Consumption taxes and taste heterogeneity*

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Abstract

We study optimal commodity taxes in the presence of non-linear income taxes when agents differ in skills and tastes for consumption. We show that commodity taxes are partly determined by a many-person Ramsey rule when there is taste heterogeneity within income classes. The usual role of consumption taxes in relaxing incentive constraints explains the remaining part of these taxes when there is taste heterogeneity between income classes. We quantify the importance of these two components on Canadian microdata using a new method to identify empirically the binding incentive constraints. Incentives matter but tax exemptions are mostly justified by Ramsey considerations.

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1 Introduction

One common way of easing the fiscal burden on those in need is to make necessities tax-free or tax them at a lower rate than luxuries. Whether commodity taxes should be used in this way as part of the progressivity of the overall tax system is, however, subject to continued debate in public finance. In a second-best world, in the case where social tastes for redistribution are ordered from the rich to the poor, the many-person Ramsey rule derived by Diamond and Mirrlees [14] does indeed recommend that the demand for the goods preferred by the poor be less-heavily discouraged by taxes. However, this recommendation only applies when there is no income taxation. In the more relevant case where the government can also apply a general non-linear income tax, the redistribution from rich to poor can partly be effected via direct income taxes and transfers. The classic analysis of Atkinson and Stiglitz [2] and its generalization by Mirrlees [22] demonstrated that commodity taxation is then needed to relax the incentive constraints implied by any imperfect information about taxpayers. If labor skill, for example, is private information to taxpayers, redistribution from high- (rich) to low-skill (poor) individuals will involve high taxes on necessities when these taxes help to discourage the high-skilled from reducing their labor effort. Of course, the low-skilled also suffer from a greater tax burden but they may gain from the greater scope for income redistribution.

In the existing literature there is a suspicion that the role of commodity taxes delineated by Atkinson and Stiglitz [2] and Mirrlees [22] is bound up with the restrictive modeling assumption that labor skill is the only dimension in which agents differ. The early contributions of Cremer and Gahvari [7] and [8] have indeed shown that non-linear commodity taxes might play a redistributive role when there is heterogeneity in consumption tastes, as well as labor skill, although non-linear income taxation is also available. The current paper analyzes the respective roles of indirect linear commodity taxation and direct non-linear income taxation when agents differ in terms of both labor skill and consumption tastes. Its main purpose is to study whether heterogeneity in consumption tastes, as well as labor skill, may save some version of the many-person Ramsey rule.

Much effort has recently been expended on the optimal shape of linear commodity taxes when individuals differ in two private-information dimensions: see in particular Cremer, Pestieau and Rochet [9] and [10], Saez [24], Diamond [12], Blomquist and Christiansen [3], Kaplow [20], Diamond and Spinnewijn [15] or Golosov, Troshkin, Tsyvinski and Weinzierl [18]. This literature does not provide any justification for the heavy taxation of luxuries based on many-person Ramsey rule considerations, and rather underlines that the role of commodity taxes in relaxing incentive constraints continues instead to apply in this more general framework. Our paper highlights that this role for commodity taxes relies on the assumption that different types of agents pay different income taxes. This full flexibility of the income tax schedule is open to question. It is known from Rochet and Choné [23] that more than one dimension of individual heterogeneity will likely yield bunching in income taxes where different types of agents have the same pre- and post-tax incomes. This flexibility assumption will also not hold when income is determined by a limited number of occupations or jobs, as in the literature following Diamond [13]. When there are only a limited number of income classes relative to the total number of different taste types, some agents with different tastes will necessarily be grouped together in the same income class. Income taxation can be used to address heterogeneity between income classes, but is obviously no help for the finer redistribution within income classes: this role is taken up by commodity taxation. Our main theoretical result is to show that commodity taxes are then partly shaped by a version of the many-person Ramsey rule: taxes are determined by the relationship between consumption and consumers' social valuations within each income class.

The closest papers to ours are Cremer, Pestieau and Rochet [9] and Diamond and Spinnewijn [15]. Using a Lagrangian approach, Cremer, Pestieau and Rochet [9] derive an optimal rule whereby commodity taxes only depend on the 'incremental net demand of mimickers', which is defined as the difference between the consumption of mimickers and mimicked agents. They show that the demand for a given commodity should be discouraged when mimickers consume more of this commodity than do the mimicked. For example, groceries should be heavily taxed if the rich (mimickers) like them to the extent that they would have relatively high grocery consumption even with the lower income of the poor (who are the mimicked here). Diamond and Spinnewijn [15] consider a dynamic setup where labor income is determined by occupation. Assuming that impatient high-earners, who have a taste for early consumption, are ready to mimic low-earners, the 'incremental net demand of mimickers' rule recommends subsidizing the savings of low-earners. One particular feature of the optimal tax system in Diamond and Spinnewijn [15] is to complement this subsidy by a tax on high-earners' savings. This additional tax is seen as a way of relaxing the incentive constraints. Taxing the savings of the rich redistributes welfare from the patient to the impatient rich, and hence raises the welfare of potential mimickers (the impatient rich) if they do not reduce their labor effort.

Our paper shows that this additional tax on the savings of the rich in fact can be viewed as part of a many-person Ramsey rule. Commodity taxes allow the government to carry out a finer redistribution between patient and impatient agents within rich and poor income classes. Since there cannot be incentive problems within an income class, the forces identified by Atkinson and Stiglitz [2] and Mirrlees [22] are irrelevant within an income class. This produces commodity taxes that are shaped by the individual heterogeneity that remains within income classes, namely the relationship between the consumption and the social valuations of patient and impatient consumers. Later consumption will be discouraged by a tax on savings when impatient agents are socially favored.

We use a method related to that in Cremer, Pestieau and Rochet [9] in an occupational setup that generalizes Diamond and Spinnewijn [15]. Unlike Cremer, Pestieau and Rochet [9] we solve for a dual program allowing for a separate treatment of commodity taxes and labor supply, extending Laroque [21] and Gauthier and Laroque [17] to introduce greater individual heterogeneity. Our program yields a necessary condition for optimal indirect taxes given any arbitrary (and possibly sub-optimal) pre-tax income distribution. This condition can be written in two different ways. The first corresponds to the standard many-person Ramsey rule, once agents' social weights are suitably redefined. Following Diamond [11], agents' social weights are usually defined in the main literature as the change in social welfare from an income transfer to this agent in the absence of incentive issues. In our setup the social valuation of an agent also incorporates an incentive component, as income transfers render the allocations of agents who benefit from the transfer more desirable to those who envy this allocation. Some social cost is to be borne to avoid violations of incentive requirements: from a pure incentive viewpoint it is on the contrary preferable in a social-welfare sense to reduce income transfers to envied (mimicked) agents. The relevant weight in the many-person Ramsey rule turns out to be the 'intrinsic' social weight used by Diamond [11] net of an adjustment relating to incentives. This new social weight, which we call the 'consolidated' weight, is lower than Diamond's typical intrinsic social weight when incentive considerations are present; it can also even be negative, as is sometimes found in the empirical literature on the estimation of social weights consistent with the many-person Ramsey rule (see, for example, Ahmad and Stern [1]).

The second reading of this condition follows from the separation the two components of the consolidated social weights. This yields another formulation of the optimal indirect-taxation rule that mixes together a many-person Ramsey rule using Diamond's typical intrinsic social weights, and an incentive-component element referring to the incremental net demand of mimickers. This formulation reveals that the usefulness of indirect taxes is related to taste heterogeneity in two different ways. First, indirect taxes are determined by a many-person Ramsey rule when agents in the same occupation or income class have different consumption tastes. Second, indirect taxes are useful when agents in different income classes also have different tastes, as they allow the tax authorities to relax incentive constraints.

The main lesson from our theoretical analysis therefore is that heterogeneity within income classes can justify the discouragement of the consumption of those with low intrinsic weights, even in the presence of a general non-linear income tax. Commodity taxation then reinforces the progressivity of the tax system by addressing taste heterogeneity within income classes, while the income tax itself instead deals with between-class income heterogeneity.

Our empirical illustration on Canadian consumption microdata identifies groups of agents with the same preferences by appealing to the nonparametric revealed preferences clustering in Crawford and Pendakur [6]. The assumption that the Federal Good and Services Tax (GST) is set optimally yields estimates for the groups' consolidated social weights. We provide evidence of considerable variation in consolidated social weights across taste groups. All these weights turn out to be positive, except for rich urban households consisting of old individuals living in West Canada.

The recovery of the intrinsic social weights requires the identification of the relevant incentive constraints, reflecting the existence of private information, at the disaggregated taste $\times$ occupation level. The existing empirical literature offers a number of tests for the presence of asymmetric information in an overall market (see Chiappori and Salanié [5] and Finkelstein and McGarry [16]), but there is no available test at the finer level that we require here. We develop a new method to identify binding incentive constraints, based on the standard qualification requirements in the Lagrangian approach. This methods shows that in Canada incentive problems only concern those households with negative consolidated social weights. The consolidated social weights of the rich, old urban families in West Canada thus underestimate their true underlying intrinsic weights. The size of the bias is such that their intrinsic weights are positive, even though they remain the main contributors to redistribution in favor of other groups. This result is more prominent when the Liberal Party is in power.

The identification of the binding incentive constraints enables us to decompose the discouragement indices (the percentage by which taxes reduce consumption) of the different categories into the many-person Ramsey rule element from within income class taste heterogeneity and the incentive component related to between-income class taste heterogeneity. We find that the many-person Ramsey rule mostly justifies the tax-free categories whereas the taxation of Housing expenditures, Recreation and Restaurants reflects incentive concerns.

The remainder of the paper is organized as follows. Section 2 describes the setup with agents differing in two dimensions. The necessary conditions for an optimal tax system are set out in Section 3, and Section 4 concludes the theoretical part of the paper by providing the new formulation of these conditions separating equity/efficiency from incentive considerations. The illustration on Canadian consumption data appears in Section 5. The appendix discusses alternative interpretations of our theoretical framework and provides various robustness checks of the results presented in the empirical illustration.

2 General setup

We consider a population of agents who differ in terms of their labor skill i ($i = 1, \dots, I$) and consumption tastes j ($j = 1, \dots, J$). There are n_{ij} type ij agents and the total population size is normalized to 1. The preferences of a type-ij agent are represented by the utility function $U_i(V_j(x), y)$, where x is a bundle of consumption goods, y is a nonnegative real number which stands for pre-tax labor income, and V is a sub-utility function referring to consumption. The functions U_i and V_j satisfy the standard monotonicity and convexity properties.

The government observes individual incomes and the aggregate consumption of each good, but skill and tastes are agents' private information. The government can apply nonlinear income taxes and linear consumption taxes. An agent with pre-tax income of y has post-tax income of $R(y)$. Consumption taxes are given by $q - p$, where q and p are the vectors of consumer and producer prices respectively. As is standard, one commodity is assumed to be untaxed.

Income heterogeneity appears via the income classes k ($k = 1, \dots, K$). Agents in class k earn pre-tax income of y_k and post-tax income of $R_k = R(y_k)$. In what follows we assume that $K \leq IJ$. The limited number of income classes may reflect some exogenous restriction on the number of possible occupations or jobs, as in Diamond [13] and Diamond and Spinnewijn [15], or, as will become clear below, some endogenous income bunching.[1]

Given (y, R) a type-ij agent chooses a consumption bundle $\xi_j(q, R)$ maximizing $V_j(x)$ subject to the budget constraint $q \cdot x \leq R$. The agent obtains (conditional) indirect subutility $V_j(\xi_j(q, R)) \equiv V_j(q, R)$ from consumption, with a slight abuse of notation. A type-ij agent in class k has utility $U_i(V_j(q, R_k), y_k)$ and thus self-selects into this class if and only if

$$U_i(V_j(q, R_k), y_k) \geq U_i(V_j(q, R_{k'}), y_{k'}) \tag{1}$$

for all k'.

A tax system is defined by a vector q of consumer prices, an income tax profile (y_k, R_k) and an allocation rule (μ_{ijk}), where μ_{ijk} equals 1 if ij agents are assigned to class k, and 0 otherwise. This satisfies incentive compatibility if (1) holds for each type ij and each pair of classes k and k' such that $\mu_{ijk} = 1$. It is feasible when

$$\sum_{jk} n_{jk} \left[(q - p) \cdot \xi_j(q, R_k) + (y_k - R_k)\right] \geq 0, \tag{2}$$

where

$$n_{jk} \equiv \sum_i n_{ij} \mu_{ijk}$$

is the number of taste-j agents in class k.

A tax system is (socially) optimal when it maximizes some social objective subject to the incentive and feasibility constraints (1) and (2). In what follows, the social objective is assumed to be Paretian, increasing with agents' utilities.

3 A dual program

It is difficult to deal with the incentive constraints (1) at this level of generality. The literature usually imposes more structure than just separability on individual preferences, e.g., some version of the single-crossing condition, to deal with these constraints. It is not clear how relevant these additional restrictions are in practice. In this section we consider a 'reference' tax system $((\bar{\mu}_{ijk}), \bar{q}, (\bar{y}_k, \bar{R}_k))$ satisfying (1) and (2), and derive conditions for consumer prices $\bar{q}$ and the post-tax income profile $(\bar{R}_k)$ to be optimal given $(\bar{\mu}_{ijk})$ and $(\bar{y}_k)$. This methodology makes additional restrictions on individual preferences unnecessary.

Suppose that the economy is locally non-satiated under the reference tax system: a small amount of additional resources can be used to achieve a Pareto improvement without violating the incentive-compatibility requirements. This assumption implies that $\bar{q}$ and the profile $(\bar{R}_k)$ are part of an optimal tax system only if given $(\bar{\mu}_{ijk})$ and $(\bar{y}_k)$ there is

[1] In the appendix we provide an alternative model abstracting from occupations, where type ij earns pre-tax income y_{ij} but there are exogenous restrictions on the income-tax schedule. This alternative model yields the same results as those derived in the main text.

no q and (R_k) that yield additional tax resources without reducing the welfare of some agents or violating incentive-compatibility requirements. Consider an alternative tax system where indirect taxes are q and post-tax incomes are (R_k), while pre-tax incomes and the assignment remain as in the reference situation $(\bar{y}_k)$ and $(\bar{\mu}_{ijk})$. No agent suffers from the implementation of this alternative tax system if and only if

$$U_i(V_j(q, R_k), \bar{y}_k) \geq U_i(V_j(\bar{q}, \bar{R}_k), \bar{y}_k) \tag{3}$$

for all ijk such that $\bar{\mu}_{ijk} = 1$.

Suppose now that there is some type-ij agent in occupation k' $(\mu_{ijk'} = 1)$ who envies someone in occupation k in the reference situation, that is the incentive constraint $U_i(V_j(\bar{q}, \bar{R}_{k'}), \bar{y}_{k'}) \geq U_i(V_j(\bar{q}, \bar{R}_k), \bar{y}_k)$ holds with equality. Under the alternative tax system incentive compatibility is preserved if and only if

$$U_i(V_j(q, R_{k'}), \bar{y}_{k'}) \geq U_i(V_j(q, R_k), \bar{y}_k).$$

By (3), a sufficient condition for this inequality to be met is

$$U_i(V_j(q, R_k), \bar{y}_k) \leq U_i(V_j(\bar{q}, \bar{R}_k), \bar{y}_k).$$

Let $\bar{V}_{jk} \equiv V_j(\bar{q}, \bar{R}_k)$ stand for the sub-utility of a type-ij agent under the reference tax system. The reference tax system is optimal only if, given the allocation $(\bar{\mu}_{ijk})$ and pre-tax income levels $(\bar{y}_k)$, the tax tools $(q, (R_k)) = (\bar{q}, (\bar{R}_k))$ maximize total tax resources

$$\sum_{jk} n_{jk} \left[(q - p) \cdot \xi_j(q, R_k) + (\bar{y}_k - R_k) \right]$$

subject to

$$V_j(q, R_k) \geq \bar{V}_{jk} \tag{4}$$

for all ijk such that $\bar{\mu}_{ijk} = 1$, and

$$V_j(q, R_k) \leq \bar{V}_{jk} \tag{5}$$

for all ijk such that $U_i(\bar{V}_{jk}, \bar{y}_k) = U_i(\bar{V}_{jk'}, \bar{y}_{k'})$ and $\bar{\mu}_{ijk'} = 1$ for some $k' \neq k$.

We solve this problem using the Lagrangian approach. The reference tax system is optimal only if $(\bar{q}, (\bar{R}_k))$ is a local extremum of the Lagrangian function

$$\sum_{jk} n_{jk} \left(t \cdot \xi_j(q, R_k) - R_k \right) + \sum_{jk} (n_{jk}\lambda_{jk} - \tilde{n}_{jk}\gamma_{jk}) \left[V_j(q, R_k) - \bar{V}_{jk} \right],$$

where

$$n_j \equiv \sum_k n_{jk} \quad \text{and } \tilde{n}_{jk} \equiv \sum_i \sum_{k' \neq k} n_{ij} \bar{\mu}_{ijk'} \mathbb{1}\left[U_i(\bar{V}_{jk'}, \bar{y}_{k'}) = U_i(\bar{V}_{jk}, \bar{y}_k) \right]$$

are respectively the number of taste-j agents, and the number of taste-j agents assigned to class $k' \neq k$ who contemplate switching to k.

For the Lagrangian approach to be valid we require the qualification of the active constraints in the reference situation.

Assumption 1. Qualification requirement. *With* N *taxable consumption goods the* $JK \times (N+K)$ *Jacobian matrix whose* jk*-th row is* $\nabla V_j(\bar{q}, \bar{R}_k)$ *has rank* JK.

Assumption 1 requires that $(J-1)K \leq N$, i.e. a large number of taxable goods relative to agent heterogeneity. This does not seem to be very demanding in practice, as there will be a large number N of taxable goods, but is likely to be problematic for the empirical analysis using consumption data where goods are aggregated into only a few categories. Under Assumption 1 there exist JK non-negative Lagrange multipliers $n_{jk}\lambda_{jk} - \tilde{n}_{jk}\gamma_{jk}$ associated with (4) and (5). By convention, we set $n_{jk}\lambda_{jk} \geq 0$ and $\tilde{n}_{jk}\gamma_{jk} = 0$ when one such multiplier is non-negative, and $\tilde{n}_{jk}\gamma_{jk} > 0$ and $n_{jk}\lambda_{jk} = 0$ otherwise. This convention makes clear that for any given jk the only relevant (binding) constraint is (4) if $n_{jk}\lambda_{jk} \geq 0$ and (5) if $\tilde{n}_{jk}\gamma_{jk} > 0$. Type jk is 'envied' (or mimicked) when $\tilde{n}_{jk}\gamma_{jk} > 0$, and is not envied otherwise.

4 A Many-Person Ramsey Rule

The first-order condition for the consumer price q^h to be optimal is, using α_{jk} for the marginal utility of income of a taste-j agent in class k,

$$\sum_{jk} n_{jk} \left(\xi_{jk}^h + \sum_{\ell} t^{\ell} \frac{\partial \xi_{jk}^{\ell}}{\partial q^h} \right) - \sum_{jk} (n_{jk}\lambda_{jk} - \tilde{n}_{jk}\gamma_{jk}) \alpha_{jk} \xi_{jk}^h = 0,$$

where all of the variables are evaluated under the reference tax system.

Let

$$\beta_{jk} = \sum_{\ell} t^{\ell} \frac{\partial \xi_{jk}^{\ell}}{\partial R} + \lambda_{jk}\alpha_{jk}. \tag{6}$$

stand for the 'intrinsic' social weight of one taste-j agent assigned to class k. The intrinsic social weight measures the marginal social valuation of an income transfer in the absence of any incentive problems involving this agent.

The same transfer also benefits taste-j agents allocated to another class $k' \neq k$ when they switch to k. The impact on the objective of the tightening of the associated incentive constraint is measured by

$$\tilde{\beta}_{jk} = \gamma_{jk}\alpha_{jk}. \tag{7}$$

As a result the total social value of a one-unit income transfer toward each taste-j agent in class k, which we call the 'consolidated' social weight, is

$$b_{jk} = n_{jk}\beta_{jk} - \tilde{n}_{jk}\tilde{\beta}_{jk}. \tag{8}$$

This consolidated social weight b_{jk} is equal to the intrinsic social weight of taste-j agents in class k net of the incentive correction $\tilde{n}_{jk}\tilde{\beta}_{jk}$.

Appealing to the Slutsky properties, the first-order condition in q^h can be rewritten as

$$\sum_\ell t^\ell \frac{\partial \hat{\xi}^h}{\partial q^\ell} = -\xi^h + \sum_{jk} b_{jk} \xi^h_{jk} \tag{9}$$

where

$$\xi^h \equiv \sum_{jk} n_{jk} \xi^h_{jk}$$

represents the aggregate demand for good h, and $\hat{\xi}^h$ is the aggregate compensated demand for this good. Using the first-order condition in the post-tax income chosen for class k,

$$\sum_j b_{jk} = \sum_j n_{jk} \equiv n_k, \tag{10}$$

the first-order condition in q^h finally yields a version of the many-person Ramsey rule that is set out in Proposition 1.

Proposition 1. *Suppose that Assumption 1 holds. Consider some assignment* $(\bar{\mu}_{ijk})$, *a vector of consumer prices* $\bar{q}$ *and an income-tax schedule* $(\bar{y}_k, \bar{R}_k)$ *that satisfies the incentive-compatibility and feasibility requirements (1) and (2). Optimal taxes are such that*

$$\sum_\ell t^\ell \frac{\partial \hat{\xi}^h}{\partial q^\ell} = \sum_k n_k \Phi^h_k \tag{11}$$

where

$$\Phi^h_k \equiv \sum_j \frac{b_{jk}}{n_k} \xi^h_{jk} - \sum_j \frac{n_{jk}}{n_k} \xi^h_{jk} = \operatorname{cov}\left(\frac{b_{jk}}{n_{jk}}, \xi^h_{jk}\right).$$

The covariance Φ^h_k is positive when the agents in class k who have high consolidated social weights like good h. Rule (11) looks like the standard many-person Ramsey rule, with Φ^h_k being the distributive factor for good h advocated by Diamond [11], here calculated within income class k. In the typical textbook formulation, however, intrinsic social weights replace the consolidated social weights. The social weights in (11) underestimate the true underlying social value of an agent measured by her intrinsic social weight as income transfers toward agents in class k render this class more desirable to the other agents, which tightens the incentive constraints. This helps to explain why the empirical literature has sometimes produced negative estimates of social values consistent with the many-person Ramsey rule (see, for example, Ahmad and Stern [1]). This literature in fact has produced estimates of the consolidated social weights, rather than the intrinsic weights, which explains the discrepancy. We shall return to this point in our illustration.

The expression for the covariance Φ^h_k supposes that every taste j is represented in each income class k. When $n_{jk} = 0$ for some jk the covariance expression remains valid when no taste-j agents in income class $k' \neq k$ contemplate switching to k, as we can then without loss of generality set b_{jk} to 0. This argument no longer applies when both $n_{jk} = 0$ for some jk and some taste-j agents in class $k' \neq k$ contemplate switching to k. Here the covariance Φ_k^h involves the hypothetical consumption levels that jk' agents would have in class k. In order to disentangle effective (observed) consumption from the hypothetical consumption of mimickers we require a more suitable form of (11). Note that

$$\Phi_k^h = \text{cov}\left(\beta_{jk}, \xi_{jk}^h\right) - \text{cov}\left(\frac{\tilde{n}_{jk}}{n_{jk}}\tilde{\beta}_{jk}, \xi_{jk}^h\right),$$

where

$$\text{cov}\left(\beta_{jk}, \xi_{jk}^h\right) \equiv \phi_k^h = \sum_j \frac{n_{jk}}{n_k}\beta_{jk}\xi_{jk}^h - \sum_j \frac{n_{jk}}{n_k}\beta_{jk}\sum_j \frac{n_{jk}}{n_k}\xi_{jk}^h \tag{12}$$

is the distributive factor of good h used by Diamond [11] (here this is calculated in class k) relying on intrinsic social weights. Similarly,

$$\text{cov}\left(\frac{\tilde{n}_{jk}}{n_{jk}}\tilde{\beta}_{jk}, \xi_{jk}^h\right) = \sum_j \frac{\tilde{n}_{jk}}{n_k}\tilde{\beta}_{jk}\left(\xi_{jk}^h - \xi_k^h\right) \tag{13}$$

where

$$\xi_k^h \equiv \sum_j \frac{n_{jk}}{n_k}\xi_{jk}^h$$

is the average (actual) demand for good h in class k. A type-ij agent in class $k' \neq k$ would have the same consumption ξ_{jk}^h as the taste-j agents initially assigned to class k. The covariance in (13) is thus a weighted sum of the differences between the fictive consumption of good h by agents who contemplate switching to class k and the actual consumption of this same good by agents who are allocated to class k in the reference situation. This is the 'incremental demand of the mimickers' that appears in Guesnerie [19] and Cremer, Pestieau and Rochet [9].

Proposition 1 can then be rewritten as follows:

Proposition 2. *Suppose that Assumption 1 holds. Consider some assignment $(\bar{\mu}_{ijk})$, a vector of consumer prices $\bar{q}$ and an income-tax schedule $(\bar{y}_k, \bar{R}_k)$ that satisfies the incentive compatibility and feasibility requirements (1) and (2). Optimal taxes are such that*

$$\sum_\ell t^\ell \frac{\partial \hat{\xi}^h}{\partial q^\ell} = \sum_k n_k \phi_k^h - \sum_{jk} \tilde{n}_{jk}\tilde{\beta}_{jk}\left(\xi_{jk}^h - \xi_k^h\right), \tag{14}$$

where ϕ_k^h is the within class k distributive factor for good h.

Proposition 2 yields the rules obtained in the previous literature as special cases.

1. Incentive considerations are irrelevant in the single class $K = 1$ case, i.e. $\tilde{n}_{jk}\tilde{\beta}_{jk} = 0$ for all jk. The income tax then degenerates to a uniform lump-sum tax and the rule given in Proposition 2 can be simplified to

$$\sum_\ell t^\ell \frac{\partial \hat{\xi}^h}{\partial q^\ell} = \sum_k n_k \phi_k^h = \phi_1^h.$$

   This coincides with the familiar many-person Ramsey rule (when a uniform income tax is allowed). The discouragement of the compensated demand for good h should equal the distributive factor of this good. Indirect taxation is useful as long as there is taste heterogeneity in the (unique) income class.

2. When there are $K = IJ$ different classes, $\phi_k^h = 0$ for all h and k, and the optimal rule for indirect taxation given in (14) becomes

$$\sum_\ell t^\ell \frac{\partial \hat{\xi}^h}{\partial q^\ell} = -\sum_{jk} \tilde{n}_{jk}\tilde{\beta}_{jk} \left(\xi_{jk}^h - \xi_k^h\right). \tag{15}$$

   Discouragement only relies on the incremental net demand of the mimickers, as in Mirrlees [22], Guesnerie [19], and Cremer, Pestieau and Rochet [9] and [10]. The formula in equation (15) is of the same kind as those derived by Saez [24] from his Assumption 3. It also applies in the special case where tastes are perfectly correlated with skill, as in Golosov, Troshkin, Tsyvinski and Weinzierl [18]. Indirect taxation is of no use when no agent contemplates switching to another class ($\tilde{n}_{jk}\tilde{\beta}_{jk} = 0$ for all jk). Indirect taxation is also of no use in the homogeneous-taste case, $V_j(x) = V(x)$ for all j, since then $\xi_{jk}^h = \xi_k^h$ for all j. This is the theorem in Atkinson and Stiglitz [2]. When $\tilde{n}_{jk}\tilde{\beta}_{jk} > 0$ for some jk, consumption of a given good should be discouraged when agents who contemplate switching to k have a higher consumption of this good than the agents who are actually assigned to class k. The role of indirect taxes in (15) is to relax the incentive constraints, which is possible only if agents in different income classes also have different tastes, i.e. in the presence of heterogeneity across income classes.

The considerations resulting from these two polar cases come together in a surprisingly simple manner in the more general configuration where $1 \leq K \leq IJ$. Optimal discouragement should then equal the sum of the distributive factors over the different income classes and a measure of the excess consumption of mimickers.

In each configuration non-linear income taxes address agent heterogeneity across income classes. Proposition 2 highlights that indirect taxes are useful under two kinds of circumstances. First, they help address equity when individuals allocated to the same income class have different consumption tastes, as they then allow the tax authority to manage within income class taste heterogeneity. Second, they ensure the relaxation of the incentive constraints when individuals who are allocated to different income classes have different tastes, i.e. when there is between-class taste heterogeneity.

Proposition 2 shows that the considerations from the many-person Ramsey rule should partly affect indirect taxes. Luxuries should be heavily taxed when the government puts a high weight on agents who like necessities. Even so, we cannot conclude that indirect taxes should always serve to reinforce the progressivity of the tax system, with luxuries being more heavily taxed than necessities. In particular there is pressure for high taxes on necessities in the redistributive case where agents from the higher income classes have lower social values and like necessities more than do the less well-off. The signal of a relative taste for necessities is based on a (fictitious) neutralization of income differences. Through the incremental net demand of the mimickers, the appraisal of taste heterogeneity across income classes relies on the comparison of the actual consumption of necessities by the poor and that by agents who are currently in the upper income class were they to be endowed with the same income as the poor. The upper income classes like necessities more than do the less well-off if, when endowed with lower income, they would consume more necessities than do the poor.

These ideas can be illustrated by a simple example. Consider two income classes, with some agents earning 20 USD and others 10 USD. There are only two types of tastes, indexed by `Pot` and `Cav`. `Pot`-taste agents consume only potatoes: each rich (poor) `Pot`-taste agent thus spends 20 USD (10 USD) on potatoes. `Cav`-taste agents with the high 20 USD income only consume caviar, while those in the 10 USD lower income class spread their 10 USD income evenly between caviar and potatoes. Such tastes could be driven by some hidden wealth or merely reflect subjective personal preferences. In any case, if the government favors those who like potatoes, i.e. `Pot`-taste agents, the many-person Ramsey rule considerations imply that caviar should be taxed more heavily than potatoes. Nevertheless heterogeneity across income classes might produce higher taxes on potatoes if the rich `Pot`-taste agents envy the poor, since poor `Pot`-taste agents have greater (10 USD) consumption of potatoes than that of the poor (a poor-population weighted sum of 5 USD and 10 USD). The same argument applies to the taxation of household savings in a dynamic setup where there is only one consumption good, say potatoes, income is received at some initial date, and when `Pot` and `Cav` are replaced by patient and impatient agents, respectively. Patient agents prefer the later consumption of potatoes.

In practice it may be difficult to obtain information on the fictitious consumption of mimickers that is important in the optimal design of indirect taxes. Fictitious consumption can be identified empirically when taste heterogeneity within each income class is large enough. This comes about in the examples above (where $J = K$) and will also hold in our empirical illustration, where all possible tastes appear in each income class.

5 An empirical illustration

We consider Canadian consumption microdata to provide a decomposition of discouragement in line with that set out in Proposition 2, with a many-person Ramsey component and an index for the excess consumption of mimickers. To this end we first reorganize the data into groups of agents who have similar tastes and estimate the consolidated social values (b_{jk}) of these groups. We then present a new method for the identification of the relevant (binding) incentive constraints. This method yields separate estimates for the incentive corrections ($\tilde{n}_{jk}\tilde{\beta}_{jk}$) and the intrinsic social weights (β_{jk}). From these estimates we deduce all of the values of the statistics in Proposition 2.

5.1 Data, consumption and taxes

The main data comes from the Survey of Family Spending (for 1992, 1996, 1997 and 1998) and the Survey of Household Spending (annually from 1999 to 2008) collected by Statistics Canada.[2] The annual surveys have from 8,624 to 16,461 observations, yielding a 14-year pooled sample of 183,971 observations at the household level. Each observation contains information on some observable household characteristics as well as household spending on 12 aggregate categories of goods based on Classification of Individual Consumption According to Purpose (COICOP) used by the United Nations.[3] The summary statistics for this sample appear in column 1 of Table 1.

Post-tax price indices come from the Statistics Canada Consumer Price Index. These are calculated at the category $\times$ province $\times$ year level and are harmonized across provinces using the 2008 Inter-city Indices of Consumer Price Levels. Canada has both a federal Goods and Services Tax (GST) and local commodity taxes. Some provinces set local taxes in accordance with the GST in the framework of the Harmonized Sales Tax (HST). Others may have provincial or retail sales taxes on top of the GST. In most of this illustration we focus our attention on federal redistribution. This amounts to taking local taxes as given and thus ignoring any vertical tax interactions between different government levels. Table 7 in the appendix presents the results based on both federal and local taxes that partially take into account vertical tax interactions. The federal GST was enacted in 1991 at a rate of 7% through legislative arrangements promoted by Brian Mulroney and part of the Progressive Conservative party, but disapproved of by other Right-wing members of Parliament, the Liberal party and most of the population. The Conservative Party subsequently lowered the GST rate to 6% in 2006 and 5% in 2008.

Most goods and services are subject to the GST, but some items are zero-rated or tax-free.[4] The excluded items from the GST are concentrated in specific goods and services categories. However the aggregate COICOP categories include both taxed and tax-free items. In the absence of more detailed information, our baseline specification considers

[2]Details regarding this data can be found in Boelaert [4].

[3]The 12 categories are: Food and non-alcoholic beverages; Alcoholic beverages, tobacco and narcotics; Clothing and footwear; Housing, water, electricity, gas and other fuels; Furnishings, household equipment and routine household maintenance; Health; Purchase of vehicles, operation of personal transport equipment; Transport services; Communication; Recreation and culture; Education; Restaurants and hotels; and Miscellaneous goods and services. The United Nations Statistics Division provides detailed information available at `http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=5&Lg=1`.

[4]These excluded items are listed at `http://www.cra-arc.gc.ca/E/pub/gm/4-3/4-3-e.html`.

Table 1: Summary statistics

No. of observations	Full sample 183,973	Full sub-sample 100,000	Final sub-sample[1] 33,025
Urban (ref: Rural) (in percent)	67	67	68
Age (in years)	49.1	49.1	49.1
Income (in CAD)	42,111	42,147	43,621
Family type (ref: Other) (in percent)			
Single	25.5	25.5	28.3
Couple with children	30.9	31.1	30.6
Childless couple	25.7	25.5	23.4
Single-parent family	8	7.9	8
Housing tenure (ref: tenancy) (in percent)			
Mortgaged owner occupancy	32.9	32.8	34.8
Outright owner occupancy	33.2	33.2	29.9
Education (ref: Primary education) (in percent)			
Secondary education	12.4	12.3	11.8
Partial post-secondary education	4.7	4.7	4.7
Complete post-secondary education	7.6	7.7	7.8
Higher education	9.4	9.3	10.4
(Not reported)	(56.9)	(57)	(56.2)
Region (ref: Ontario) (in percent)			
Atlantic Canada[2]	30	29.9	32.7
British Columbia	11.3	11.3	10
Canadian Prairies[3]	30.5	30.5	32.4
Quebec	14.3	14.4	13.4

Notes: 1. This sub-sample refers only to individuals who are in taste groups 1 to 4.
2. New Brunswick, Newfoundland and Labrador, Prince Edward Island, and Nova Scotia.
3. Alberta, Manitoba, Saskatchewan, Yukon, Nunavut, and Northwest Territories.

Food, Health, (public and private) Transport and Education as being tax-free. We have also set a 100% tax rate on Alcoholic beverages, tobacco and narcotics. These choices are of course debatable. In the appendix we assess the robustness of our results to our benchmark tax base and find no significant impact of departures from these assumptions.

5.2 Revealed-preference taste groups

The identification of the groups of households with the same consumption tastes relies on the revealed-preference based method recently developed by Crawford and Pendakur [6]. We use the `R` algorithm `revealedPrefs` to cluster the data. This algorithm yields groups of observations that do not violate the Generalized Axiom of Revealed Preferences. Households in the same group therefore have the same preferences and demand functions. The algorithm is computationally very demanding, and we thus work with a random subsample of $100,000$ observations from our initial sample. In line with Crawford and Pendakur [6], we find that taste heterogeneity does matter, but a small number of groups suffices to explain the majority of observed consumption behaviour, with only eight taste groups being required to explain the behaviour in 50% of observations.[5] In order to meet the qualification requirements set out in Assumption 1 we will consider the four taste groups with the most observations, i.e. we set $J = 4$. Columns 2 and 3 of Table 1 present the summary statistics of the 100,000 observation sample and the subsample in these four taste groups (which cover one-third of households). This latter is fairly representative of the full sample.

The taste groups are unbalanced in size. The first includes twice as many household observations as any of the other three: there are $12,555$ observations in taste-group 1, $6,883$ in group 2, $7,441$ in group 3 and $6,146$ in group 4. The detailed characteristics of the different groups appear in Table 2. Taste-group 1 comprises better-educated and richer households than the other groups, but otherwise the observable characteristics in taste groups 1 and 3 are very similar. Both consist of young rural households living in East Canada (Quebec and the Atlantic regions). Households in taste groups 2 and 4 are older and live instead in Western Canada. Table 6 shows the consumption spending of the different taste groups.

5.3 Social-weight estimates

Assuming that the GST rates are set optimally, the best estimates for the social weights (b_{jk}) must satisfy (9) and (10). The first-order condition (9) associated with category h can be rewritten as

$$\sum_{\ell} \frac{t^{\ell}}{q^{\ell}} \hat{\varepsilon}^{h\ell} = -1 + \sum_{jk} b_{jk} \frac{\xi^h_{jk}}{\xi^h}, \tag{16}$$

[5]We find that 18 taste groups explain 75% of the data, and 79 groups are required to explain the whole 100,000 observation dataset.

Table 2: Crawford-Pendakur taste groups

(ref: Taste group 4)	Taste 1	Taste 2	Taste 3
Urban (ref: Rural)	−0.11*	−0.0003	−0.11*
	(0.06)	(0.07)	(0.07)
Age (in logs)	−0.17**	−0.06	−0.24**
	(0.08)	(0.09)	(0.09)
Income (in logs)	0.11**	−0.03	0.08
	(0.04)	(0.05)	(0.05)
Family type (ref: Other)			
Single	0.07	0.08	−0.06
	(0.09)	(0.10)	(0.10)
Couple with children	0.03	−0.01	−0.02
	(0.09)	(0.10)	(0.10)
Childless couple	0.05	−0.02	−0.13
	(0.11)	(0.13)	(0.13)
Single-parent family	0.04	−0.06	−0.17
	(0.10)	(0.11)	(0.11)
Housing tenure (ref: tenancy)			
Mortgaged owner occupancy	−0.33***	−0.21***	−0.30***
	(0.07)	(0.08)	(0.08)
Outright owner occupancy	0.22***	0.20**	0.40***
	(0.07)	(0.08)	(0.08)
Education (ref: Primary education)			
Secondary education	0.03	−0.04	0.002
	(0.07)	(0.08)	(0.08)
Partial post-secondary education	0.07	−0.11	0.02
	(0.09)	(0.10)	(0.10)
Complete post-secondary education	0.17**	0.02	0.11
	(0.08)	(0.09)	(0.09)
Higher education	0.18**	0.03	0.04
	(0.08)	(0.09)	(0.09)
Region (ref: Ontario)			
Atlantic Canada[1]	0.46***	−0.01	0.67***
	(0.08)	(0.09)	(0.09)
British Columbia	−0.03	−0.03	−0.19*
	(0.09)	(0.10)	(0.11)
Canadian Prairies[2]	0.20***	−0.12	−0.01
	(0.07)	(0.08)	(0.09)
Quebec	0.28***	−0.22**	0.28***
	(0.09)	(0.10)	(0.10)
Constant	−0.08	0.63	−0.01
	(0.57)	(0.65)	(0.65)
Akaike Inf. Crit.	38,692.84	38,692.84	38,692.84

Notes: *p<0.1; **p<0.05; ***p<0.01
1. New Brunswick, Newfoundland and Labrador, Prince Edward Island, and Nova Scotia
2. Alberta, Manitoba, Saskatchewan, Yukon, Nunavut, and Northwest Territories

where

$$\hat{\varepsilon}^{h\ell} = \sum_{jk} n_{jk} \frac{\xi_{jk}^h}{\xi^h} \hat{\varepsilon}_{jk}^{h\ell}$$

is the price elasticity of the compensated aggregate demand for category h with respect to consumer price q_ℓ, and

$$\hat{\varepsilon}_{jk}^{h\ell} = \frac{q_\ell}{\xi_{jk}^h} \frac{\partial \hat{\xi}_{jk}^h}{\partial q_\ell}$$

is the price elasticity of the compensated demand for category h with respect to consumer price q_ℓ by a taste-j agent in income class k. From (10), we have

$$b_{1k} = \sum_j n_{jk} - \sum_{j \geq 2} b_{jk} \equiv n_k - \sum_{j \geq 2} b_{jk} \tag{17}$$

for all k. Replacing b_{1k} in (16) by its expression given in (17), the best estimate (b_{jk}^*) of the consolidated social weights of taste groups $j \geq 2$ is a profile (b_{jk}) minimizing

$$\left(\sum_\ell \frac{t^\ell}{q^\ell} \hat{\varepsilon}^{h\ell} + 1 - \sum_k n_k \frac{q^h \xi_{1k}^h}{q^h \xi^h} - \sum_k \sum_{j \geq 2} b_{jk} \frac{q^h \xi_{jk}^h - q^h \xi_{1k}^h}{q^h \xi^h} \right)^2. \tag{18}$$

The best estimate (b_{1k}^*) for taste group 1 is then obtained from (17).

The data provides us with $q^h \xi_{jk}^h$ for all j, k and h. The movements in price from changes in the Consumer Price Index over time and provinces are insufficient to yield convincing estimates of the cross-price effects in a full AIDS formulation. In the context of this illustration we have thus neglected the Marshallian cross-price effects. This is certainly not entirely satisfactory. The price elasticity of compensated demand is derived from a QUAIDS specification with no cross-price effects. The budget share w_s^h of category h is

$$w_s^h = \alpha_j + \gamma_j^h \frac{q^h}{P_s} + \beta_j^h \log\left(\frac{R_s}{P_s}\right) + \lambda_j^h \log\left(\frac{R_s}{P_s}\right)^2 + \varepsilon_s$$

for agent s in taste-group j, with P_s being a (personalized) Stone price index. For all taste groups the Marshallian own price and income effects are significant for most goods categories and are of the same order of magnitude as those found in the existing literature.

In equation (18) the taxes t^ℓ are excise taxes. The conversion into *ad valorem* taxes implies the replacement of t^ℓ/q^ℓ by $t^\ell/(1+t^\ell)$.[6] In our illustration t^ℓ is set to the mean GST rate over time.

[6]Let p^ℓ be the producer price of good ℓ. Formula (18) considers excise taxes, so that $q^\ell = p^\ell + t^\ell$. Let t_{adv}^ℓ be the ad valorem GST tax rate. We have $q^\ell = (1 + t_{\text{adv}}^\ell) p^\ell$. Therefore

$$p^\ell + t^\ell = (1 + t_{\text{adv}}^\ell) p^\ell \Leftrightarrow t_{\text{adv}}^\ell = \frac{t^\ell}{p^\ell} = \frac{t^\ell}{q^\ell}(1 + t_{\text{adv}}^\ell).$$

From now on, with a slight abuse of notation, t_{adv}^ℓ is denoted by t^ℓ.

We choose as our benchmark $K = 2$ income classes comprising households whose income (total expenditure) is above or below median Canadian income. Annual income is between 309 and 35,232 CAD in the bottom income class, and between 35,232 and 354,206 CAD in the upper class. In the appendix we consider a three income-class economy. The two class setup seems to reduce the redistributive stance toward the poor.

With $J = 4$ different tastes and $K = 2$ income classes we have eight different groups characterized by their tastes $j = 1, 2, 3, 4$ and their income class $k = 1, 2$. We disregard the first-order condition (9) associated with Alcohol since alcohol taxes likely depend on other considerations, such as public health, than just efficiency/equity. The qualification requirements are thus satisfied, with $(J-1)K = 6$ being less than $N = 11$ (the twelve COICOP categories minus Alcohol).

Table 3 shows for every jk the ratio b^*_{jk}/n_{jk} obtained from (17) and (18). This ratio measures the gross social value (in CAD) of a one CAD transfer to a household in the jk group. When such a transfer is socially profitable this is greater than 1. The first row of Table 3 presents the best estimates of these ratios. The main lesson from this exercise is that tastes matter: redistribution goes from taste-group 2 to taste-groups 1 and 4. The consolidated weight on the upper class of taste-group 2 even turns out to be negative. In two taste groups a greater weight is put on the rich.

Table 3: Consolidated social weights

	b^*_{jk}/n_{jk} (in CAD)							
Taste group j	Taste 1		Taste 2		Taste 3		Taste 4	
Income class k	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Full sample	1.054	1.514	0.178	-0.642	0.608	1.739	2.383	0.964
Conservative Party	1.044	1.496	0.197	-0.562	0.625	1.701	2.361	0.954
Liberal Party	1.097	1.554	0.146	-0.786	0.564	1.793	2.384	0.981

In the second and third rows of Table 3 the tax rate is set to the mean GST rate in the years when the Prime Minister is from the Conservative Party (1993, 2006, 2007, and 2008) and from the Liberal Party (1992, and every year from 1996 to 2005), respectively. The same general pattern holds as in the full sample. The Liberal Party puts more weight on taste group 1; it also seems to relatively penalize rich taste-2 agents and favor the upper income classes within the other taste groups.

5.4 Incentive patterns and intrinsic social values

We know from Proposition 2 that the weights in Table 3 may yield a biased view of the federal government's underlying preferences. The intrinsic social weights (measured by β_{jk})

will only be equal to b_{jk}/n_{jk} if group jk is not envied by any other group ($\tilde{n}_{jk}\tilde{\beta}_{jk}$ is zero in (8)).

In this section we provide a simple argument that allows us to identify the relevant (binding) incentive constraints. This argument is based on the qualification requirements made in Assumption 1, which imply that $\lambda_{jk} \geq 0$, $\tilde{n}_{jk}\tilde{\beta}_{jk} \geq 0$ and $\tilde{n}_{jk}\tilde{\beta}_{jk}\lambda_{jk} = 0$ for all jk. From (6), (7) and (8) we have

$$n_{jk} \sum_{\ell} t^{\ell} \frac{\partial \xi_{jk}^{\ell}}{\partial R^k} - b_{jk} = \tilde{n}_{jk}\tilde{\beta}_{jk} - n_{jk}\alpha_{jk}\lambda_{jk}. \tag{19}$$

It follows that

$$n_{jk} \sum_{\ell} t^{\ell} \frac{\partial \xi_{jk}^{\ell}}{\partial R^k} - b_{jk} > 0 \Leftrightarrow \tilde{n}_{jk}\tilde{\beta}_{jk} > 0.$$

Table 4 presents the estimated values of the left-hand side of (19) with b_{jk} replaced by b_{jk}^* and calculating the income effects consistent with the QUAIDS formulation.[7] If positive, this provides an estimate of $\tilde{n}_{jk}^*\tilde{\beta}_{jk}^*$ for $\tilde{n}_{jk}\tilde{\beta}_{jk}$. In this case we consider that jk agents are envied, with a binding incentive constraint involving group jk ($\tilde{n}_{jk}\tilde{\beta}_{jk} \geq 0$). Taste-$j$ agents in occupation k are envied by taste-j agents in occupation $k' \neq k$. If, on the other hand, the estimate $\tilde{n}_{jk}^*\tilde{\beta}_{jk}^*$ turns out to be negative, jk agents are not envied, i.e. the incentive constraints involving group jk are considered to be slack ($\tilde{n}_{jk}\tilde{\beta}_{jk} = 0$).

Table 4: Incentive corrections

	$\tilde{n}_{jk}^*\tilde{\beta}_{jk}^*$ (in CAD)							
Taste group j	Taste 1		Taste 2		Taste 3		Taste 4	
Income class k	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Whole sample	-0.198	-0.270	-0.014	0.072	-0.064	-0.188	-0.201	-0.092
Conservative Party	-0.196	-0.267	-0.016	0.064	-0.066	-0.184	-0.200	-0.091
Liberal Party	-0.205	-0.277	-0.010	0.088	-0.058	-0.193	-0.201	-0.094

Table 4 shows that incentive considerations only matter within taste group 2, where the upper class is envied by the (taste-2) poor. When the incentive constraint binds for a

[7] The conversion to *ad valorem* taxes yields

$$\tilde{n}_{jk}^*\tilde{\beta}_{jk}^* = n_{jk} \sum_{\ell} \frac{t^{\ell}}{1+t^{\ell}} \frac{q^{\ell}\xi_{jk}^{\ell}}{R_{jk}} \frac{\partial \log \xi_{jk}^{\ell}}{\partial \log R_{jk}} - b_{jk}^*.$$

group jk, from (6) the intrinsic social weight is[8]

$$\beta_{jk} = \sum_{\ell} t^{\ell} \frac{\partial \xi^{\ell}_{jk}}{\partial R^{k}}.$$

Applying this correction yields the intrinsic social weights given in Table 5. A group is

Table 5: Intrinsic social weights

	β_{jk} (in CAD)							
Taste group j	Taste 1		Taste 2		Taste 3		Taste 4	
Income class k	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Whole sample	1.054	1.514	0.178	0.047	0.608	1.739	2.383	0.964
Conservative Party	1.044	1.496	0.197	0.045	0.625	1.701	2.361	0.954
Liberal Party	1.097	1.554	0.146	0.051	0.564	1.793	2.384	0.981

socially favored when $\beta_{jk} > 1$ and socially penalized otherwise. The redistribution present in federal taxation suggests that social preferences are more intricate than is generally assumed in the theoretical literature. The taste-4 poor and the rich in the taste groups 1 and 3 appear to be socially favored at the expense of the entire taste-2 group. This pattern seems to be magnified when the Liberals are in power.

The appendix provides a number of robustness checks of these results. The redistribution pattern in Table 5 continues to hold with different tax bases and tax rates. It also holds after controlling for household size. It is nevertheless qualitatively sensitive to the rough split into two income classes. With three income classes the anti-redistributive pattern in Table 5 disappears, with redistribution going from the taste-2 group to the taste-1 poor and taste 3 and 4 middle classes. The rich are always assigned a lower intrinsic social weight than are the poor and/or the middle class.

5.5 Discouragement and incentives

The intrinsic social weights in Table 5 matter in the many-person Ramsey rule component, while the incentive corrections in Table 4 allow us to calculate the contribution of the incremental net demand of mimickers. We are thus in a position to decompose the actual discouragement for each category of goods, as in Proposition 2.

[8] For *ad valorem* taxes this equation is rewritten as

$$\beta_{jk} = \sum_{\ell} \frac{t^{\ell}}{1+t^{\ell}} \frac{q^{\ell}\xi^{\ell}_{jk}}{R_{jk}} \frac{\partial \log \xi^{\ell}_{jk}}{\partial \log R_{jk}}.$$

As expected, the demand for taxed COICOP categories is found to be discouraged by the tax system while the demand for the tax-free categories is encouraged. The third row of Table 6 shows the contribution of the many-person Ramsey rule component to the discouragement for each category of goods. The largest many-person Ramsey contributions are found for the tax-free categories, suggesting that it is redistributive concerns that mostly justify these exemptions. As the taste-1 group has the most observations, the many-person Ramsey rule component is likely driven by the consumption profile of this group. Society is neutral with respect to the poor in this taste group but favors the rich. Food indeed appears to be encouraged, as upper income class taste-1 households consume relatively more food. The same applies for the Transport, Health and Education categories.

The smallest contributions obtain for Housing (the largest expenditure category) and, to a lesser extent, Recreation and culture, and Restaurants and hotels. Since taste-2 households in the upper class are the only ones who are mimicked, the relevant incremental net demand of the mimickers comes from lower-class taste-2 households. The consumption pattern of upper income class taste-2 households coincides with the consumption that would be chosen by a currently lower income class taste-2 household if endowed with a higher income. The upper income class taste-2 consumption of Housing, Recreation and Restaurants is indeed about 3% higher than the corresponding average expenditure of the rich. Discouraging the consumption of these categories is therefore one way to alleviate incentive issues within taste-2 households. On the contrary, when these households have consumption similar to the average expenditure of the rich, the decomposition in (14) implies that discouragement is mainly driven by the many-person Ramsey rule component. This is what happens in the Communication category.

Table 6: Discouragement decomposition

	Food	Alc	Cloth	Hous	Equi	Health	Trans	Com	Rec	Educ	Rest	Misc
Expenditures (as a percent of total income)	10.8	2.3	5.4	21.7	7.4	2.2	17	2.6	8.5	1.3	4.6	16.2
Discouragement index (in percent)	0.7	-24	-0.2	-0.3	-0.2	2.7	1.1	-0.3	-0.35	2.8	-0.4	-0.23
Many-person contribution (in percent)	93		66	1	24	87	59	98	10	78	4	69
Lower income class												
(†) Mean household expenditure (CAD)	3,097	639	899	5,596	1,316	595	2,306	695	1,254	112	775	2,644
Taste 1 (39%)[1] basis (†)	97.8[2]	92.9	98	100	96.9	100	95.1	98.5	96.3	96.6	99.2	97.5
Taste 2 (21%) basis (†)	99.1	95.8	98.9	99	99.3	95.4	100.1	97.6	100.6	109.9	96	98.3
Taste 3 (23%) basis (†)	104.3	100	109.1	91.2	108.6	105.4	109.6	102.9	109.1	99.4	103	108.1
Taste 4 (17%) basis (†)	100.2	121.3	93.7	112.1	96.4	97.9	98.2	102.3	95.6	96.5	102.4	96.9
Higher income class												
(‡) Mean household expenditure (CAD)	6,364	1,333	3,771	13,347	5,183	1,297	12,506	1,538	6,198	1,031	3,263	11,486
Taste 1 (37%) basis (‡)	101.2	98.3	104.1	99.7	103	106.4	104.2	102	102.2	106.5	102.4	104.5
Taste 2 (21%) basis (‡)	100.6	96	100.6	103	102.2	96.2	96.1	100	103.5	95.1	103.3	98.4
Taste 3 (22%) basis (‡)	99.6	101.2	100.8	94.8	100.3	102.7	95.4	99.1	102.5	100.5	98.2	100.9
Taste 4 (20%) basis (‡)	97.7	106.1	90.9	103.1	91.9	89.2	101.6	97.3	89.6	92.8	94.3	92.4

Notes: 1. Taste-1 households represent 39% of the lower income class.
2. Mean household taste-1 food expenditure represents 97.8% of 3,097 CAD (†).

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A Restricted income tax

This appendix provides an alternative model where agents may earn different incomes in the reference situation, so that we can actually dispense from the existence of a limited number of income classes or from bunching in the reference situation, and allow for greater income heterogeneity, if we are ready to accept an *ad hoc* restriction on the way in which income taxes and transfers can be adjusted. All the results of the paper remain unchanged. Suppose that the government can use at most K different taxes $(T_1, \dots, T_K)$, with $K \leq IJ$ exogeneously given. Propositions 1 and 2 apply provided that an income class is thought of as a group of agents with possibly different pre-tax incomes but confronted with the same taxes. Let y_{ijk} be the pre-tax income of an agent ij who faces tax T_k so that she has post-tax income $y_{ijk} - T_k$. Her consumption is $\xi_j(q, y_{ijk} - T_k)$ and she obtains utility $U_i(V_j(q, y_{ijk} - T_k), y_{ijk})$.

The incentive-compatibility constraints for ij agents facing taxes T_k are

$$U_i(V_j(q, y_{ijk} - T_k), y_{ijk}) \geq U_i(V_j(q, y_{i'j'k'} - T_{k'}), y_{i'j'k'})$$

for all $i'j'k'$. Consider a situation where these constraints are satisfied. Given $(\bar{y}_{ijk})$ these constraints are also satisfied in any tax system $(q, (T_k))$ that leaves $\bar{V}_{ijj'k} \equiv V_j(\bar{q}, \bar{y}_{ij'k} - \bar{T}_k)$ unchanged for all $ijj'k$.

Optimal taxes $(q, (T_k))$ maximize

$$\sum_{ijk} n_{ij} \bar{\mu}_{ijk} \left[(q - p) \cdot \xi_j(q, \bar{y}_{ijk} - T_k) + T_k \right]$$

subject to

$$V_j(q, \bar{y}_{ijk} - T_k) \geq \bar{V}_{ijjk}$$

for all ijk such that $\bar{\mu}_{ijk} = 1$, and

$$V_j(\bar{q}, \bar{y}_{ij'k} - \bar{T}_k) \leq \bar{V}_{ijj'k}$$

for all $ijj'k$, such that there is some type $i'j$ facing taxes $\bar{T}_{k'}$ in the reference situation such that $U_{i'}(\bar{V}_{i'jjk'}, \bar{y}_{i'jk'}) = U_{i'}(\bar{V}_{ijj'k}, \bar{y}_{ij'k})$.

When all agents of the same type face the same tax, there are IJ^2 active constraints in the program. Qualification now requires $IJ^2 < K + N$, which is much more demanding than in the setup used the main text.[9] If this inequality is satisfied, then Propositions 1 and 2 are unchanged, with an income class defined as a group of agents facing the same taxes. The same argument applies in the more plausible situation where any income falling in a given bracket is associated with a given amount of tax.

[9] A similar alternative setup that is less demanding in terms of qualification requirements but still accommodating greater income heterogeneity than in the main text is one where pre-tax income does not depend on consumption tastes. When the pre-tax income of a type ij facing tax T_k is y_{ik} (so that labor skills influence labor income) a similar argument yields Propositions 1 and 2 provided that $IJ < K + N$.

B Robustness checks for the illustration

B.1 Tax base and tax rates

In the main text we considered Food, Health, and Transport and Education to be tax-free. However these broad categories certainly consist of some taxed items. Transport comprises both public-transport services and private transport, and this last sub-category includes gasoline items which are heavily taxed. Table 7 shows that the intrinsic weights are roughly unchanged when the whole Transport category is considered to be taxed.

Table 7: GST TAX ON THE TRANSPORT CATEGORY

	β_{jk} (in CAD)							
Taste-group j	Taste 1		Taste 2		Taste 3		Taste 4	
Income-class k	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Whole sample	1.079	1.460	0.055	0.062	0.062	2.291	3.587	0.496
Conservative Party	1.069	1.446	0.052	0.059	0.082	2.212	3.475	0.512
Liberal Party	1.114	1.494	0.059	0.068	0.066	2.406	3.747	0.467

We have also considered a second variant on the tax base where all categories are uniformly subject to the GST (except Alcohol). Table 8 shows that the intrinsic social weights become closer to 1, i.e. redistributive concerns from indirect taxes tend to vanish. Note however the persistence of a high social value on the lower income class taste-4 group.

Table 8: UNIFORM TAX BASE

	β_{jk} (in CAD)							
Taste-group j	Taste 1		Taste 2		Taste 3		Taste 4	
Income-class k	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Whole sample	0.879	1.147	0.902	1.008	0.898	0.923	1.528	0.807
Conservative Party	0.885	1.150	0.900	1.009	0.891	0.919	1.525	0.805
Liberal Party	0.868	1.144	0.923	1.008	0.898	0.926	1.530	0.809

We have also looked at the sensitivity of our results to changes in tax rates. In the main text we considered that the federal level takes local taxes as given. If we instead assume that the federal stance takes into account the change in local commodity taxes that results from any change to the GST rate, for instance through the (HST) harmonization settlement, then the sum of the federal and provincial tax rates is better suited for the analysis. The total commodity tax rate is the GST rate in Alberta, Yukon, Northwest Territories and Nunavut, it is the sum of the GST and a Provincial rate (PST) in British Columbia, Manitoba and Saskatchewan, the sum of the GST and the Quebec Sales Tax (QST) in Quebec, while the Harmonized Sales Tax (HST) applies in other provinces.[10] The current total tax rates range from 5% (in provinces and territories where only the GST applies) to 14.975% in Quebec and 15% in Nova Scotia. The results with the GST rate replaced by the total (federal and provincial) tax rate appear in Table 9, the tax base being that used in the main text. The general flavor of the results does not change. Incentive issues are still concentrated within taste-group 2. They now expand to the lower income class of this group, which has a small positive incentive correction. Note that the correction reported in Table 4 for the taste-2 poor was negative but very close to zero.

Table 9: Total federal and provincial taxes

Taste-group j	Taste 1		Taste 2		Taste 3		Taste 4	
Income-class k	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Consolidated social weights b^*_{jk}/n_{jk} (in Canadian Dollars)								
Full sample	1.303	1.808	-0.216	-1.836	0.306	2.261	2.692	1.100
Conservative Party	1.256	1.781	-0.195	-1.766	0.335	2.249	2.735	1.088
Liberal Party	1.291	1.825	-0.253	-1.967	0.272	2.354	2.806	1.103
Incentive correction $\tilde{n}^*_{jk}\tilde{\beta}^*_{jk}$ (in Canadian Dollars)								
Full sample	-0.241	-0.319	0.030	0.201	-0.026	-0.242	-0.226	-0.103
Conservative Party	-0.232	-0.314	0.028	0.194	-0.029	-0.241	-0.229	-0.102
Liberal Party	-0.238	-0.321	0.034	0.215	-0.022	-0.252	-0.235	-0.103
Intrinsic social weights β_{jk} (in Canadian Dollars)								
Full sample	1.303	1.808	0.073	0.078	0.306	2.261	2.692	1.100
Conservative Party	1.256	1.781	0.071	0.075	0.335	2.249	2.735	1.088
Liberal Party	1.291	1.825	0.076	0.081	0.272	2.354	2.806	1.103

B.2 Equivalence-scale adjustment

In the main text the social weights were estimated at the household level without any adjustment for family size. A larger weight on some group could therefore simply reflect there being more people in the household in this group. Table 10 shows the average number of consumption units in each household group;[11] it also includes the social weights

[10] See `http://www.taxtips.ca/salestaxes/salestaxrates.htm` for detailed information.

[11] Statistics Canada refers to the Low Income Measure (LIM) equivalence scale where the oldest person in the family has a factor of 1, all other members aged 16 and over each a factor of 0.4, and those under

and incentive corrections given in Table 7 divided by the average number of consumption units. In our sample there are 1.3 consumption units in poor households, with an analogous figure of 1.75 in rich households. Again the general flavor of the results in Table 7 remains unchanged, though the lower size of poor households (mechanically) pushes redistribution toward these households.

Table 10: Equivalence-scale adjustment

Taste-group j	Taste 1		Taste 2		Taste 3		Taste 4	
Income-class k	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Number of consumption units	1.28	1.74	1.29	1.74	1.30	1.73	1.26	1.72
Full sample	0.858	0.877	0.147	0.027	0.450	0.989	1.817	0.560
Conservative Party	0.811	0.862	0.170	0.026	0.491	0.979	1.841	0.558
Liberal Party	0.825	0.891	0.102	0.029	0.441	1.058	1.960	0.569

B.3 Social weights in the whole population

So far we have restricted our attention to the four taste groups with the most observations, which represent one-third of the full sample. The estimated social weights in Table 5 are therefore valid under the assumption that the federal government does not care about the rest of the population when setting GST rates. This is too extreme a position. The qualification requirements prevent us from taking into account every taste group. A possible ad hoc way to deal with the whole population is to bundle the rest of the population into a fifth taste group. We have then $(J-1)K = 8 < N = 11$ so that qualification requirements are still met. This bundling yields the social weights reported in Table 11. The government actually appears neutral about the rest of the population (which group has associated intrinsic social weights around 1). Since the total weight of each income class is fixed by the first-order conditions (10), there must be some reallocation of the social weights across the most populated taste groups. However the general insights from our baseline specification are still valid. Taste-group 2 is socially penalized, but the beneficiaries from redistribution in taste-groups 1, 3 and 4 change. The pattern of binding incentive constraints is not affected by the presence of the rest of the population whenever the incentive correction is far enough from 0 in Table 4. As was observed following a change in tax rates, a slight instability in the pattern of the relevant incentive constraints occurs when the incentive correction is close to 0 in Table 4. This implies discontinuous changes in the intrinsic social weights.

age 16 a factor of 0.3.

Table 11: Social weights from the full sample

Taste-group j	Taste 1		Taste 2		Taste 3		Taste 4		Rest of the population	
Income-class k	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Consolidated weight	2.448	0.578	0.523	0.581	-1.122	1.707	-1.339	1.729	1.215	0.971
Incentive correction	-0.160	-0.031	-0.017	-0.018	0.046	-0.059	0.040	-0.055	-0.385	-0.314
Intrinsic weight	2.448	0.578	0.523	0.581	0.052	1.707	0.044	1.729	1.215	0.971

B.4 Income heterogeneity

Our two income-class setup keeps the presentation simple but is not able to capture the particular consumption patterns of households at the lower and upper bounds of the income distribution. We have carried out a number of experiments with three income classes. When $K = 3$ the qualification requirements are still met, $(J-1)K = 9$ being less than the number $N = 11$ of taxable goods (recall that alcohol taxes are not taken into account as they probably reflect considerations other than equity and efficiency). The results in Table 12 pertain when we separate the very rich households in the top 5 percent of the income distribution from two other equal-size income classes. Income in the lower class is under $33,498$ CAD while it is over $108,033$ CAD in the upper class. Otherwise we use our baseline specification yielding Tables 3 to 5 in the main text, i.e. the full (Conservatives and Liberals) sample with tax rates set to the mean GST rate. Redistribution still appears to penalize the taste-2 group and incentive issues are still found only for this taste group. Unlike the two-class variant in Table 4, each income class in the taste-2 group is now envied. In the three-class economy it is no longer possible to identify taste-2 mimickers. One central insight from this finer income class decomposition is that the anti-redistributive motive in Table 5 disappears. The high intrinsic social weight of households with above-median income is now spread out over all three classes: the weight of the households whose income is above but close to the median is partly imputed to the lower income class, while the weight put on the very rich remains in the upper class. The impact of this reallocation is clear: most of the weight in the taste-1 group now goes to the poor, while it goes to the middle class in taste-groups 3 and 4. This reveals that a high weight is indeed put on the median income in taste-group 1. On the contrary, the weight is on upper income deciles in taste groups 3 and 4 (though the very rich in these last two groups are slightly penalized). These three groups are the main beneficiaries of redistribution.

The three income class setup modifies the decomposition of discouragement into the many-person Ramsey rule and the incremental net demand of the mimickers contributions. Among the tax-free categories, Food and Education discouragement remains mostly explained by equity/efficiency considerations, while about half of Health and Transport discouragement can now be attributed to the incentive component. Among the taxed categories, Housing and Recreation are still the categories with the smallest equity/efficiency contribution to discouragement. The detailed results are not reported here.

A finer income class decomposition tends to reduce taste heterogeneity within each

Table 12: Ends against the middle

Taste-group j		Taste 1			Taste 2			Taste 3			Taste 4	
Income-class k	Lower[1]	Middle	Upper[2]	Lower	Middle	Upper	Lower	Middle	Upper	Lower	Middle	Upper
No. of observations	6,144	5,708	703	3,223	3,301	359	3,602	3,524	315	2,718	3,153	275
No. of consumption units (per household)	1.271	1.703	1.890	1.274	1.716	1.888	1.287	1.701	1.928	1.253	1.697	1.869
Consolidated weight (per household)	2.174	0.860	1.577	-0.807	-0.791	-0.363	0.701	2.161	1.765	0.885	1.830	0.428
Incentive correction	-0.396	-0.141	-0.033	0.083	0.084	0.004	-0.071	-0.226	-0.016	-0.069	-0.171	-0.003
Intrinsic weight (per household)	2.174	0.860	1.577	0.045	0.047	0.045	0.701	2.161	1.765	0.885	1.830	0.428
Intrinsic weight (per individual)	1.711	0.505	0.834	0.036	0.028	0.024	0.545	1.270	0.915	0.706	1.079	0.229

Notes: [1] Income below 33,498 CAD.
[2] Income above 108,033 CAD.

income class and thus could restrict the importance of Ramsey considerations. To assess the strength of Ramsey considerations with finer income classes we considered income quintiles and treated the bottom and top income deciles separately, yielding 6 income classes. To fit the qualification requirements we focus on the two most populated taste groups $j = 1, 2$. The different social weights and incentive corrections appear in Table 13. Incentive issues do not matter within taste-group 1; they do however matter within taste-group 2, where most households are involved in binding incentive constraints (the incentive correction is either positive or negative and close to 0, apart from the $30 - 50$ median quintile). The resulting Ramsey considerations in optimal discouragement are in fact more balanced across the different categories of goods than in Table 6, ranging from 49% for Restaurants to 90% for Food. The highest Ramsey contributions apply to the tax-free categories. These results are consistent with those reported in the main text.

Table 13: Finer income class decomposition

Taste-group j	Taste 1						Taste 2					
Income quantile k	$0-10$	$10-30$	$30-50$	$50-70$	$70-90$	$90-100$	$0-10$	$10-30$	$30-50$	$50-70$	$70-90$	$90-100$
Consolidated weight	1.861	3.164	0.454	1.262	1.045	1.022	-0.569	-3.461	1.991	0.555	0.923	0.959
Incentive correction	-0.117	-0.420	-0.052	-0.153	-0.126	-0.064	0.022	0.229	-0.138	-0.038	-0.065	-0.032
Intrinsic weight	1.861	3.164	0.454	1.262	1.045	1.022	0.041	0.043	1.991	0.555	0.923	0.959