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**WHO PREFERS QUOTAS TO VER AND WHEN?
A CASE OF DIFFERENTIATED OLIGOPOLY**

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Abstract: This paper analyses the effects of a shift to a source-specific VER from a quota regime that allows at most the same total imports as under the VER in the context of differentiated oligopoly. The VER, despite injecting more foreign competition into the economy, may generate greater protection for a specified range of non-cooperative conjectures. The level of protection generated by a global quota under Cournot and cooperative conjectures, on the other hand, depends on the degree of product differentiation. Interestingly, the responses of consumers and producers towards the policy shift may not always be conflicting.

1. INTRODUCTION

Since the seminal works of Bhagwati (1965, 1968) the non-equivalence of equal-import tariff and quota under imperfectly competitive market conditions is well recognised. The literature gained momentum, however, with the development of the game theoretic models of trade in the early 1980s. These theories provided a convenient framework for analyzing the different aspects of such non-equivalence between tariffs and quotas. Of late, with the increasing use of the voluntary export restraints (VER) instead of import quotas, the focus has been shifted to the various aspects of the VER and its non-equivalence with the import quotas which are generally *global* [Acharyya (1995), Dean and Gangopadhyay (1991), Dinopoulos and Kreinin (1989), Harris (1985), Krishna (1990), and Murray, Schmidt and Walter (1988)].

The US market for automobiles provides one such example of switching to a regime of VER from that of import quotas in an imperfectly competitive environment. The US automobile market, particularly in the 1980s, was typically a differentiated oligopoly market with big American and Japanese firms competing with each other alongwith few other foreign companies. In the late 1970s and early 1980s, tariff was the main instrument of protecting the US companies from the increased foreign com-

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petition. During 1981–84, the US government restricted import of Japanese cars through import quotas and then in April 1984 a further shift in policy was observed. Instead of the US restrictions on the imports of Japanese cars, the US government negotiated with the Japanese government to voluntarily restrict its exports to the US market. There was also an increase in the physical limits of such imports from Japan. Other examples of such policy shift is not uncommon.

One peculiar aspect of such VERs is that they are often negotiated with only one or two major suppliers. In the US automobile example, the German and other non-Japanese cars were left unrestrained by the VER negotiation. This may seem curious as such a *source-specific* VER is expected to generate a lower level of protection for the domestic producers compared to the import quotas that restrict imports irrespective of the source of supplies.¹ In this context, it is important to distinguish between two cases. One in which the equal-import quota is imposed only on the VER-firm leaving the non-VER firm unrestrained as before which is comparable to the kind of policy shift observed in the US automobiles market in the 1980s. The second is imposing quota restrictions on the non-VER firms as well but allowing them just what they were selling before. Even if both types of quota regimes permit same *total* imports, they are different in one fundamental respect and this has far reaching implications on the effect of the policy shift from the (equal-import) VER to quota with which we are concerned here. The latter type of quota regime, the *non-discriminatory* or *global* quota, essentially eliminates all foreign competition compared to the former type of quota regime which is *source-specific* or *discriminatory*. Accordingly, though a shift from the source-specific quota to the source-specific VER will have no implications except when the physical limits are different,^{2,3} the shift from the non-discriminatory or global quota to source-specific VER, even if total imports are same, will have quite different implications. For example, as demonstrated earlier, despite injecting more competition the source-specific VER may lead to greater protection [Acharyya (1995)]. The logic is similar to that of the non-equivalence of tariff and quota under oligopoly [Hwang and Mai (1988)] or effect of quota set at the free trade level [Itoh and Ono (1982)].⁴

However, the theoretical literature is primarily concerned with the implications of the *nature* of competition or rivalry among firms on the asymmetric effects of tariff and non-tariff barriers. The role that the product differentiation may play in this context, has not been recognised properly. But one primary feature of many oligopolistic markets, including the US automobiles market, is the high degree of product differentiation. One might then enquire whether the existing results regarding protective ef-

¹ We use the term protection in the traditional sense: A trade policy protects the domestic producers if it raises their output and domestic market shares.

² The differences that may arise is with respect to the accrual of the associated scarcity rents to the different set of agents under the alternative regimes.

³ In a recent empirical study, Goldberg (1995) has analysed the effects of such restrictions on the market equilibrium and compared it with the equal-import tariff.

⁴ See Krishna (1990) for a survey of protective effect of quota in a duopoly framework under alternative behavioural assumptions.

fects of quota and VER would be altered in such a context and if so in which direction. The present work is primarily motivated by such an enquiry.⁵ In addition, we examine the effects on price and consumers surplus of the policy shift from a quota to an *import-equivalent* VER regime and show that in some situations the domestic producers and consumers may have identical responses towards such a policy shift.

The scenario is as follows. There are one domestic and two foreign firms competing in the former's domestic market. The initial trade restriction was one of VER on one of the foreign firms restricting its sales to a level lower than that it would supply under free trade. The other foreign firm is left unrestrained. Consider now the policy shift whereby the other foreign firm is also restrained either at a lower level of production or just at the level it was producing before. In the former case, quota permits less *total* imports whereas in the latter we have equal-import quota and VER regimes. We then examine how the domestic firm and the consumers react to this policy shift from a source-specific VER to an equal-import global quota.

The rest of the paper is organised as follows. In section 2 we set out the model. Section 3 and 4 derive the main results whereas in section 5 we conclude the paper.

2. THE MODEL

Consider a domestic country market where one domestic firm (1) and two foreign firms (2 and 3) are selling differentiated products. Each firm's production unit is located in its country of origin. The degree of differentiation between the products is captured by the index $\theta_{ij} \in [0, 1]$, $i, j = 1, 2, 3 (i \neq j)$. Higher is the value of θ_{ij} less differentiated are the products of the i -th and the j -th firms with unit value of it implying homogeneous products. Each firm is assumed to produce only one variety of the product.⁶ The product differentiation we consider here is *horizontal* in nature so that they do not make much differences in the cost levels of the firms. In our example of US automobiles market we can think of different firms producing different *brands* of cars in a particular category but not different categories of cars, and that such *brand differentiations* are superficial. The differences in average and marginal costs among the firms, if any, are the reflections of how efficiently the production activities are organised by each firm or of higher resource costs in each country but not of the product differentiation as such. On the other hand, though we are assuming away the wide varieties that may be produced within a country and exported by each foreign firms, such disaggregations in product categories and varieties matters little in this model. Alternatively, we can consider θ_{ij} to be some *aggregate* index of the degree of heterogeneity of the American cars *as a whole* from the cars produced in the j -th country. When the do-

⁵ Often in the strategic trade literature the term *protection* is used to mean generating greater *market power* for the domestic firms enabling them to *reduce* outputs and raise price instead of the conventional use of the term. In such a case, our analysis should be interpreted as one of identifying cases where a more restrictive trade regime reduces domestic firms' market power.

⁶ The product variety is assumed to be exogenously given. By assuming away firms' choices of product differentiation, we essentially rule out any effect of quota or VER on the product differentiation itself.

mestic consumers distinguish more between the American and foreign cars but not so much between different makes of American cars (within a category) this seems to be a reasonable approximation though not at all necessary for our results to hold.

Each firm produces its output at zero fixed cost and constant marginal cost (MC). Constant MCs simplify the whole analysis by *segmenting* the domestic and foreign markets and consequently allow us to neglect US-firm's export decisions or the foreign firms' supplies in their own country markets. However, we assume the marginal costs to be firm-specific and are thus distinguished by the subscript 'i':

$$c_i \neq c_j, \quad \forall i \neq j \quad (1)$$

Regarding the firm strategies we consider the firms to be quantity-setters. But instead of limiting our attention to a particular game, we consider the conjectural variation (CV) model widely used in the literature [Acharyya (1995), Eaton and Grossman (1986), Hwang and Mai (1988, 1989)]. The CV in output reflects one firm's beliefs about the rival's response to a change in its own output, and generally constant and symmetric CVs are assumed. Denoting it by λ we can define the CV as,

$$\lambda \equiv dx_i/dx_j = dx_j/dx_i, \quad \forall i \neq j \quad (2)$$

Finally, following Martin (1993) we specify the linear demand functions in inverse form faced by each firm in the domestic market as,

$$P_i = A - x_i - \sum_j \theta_{ij} x_j, \quad \forall i \neq j \quad (3)$$

Note that $\theta_{ij} = \theta_{ji}$. Using (1) and (3) the profit functions can be written as,

$$\pi_i = Ax_i - x_i^2 - \sum_j \theta_{ij} x_j x_i - c_i x_i, \quad i = 1, 2, 3 \quad (4)$$

The three first order conditions, $\partial \pi_i / \partial x_i = 0$, yield the reaction functions which together solve for the free trade equilibrium levels of sales:

$$\bar{x}_i = \bar{x}_i(\lambda, \theta_{ij}, \theta_{ik}, \theta_{jk}), \quad \forall i \neq j \neq k \quad (5)$$

3. IMPORT RESTRICTIONS: VER AND QUOTA

Consider first the VER regime. Suppose the local government negotiates a VER with the second foreign firm (firm 3) that it must restrict its sales to $\tilde{x}_3 < \bar{x}_3$ for any variety that it produces. The other foreign firm is, however, left unrestrained. Under such a source-specific VER, the domestic firm faces direct competition only from this unrestrained (non-VER) firm and vice versa. The extent to which the VER-firm produces a differentiated product is important only in that it determines the position of the *residual* demand faced by the other firms:

$$P_i = A'_i - x_i - \theta_{ij} x_j, \quad i \neq j, i, j = 1, 2 \quad (6)$$

where, $A'_i = A - \theta_{i3} \tilde{x}_3$. The profit functions now can be written as,

$$\pi_i = (A'_i - c_i) \cdot x_i - x_i^2 - \theta_{ij}x_ix_j, \quad i, j = 1, 2 \quad (7)$$

From the first order conditions we then solve for the two output levels under VER:

$$\tilde{x}_1 = \frac{1}{D}[(2 + \lambda\theta_{12})(A'_1 - c_1) - \theta_{12}(A'_2 - c_2)] \quad (8)$$

$$\tilde{x}_2 = \frac{1}{D}[(2 + \lambda\theta_{12})(A'_2 - c_2) - \theta_{12}(A'_1 - c_1)] \quad (9)$$

where, $D = (2 + \lambda\theta_{12})^2 - \theta_{12}^2 > 0$.

Like free trade, output levels depend both on the degree of product differentiation and the value of CV with the only exception that now firms 1 and 2 *know* that the VER-firm's output is fixed. The effect of a change in product differentiation works in two ways. The direct effect is the one which changes demand for each firm's own variety as captured by the second terms in the numerators in (8) and (9). As products are less differentiated from each other, i.e., as θ_{12} increases, such a demand falls for any given rival output (see figure 1) thereby reducing own output levels.

There is also the indirect effect of product differentiation on own output level through *induced* changes in rival output. This indirect effect, however, depends on firms' conjectures. For example, in case of Cournot conjecture, each believes that his rival does not change his output following changes in his own output due to fall in residual demand. Accordingly there will be no further adjustments in own outputs. But for non-Cournot conjectures ($\lambda \neq 0$) domestic firm, for example, adjusts its output further anticipating a change in x_2 in response to initial fall in x_1 . The indirect effect may

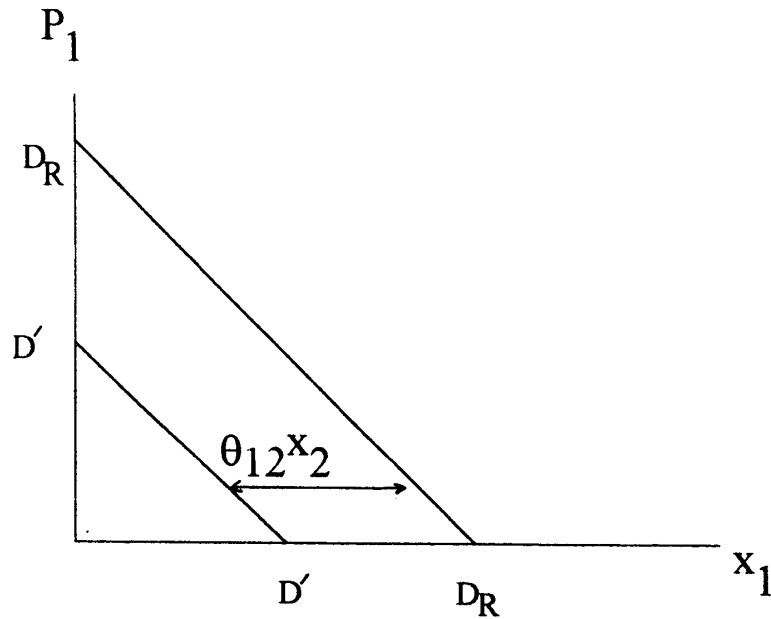


Fig. 1. Product Differentiation and demand for domestic variety.
 $D_R D_R$: Residual demand for domestic and (non-VER) foreign variety
 $D' D'$: Demand for domestic variety

go either way unlike the direct effect depending on firms' conjectures. On the balance, the output effect of change in product differentiation depends on the value of CV (see appendix),

$$\frac{\partial x_i}{\partial \theta_{12}} < 0 \quad \forall \lambda > 0 \quad (10a)$$

$$\frac{\partial x_i}{\partial \theta_{12}} > 0 \quad \forall \lambda < 0 \quad (10b)$$

Now suppose the domestic government switches to a regime of global import quota by limiting sales of both the foreign firms. To keep things simple let the restrictions be such that,

$$\bar{\bar{x}}_2 = \tilde{x}_2 - \alpha, \quad \bar{\bar{x}}_3 = \tilde{x}_3 < \bar{x}_3 \quad (11)$$

where the variables with double-bar (=) over them denote the quota regime, and $\alpha \geq 0$ indicates the strictness of the quota regime. Quota restricts imports more than the VER when $\alpha > 0$. A quota regime turns the domestic firm *effectively* into a monopolist who maximises his profit by choosing a price-quantity combination along the following residual demand curve:

$$\bar{\bar{P}} = A'' - \bar{\bar{x}}_1 \quad (12)$$

where, $A'' = A'_1 - \theta_{12} \bar{\bar{x}}_2$. The domestic output under the quota regime is therefore simply the monopoly output:

$$\bar{\bar{x}}_1 = (A'' - c_1)/2 \quad (13)$$

This can alternatively be expressed as,

$$\bar{\bar{x}}_1 = (2 + \lambda \theta_{12}) \cdot \tilde{x}_1 / 2 + \alpha \theta_{12} / 2 \quad (13a)$$

Finally, subtracting \tilde{x}_1 from both sides of (13a) we obtain our result:

$$\bar{\bar{x}}_1 - \tilde{x}_1 = \theta_{12} [\lambda \tilde{x}_1 + \alpha] / 2 \quad (14)$$

Therefore, whether quota generates more protection for the domestic firm compared to the VER depends on the value of CV(λ), the quota level (α), as well as on the degree of product differentiation (θ_{12}).

The protective effect depends on the product differentiation in two ways. First is the direct effect captured by θ_{12} on the right hand side in (14): It measures how much of the quota-constrained foreign firm's market can the domestic firm capture after its sales are restricted. For $\theta_{12} = 0$, products are *unrelated* and import quota does not benefit the domestic firm at all. The level of protection generated by the quota and the VER regimes are same irrespective of the level of quota or firm conjecture. For $\theta_{12} > 0$, as products of the domestic firm and the quota-constrained foreign firm become less and less heterogenous (i.e., as θ_{12} increases in value), more and more consumers of foreign brand now can meet their unsatisfied demand (due to import quota) by purchasing the

home brand. Domestic firm increases its output accordingly.

The second effect of product differentiation operates via domestic production changes under VER, \tilde{x}_1 , which, however, depends on the value of CV as indicated in (10).

What appears from (14) is that as long as firms hold Cournot or cooperative conjectures ($\lambda \geq 0$), a (global) quota is protective as is usually believed to be the case. With the exception of the Cournot conjecture, quota generates more protection *even when it is set at the VER level*, i.e., $\alpha=0$, and such a level of protection is greater the less heterogenous the products are. But in case of non-cooperative conjectures ($\lambda < 0$), quota is not necessarily protective compared to VER. In particular, the import quota is anti-protective when the non-cooperative conjecture is such that,

$$\lambda < \frac{\alpha}{\tilde{x}_1(\lambda, \theta_{12})} \quad (15)$$

For example, if the quota regime is such that $\alpha < \tilde{x}_1(\lambda, \theta_{12})$, it reduces the domestic output compared to the VER regime (i.e., $\bar{\tilde{x}}_1 < \tilde{x}_1$) under the Bertrand conjecture ($\lambda = -1$).

Therefore,

PROPOSITION 1. a. *When firms' conjectures are Cournot or cooperative ($\lambda \geq 0$), a quota permitting less imports than VER ($\alpha > 0$) is always protective and the level of such protection increases as products become less heterogenous.*

b. *In case of non-cooperative conjecture ($\lambda < 0$), quota is protective only for $\lambda > \alpha/\tilde{x}_1$.*

Proof. Follows from (10), (15) and the above discussion.

COROLLARY 1. *Under Bertrand conjecture ($\lambda = -1$), quota is anti-protective for all $\alpha \in [0, \tilde{x}_1]$.*

COROLLARY 2. *When the global import quota is set at the VER level ($\alpha = 0$), it is anti-protective for all non-cooperative conjectures.*

Note that if the import quota is set at the VER level (\tilde{x}_2), i.e., $\alpha = 0$, domestic production remains same under Cournot conjecture ($\lambda = 0$) irrespective of the degree of product differentiation: $\tilde{x}_1 = \bar{\tilde{x}}_1$. In case of Cournot conjecture, under the VER regime the domestic firm *believes* that the (non-VER) foreign firm does not change his output when he changes his own. This is exactly the case under quota regime. The conjecture of the domestic firm regarding rival's output changes under VER matches exactly with the actuality under quota. Accordingly, as long as the quota on the non-VER foreign firm is set at the VER level, there is no reason why domestic firm gains *market power* and change his output level.

But for non-Cournot conjectures, this is not so and consequently with $\alpha = 0$, the domestic firm reduces output if it had a non-cooperative conjecture regarding the non-VER foreign firm's output changes. And such output variations are greater when products are less heterogenous than otherwise.

4. PRICE AND CONSUMERS SURPLUS

How the domestic consumers react to the policy shift from the source-specific VER to the non-discriminatory quota? From the above it appears that much depends on whether quota is protective or not. Moreover, the consumers of domestic and foreign brands may well find their interests conflicting. To demonstrate, we calculate the differences in the prices of both these brands under the alternative regimes:

$$\bar{P}_1 - \tilde{P}_1 = \theta_{12}[-\lambda\tilde{x}_1 + \alpha] \quad (16)$$

$$\bar{P}_2 - \tilde{P}_2 = \alpha - \theta_{12}^2[\lambda\tilde{x}_1 + \alpha]/2 \quad (17)$$

Eq. (17) deserves attention. It indicates that a quota restriction on the non-VER foreign firm does not necessarily raise the price of its brand as is often believed. The right hand side in (17) is actually the decomposition of the total effect of the policy shift in terms of the *direct effect* which raises price proportionate to the amount by which imports are restricted (α) and the *indirect effect* which affects price in either direction through the change in the output of the rival. The magnitude of the indirect effect varies inversely with the degree of differentiation and vanishes under complete differentiation ($\theta_{12}=0$). On the other hand, the role of the value of conjectural variation is evident from the following alternative expression of (17):

$$\bar{P}_2 - \tilde{P}_2 = [(2 - \theta_{12}^2)\alpha - \lambda\theta_{12}^2\tilde{x}_1]/2 \quad (17a)$$

Therefore,

PROPOSITION 2. a. *For all non-cooperative conjectures ($\lambda < 0$), quota raises the prices of both the domestic and foreign brand and thus makes all such consumers strictly worse-off compared to the VER regime.*

b. *For cooperative conjectures ($\lambda > 0$), the direction of the change in the consumers surplus depends on the values of the parameters.*

Proof. a. Follows directly from (16) and (17a).

b. For $\lambda > 0$, on the other hand, it is evident from (16) and (17a) that,

$$\bar{P}_1 \underset{<}{>} \tilde{P}_1 \quad \text{as} \quad \lambda \underset{>}{<} \frac{\alpha}{\tilde{x}_1}, \quad \bar{P}_2 \underset{<}{>} \tilde{P}_2 \quad \text{as} \quad \lambda \underset{>}{<} \frac{(2 - \theta_{12}^2)\alpha}{\theta_{12}^2 \tilde{x}_1} \quad (19)$$

Hence the result. \square

COROLLARY 3. *When the import quota is set at the VER level ($\alpha=0$), the consumers of both home and foreign brands are strictly better-off compared to the VER regime under cooperative conjectures.*

PROPOSITION 3. *In a Cournot-Nash game, the VER makes the domestic consumers better off irrespective of whether products are differentiated or homogeneous, provided, of course, the quota is not set at the VER level ($\alpha > 0$).*

Proof. For $\lambda=0$ and for all $\alpha>0$, (16) and (17a) boil down to,

$$\begin{aligned}\bar{\bar{P}}_1 - \tilde{P}_1 &= \alpha\theta_{12} > 0 \\ \bar{\bar{P}}_2 - \tilde{P}_2 &= \frac{2 - \theta_{12}^2}{2}\alpha > 0\end{aligned}$$

Hence the result. \square

What appears from the above discussions is that the unambiguous ranking of the policies in terms of their effects on prices and consequently on the consumers surplus can be obtained only for non-cooperative and Cournot conjectures. But for cooperative conjectures on part of the firms (under the VER regime), the particular value of the conjectural variation in relation to the degree of product differentiation (θ_{12}) and the strictness of the import quota regime (α) is important. For example, consider the value of λ such that,

$$\frac{\alpha}{\tilde{x}_1} < \lambda < \frac{2 - \theta_{12}^2}{2} \frac{\alpha}{\tilde{x}_1} \quad (20)$$

From (19) it follows that $P_1 < \tilde{P}_1$ but $P_2 > \tilde{P}_2$. Therefore, the switch from (source-specific) VER to the (global) quota regime makes the consumers of the home brand better-off and the consumers of the foreign brand worse-off. Consequently, the net effect on the consumers surplus is ambiguous.

More interestingly, the overall responses of the consumers and the domestic producers are not necessarily conflicting as is often conceived. Consider, for example, the case of Bertrand conjecture ($\lambda=-1$). A quota is anti-protective (see Corollary 1) as well as makes the consumers of both home and foreign brands unambiguously worse-off. Therefore, both the domestic producer and consumers will prefer the source-specific VER regime to the global quota regime in this situation. At the other extreme case of (tacit) collusion, $\lambda=1$, it can easily be verified that the domestic producer and consumers will together support the switch to the more restrictive quota regime.

The implication of the above results is that the non-discriminatory quota instead of the source-specific VER in markets like the US automobiles market may not lead to greater protection and/or hurt the domestic consumers contrary to expectations.

5. CONCLUSION

This paper extends the earlier analyses of the effect of a policy shift from a source-specific VER to a non-discriminatory quota allowing same or less (total) imports in the context of a differentiated oligopoly. For cooperative conjectures, less heterogeneous the home and foreign brands are, greater is the level of protection generated by an import quota compared to VER. When firms hold non-cooperative conjectures, quota may be anti-protective depending on the values of the parameters (see (15) and Corollary 1).

The consumers' responses to the policy shift, on the other hand, is found to be ambiguous. All depends on the particular behavioural assumption one wishes to make. For example, in a Cournot–Nash game the consumers of the domestic brand and of the non-VER foreign brands are unambiguously better off (Corollary 2).

APPENDIX

Output effect of change in product differentiation:

Differentiating (8) with respect to θ_{12} we obtain:

$$\frac{\partial \tilde{x}_1}{\partial \theta_{12}} = - \left[\frac{\beta_0}{D^2} (A'_1 - c_1) + \frac{\beta_1}{D^2} (A'_2 - c_2) \right] \quad (\text{A.1})$$

where,

$$\beta_0 = \lambda [(2 + \lambda\theta_{12})^2 + \theta_{12}^2] + 2\theta_{12}(2 + \lambda\theta_{12})$$

$$\beta_1 = (2 + \lambda\theta_{12})^2 + \theta_{12}^2 - 2\lambda\theta_{12}(2 + \lambda\theta_{12})$$

Note that, since $|\lambda| < 1$, so $\beta_1 > 0$ for all λ . But, whereas $\beta_0 > 0$ for $\lambda > 0$, for non-cooperative conjectures ($\lambda < 0$), β_0 may either be positive or negative depending on the value of the parameters. Hence, the sign in (A.1) depends on the value of CV as indicated in (10) in the text.

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