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Regulation, Quality Adjustment, and Relative Price Changes : The Case of Yen Appreciation Shock of 1985[1]

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Abstract

This paper develops a model of small open economy with two sectors - tradable and non-tradable - where the non-tradable sector is subject to a price ceiling and quality adjustment. The model is used for analyzing the effects of exchange rate appreciation on relative prices and employment. The paper shows that, when the economy is initially distorted by a binding price ceiling and suboptimal product quality, an appreciation of the home currency (and the resulting fall of the tradable good price) will induce the non-tradable producers to raise product quality instead of lowering the price at the same pace as the tradable good price. The improved quality will increase the non-tradable demand, and the non-tradable employment level will also increase. The model is applied to the analysis of the yen appreciation shock in 1985-87. Some anecdotal evidences consistent with the model's prediction are also presented.

Ⅰ. Introduction

One of the best-known events in the post-war economic history of Japan is a sharp appreciation of the yen in the mid 1980s. The dollar-yen exchange rate, which had been hovering around ¥240/$ during the early 1980s (between the inauguration of Reagan Administration in January 1981 and the Plaza Agreement in September 1985), tumbled down to ¥122/$ in December 1987, almost doubling the yen's value in two years. (See Fig. 1.) Both the magnitude and speed of the

[1] I am grateful to Hisahiro Naito and the seminar participants at U. C. Irvine for helpful comments and suggestions. All the remaining errors are mine.

appreciation were unprecedented, whose record has not been broken until now.[2]

A less known fact, although noticed by some observant economists (most notably McKinnon and Ohno [1997, 2001]), is that the historic rise of the yen in 1985-87 coincided with a substantial change in relative prices - what McKinnon and Ohno call "price diffusion". This is by no means a trivial fact ; it contradicts the standard neoclassical theory with monetary neutrality, which predicts that the coordinated devaluation of the dollar in 1985-87 - a negative *monetary* shock - should cause *equi-proportionate* falls in Japanese prices, bringing down the *aggregate* price level while leaving *relative* prices unchanged ; in reality, prices did *not* fall in unison but kept drifting apart ; as one can see in Fig. 2, between January 1985 and December 1987, the export WPI and domestic WPI fell by 25.8% and 8.4%, respectively, while the CPI *rose* by 1.6%. A shock in the nominal exchange rate, whose effect should be confined to *nominal* variables, apparently had a *real* impact.

How do we explain this apparent non-neutrality of the exchange rate? After conducting some empirical analysis and ruling out alternative explanations (e. g. global deflation in tradable goods), McKinnon and Ohno [1997] attribute the price diffusion to "varying degrees of price stickiness and exchange rate path-through", which in turn arise from "difference in the degree of exposure to foreign competition".[3] Similarly, a number of public reports (most notably OECD [1990]) point out that regulations (such as price support and entry restriction) could make it easier for the incumbent firms to form collusion and maintain oligopolistic prices, causing the non-tradable prices to fall less than the tradable prices in response to the yen appreciation. This remark indeed seems consistent with the data : within the non-tradable sector, regulated industries (such as communication and transportation) had a much smaller decrease in the price than other industries in 1985-87. (See Fig. 3.)

The above explanation (which relates the non-neutrality of the exchange rate to regulation-

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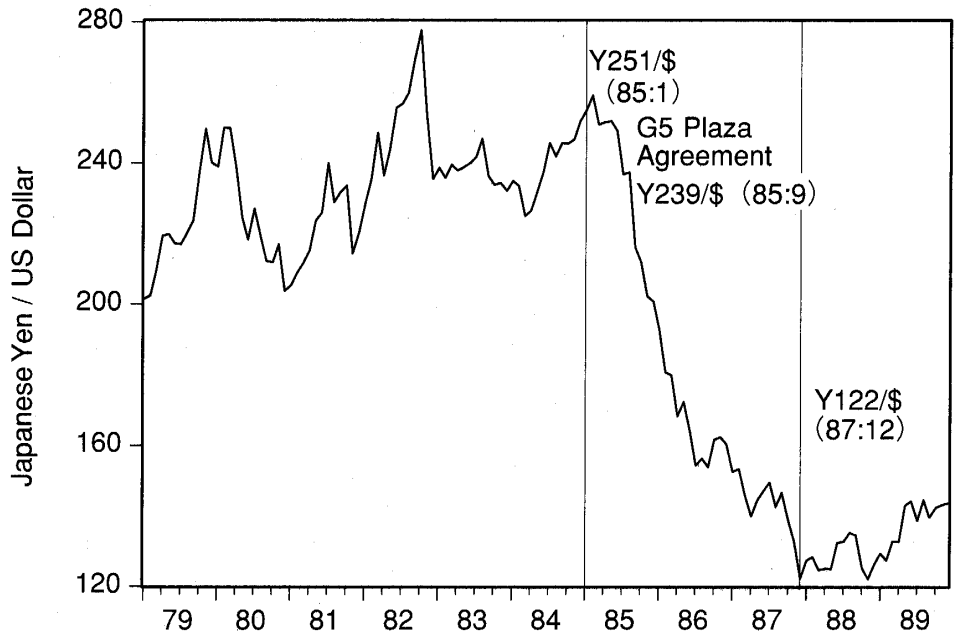
[2] Other notable episodes of yen appreciation are those in 1970-73 (from ¥360/$ to ¥265/$), 1976-79 (from ¥305/$ to ¥201/$), and 1992-95 (from ¥135/$ to ¥79/$).

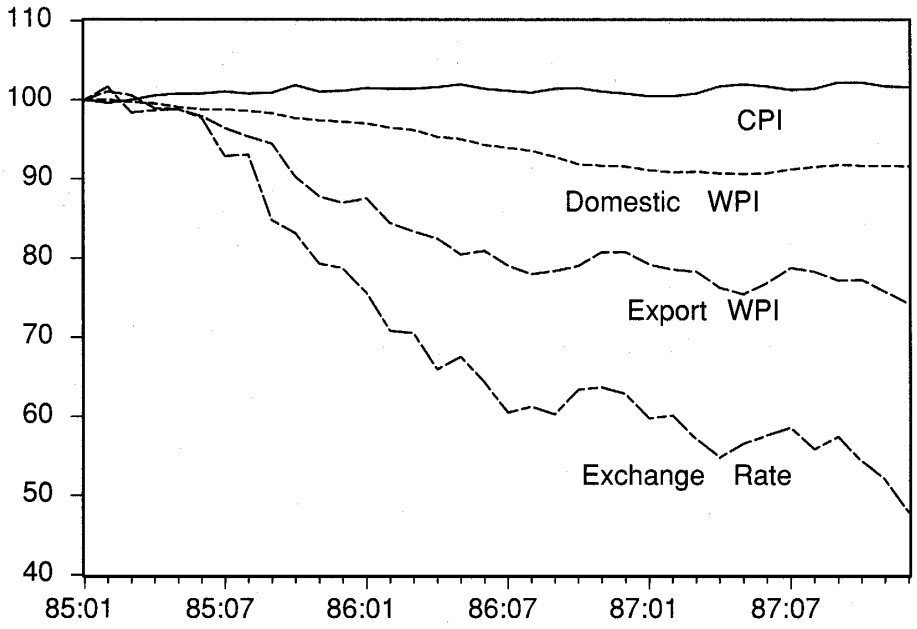
[3] Other than by commodity deflation, the observed pattern of price diffusion (a relative decline in the tradable good prices) could (in principle) be caused by a fiscal expansion (which increases the demand for non-tradable goods) and/or sectoral differences in productivity growth (the Balassa-Samuelson effect). As McKinnon and Ohno [1997] point out, however, the speed at which these real shocks take effect is much slower than what is implied by Fig. 2.

Fig. 1 Dollar Yen Exchange Rate 1979:1-1989:12



Source : IMF

Fig. 2 Exchange Rate and Prices (1985:1=100) 1985:1-1987:12



Source : Bank of Japan

induced price stickiness), while doubtlessly capturing an important aspect of the Japanese economy in the mid 1980s, has its limitations. It may well be true that firms in regulated industries had some market power, which enabled them to maintain the prices of their products even under the deflationary pressure caused by the yen appreciation. Yet, such pricing behavior (although near-rational to each firm in the sense of Akerlof and Yellen [1985]) should undermine the competitive position of the regulated industries as a whole (vis-à-vis those with lowered prices), reducing the level of output/employment. In reality, however, there is no clear sign of deterioration in the employment level of the regulated industries (such as transportation and communication) compared to other (less regulated) industries. (See Fig. 4.)

This paper aims at going beyond the conventional sticky-price story and giving a simultaneous account of the observed patterns of relative prices (Fig. 3) and employment (Fig. 4). More specifically, the paper presents a model of a partially regulated economy with two sectors - tradable and non-tradable - where the tradable sector is characterized by invariable product quality and international price arbitrage, whereas the non-radable sector is characterized by variable quality and a price ceiling.[4] It is shown that, when the economy is initially in a distorted equilibrium with a binding price ceiling and sub-optimal quality in the non-tradable sector, an appreciation of the home currency (and the resulting fall in the tradable good price) will cause the non-tradable good producers to maintain the price (i. e. let the relative price of their product rise) and raise the quality instead. Since the home appreciation relaxes the initial distortion and increases the non-tradable demand, the non-tradable employment level will also increase.

The rest of the paper is organized as follows : the next section presents a model to illustrate the key insight of the paper. The third section explores the empirical relevance of the model by looking at some anecdotal evidences. The final section concludes the paper.

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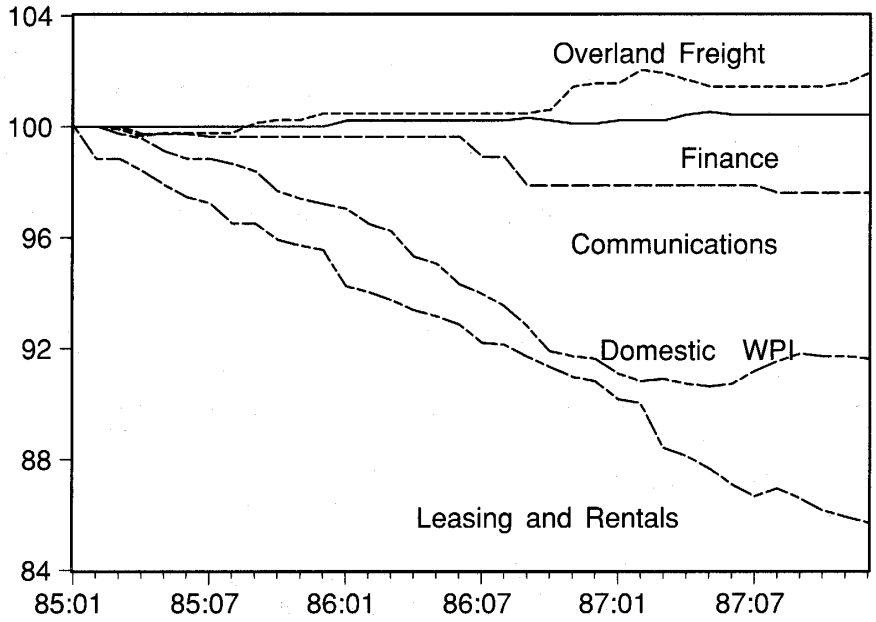
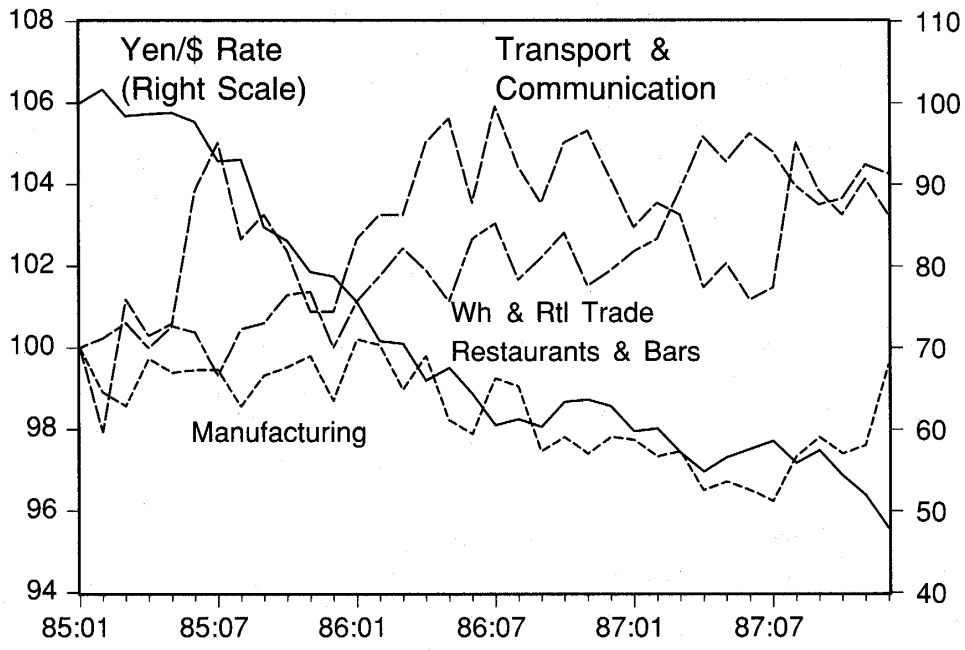
[4] To be exact, most of the price regulations in Japan in the mid 1980s took the form of approval system rather than pure price ceiling system. One can argue that it was politically more difficult for the regulatory authority to approve a price increase than a decrease, so price ceiling can be used as a crude approximation.

Fig. 3 Prices during Yen Appreciation (1985:1=100) 1985:1-1987:12



Source : Bank of Japan

Fig. 4 Exchange Rate and Employment (1985:1=100)



Statistics Bureau, MIAC

Ⅱ. The Model

Consider a small open economy with two sectors, tradable and non-tradable. The tradable sector is subject to international price arbitrage and perfect path-through, so that the following condition will always hold among the home tradable price P_T, foreign tradable price P_T^* and nominal exchange rate E:

$$P_T = EP_T^* \cdots (1)$$

The non-tradable sector faces no competition from abroad but is subject to a price regulation that caps the price from the above by the maximum price $\overline{P}_N$:

$$P_N \leq \overline{P}_N \cdots (2)$$

The quality of the tradable good is assumed to be constant, while that of the non-tradable good (hereafter measured by z) is assumed to be adjustable, enabling the non-ttradable good producers eliminate excess demand even when the price ceiling happen to be binding ($P_N = \overline{P}_N$). Examples of such quality adjustment are congestion in public transportation and a long waiting time at hospitals.[5]

In what follows, we will first look into the behavior of households and firms to derive the key equations (demand and supply equations) of the model. We will then characterize the general equilibrium with and without a binding price ceiling. Finally, we will examine the effect of an exchange rate appreciation (a decrease in E) on the relative price and employment.[6]

Households

The economy is inhabited by a large number of households, whose population size is normalized to one. Each household (elastically) supplies labor and earns an amount Wl of labor income. In

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[5] To be complete, one must explain how the ceiling price $\overline{P}_N$ is determined and why it could be binding in the first place. Here, we simply assume that the ceiling price is exogenously given and it is binding due to the legacy of price controls introduced at the times of the Oil Shocks in the 1970s.

[6] The model presented here is a generalized version of the hedonic price model by Rosen [1974]. It differs from the original Rosen model in having *1)* an explicit analysis of the factor markets, *2)* money (so that the aggregate price level can be determined), and *3)* a price ceiling. For more details of these extensions, see Furuya [2004].

addition, they own an amount $\bar{K}$ of physical capital (all of which is inelastically supplied to firms, which pay back an amount $R\bar{K}$ of dividends) and an amount $\bar{M}$ of money stock (the supply of which is pre-determined).

The preference of the households is defined over the amount of goods consumed, real money balances, and hours of work. More specifically, the utility function of the representative household is assumed to have the following weakly separable form :

$$U=U\left[u\left(c,\frac{m}{P}\right),l\right] \quad \cdots(3)$$

where c is the composite consumption index, (m/P) is real money balances, l is the amount of labor supplied, and u is the sub-utility function homogenous of degree one in terms of the two arguments. The composite consumption index c depends positively on the tradable and non-tradable consumption levels (c_T and c_N) and non-tradable quality z :

$$c=\Omega(c_T, c_N, z) \quad \cdots(4)$$

Assuming that Ω is homogenous of degree one in terms of c_T and c_N, we can obtain a corresponding CPI

$$P=\Phi(P_T, P_N, z) \quad \cdots(5)$$

which depends positively on P_T and P_N and negatively on z.

Maximizing the utility function defined by (3)-(5) subject to the budget constraint

$$P_Tc_T+P_Nc_N+m=Wl+R\bar{K}+\bar{M}\ (\equiv Z) \quad \cdots(6)$$

and exploiting the homogeneity assumptions, we can obtain the following relations :

(Tradable Demand) $\quad c_T=c_T\left(\frac{P_T}{P},\ (1-k)\left(\frac{Z}{P}\right)\right) \quad \cdots(7)$

(Non-tradable Demand) $\quad c_N=c_N\left(\frac{P_N}{P}, z,\ (1-k)\left(\frac{Z}{P}\right)\right) \cdots(8)$

(Money Demand) $\quad m=kZ \quad \cdots(9)$

(Labor Supply) $\quad l=l\left(\frac{W}{P}\right) \quad \cdots(10)$

where Z is the nominal value of total endowment given by (6) and k is the share parameter for real money balances. Using (7)-(10) in the above, the indirect utility function of the

representative household can be written as

$$V=V\left(\frac{Wl+R\bar{K}+\bar{M}}{P},\ l\right) \cdots(11)$$

where l is optimally chosen according to (10).

Firms

The production side of the economy has fairly standard features ; perfect competition and CRS technology are assumed for all the sectors. More specifically, the production functions for the tradable and non-tradable sectors are given by

$$Q_T=F(L_T, K) \cdots(12)$$

$$Q_N=G(L_N, z)=\frac{1}{\tau(z)}L_N \cdots(13)$$

where Q_i and L_i $(i=\mathrm{T}, \mathrm{N})$ are the levels of output and employment in sector i and the labor requirement coefficient $\tau(z)$ is strictly convex in terms of z:[7]

$$\tau'(z)>0,\ \tau''(z)>0 \cdots(14)$$

Profits of the representative firm in each sector are thus given by

$$\pi_T=P_TQ_T-WL_T-RK \cdots(15)$$

$$\pi_N=P_NQ_N-WL_N \cdots(16)$$

Maximizing the profit functions (15)-(16) subject to (12)-(13) will yield the following supply equations :

$$P_T=\gamma(W, R) \cdots(17)$$

$$P_N=\tau(z)W \cdots(18)$$

where γ is a unit cost function that is homogenous of degree one in terms of W and R.

General Equilibrium

Market clearing of consumption goods, labor, and capital requires that

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[7] This means the marginal cost will be increasing more and more as the firms raise the quality of their products.

$$c_T = Q_T \quad \cdots(19)$$

$$c_N = Q_N \quad \cdots(20)$$

$$m = \bar{M} \quad \cdots(21)$$

$$L_T + L_N = l \quad \cdots(22)$$

$$W = P_T \frac{\partial}{\partial L_T} F(L_T, \bar{K}) \quad \cdots(23)$$

$$R = P_T \frac{\partial}{\partial K} F(L_T, \bar{K}) \quad \cdots(24)$$

Furthermore, the endogenous determination of quality requires the boundary condition

$$\left.\frac{\partial P_N}{\partial z}\right|_{dV=0} = \left.\frac{\partial P_N}{\partial z}\right|_{d\pi_N=0} \quad \cdots(25)$$

Finally, the nominal exchange rate E will be determined so that the tradable PPP condition (1) holds. The above conditions (19)-(25), together with the auxiliary equations (1), (5)-(18) and the price-ceiling constraint (2), constitute an equations system which determines the general equilibrium of this economy.

By introducing normalized variables such as $p \equiv (P_N/P_T)$, $\bar{p} \equiv (\bar{P}_N/P_T)$ and $\omega \equiv (W/R)$, the above system can be further simplified as follows :

(Relative Demand) $L_T(\omega, \bar{K}) + L_N(\omega, p, z, K) = l(\omega, p, z) \quad \cdots(26)$

(Relative Supply) $p = \tau(z)\,\phi(\omega) \quad \cdots(27)$

(Boundary Condition) $\left.\frac{\partial p}{\partial z}\right|_{dV=0} = \left.\frac{\partial p}{\partial z}\right|_{d\pi_N=0} \quad \cdots(28)$

$V = V(\omega, l, p, z, \bar{K}) \quad \cdots(29)$

(Price Ceiling) $p \leq \bar{p} \quad \cdots(30)$

When (30) is not binding $(p < \bar{p})$, three equations (26), (27), and (28) (with definition (29)) will determine the equilibrium values of ω, p, and z. In contrast, when (30) is binding $(p = \bar{p})$, the boundary condition (28) cannot be satisfied. The quality will be constrained to a sub-optimal level $\underline{z}$ such that (26) and (27) are satisfied at $p = \bar{p}$.

The effect of price ceiling (30) can be best understood in graphs. Fig. 5 depicts the equilibrium in the (z, p) space when the price ceiling is not biding $(p < \bar{p})$. The steeper curve $\pi_N\pi_N$ is an iso-

profit curve consistent with the relative supply relation (27). The region above this curve (characterized by higher prices and lower quality) corresponds to positive profits. The flatter curve VV is an indifference curve derived from the indirect utility function (29). The region below this curve (characterized by lower prices and higher quality) corresponds to higher utility levels. The equilibrium levels of z and p [(z^o, p^o) in the figure] are indicated by point E, where the iso-profit curve $\pi_N\pi_N$ and the indifference curve VV are tangential to each other. This result comes from the boundary condition (28), which requires that the households' marginal valuation of quality is equal to the marginal cost of quality improvement. The horizontal line indicates the price ceiling. Since it is not binding, the equilibrium price lies below the ceiling price.

Fig. 6 describes the case when the price ceiling is binding ($p=\bar{p}$). The equilibrium is given by point $\underline{E}$ in the figure, where the horizontal price ceiling line and the iso-profit curve $\pi_N\pi_N$ intersect. The quality level is given by $\underline{z}$ in the figure. Notice that point $\underline{E}$ lies in the southwest of point E, which represents the unconstrained optimum. Thus, the indifference curve going through point $\underline{E}$ (labeled $\underline{V}\ \underline{V}$) lies above the one going through point E (labeled VV), meaning that the households will be worse-off than at the unconstrained optimum.

Effects of Exchange Rate Appreciation

We are now ready to analyze the effects of an exchange rate appreciation, namely, a decrease in E (which can be modeled as a fall in the money share k in (9)). Let us first look at what will happen to the equilibrium levels of relative price $p\ (=P_N/P_T)$ and quality z.

Figs. 7 and 8 depict the effects of an appreciation with and without the initial distortion. Fig. 7 corresponds to the case in which the price ceiling is not binding in the initial equilibrium, while Fig. 8 corresponds to the case in which the price ceiling is initially biding. In both cases, the revaluation will shift up the solid horizontal line representing the price ceiling ($p=\bar{p}\equiv(\bar{P}_N/P_T)$). This is because a decrease in E and the resulting fall in the tradable price $P_T\ (=EP_T^*)$ will raise the relative value of ceiling $\bar{P}_N$.

The effects on the equilibrium levels of p and z can be easily seen from Figs. 7 and 8. When the price ceiling is not binding in the first place (as in Fig. 7), an appreciation and the resulting increase

Fig. 5 Equilibrium when Price Ceiling is not Binding

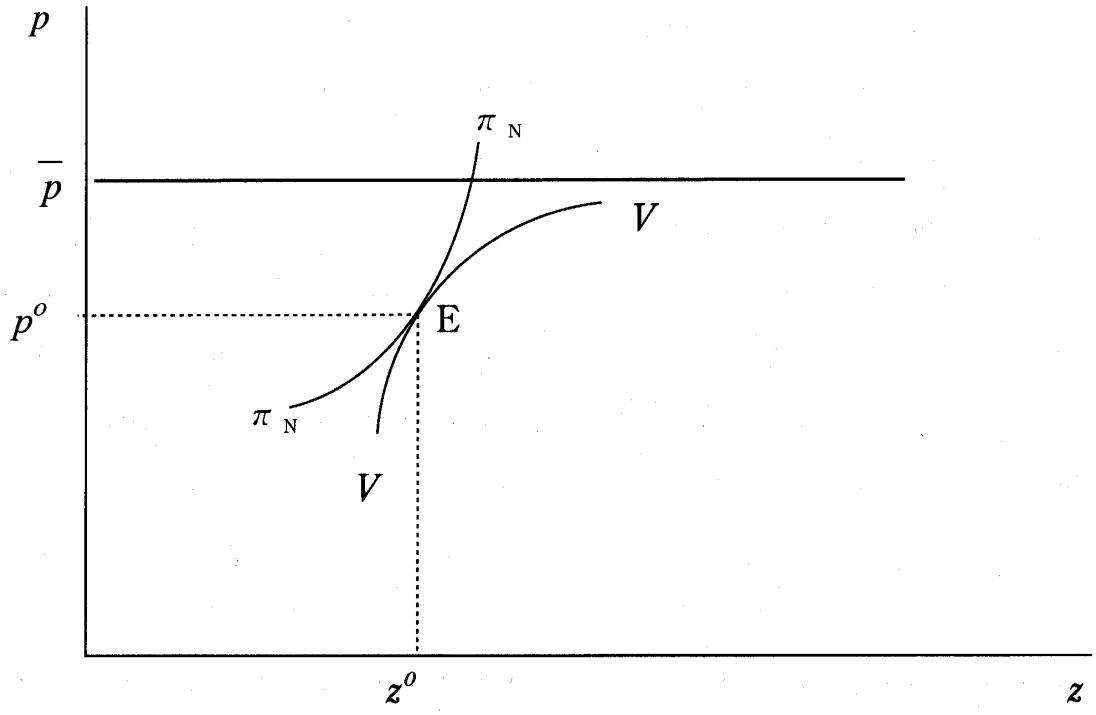
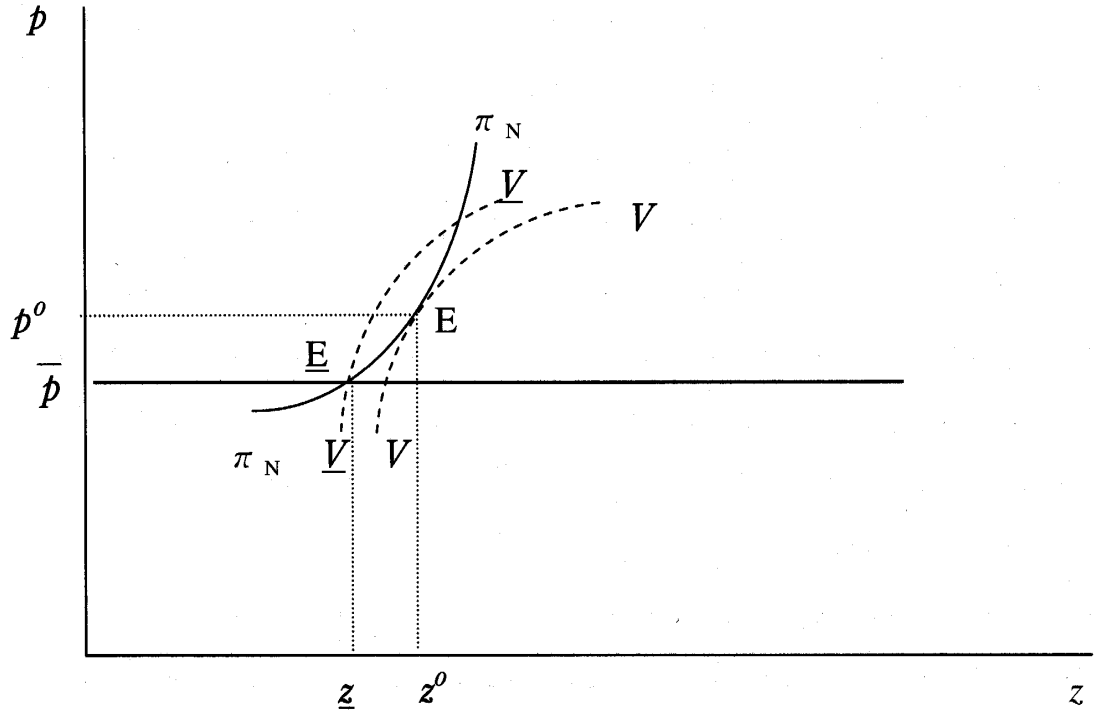


Fig. 6 Equilibrium when the Price Ceiling is Binding



in $\bar{p}$ will have no effect on the equilibrium levels of p and z ; the equilibrium will remain at point E. In contrast, when the price ceiling is binding in the initial equilibrium (as in Fig. 8), an appreciation and the resulting increase in $\bar{p}$ will cause the equilibrium point to slide along the iso-profit curve $\pi_N\pi_N$. The equilibrium levels of p and z will increase accordingly.

The effect of an appreciation on employment can similarly be determined by Figs. 7 and 8. When the price ceiling is not binding in the first place (as in Fig. 7), an appreciation will have no effect on employment. In contrast, when the price ceiling is binding in the initial equilibrium (as in Fig. 8), an appreciation will raise the equilibrium product quality and release the suppressed demand for the non-tradable good. Thus, the employment level in the non-tradable sector will also increase.

Ⅲ. Discussion

The extent to which the above model (particularly the case of a binding price ceiling described by Fig. 8) represents the Japanese economy in 1985-87 is very difficult to evaluate, since the data on service quality in regulated industries is not widely available. However, there is a shred of anecdotal evidence for quality improvement at the times of the rapid yen appreciation.

The most conspicuous (in terms of media coverage) is improvements of service quality in the passenger railroads sector. At least three major changes were initiated in the mid 1980s. One is a rapid increase in air-conditioned carriages during summer. From 1985 to 1986, the air-conditioning rate (in metropolitan Tokyo area) increased from 81% to 85% for the Japan National Railway and from 76% to 81% for all the commercial lines (Nihon Keizai Shinbun, 5/17/86, 3/27/87). Another change is substantial revisions of train schedules ; the service hours (i. e. the departure time for the last train) were extended ; frequency of arrivals was increased during the peak hours ; the number of express lines was also increased (*Nihon Keizai Shinbun*, 8/1/86). The other change is an extension of subway routes ; the construction of the *Oedo* Subway Line began in the summer of 1986 (*Nihon Keizai Shinbun*, 11/8/86).

The evidences for other regulated industries are less conspicuous, yet there are a few. One is electric power companies, which explicitly stated that they would improve service quality (by burying power cables underground for greater safety) rather than lowering the user fees (*Nihon*

Fig. 7 Effects of Revaluation when the Price Ceiling is initially not Binding

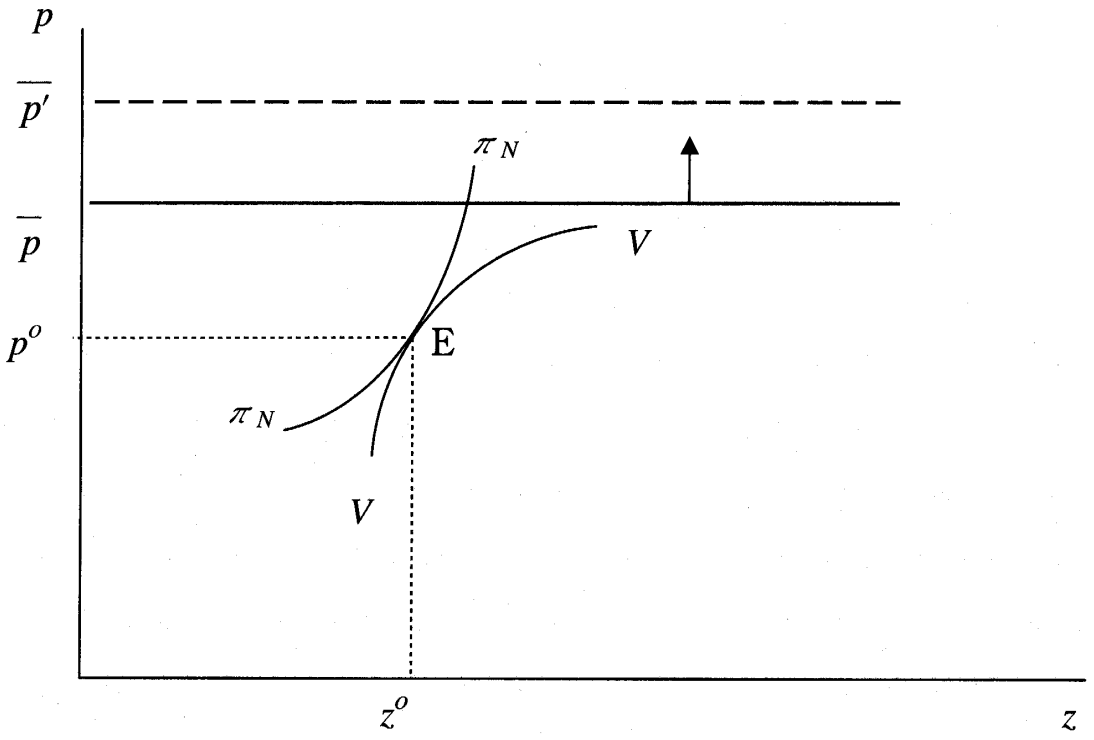
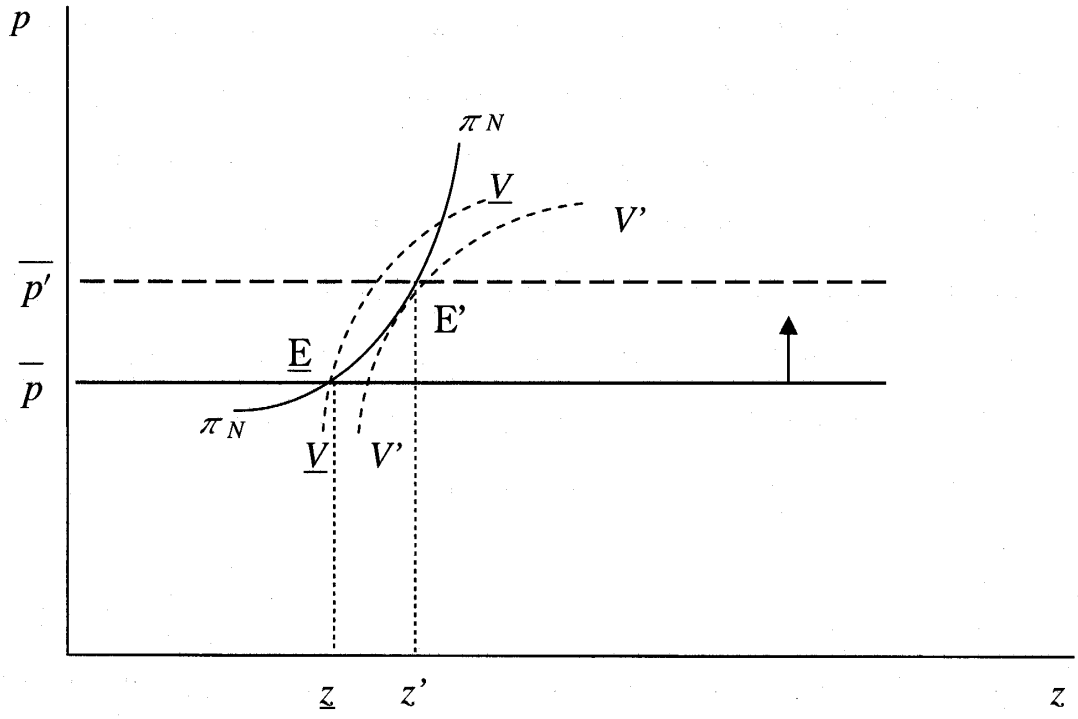


Fig. 8 Effects of Revaluation when the Price Ceiling is initially Binding



Keizai Shinbun, 6/25/86). The other is the banking sector, which increases the number and service hours of ATM/CD's (*Nihon Keizai Shinbun*, 11/5/85, 9/13/86, 10/20/87).

Ⅳ. Conclusion

According to the standard neoclassical economic theory (with monetary neutrality), a negative monetary shock (such as the coordinated devaluation of the dollar in 1985-87) will only cause equi-proportionate falls in nominal variables, leaving real variables (including relative prices) unaffected. However, such a prediction is refuted by the experience of Japan in 1985-87, when a sharp appreciation of the yen gave rise to a substantial change in the relative price structure. This apparent non-neutrality of the exchange rate has conventionally been attributed to cross-sectoral differences in price stickiness, yet the conventional explanation fails to account for the actual pattern of employment, in which sectors with greater price rigidity did not necessarily have greater employment loss.

This paper attempts to give a simultaneous account of the patterns of relative prices and employment observed in Japan in the mid 1980s. For that purpose, the paper develops a model of partially regulated economy with two sectors - tradable and non-tradable - where the non-tradable sector is subject to a price ceiling and quality adjustment. It is shown that, when the economy is initially distorted by a binding price ceiling and suboptimal product quality, an appreciation of the home currency (and the resulting fall of the tradable good price) will induce the non-tradable producers to raise the product quality rather than lowering the price along the tradable price. The improved quality will increase the non-tradable demand, and the non-tradable employment level will also increase. Formally testing the empirical relevance of the model is beyond the scope of this paper, yet a shred of anecdotal evidence consistent with the model can be found in a few regulated industries such as passenger railroads, electric power, and banking.

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