I. **Executive Summary:** In theory, there undoubtedly exist superior models of commodity taxation compared to the 5% taxation on household heating and 20% on most other commodities. By that metric, the current scheme is not "good policy." Pragmatically and politically, it would be difficult to implement a more differentiated commodity taxation system in line with economic theory. And even a more differentiated commodity taxation system is still less preferable than a generally uniform taxation system for commodities without externalities, combined with a more robust means-tested transfer payment/voucher system.

II. Theory Fundamentals

A. First Principles

We must begin from first principles. $v(p,m)$ This is the general form of a consumer's indirect utility, as a function of p (vector of prices for goods) and m (budget). From here, we can begin composing the government's maximization problem subject to a constraint.

The government's mandate is to maximize the social welfare function (SWF) as a function of each consumer's indirect utilities, composed of post-tax consumer prices (p^c), and post-transfer incomes (m^k), for each individual in the society k = 1, … , N, weighted in a manner specific to a society's preference.

$$W = \sum_k G(u^k) = \sum_k G\left(v^k(p^c, m^k)\right).$$

The SWF is constrained by where the sum of individual tax receipts T^k (i.e., tax revenue) equals a specific revenue target R, which can be equal to the sum of all lump-sum benefits (which can be tailored B^k) provided to each consumer and the total cost of public good production.

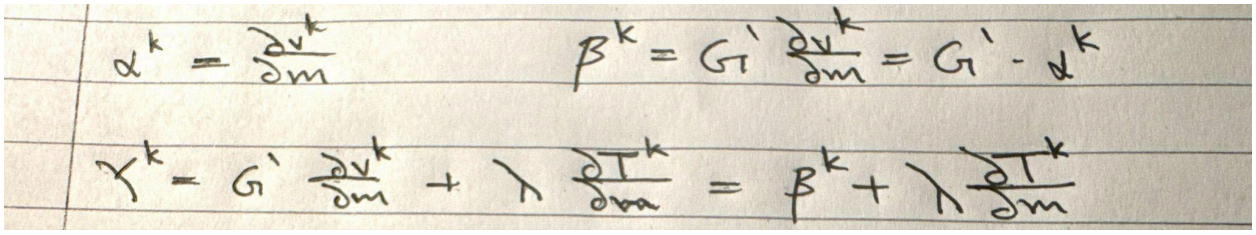
$$\sum_k T^k = R = \sum_k B^k + p_g g$$

Now we have the general government Lagrangian.

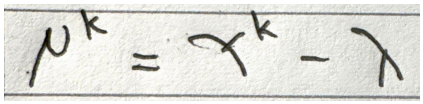
$$\mathcal{L} = \sum_k G\left(v^k(p^c, m^k)\right) + \lambda\left(\sum_k T^k - R\right)$$

λ represents the social value of government revenue, i.e., the effect of a slightly loosening of the constraint. At higher tax burdens, λ is also higher.

Next are definitions of "parameters for distributional concerns."



α^k = individual marginal utility of income/consumption
β^k = social marginal utility of consumption
γ^k = social marginal utility of income

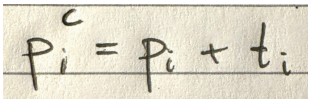


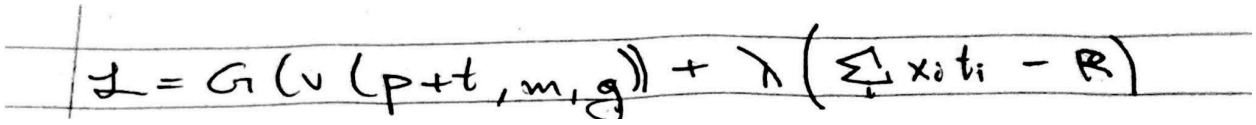
μ^k = social marginal utility of transfer

This last term is central in assessing the social value of transfers at the margin.

B. Commodity Taxation Model

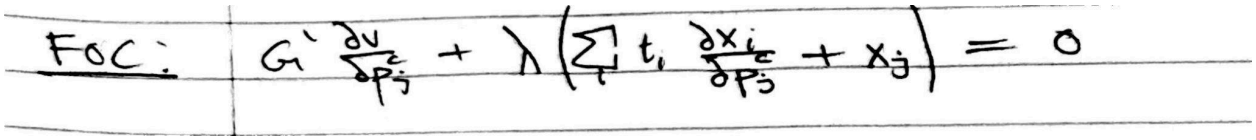
1. Ramsey Model

With this framework in place, we can move to the commodity taxation model, the single-person Ramsey tax problem, where there is no income tax, no individualized lump-sum taxation (which would otherwise be the best option), fixed producer prices, constant returns to scale, perfect competition, and exogenous labor costs. Finally, there are linear commodity taxes, in the form of excise taxes. 
t_i is the tax on good i.

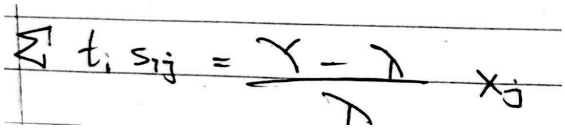


Optimizing this tax problem is shown above. This is similar to the general government Lagrangian as above, except t is the relevant commodity tax vector, and g is a measure of public goods, and where was once T^k is analogously the sum total of commodity tax receipts.

To find the value of a commodity tax that maximizes social welfare, we find the FOC, partially differentiating the Lagrangian w.r.t. t_j.



After a series of rearranging terms, also using Roy's Identity, the Slutsky equation, and parameter definitions, we arrive at the Ramsey Rule.



First, s_{ij} has a particularly important meaning, which comes from the derivation.

$$s_{ij} = \frac{\partial h_i}{\partial p_j}$$

Mathematically, this can be seen as the infinitesimal compensated change in demand for good i after a price change of good j, so then $t_i s_{ij}$ is the total approximate change in compensated demand for good j due to a tax on good i as a property of calculus. So the left-hand side of the Ramsey Rule is a summation of each of these changes in compensated demand for good j due to a tax on each other good in the system, and therefore the LHS represents the approximate change in demand for good j due to the whole tax system.

$$\frac{\sum t_i s_{ij}}{x_j} = \frac{Y - \lambda}{\lambda}$$

(Finalized Ramsey Rule)

Here we see that if we divide both sides of the Ramsey Rule by x_j, the RHS is a constant, and the LHS becomes the *proportional* change in demand for good j due to the whole tax system.

2. Ramsey Model Takeaways

The numerator of the RHS of the (finalized) Ramsey Rule is definitionally equal to μ, the social marginal utility of transfer as defined in Part I.A. Thus, the RHS is the proportional welfare implication, which equals the LHS (defined earlier) at the optimum tax rate. So "the optimal tax system changes the compensated demand for each good by the same proportional rule."

Thus substitutes to a good must be taxed effectively, because the optimal tax system minimizes distortions. Consumers must be unable to substitute another good because of one being taxed. Complements must be taxed in a slightly different fashion, because taxing one good already reduces the demand for the complementary good. Altogether, this system of uniform taxation (in terms of compensated demand changes, not price changes) disincentivizes labor. Leisure becomes relatively more appealing. Because policymakers cannot tax leisure directly, they must tax its complements. This blunts some of the labor disincentives. Now we have reduced compensated demand for *every* good, *including* leisure.

Good

Extending this is the Corlett-Hague Theorem (Corlett and Hague 1953). It deems that "in the 3 goods case (two consumption goods and leisure), the good more complementary with leisure should be taxed more heavily."

$$\sum_k \sum_i t_i s_{ij}^k = \frac{1}{\lambda} \sum_k \mu^k x_j^k$$

Aside, A many-person Ramsey model looks very similar to the one-person model, except there is now summation notation on both sides, indexed by k, representing each person, k = 1, … , N. The same conclusion as above holds, but now we can extend to further conclusions.

First, the μ_k differs as benefits/rebates are provided to different types of consumers. In certain cases, when the tax target R is not too large, and thus deadweight losses inextricably tied to taxation are not too large, then μ_k can be positive for some people, and hence subsidizing goods disproportionately demanded by high-γ people contributes to optimizing society's welfare. This differential taxation holds intrinsic appeal at first glance.

Altogether, we arrive at the Diamond-Mirrlees conclusion, where "the introduction of distributional considerations alters the equal proportional reductions rule substantially" (Heady, 1993). He continues: the extent of the differentiation in proportional reduction depends on society's degree of concern for the poor (represented by parameter ε) and the extent in differences of consumption patterns between the rich and poor for the respective good.

Good

III. Findings

A. Pure Theory

Finally, directly pertaining to the question, we can use our intuition regarding the discrepancy between household heating taxation (5%) and general consumer good taxation (20%). The first question I will ask is "is this scheme internally consistent?" before I ask "are there better schemes than this, whether within the confines of commodity taxation or outside it?"

Before consulting empirical data, it is difficult to believe that the *optimal* commodity taxation scheme is the current one, mathematically. Hypothetically, if this scheme was optimal, that would mean that a 20% tax on every good's price (excepting 5% on household heating) would change the compensated demand for each good by the same proportion, taking into account the cross-effects mentioned above via the Ramsey Rule. This does not seem plausible. Although the Ramsey model above is kneecapped by the list of assumptions from Part B.1., it is nonetheless a starting point for understanding, and the current scheme cannot reconcile with it intuitively.

To elaborate, is it so plausible that *only* household heating differs from all other consumer goods in terms of differential consumption patterns between the rich and the poor? That *only* household heating is disproportionately demanded by high-γ people? This is what the Diamond-Mirrlees conclusion would have us believe if this status quo taxation scheme was optimal. Again, this scenario is not plausible at all.

B. Empirical Results + Theory

On the simplest empirical level, the status quo scheme is also unfounded.

Table 4.1. Estimates of commodity demand complementarities with leisure (Crawford, Keen, and Smith (2008))

	Impact on budget percentage share of an additional hour worked (t statistics in brackets)	
Bread and cereals	−0.024	(64.3)
Meat and fish	−0.060	(−49.2)
Dairy products	−0.045	(−66.6)
Tea and coffee	−0.008	(−29.5)
Fruit and vegetables	−0.037	(−52.8)
Other zero-rated foods	−0.020	(−28.1)
Standard-rated foods	−0.027	(−40.0)
Food eaten out	0.054	(38.5)
Beer	0.020	(13.3)
Wine and spirits	0.020	(21.2)
Tobacco	−0.026	(−16.6)
Domestic fuels	−0.049	(−30.6)
Household goods and services	0.064	(24.2)
Adult clothing	0.000	(−0.0)
Childrens' clothing	−0.006	(−8.7)
Petrol and diesel	0.046	(35.9)
Public transport	−0.006	(−6.2)
Leisure goods	0.019	(9.4)
Books and newspapers	−0.001	(−2.0)
Leisure services	0.086	(28.1)

Note: Results from demand system estimates reported by Crawford, Keen, and Smith (2008), based on household micro-data from 22 years of the UK Family Expenditure Survey (1978–99). The table shows the impact of an additional hour worked on the budget (percentage) share of each commodity group in household spending. Thus, for example, an additional hour worked reduces the (average) percentage of households' spending devoted to bread and cereals by 0.024 points. Commodities for which the coefficient is negative are leisure complements, and those for which the coefficient is positive are leisure substitutes. All coefficients except that on adult clothing are significantly different from zero, implying that weak separability is firmly rejected.

Domestic fuels, which I believe is the closest analogue to household heating, has a relatively large negative coefficient attached to it. That is, an additional hour worked reduces the average percentage of households' spending devoted to domestic fuels by 0.049 points. Thus, purely with this piece of data (and nothing else), we could say that because household heating appears to be a leisure complement, it should be taxed more stringently than the average commodity.

However, as the IFS Report notices, domestic energy should be taxed less than others once cross-price effects are taken into account. While my instinct may be that "warming the home is tied to spending time at home, which is leisure and not labor," a high domestic energy tax would result in unfavorable distortions in compensated demand for other goods. So this *supports* the status quo of UK tax policy, if only slightly.

Very good

Nonetheless, it begs the question why the whole host of other commodities are not differentially taxed as well. Differential taxation can be done for at least one or two reasons: equity grounds and/or efficiency grounds. For the sake of explanation, let's say the 5% tax on household heating was the *optimal* course. That could mean one or two things. One, those with high-γ (generally poorer consumers) disproportionately demand household heating, so $\mu > 0$ as policymakers marginally decrease the tax from the standard 20% to 5% (where $\mu = 0$). And/or, a 5% tax on household heating yields identical changes in compensated demand (after taking into account cross-effects) as a 20% tax does on all other goods' compensated demands. Again, the former seems more plausible than the latter.

Altogether, our multi-consumer Ramsey model would have us conclude that most goods should be differentially taxed, perhaps 3.2% for one good and 27.8% for another good, to equalize the reductions in compensated demand and accounting for what γ-type of consumer disproportionately demands it and society's degree of concern for the poor. So this scheme is not internally consistent. Next question: are there better systems to replace the status quo?

C. Reality Check

The Mirrlees Review observes that in reality, outside the oversimplified Ramsey model, differentiation is not a preferable, realistic option. This is because commodity taxes—indirect taxes—are not the only taxation instrument that the UK government has at its disposal. The Mirrlees Review deems commodity taxes as "blunt" instruments. Indeed, there are income taxes, among other tools. Stern (1987) emphasizes that "taxation concerned with distribution…should as much as possible go to the root of the problem." A near-uniform taxation scheme (except for household energy) evidently does not reach the root. It is circuitous—indirect.

Aside, the concept of separable preferences is important in public economics: are all goods equally complementary to leisure? Both Crawford, Keen, and Smith (2008) and Browning and Meghir (1991) confidently *reject* weak separability. Among the former, the estimates varying significantly from 0 explain why (in the table above). Indeed, if weak separability existed, we could uniformly proportionally tax all goods (in terms of price, not compensated demand changes) (Crawford, et al., 2010).

Relatedly, Stern (1987) deems a particular case where uniformity in taxation is desirable: identical individuals (except in wage rate) and an optimal linear income tax. As he continues, these assumptions are not likely found in reality. First, individuals differ in preferences (he mentions religion, caste, and education for developing countries), and income tax has not been set optimally. So we arrive at the same conclusion we did from the Ramsey Rule: from the point of economic theory, we *should not* have uniform taxation.

In contrast, Crawford et. al (2010) are more skeptical about the potential benefits of moving towards a more differentiated commodity taxation scheme. They deem their own estimates (in the table above) as small, and as such, might not warrant a new scheme *even if* the optimal differentiated structure could be known (their estimates are just that—estimates). Indeed, they assert that both theory and empirical evidence are too limited to translate into commodity tax policy recommendations. To summarize, there is a paradox: we *know* that additional commodity tax rate differentiation would yield a more optimal solution, but we are prevented from implementing this due to a variety of obstacles.

For example, Crawford et al. (2010) continues with the litany of administrative and enforcement headaches that a differentiated system of commodity taxation would yield, where products would need to be verified as a particular species for taxation. There will be burdens on manufacturers and traders, as well as a refund/court system

for mistakes in the process. A uniform commodity taxation system has no such room for dispute. Again, to caveat, this uniform commodity taxation system should only apply to goods without externalities—gasoline and alcohol and cigarettes are altogether separate.

Crawford et. al (2010) asserts that "[i]t has been recognized for more than twenty years that the policy rationale for the zero-rating of food and children's clothing is extremely weak." They conclude that zero-rating these goods, especially when their own empirical analysis deems most foodstuffs complementary with leisure, is simply a product of politics.

Politicians cannot convince their electorates that replacing these carveouts with economically superior methods of redistribution is preferable—there is natural skepticism. The report continues with an example directly pertaining to our question at hand, household heating: there already exists a "winter allowance" for pensioners. Again, this begs the "second-best" nature of commodity taxation. Why distort preferences with a complex, imperfect scheme of different tax rates? In fact, according to Crawford et al. (2010), scrapping zero & reduced-rated taxes (matching the uniform rate), and compensating former (relatively poorer) beneficiaries with income supports would still leave £11 billion left over.

This brings me to my next point particular to household heating. I fail to see how household heating is tremendously different from gasoline, to the point where the government indeed applies the opposite consequence to it, reducing its tax as opposed to imposing a substantial one (on gasoline), in addition to likely penalizing pollution in a whole host of other ways, such as carbon taxation. Aren't there externalities in the case of household heating too? Have the environmental consequences been studied when arriving at the 5% status quo number? And in the case that intermediate goods have been taxed to "rectify" this externality, that violates a fundamental principle of production taxation.

D. Conclusion

In conclusion, I am not inherently opposed to household heating being taxed at a lower percentage relative to the average good. This could be justified after a thorough investigation of its cross-price effects and compensated demand patterns. What I am opposed to are one-off carveouts to an otherwise uniform rate. On principle, I would like to see more of an "all or nothing" situation. Option 1: There should be significantly more carveouts *rooted in economic theory*, if not a fully differentiated commodity taxation system. Rigorous analyses and robust administrative systems will need to be conducted/created for a chance at success. Unfortunately, this will be met with tremendous public skepticism when some commodity taxes are inevitably raised to achieve economic optimum. Option 2: Remove all zero/reduced-ratings, ensuring uniform commodity taxation. Be sure to compensate the "economic losers" (generally poorer, with high-γ) with income supports. Undoubtedly, this also seems politically infeasible.

Altogether, the practical drawbacks of any potential improvement prevent the status quo from being changed. So the current system is not “good,” insofar as it is nowhere close to the ideal, but we are forced to live with it.

This is a very strong essay. You show a good understanding of the models covered in the lecture and the wider literature. You could have discussed a bit more how responsive demand for household heating is to price changes.

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