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DUAL PRICING, RATIONING, AND RAMSEY COMMODITY TAXATION: THEORY AND AN ILLUSTRATION

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INTRODUCTION

It has been usual to treat rationing as a method to assure minimum supplies to all consumers of a commodity in short supply. In almost all the countries of the world, critical situations, like wars, have necessitated rationing. In India, however, rationing and the elaborate public distribution system that goes with it, have often been viewed as a method to provide essential items at a low cost. Thus rationing has been used as a redistributive device as well. The available literature on rationing in India takes the existing arrangements as a datum, i.e., there are fixed quotas of rationed commodities that people (both rich and poor) can purchase at "fair price shops" and demands of people over and above these fixed quotas have to be met at free market prices.

This rationing arrangement has, perhaps, not been able to achieve its professed aim of redistribution. Supplies of essential commodities to the rural poor through "fair price shops" are often meager, uncertain, and of poor quality whereas richer people mainly rely on the free market supplies of these commodities. It would perhaps be appropriate to say that it is primarily the urban middle class that has benefited from rationing.

In this paper we undertake an exploratory exercise. We conceive of rationing as a purely redistributive measure[1] and, thereby, formally introduce dual pricing. We use the nine-commodity classification studied by Ahmad and Stern [1] and Murty and Ray [7] [8]. The producer prices of all nine commodities are fixed. There are two decision-making authorities who, in coordination with each other, attempt to maximize social welfare. One of these authorities—call it the Food Department (FD)—sets the price of food to be paid by the poor and rich. The other—call it the Tax Department (TD)—is responsible for setting commodity tax rates. We now proceed to describe the activities of these departments in some detail.

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1 Since income and other direct taxes are relatively unimportant in India, one has to turn toward indirect taxes for revenue as well as redistribution (see Jha [6]). It is in this context that several authors have expressed their agnosticism about the degree of redistribution possible simply through linear indirect taxes. The arrangement described in this paper improves upon a purely linear indirect tax structure.

The producer price of foodgrains is fixed and the entire amount of the harvest is available to the government at this fixed price. Foodgrains are the most important consumption item for the poor. For humanitarian reasons or, perhaps because the price of foodgrains is a very visible political consideration, the FD fixes the nominal subsidy on foodgrains consumed by the poor[2] who can buy any amount of foodgrains at this subsidized price.[3] This price is, however, not available to the rich. Additionally, the FD sets the price of foodgrains to be paid by the rich. To do this, however, it has to act in concert with the TD.

The TD sets Ramsey optimal commodity tax rates for the other eight commodities by solving a standard many-person Ramsey problem. Apart from the usual revenue constraint associated with these problems, the TD faces two additional constraints. First, the price of foodgrains to be paid by the poor is parametrically given to it. Second, the price of foodgrains (set by FD) to be paid by the rich is such that the market for foodgrains clears in the sense that foodgrain demand by the poor (at the price fixed for them) plus foodgrain demand by the rich (at the price determined for them) is exactly equal to the available supply of foodgrains. Moreover, the price of foodgrains for the rich is such that the surplus earned from them *exactly* pays for the subsidy given to the poor. Thus FD balances its budget and TD meets the stipulated revenue condition. Apart from this price, the algorithm used in this paper computes optimal consumption of all nine commodities by rich and poor, the Ramsey optimal commodity effective tax/subsidy rates (common to rich and poor) for the other eight commodities, the marginal social value of the expenditure by rich and poor and the marginal social values of a rupee earned from alternative revenue instruments for different values of the subsidy on foodgrains to the poor and alternative values for the inequality aversion parameter of Atkinson's [2] social welfare function.

The plan of the rest of this paper is as follows. In Section I we outline in detail the rationing scheme advocated by us. In Section II we work out in detail the rationing / dual pricing structure and the associated Ramsey rule for commodity taxation when one of the commodities is subject to rationing. Section III reports results of an empirical illustration using Indian budget data from the 32nd Round of the National Sample Survey (1977–78) available in the Government of India [5]. The final section offers some concluding comments.

I. A REDISTRIBUTIVE ROLE FOR RATIONING

Consider an economy with n commodities: n_1 of these commodities are subject to rationing / dual pricing whereas n_2 $(=n-n_1)$ are not. There are two classes of people: poor (A) and rich (B). The supplies of rationed commodities are fixed at $\overline{X}_i$ $(i=1, 2, \ldots, n_1)$ and all the commodities are supplied at constant producer

[2] An alternative would be to allow for the optimal subsidy to be determined by the solution to the many-person Ramsey problem. The arrangement described in this paper is, however, a closer approximation to existing practice in India.

[3] We assume that the possibility that the poor sells foodgrains to the rich can be ruled out. Allowing for this would be an interesting extension of the present work.

prices[4] in the economy. Let q_i and P_i $(i=1, \ldots, n)$ represent respectively the producer and consumer prices of commodities. Assuming that the difference between consumer and producer prices of non-rationed commodities is only due to commodity taxes, we have (if t_i is the tax on the ith commodity):

$$P_i = q_i + t_i, \qquad i = (n_1 + 1), (n_1 + 2), \ldots, n.$$

In the case of rationed commodities the government procures them from producers at fixed producer prices $(q_i\ [i=1, \ldots, n_1])$. The nominal subsidies (s_i) given on these items for consumers of type A are also predetermined by the government. Hence if P_i^A is the price paid by type A consumers for the ith rationed commodity, we have

$$P_i^A = q_i - s_i, \qquad i = 1, \ldots, n_1.$$

The prices of rationed commodities for type B consumers (P_i^B) is set such that (i) the demand for each rationed good is exactly equal to the supply, and (ii) the total subsidy to the poor on each item is entirely met by payments made by the rich through a higher price so that these subsidies have no budgetary implications for setting taxes / subsidies for non-rationed commodities.

Thus we have

$$P_i^A x_i^A + P_i^B(\overline{X}_i - x_i^A) = q_i \overline{X}_i, \qquad i=1, \ldots, n_1, \tag{1}$$

where x_i^A and x_i^B $(= \overline{X}_i - x_i^A)$, $i = 1, \ldots, n_1$, are consumptions of ith rationed commodity by poor and rich respectively.

Consumers of type A have the following well-behaved direct utility function

$$u^A(x_1^A, x_2^A, \ldots, x_{n1}^A, x_{n1+1}^A, \ldots, x_n^A), \tag{2}$$

and a budget constraint

$$\sum_{i=1}^{n1} P_i^A x_i^A + \sum_{j=n1+1}^{n} P_j x_j^A = y^A, \tag{3}$$

where y^A is the income of type A consumer. Maximizing equation (2) subject to equation (3), we obtain the following demand functions for the rationed goods:

$$x_i^A = x_i^A(P_1^A, \ldots, P_{n1}^A; P_{n1+1}, \ldots, P_n, y^A), \qquad i=1, \ldots, n_1. \tag{4}$$

Let the demand function for the ith rationed good by consumers of type B be:

$$x_i^B = x_i^B(P_1^B, \ldots, P_{n1}^B; P_{n1+1}, \ldots, P_n, y^B), \tag{5}$$

where y^B is the income of type B consumer.

We now consider the problem of determining x_i^A, x_i^B $(i = 1, \ldots, n_1)$, the optimal tax / subsidies on n_2 non-rationed commodities, and prices changed by the government to consumers of type B (P_i^B) for rationed commodities in the many-person Ramsey rule framework for optimal commodity taxes. Let V^A $(P_1^A, \ldots, P_{n1}^A; P_{n1+1}, \ldots, P_n, y^A)$ and $V^B(P_1^B, \ldots, P_{n1}^B; P_{n1+1}, \ldots, P_n, y^B)$ be indirect

[4] Almost all the literature on applied optimal taxation concentrates on models with fixed producer prices. We work with the same assumption. Allowing for supply side effects is an important (albeit difficult) problem yet to be satisfactorily tackled.

utility functions of individuals of types A and B. Aggregate social welfare is given by

$$W = W(V^A, V^B). \tag{6}$$

We assume that $W(\cdot)$ is concave. The government revenue constraint is given as

$$\sum_{j=n1+1}^{n} t_j x_j = R, \tag{7}$$

where $x_j = x_j^A + x_j^B$ and R is the exogenously-fixed government revenue requirement. As mentioned above, there is no surplus or deficit in the government budget on account of n_1 rationed commodities. For given t_j and hence P_j $(j = n_1 + 1, \ldots, n)$ and exogenously-fixed P_j^A $(j = 1, \ldots, n_1)$, P_j^B $(j = 1, \ldots, n_1)$, x_i^A, and x_i^B are automatically defined from equations (1), (4), and (5). The many-person Ramsey problem is, therefore, to

$$\max_{t_{n1+1}, \ldots, t_n} W(V^A, V^B), \tag{8}$$

subject to the constraints given by equations (1) and (7).

II. RATIONING OF FOODGRAINS: AN ILLUSTRATION USING INDIAN CONSUMER BUDGET DATA

In the empirical analysis we use a nine-commodity framework for consumer goods with foodgrains as one of the commodity groups. We suppose that only one commodity—foodgrains—is sold through fair price shops. We assume that both poor and rich have Stone-Geary utility functions

$$u = \sum_{i=1}^{9} \beta_i \ln(x_i - \gamma_i), \tag{9}$$

with $\sum_{i=1}^{9} \beta_i = 1$ and γ_i as the minimum quantity of the ith commodity. The indirect utility functions for consumers of type A and B are given as

$$V^A = \frac{y^A - \gamma_1 P_1^A - \sum_{i=2}^{9} \gamma_i P_i}{(P_1^A)^{\beta 1} \prod_{k=2}^{9} (P_k)^{\beta k}}, \tag{10}$$

$$V^B = \frac{y^B - \gamma_1 P_1^B - \sum_{i=2}^{9} \gamma_i P_i}{(P_1^B)^{\beta 1} \prod_{k=2}^{9} (P_k)^{\beta k}}, \tag{11}$$

where $y^A = P_1^A x_1^A + \sum_{k=2}^{9} P_k x_k^A$ and $y^B = P_1^B x_1^B + \sum_{k=2}^{9} P_k x_k^B$.

Demand for x_1 by a consumer of type A is given by

$$x_1^A=\gamma_1+[(\beta_1)/(P_1^A)][y^A-\gamma_1P_1^A-\sum_{k=2}^{9}\gamma_kP_k]. \tag{12}$$

Correspondingly,

$$x_1^B=\gamma_1+[(\beta_1)/(P_1^B)][y^B-\gamma_1P_1^B-\sum_{k=2}^{9}\gamma_kP_k]. \tag{13}$$

The amount of foodgrains available is fixed exogenously at $\overline{X}_1$, say, by the harvest. Hence

$$x_1^A + x_1^B = \overline{X}_1. \tag{14}$$

The subsidy on food for the poor is entirely and exactly met by the payments made by the rich, i.e.,

$$P_1^Ax_1^A + P_1^Bx_1^B = q_1\overline{X}_1, \tag{15}$$

whence

$$P_1^B=\frac{q_1\overline{X}_1-P_1^Ax_1^A}{(\overline{X}_1-x_1^A)}. \tag{16}$$

Now the Ramsey problem can be written as

$$\max_{t_2,\ldots,t_9} W(V^A, V^B), \tag{17}$$

subject to $\sum_{k=2}^{9} t_kx_k=R$, and (16).

Recently Murty and Ray [7] [8] have developed a method of computing Ramsey optimal commodity tax rates. We proceed to briefly describe this method. Following Ahmad and Stern [1] we define λ_i as the marginal social cost of raising a rupee of government revenue with a tax on the ith commodity as

$$\lambda_i=-\frac{(\partial W/\partial t_i)}{(\partial R/\partial t_i)}, \qquad i=2, \ldots, 9. \tag{18}$$

If $\lambda_i\neq\lambda_j$, then social welfare can be increased by reducing taxes on commodities with higher λ_i's and raising taxes on others—in other words the scope for welfare-improving tax changes exists until the λ_i's are all equal, which characterizes the state where commodity taxes are optimal (see [1]). Following Atkinson [2], Ahmad and Stern [1], and Murty and Ray [7] [8] we use the form of the social welfare function defined in (19) below:

$$W=\frac{1}{(1-\varepsilon)}[(V^A)^{1-\varepsilon}+(V^B)^{1-\varepsilon}]. \tag{19}$$

This form of the social welfare function has some very desirable properties and has, hence, been extensively studied in applied work on optimal taxation. $\varepsilon\geq 0$ denotes the inequality aversion of the policy planner. We define b^h $(h = A, B)$ as the social marginal utility of income or welfare weight of consumer h. Normalizing $b^A = 1$ for type A individuals, we may define b^B the social marginal utility of individuals of type B as

$$b^B = [(V^A/V^B)]^\varepsilon \frac{(\partial V^B/\partial y^B)}{(\partial V^A/\partial y^A)} . \tag{20}$$

Then $\partial V^h/\partial y^h$ denotes the private marginal utility of income to the hth individual ($h = A, B$). Equation (20) implies that the b's depend via the V's on both prices and incomes. This dependence is allowed for in the iterative process for calculating optimal commodity taxes used in this paper and in Murty and Ray [8].

Now

$$(\partial W/\partial t_i) = (\partial W/\partial V^A)(\partial V^A/\partial t_i) + (\partial W/\partial V^B)(\partial V^B/\partial t_i) + (\partial W/\partial V^B)(\partial V^B/\partial P_1{}^B)(\partial P_1{}^B/\partial t_i).$$

Upon appropriate substitution we have

$$(\partial W/\partial t_i) = -[b^A x_i{}^A + b^B(x_1{}^B\{(e_{ii}x_1{}^A)(q_1\overline{X}_1 - P_1{}^A x_1{}^A)/(t_i) - [P_1{}^A x_1{}^A e_{1i}(\overline{X}_1 - x_1{}^A)]/(t_i)\}(\overline{X}_1 - x_1{}^A)^{-1} + x_i{}^B)], \tag{21}$$

where e_{1i} is the cross price elasticity of demand for commodity 1 with respect to the ith price ($i = 2, \ldots, 9$); e_{ii} is the own price elasticity of the ith commodity ($i = 2, \ldots, 9$). Equation (21) can be further simplified by substituting $b^A = 1$.

Similarly,

$$(\partial R/\partial t_i) = x_i + \sum_{k=2}^{9} [(t_k e_{ki} x_k)/t_i], \tag{22}$$

where e_{ki} is the price elasticity of the kth commodity with respect to the ith price.

Using (21) and (22) it is now possible to define λ_i. Our procedure enables us to compute the optimum Ramsey taxes with respect to which

$$\lambda_i = \lambda_j = \overline{\lambda}, \qquad i, j = 2, \ldots, 9. \tag{23}$$

For any value of $P_1{}^A$ this procedure allows us to compute b^B, the market clearing price ($P_1{}^B$) of commodity 1, taxes on the remaining eight commodities, amounts of consumption of the nine commodities by rich and poor, and the matrix of cross and own price elasticities of demand at optimum for various values of the inequality aversion parameter ε. The iterative process used in this paper has been described in detail in Murty and Ray [8].

III. EMPIRICAL ESTIMATES

The commodity disaggregation used in this study is identical to that used in studies by Ahmad and Stern [1] and Murty and Ray [7] [8]: 1. foodgrains, 2. milk and milk products, 3. edible oils, 4. meat, fish, and eggs, 5. sugar and tea, 6. other food, 7. clothing, 8. fuel and light, and 9. other non-food.

The data set used here is taken from the table of consumer expenditure for the 32nd Round of the National Sample Survey (1977–78) available in the Government of India [5]. We have used urban data sets and corresponding urban demand parameter estimates reported in Ray [9] for linear expenditure system. The initial tax rates for eight non-rationed commodities are the effective rates of taxes[5] calculated by Ahmad and Stern [1] for the year 1978–79. Since tax estimates and consumer budget data used in this study represent two different years with a gap of only one year, we assume that consumer budget shares for the year 1978–79 may approximately represent budget shares for the year 1977–78. We have aggregated fourteen NSS monthly per capita expenditure classes for the urban sector into groups A and B (poor and rich, respectively) on the assumption that all the households with per capita consumption less (more) than the urban poverty line are to be treated as poor (rich).

The computations were made with three different values of subsidized price of foodgrains to poor ($P_1^A = 0.5, 0.75, 0.9$) and two different values of the inequality aversion parameter ($\varepsilon=2.0$, 25.0). The lower value of ε reflects the case when the policy planner is not very averse to inequality—something close to, say, the utilitarian position. The higher value of ε represents the case when the planner is very averse to inequality—a position close to, say, the Rawlsian point of view. The same values for ε are used in the calculations of Murty and Ray [7] [8]. They have been considered to be reasonably accurate representations of low and high inequality aversion by Ahmad and Stern [1], among others. The iterative procedure is continued until the algorithm converges, i.e., the coefficient of variation of λ_i becomes arbitrarily low.

The results are presented in Tables I to IV. Table I presents consumption by A and B of all nine commodities, the optimal effective tax rates for eight commodities, and the final values of P_1^B for each value of P_1^A (0.75, 0.9, 0.5) for $\varepsilon=25$. Also presented, for purposes of comparison, are the optimal effective tax rates computed by Murty and Ray [8].[6] Table II provides the same information for the case where $\varepsilon=2$. Table III lists values of social welfare weights whereas Table IV collates together various values of P_1^A with the corresponding values of P_1^B for $\varepsilon=2.0$ and 25.0.

An examination of Tables I and II readily demonstrates the sensitivity of the optimal commodity taxes to the rationing arrangement.[7] The absolute magnitudes and, in some cases, even the signs of the optimal commodity tax rates are sensitive to the chosen values of P_1^A. It is also worth noting that the Murty-Ray calculations of optimal commodity taxes are no longer optimal in the rationing framework postulated in this paper.

The policy implications of this analysis are significant. In the second-best

5 An effective rate of tax represents the tax revenue for a rupee's producer price worth of final consumer good.

6 The data set used by Murty and Ray [8] is the same as that used in this paper.

7 Since the subsidy on foodgrains to the poor is defined in this paper as a fraction of constant producer price ($q_1=1$), it cannot be compared with effective taxes / subsidies on non-rationed commodities that are given in Tables I and II.

TABLE

ESTIMATES OF OPTIMAL

Item	Initial			Final $P_1{}^A$=0.75		
	Consumption by A	Consumption by B	Effective Tax Rate	Consumption by A	Consumption by B	Effective Tax Rate
Foodgrains	18.18	22.32		10.996	29.503	
Milk and milk products	4.17	16.74	0.009	6.961	21.897	−0.074
Edible oils	2.55	6.19	0.083	1.404	3.941	0.484
Meat, fish, and eggs	1.95	5.48	0.014	1.977	5.960	0.0441
Sugar and tea	1.56	3.46	0.069	2.358	6.921	−0.359
Other food	10.93	29.90	0.114	8.701	25.666	0.234
Clothing	1.61	14.89	0.242	4.550	14.771	0.164
Fuel and light	4.17	8.57	0.247	3.453	9.448	0.031
Other non-food	8.76	51.31	0.133	16.526	53.120	0.124
Final value of $P_1{}^B$					1.093182	

TABLE

ESTIMATES OF OPTIMAL

Item	Final $P_1{}^A$=0.75			
	Consumption by A	Consumption by B	Effective Tax Rates	Consumption by A
Foodgrains	10.934	29.565		9.776
Milk and milk products	8.175	25.774	−0.212	7.300
Edible oils	1.045	2.862	1.074	1.219
Meat, fish, and eggs	1.804	5.464	0.134	1.860
Sugar and tea	3.560	10.663	−0.596	2.412
Other food	7.282	21.459	0.458	7.900
Clothing	6.015	19.378	−0.063	5.101
Fuel and light	3.180	8.664	0.108	3.040
Other non-food	18.396	59.221	0.014	17.359
Final value of $P_1{}^B$		1.0924		

situation postulated in this paper differentiated, and not uniform, taxation is optimal. Moreover, the exact structure of the second-best problem is relevant. With no rationing, Murty and Ray [8] obtain one set of estimates for optimal commodity taxes. The calculations in this paper demonstrate that with rationing the values of the optimal commodity taxes are quite different. Now, it is well known that the excess burden of commodity taxes rises sharply with the deviation of

I

COMMODITY TAXES ($\varepsilon=25$)

Final $P_1^A=0.9$			Final $P_1^A=0.5$			Optimal Commodity Taxes as Reported by Murty and Ray
Consumption by A	Consumption by B	Effective Tax Rate	Consumption by A	Consumption by B	Effective Tax Rate	
9.807	30.692		14.559	25.940		
7.098	22.638	−0.102	7.011	21.495	−0.061	0.197
1.296	3.661	0.606	1.478	4.068	0.428	0.347
1.937	5.919	0.052	2.023	5.949	0.407	0.166
2.812	8.427	−0.479	2.208	6.305	−0.296	−0.252
8.346	24.924	0.275	8.988	25.896	0.218	0.379
4.626	15.224	0.138	4.559	14.540	0.174	0.537
3.640	10.154	−0.028	3.392	9.045	0.066	0.054
16.346	53.335	0.121	16.895	52.869	0.123	0.506
	1.0319			1.2806		

II

COMMODITY TAXES ($\varepsilon=2$)

Final $P_1^A=0.9$		Final $P_1^A=0.5$			Optimal Commodity Taxes as Reported by Murty and Ray
Consumption by B	Effective Tax Rates	Consumption by A	Consumption by B	Effective Tax Rates	
30.722		14.556	25.943		
23.350	−0.130	7.134	21.866	−0.077	0.051
3.434	0.714	1.417	3.887	0.497	1.210
5.702	0.090	2.011	5.914	0.046	0.103
7.210	−0.386	2.411	6.911	−0.361	−0.233
23.625	0.334	8.823	25.407	0.240	0.397
16.759	0.052	4.683	14.794	0.158	0.358
8.323	0.150	3.490	9.340	0.037	0.422
56.692	0.058	16.946	53.030	0.120	0.318
1.031826			1.28055		

these taxes from optimal.[8] Hence, it is important to pose the second-best problem of optimal commodity taxation in a manner as close to the existing practice as

[8] The standard textbook explanation implies that the excess burden of a non-optimal commodity tax increases with the square of the difference between the actual and the optimal tax rate. See Atkinson and Stiglitz [3], Boadway and Wildasin [4], or Jha [6]. It is hence important that commodity tax rates do not deviate much from optimal.

TABLE III

ESTIMATES OF SOCIAL WELFARE WEIGHTS AND λ_i'S

	$\varepsilon=25$			$\varepsilon=2$		
	$P_1^A=0.75$	$P_1^A=0.9$	$P_1^A=0.5$	$P_1^A=0.75$	$P_1^A=0.9$	$P_1^A=0.5$
Initial mean of λ_i	0.356	0.356	0.356	0.529	0.507	0.566
Final mean of λ_i	0.448	0.442	0.457	0.607	0.5901	0.6567
Value of $\overline{\lambda}$ in Murty and Ray	0.175	0.175	0.175	0.615	0.615	0.615
Initial value of b^B $(b^A=1)$	0.258×10^{-10}	0.849×10^{-12}	0.199×10^{-10}	0.123	0.109	0.152
Final value of b^B $(b^A=1)$	0.187×10^{-11}	0.730×10^{-12}	0.143×10^{-10}	0.1176	0.107	0.146

TABLE IV

VALUES OF P_1^B

ε	P_1^A		
	0.75	0.9	0.5
2	1.0924	1.031826	1.28055
25	1.093182	1.0319	1.2806

possible. In this paper we have attempted to provide a framework which (i) incorporates salient aspects of dual pricing of foodgrains as practiced in India and other developing countries, and (ii) permits computation of optimal commodity tax rates and ensures a balanced budget for the Food Department.

CONCLUSIONS

In many developing countries commodity taxation is the most important source of government revenue. This, together with dual pricing of some items, is supposed to have an important redistributive role as well. It is, hence, quite important that policies of dual pricing and commodity taxation be pursued in a manner that will enable the policy authorities to maximize an appropriate measure of social welfare.

It is further well known that, in a second-best context, the excess burden of commodity taxation rises sharply as the actual tax diverges from the optimum. It is, hence, important that the problem of optimal commodity taxation be posed in a framework as close to the existing practice as possible.

In this paper we have presented a framework in which issues related to dual pricing and optimal commodity taxation can be analyzed. We fixed the nominal subsidy on foodgrains to the poor and introduced a dual pricing structure for it. We further calculated Ramsey optimal commodity tax rates that are consistent with the arrangements stipulated in the market for foodgrains, and enable the government to obtain the required amount of revenue. We discovered that the results are sensitive to the magnitude of the subsidy to foodgrains and to the inequality aversion of the policymakers.

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