\overline{L^R}$ is

$$\overline{L^R_{manu}} = F^R + L^R_{manu} = F^R + \frac{1+\gamma}{1+\theta}\frac{k-1}{1+\theta} L^M. \tag{5.16}$$

Figures 4 and 5 compare two economies in the case of changing money supply. The total manufacturing employment is depicted in Figure 4, where "Manufacturer-Oriented" line represents (5.14), while "Retailer-Oriented" line shows (5.10). In this figure, the vertical axis measures the money supply M, which linearly relates with L^M in (5.9).

Since $\lambda > 0$, we have

$$\frac{\partial \overline{L^M_{manu}}}{\partial M} = \left(1 + \frac{\gamma - \eta}{1+\varepsilon}\right)\frac{\partial L^M}{\partial M} > \left(1 + \frac{\gamma - \eta}{1+\varepsilon}\frac{1}{1+\lambda}\right)\frac{\partial L^M}{\partial M} = \frac{\partial \overline{L^M_{retail}}}{\partial M}$$

so that the Manufacturer-Oriented line lies above Retailer-Oriented line. Thus, when the money supply is M_0, the total manufacturing employment is AC in the manufacturer-oriented economy and BC in the retailer-oriented economy.

Suppose that the money supply is decreased from M_0 to M_1. Then, the macroeconomic equilibrium of the manufacturer-oriented economy moves from A to A', while the retailer-oriented economy shifts from B to B'. Let us draw parallel lines from A, A', and B' to get G, D, and E. Then, the rate of manufacturing employment decline is AD/AC in the manufacturer-oriented economy, while that is BE/BC in the retailer-oriented economy. Thus, by drawing liens GBH and HEF, we have $BE/BC = GF/GC'$ and $AD/AC = GA'/GC'$. Since $BE/BC = GF/GC' < GA'/GC' = AD/AC$, the rate of manufacturing employment decline in the retailer-oriented economy is always smaller than in the manufacturer-oriented economy.

Figure 5 shows the total retailing employment. Since we have (5.5), we get

$$\frac{\partial \overline{L^R_{manu}}}{\partial M} = \frac{1+\gamma}{1+\theta}\frac{k-1}{1+\theta}\frac{\partial L^M}{\partial M} < \left(\frac{1+\gamma}{1+\theta} + \frac{(\gamma-\eta)\lambda}{(1+\varepsilon)(1+\lambda)}\right)\frac{\partial L^M}{\partial M} = \frac{\partial \overline{L^R_{retail}}}{\partial M}.$$

Therefore, the Manufacturer-Oriented line is always above the Retailer-Oriented line. Then, when the money supply is M_0, the total retailing employment is JZ in the manufacturer-oriented economy and KZ in the retailer-oriented economy.

Next consider the effect of decline in money supply from M_0 to M_1. Figure 5 is the same as Figure 4 *except that the Manufacturer-Oriented line and the Retailer-Oriented line replace each other.* Therefore, the same argument in Figure 4 shows that the rate of retailing employment decline in the retailer-oriented economy, KP/KZ, is greater than that in the manufacturer-oriented economy, JQ/JZ.

Finally, let us compare the ratio of retailing employment fluctuation to manufacturing one in the retailer-oriented economy, $(KP/KZ)/(BE/BC)$, and that in the manufacturer-oriented economy, $(JQ/JZ)/(AD/AC)$. Since the former has greater numerator and smaller denominator than the latter, we have the following proposition.

PROPOSITION 5 (Sectoral Employment Fluctuation). *The ratio of retailing employment fluctuation to manufacturing one is greater in the retailer-oriented economy than in the manufacturer-oriented economy.*

The magnitude of volatility in retail employment in the retailer-oriented economy depends on the four factors: λ, γ, ε and η.. If

$$\frac{\gamma-\eta}{1+\varepsilon}\frac{\lambda}{1+\lambda}$$

is larger, then the retail-employment fluctuation is larger in the retailer-oriented economy. First, if the retailer needs a larger extra quality-maintenance cost (a large λ), then the retail employment becomes more volatile since more employment is needed in the retail sector. Second, stronger decreasing returns in production (a large γ) necessitates more quality adjustment, but because of an additional cost of quality maintenance, more adjustment burden is placed in retail service, implying more volatile retail employment. In contrast, if (i) decreasing returns in quality maintenance is more pronounced (a larger ε) and (ii) the marginal production cost is more sensitive to quality (a large η), then less importance is put on quality adjustment in the first place. Thus, the extra burden on retail service adjustment due to imperfect quality control is small, which means retail sector employment is less volatile.

Similarly, the magnitude of stability in retail employment in the manufacturer-oriented economy is determined by two factors: k and θ. If

$$\frac{k-1}{1+\theta}$$

is smaller, then the retail-employment fluctuation is smaller in the manufacturer-oriented economy. First, if the demand is less elastic (a smaller k), the retailer's service is less responsive to the retail margin which is the principal tool of the manufacturer controlling service (see (5.6)). This means the manufacturer's cost of controlling service is increased, so that the manufacturer has less incentive to change the service level of retailers. Thus, we have more stable employment in retailing in the manufacturer-oriented economy. Second, if decreasing returns is more pronounced in service provision (a larger θ), then again the service is less responsive to the retail margin. Thus, we have more stable retailing employment through the same mechanism as in the inelastic demand.

6. Concluding Remarks

In this paper, we have shown that the distribution channel competition profoundly changes the behavior of macroeconomic variable such as real wages and output. In particular, we have demonstrated that the economy with distribution channel competition is likely to have real wage rigidity. Moreover, we have argued that there is no *a priori* reason to assume that the real wage is counter-cyclical. *Without assuming technological shocks obviously making procyclical real wages*, the real wage can be procyclical depending on the value of parameters in the fixed cost of retailing, quality maintenance, and retail service provision.

We have also shown that employment is more volatile in an economy with distribution channel competition than without it, when the nominal wage is exogenously fixed. In addition, it has been revealed that the industrial organization of the distribution channels affects the sectoral behavior of employment. The retailing employment in the economy in which the retailer has an upper hand over the manufacturer, has been shown to be more volatile than in an economy where the manufacturer has an upper hand.

Finally, let us examine whether the model presented in this paper is capable of explaining the real wage behavior and international differences in the behavior of sectoral employment presented in the Introduction. Table 3 reports numerical examples based on the model of this paper.

In this table, the base case is the one in which physical output production, quality maintenance, and service provision exhibit substantial decreasing returns to scale. The

case called "Retail Service" is the one in which service provision has stronger decreasing returns than the other two, while the case "Quality Control" is the one in which quality maintenance has stronger decreasing returns.

As explained in Section 4, Japan can be considered as the manufacturer-oriented economy, with her *Keiretsu* distribution, while France and Germany can be considered as the retailer-oriented economy. The result of the table suggests the magnitude of the difference found in Table 2 can be generated if service provision is subject to strong decreasing returns to scale. Moreover, this table shows that in all three cases, real wages are procyclical rather than counter-cyclical.

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Appendix: Sectoral Employment Behavior under Quality and Service Competition: Vertical Integration, Retailer-oriented, and Manufacturer-oriented

To examine sectoral employment behavior among three regimes, it is convenient to express equilibrium with $(W/P,\, Y,\, q,\, s)$ instead of $(W/P^*,\, Y^*,\, q,\, s)$.

Vertical Integration. Taking account of $Y^* = qsY$, $P^* = P/(qs)$, the equilibrium condition derived from (4.2), (4.3), (4.4) and (4.5) are, in the case of vertically-integrated economy,

$$\ln s_{integrated} = \frac{1+\gamma}{1+\theta}\ln Y_{integrated} + \frac{1+\eta}{1+\theta}\ln q_{integrated}, \tag{A.1}$$

$$\ln q_{integrated} = \frac{1}{\varepsilon-\eta}\ln\frac{\gamma-\eta}{1+\gamma} + \frac{1+\gamma}{\varepsilon-\eta}\ln Y_{integrated} \tag{A.2}$$

$$(\ln W - \ln P)_{integrated} = -\ln\frac{k}{k-1} - (1+\eta)\ln q_{integrated} - \gamma\ln Y_{integrated} \tag{A.3}$$

$$(\ln W - \ln P)_{integrated} = \ln N + \ln Y_{integrated} - \ln\frac{\alpha}{1-\alpha} - \ln\frac{M}{W} \tag{A.4}$$

Consequently, we have

$$(1+\gamma)\left(\frac{\varepsilon+1}{\varepsilon-\eta}\right)\ln Y_{integrated} = \ln\frac{M}{W} - \ln\frac{k}{k-1} - \frac{1+\eta}{\varepsilon-\eta}\ln\frac{\gamma-\eta}{1+\gamma} + \ln\frac{\alpha}{1-\alpha} - \ln N. \tag{A.5}$$

and

$$\ln s_{integrated} = \frac{1+\gamma}{1+\theta}\left(\frac{1+\varepsilon}{\varepsilon-\eta}\right)\ln Y_{integrated} + \frac{1+\eta}{1+\theta}\frac{1}{\varepsilon-\eta}\ln\frac{\gamma-\eta}{1+\gamma}, \tag{A.6}$$

Retailer-Oriented. In the case of the retailer-oriented economy, (A.2) is replaced by

$$\ln q_{retail} = \frac{1}{\varepsilon-\eta}\ln\frac{\gamma-\eta}{(1+\gamma)(1+\lambda)} + \frac{1+\gamma}{\varepsilon-\eta}\ln Y_{retail}. \tag{A.7}$$

Consequently, we get

$$(1+\gamma)\left(\frac{1+\varepsilon}{\varepsilon-\eta}\right)\ln Y_{retail} = (1+\gamma)\left(\frac{\varepsilon+1}{\varepsilon-\eta}\right)\ln Y_{integrated} + \frac{1+\eta}{\varepsilon-\eta}\ln(1+\lambda). \tag{A.8}$$

Through straightforward calculation, we have

$$\ln q_{retail} = \frac{1}{\varepsilon - \eta} \ln \frac{\gamma - \eta}{1+\gamma} + \frac{1+\gamma}{\varepsilon - \eta} \ln Y_{integrated} - \frac{1}{1+\varepsilon} \ln (1+\lambda),$$

and

$$\ln s_{retail} = \frac{1+\gamma}{1+\theta} \left(\frac{1+\varepsilon}{\varepsilon - \eta} \right) \ln Y_{integrated} + \frac{1+\eta}{1+\theta} \frac{1}{\varepsilon - \eta} \ln \frac{\gamma - \eta}{1+\gamma}.$$

Manufacturer-oriented. In the case of the manufacturer-oriented economy, (A.1) is replaced by

$$\ln s_{manu} = \frac{1+\gamma}{1+\theta} \ln Y_{manu} + \frac{1+\eta}{1+\theta} \ln q_{manu} - \frac{1}{1+\theta} \ln \frac{1+\theta}{k-1}. \tag{A.9}$$

It is straightforward to show that Y is determined by (A.5) and the same as in the case of vertical integration. Moreover, we get

$$\ln q_{mnau} = \frac{1}{\varepsilon - \eta} \ln \frac{\gamma - \eta}{1+\gamma} + \frac{1+\gamma}{\varepsilon - \eta} \ln Y_{integrated},$$

and

$$\ln s_{manu} = \frac{1+\gamma}{1+\theta} \left(\frac{1+\varepsilon}{\varepsilon - \eta} \right) \ln Y_{integrated} + \frac{1+\eta}{1+\theta} \frac{1}{\varepsilon - \eta} \ln \frac{\gamma - \eta}{1+\gamma} - \frac{1}{1+\theta} \ln \frac{1+\theta}{k-1}.$$

Table 1: Real Wages over Business Cycles 1971-1991

			Correlation with	
	Real Wage	Value-Added	Current Real Wage	Lagged Real Wage
USA	Manufacturing, hourly	Manufacturing	0.526919885	0.597986928
Japan	Manufacturing, monthly	Manufacturing	0.567457562	0.081098389
France	Industry, hourly	Manufacturing	0.50311343	0.366070669
German	Manufacturing, hourly	Manufacturing	-0.015720357	0.072987077
Canada	Manufacturing, hourly	Manufacturing	0.015514568	0.216108059
Italy	Industry, hourly	Manufacturing	-0.086425584	0.337154467
Austria	Mining and Manufacturing, hourly	Manufacturing	-0.272867068	0.292729492
Sweden	Mining and Manufacturing, hourly	Manufacturing	0.330981821	0.10447285
Denmar	Mining and Manufacturing, hourly	Manufacturing	-0.011520552	0.231730737
Finland	Industry, hourly	Manufacturing	0.397704585	0.074266674

Source: OECD

Table 2:
Magnitude of Fluctuation over Business Cycles: Ratio of Distribution Sector to Manufacturing
1971-1993

	Standard Deviation of Employment Change		
	Distribution	Manufacturing	Dist./Manu.
USA	0.0202	0.0371	0.5429
Japan	0.0080	0.0205	0.3908
France	0.0127	0.0125	1.0121
Germany	0.0163	0.0220	0.7380
Canada	0.0257	0.0437	0.5877
Italy	0.0172	0.0197	0.8736
Austria	0.0127	0.0153	0.8346
Sweden	0.0215	0.0293	0.7322
Denmark	0.0173	0.0324	0.5359
Finland	0.0342	0.0356	0.9609

Source: OECD

Notes:

(1) French Employment Figures start at 1976.

(2) Canadian employment figures start at 1986.

(3) Austrian employment figures start at 1984.

(4) Employment of all persons.

Table 3. Numerical Example

	Base Case	Stronger Decreasing Returns in	
		Retail Service	Quality Control
PARAMETERS			
Fixed Employment/Manufacturing Employment			
Retail	0.2	0.2	0.2
Manufacturing	0.2	0.2	0.2
Demand elasticity k	3	3	3
Magnitude of Decreasing Returns			
$\gamma > 0$ (Production of Physical Products)	2	2	4
$\theta > 0$ (Provision of Service)	2	4	2
$\varepsilon > 0$ (Quality Maintenance)	2	2	4
$\eta > -1$ (Quality's Effect on Marginal Cost)	1.5	1.5	1.5
$\lambda > 0$ (Extra Quality Cost in Retailing)	0.1	0.1	0.1
	% Change in Employment: Retail/Manufacturing		
Retailer-oriented	0.983	0.889	1.031
Manufacturer-oriented	0.901	0.639	0.960
Vertically-integrated	0.976	0.879	1.012
	Elasticity of Real Wages to Money Supply Change		
Vertically-integrated	-2.6	-1.432432432	-1.727272727

Figure 1-1:
Manufacturing and Distribution Sectors
Rate of Change in Employment
United States

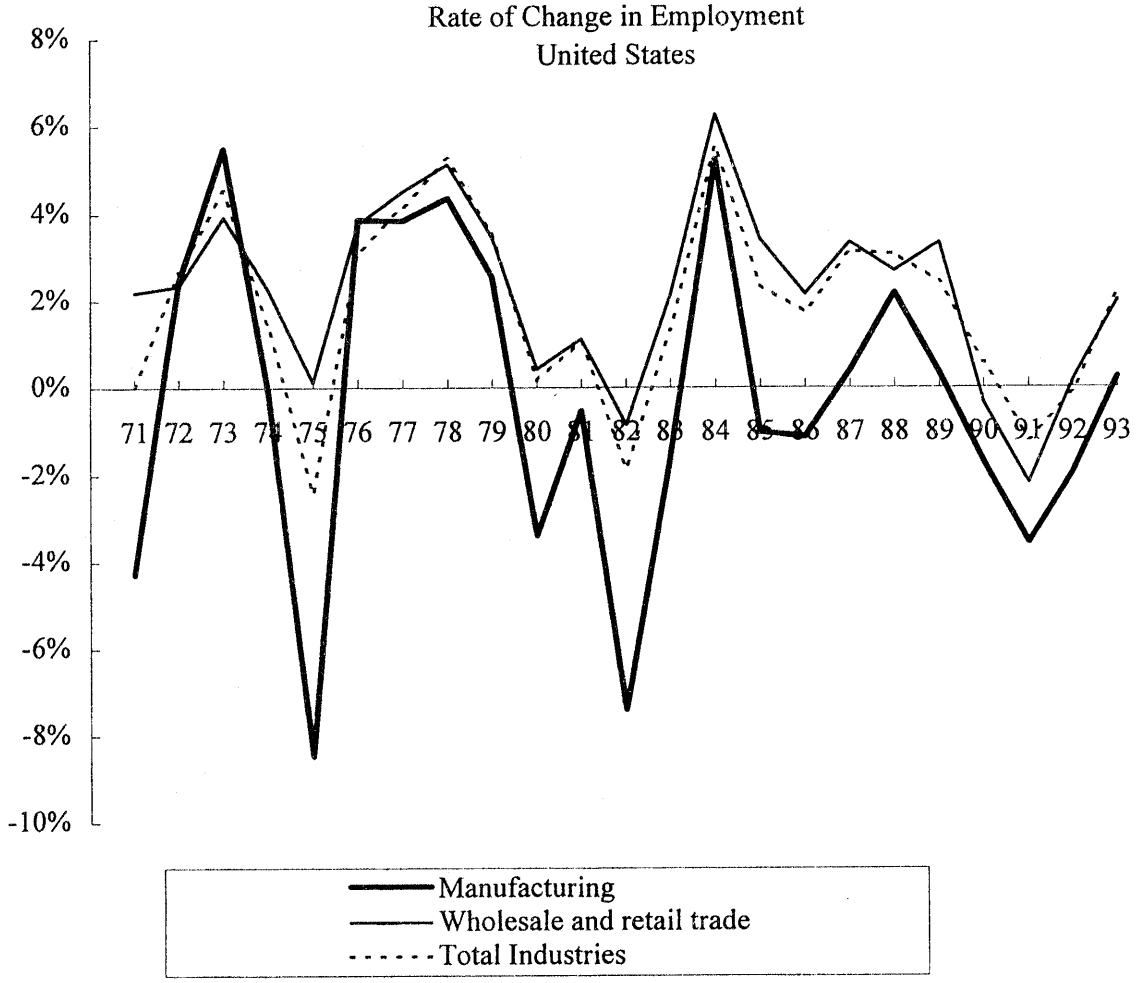


Figure 1-2:
Manufacturing and Distribution Sectors
Rate of Change in Employment
Japan

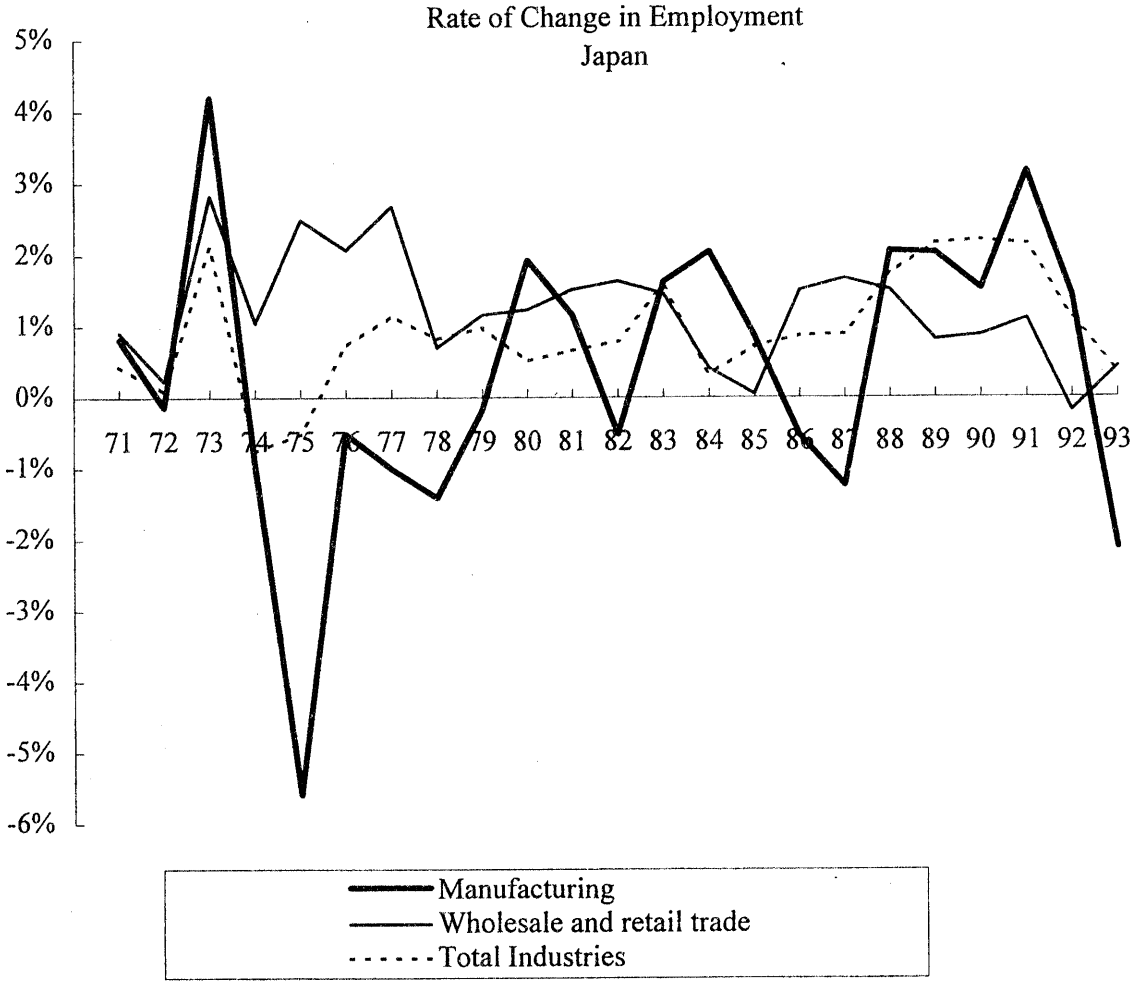


Figure 1-3:
Manufacturing and Distribution Sectors
Rate of Change in Employment
France

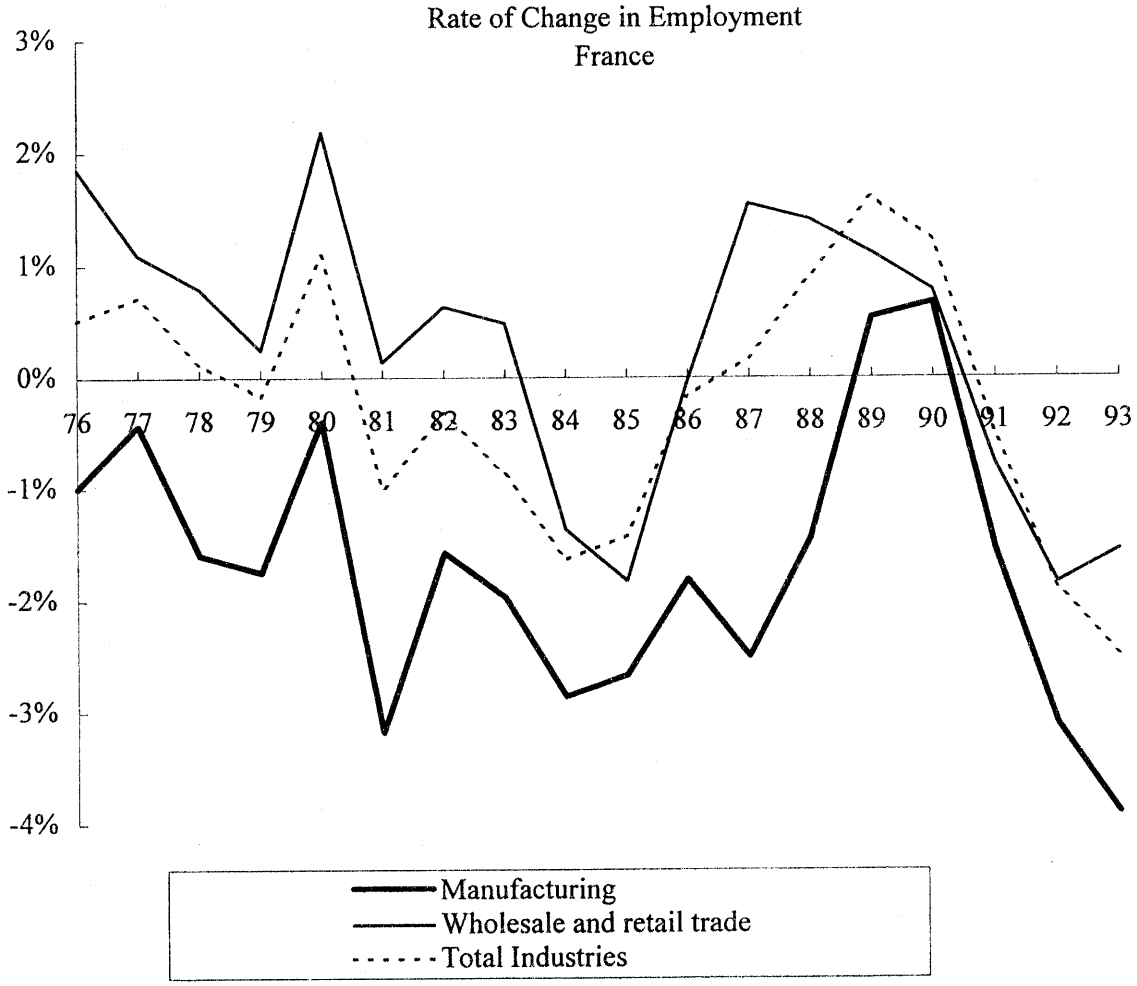
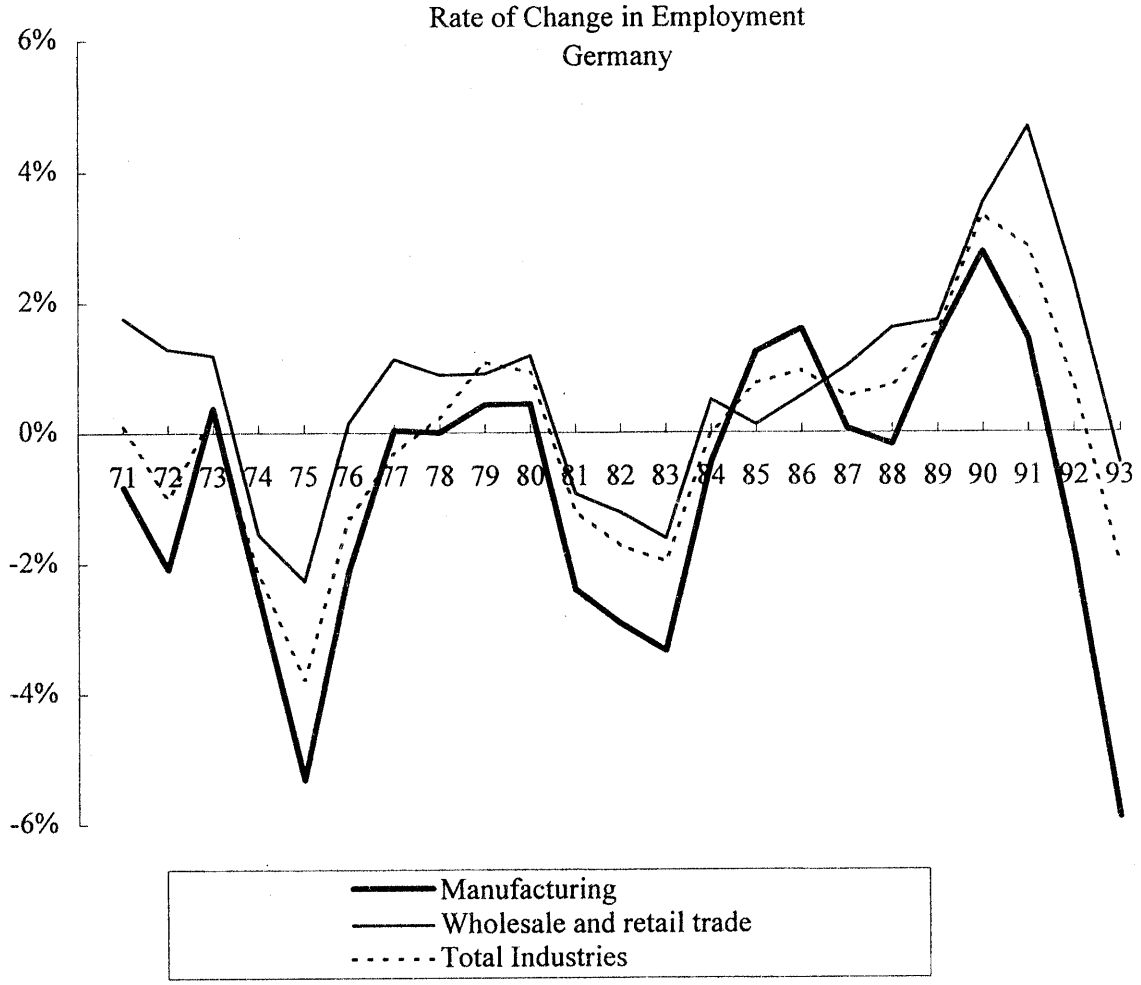


Figure 1-4:
Manufacturing and Distribution Sectors
Rate of Change in Employment
Germany



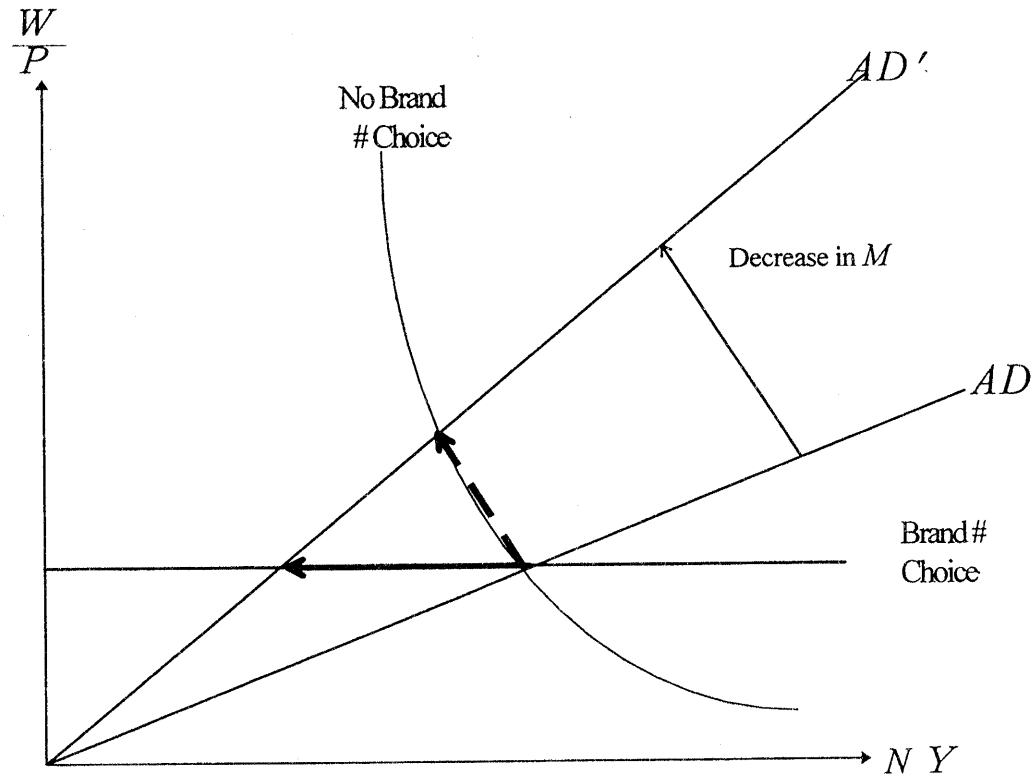


Figure 2:
Determination of Output and Price Level
under Nominal Wage Rigidity: Variety Competition

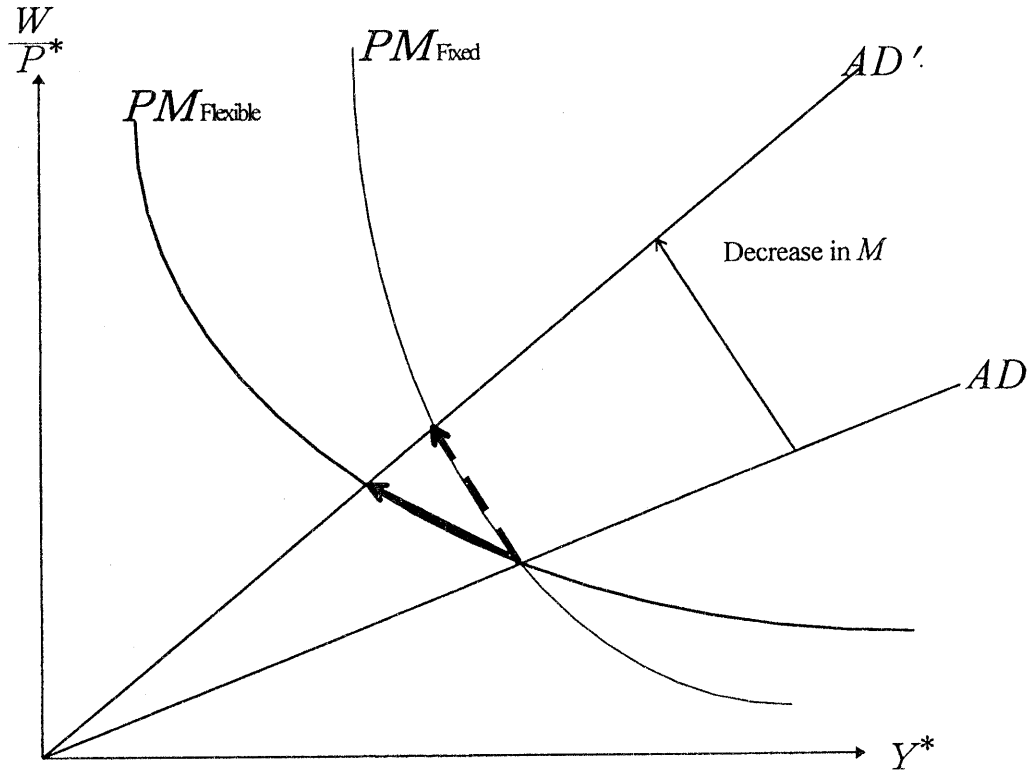


Figure 3:
Determination of Output and Price Level under Nominal Wage Rigidity: Quality and Service Competition

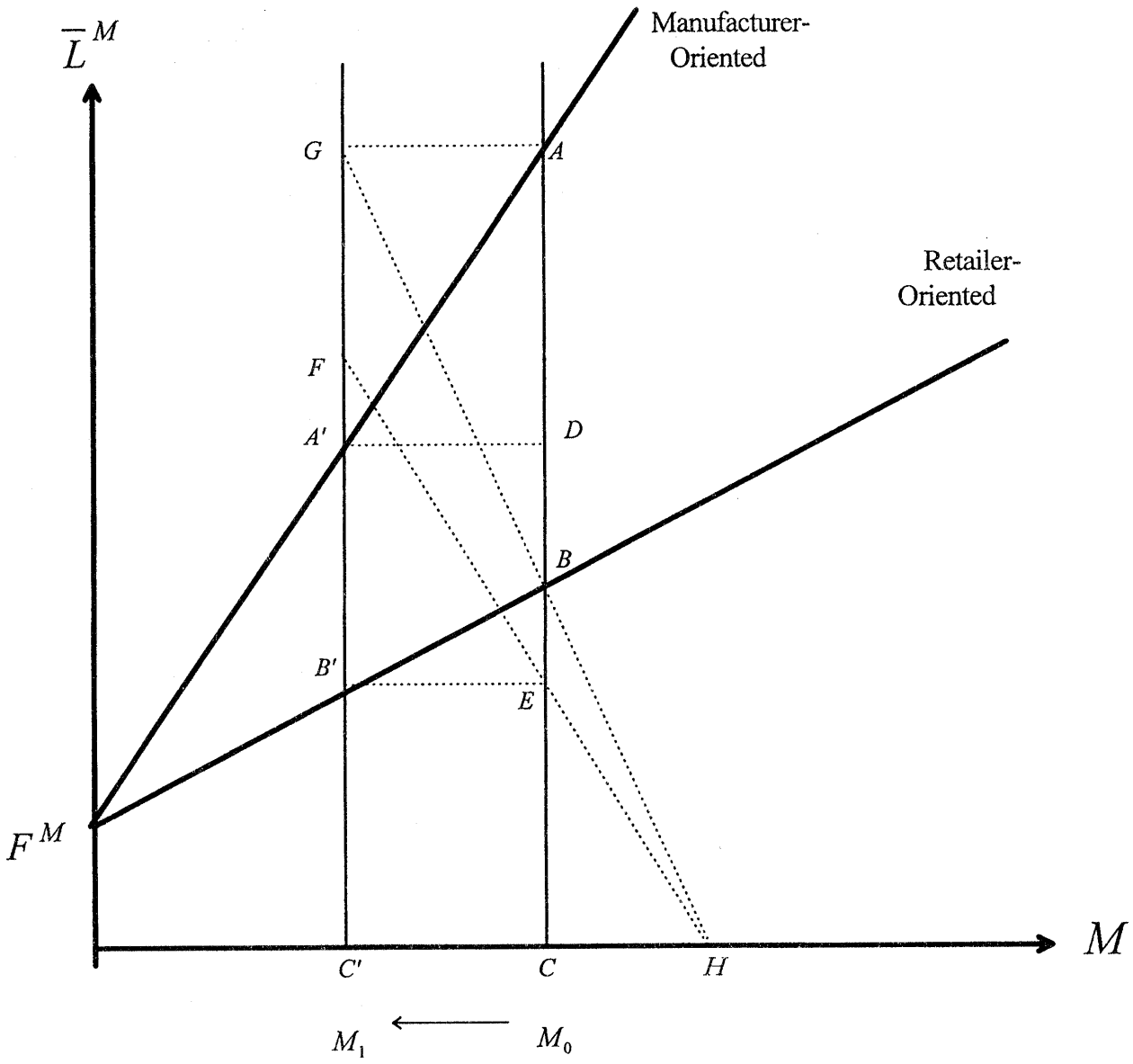


Figure 4:
Total Manufacturing Employment

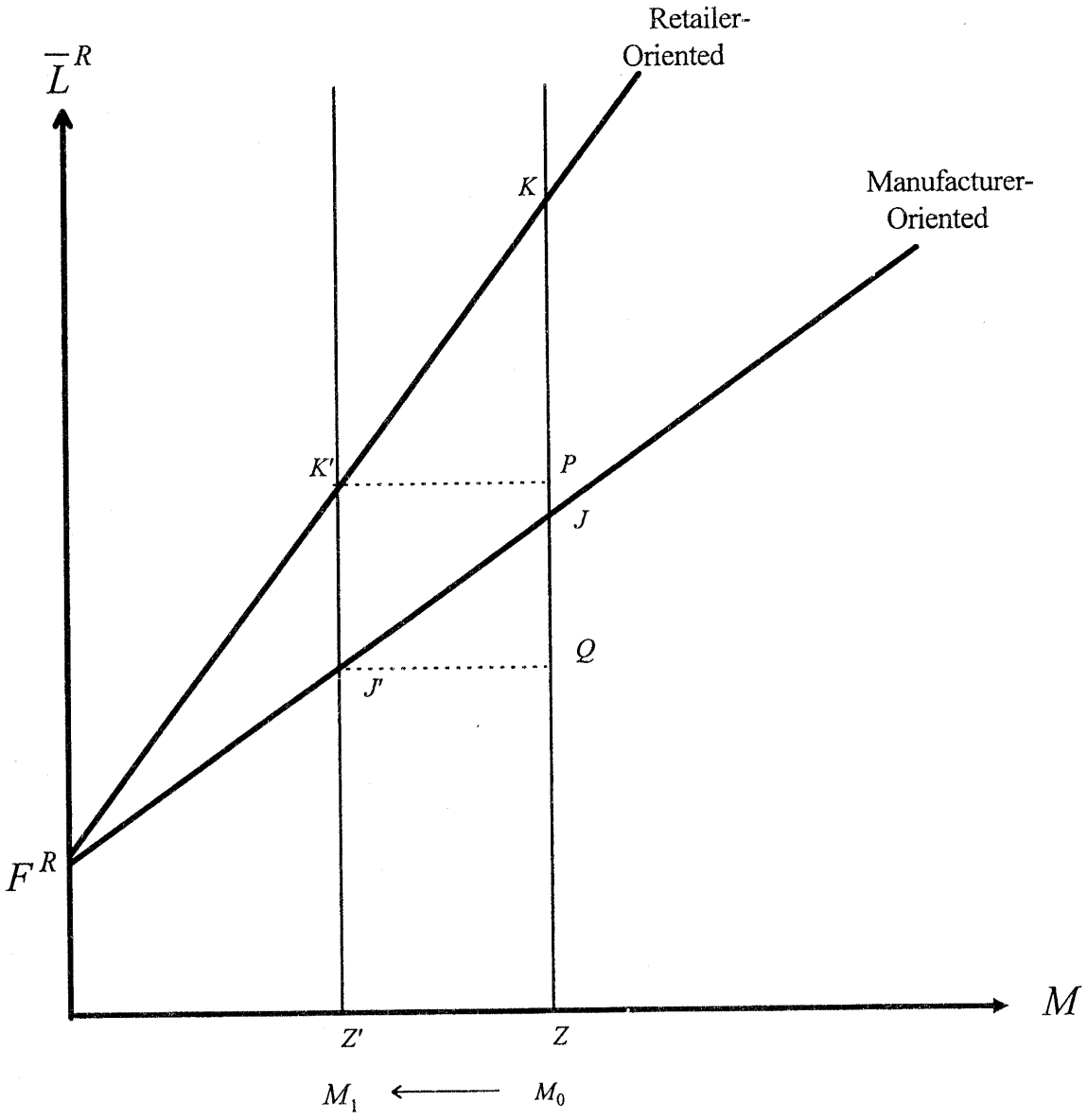


Figure 5:
Total Retailing Employment