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Buenas notches: lines and notches in tax system design

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Abstract
A wide range of tax policies create discontinuous jumps—*notches*—in the choice set of individuals and firms, arising when incremental changes in behavior cause discrete changes in net tax liability. This paper presents a taxonomy of different types of notch policies. It then discusses the mechanics of, and limitations to, estimating structural parameters using notches. Next, it considers the welfare consequences of notches and their role in optimal tax design. It concludes by speculating on why notches persist. Notches are shown to be welfare inferior absent considerations of administrative cost or salience.

1. INTRODUCTION

in tax liability net of the Saver's Credit as a function of income.[8] The original version of the American Recovery and Reinvestment Act of 2009 contained a substantial notable notch: an $8 000 tax credit for first-time purchasers of a primary residence whose income did not exceed $75 000 for singles and $150 000 for married couples; when extended in 2010 the notch was replaced by an income-related phaseout, substituting kinks for a notch. The Child and Dependent Care Credit has a phase-out range with several notches, so that within this range the percentage of expenses allowed as a credit falls by 1 per cent for every $2 000 of adjusted gross income above a threshold. The phaseout of tuition deductions features two notches in adjusted gross income.

Quantity notches can be triggered by incremental changes in tax bases other than income. The Israeli municipal property tax, known as the *arnona*, has separate tax rates per square meter for different size categories. For example, in 2010 in Zone C of Jerusalem, the annual rate of tax was NIS 40.68 for apartments of up to 120 square meters and NIS 54.70 for apartments of more than 120 square meters, thus creating a notch equal to NIS 1 682.40 at 120 square meters.[9] The same feature applies to other property tax systems, both in the United States and outside of it. When the first marginal rate is effectively zero, the apparent objective of the notched tax schedule is to exempt low-value properties, for equity or administrative cost-saving reasons, and to deny the tax saving provided by the exemption to higher valued, taxable properties. When the first rate is positive, the objective is simply to recover the infra-marginal tax break for higher valued properties. This objective could alternatively be achieved, as it is in US income tax rates, by having a higher marginal tax rate for some bracket of income so that the average tax rate can 'catch up' to the higher marginal tax rate.

Notches can assume two shapes: a *pure notch* features identically sloped budget segments on either side of the notch point; with a *zigzag notch*, the slopes of the two budget segments differ. For example, the Israeli *arnona* is a zigzag notch with a higher marginal tax rate

some cases the tax treatment depends on a characterization that is an artifact of law and is by its nature essentially discrete. The classification of business entities is an example; crossing a characteristic line between a partnership and a corporation triggers a discrete change in tax treatment, but it is difficult to think of a meaningful sense in which the tax treatment could be made continuous.[11]

2.2.2 Commodity Characteristics

A non-capricious tax system must have procedures for distinguishing among goods subject to different tax rates, and real-world consumption tax systems do that by appealing to the characteristics of the commodities. This implies that, although characteristics may be conceptually continuous, in characteristics space there are lines that determine where the discontinuous changes in tax status occur: where the notches lie.

For example, the retail sales taxes of US states often exempt food but not restaurant meals, requiring the tax law to draw a line between the two categories. This is done by appealing to a set of characteristics of restaurant meals and grocery purchases; the line must be precise when, for example, grocery stores sell pre-prepared meals that may or may not be eaten on the premises, set up in-store salad bars, or provide nearby tables, silverware, and napkins. This issue was recognized, but for the most part not pursued, in the early optimal taxation literature. For example, Stiglitz and Dasgupta (1971, p. 165) note that it is administratively difficult to have separate tax rates for every commodity, although in general an optimal tax structure would require good-specific tax rates; they note that as a result 'almost all tax systems group commodities into fairly wide classes.'[12] Barzel (1976) stressed that tax statutes cannot cover all of the multiple dimensions of commodities, thus inducing substitution away from taxed attributes and into untaxed attributes.

Characteristic lines may create incentives

truck that featured glass windows instead of panels and upholstered seats in the back.[13] Depending on the location of the line, these new goods may not be socially optimal, although they are privately optimal given the abrupt differential tax liability generated by the line.

In some cases tax treatment is differentiated on the basis of one quantifiable characteristic of a commodity. An example of this is the US Gas Guzzler Tax, under which high-performance cars are subject upon initial sale to a per-vehicle tax that is higher the lower is the fuel economy of the car, a car characteristic. For cars (but not light trucks or SUVs) that get less than 22.4 miles per gallon, the tax levy rises discontinuously as the miles-per-gallon rating crosses downward from a (rounded) 0.5 decimal ending to a 0.4 decimal ending, with the change in the tax amounting to as much as $1 300 and averaging about $800. Note that this tax schedule is discontinuous in miles-per-gallon even though this variable is continuous and fairly easy to measure, and the social benefit of more fuel-efficient cars is certainly not a step function. In this case basing the tax on a single

Clearly where a jurisdictional border lies is not a policy choice, at least not a choice made by the tax authorities. It does, though, raise the question of why relatively high sales tax rate jurisdictions do not levy continuous tax rates at borders so that the closer to a low-tax neighboring jurisdiction, the lower the tax. For example, why doesn't high-alcohol-tax Massachusetts, which borders low-tax New Hampshire, levy lower excise taxes the closer one gets to the New Hampshire border? This policy would just codify what is effectively true when the full price includes transportation costs—a lower price for those who live close to New Hampshire—but keeps more revenue for Massachusetts. If not everyone drives to New Hampshire, there are horizontal equity and efficiency issues, but these issues arise even with no geographical differentiation. The welfare economics of border notches is unique because each government jurisdiction presumably cares only about its own residents' welfare and there may be fiscal externalities across jurisdictions.[18]

2.2.4 Time Notches

The use of accounting periods, generally years, implies that there will often be discrete changes in tax treatment (ie notches) with respect to certain activities undertaken at year-end versus year-start. This may occur for two reasons: (1) anticipated legislated changes

2.2.5 Taxpayer/Remitter Notches

This brings us to the 'who' of tax base determination.[23] The same tax base may trigger different tax liabilities depending on some characteristics of the taxpayer or remitter of the tax. For example, under the US federal income tax there are separate schedules for four different categories of taxpayer marital status. When tax is based on family income, marriage penalties and bonuses arise where the sum of two individuals' tax liability depends on whether they are married. Under an individual-based system, the total tax liability of a couple depends on the division of earnings between the spouses. These

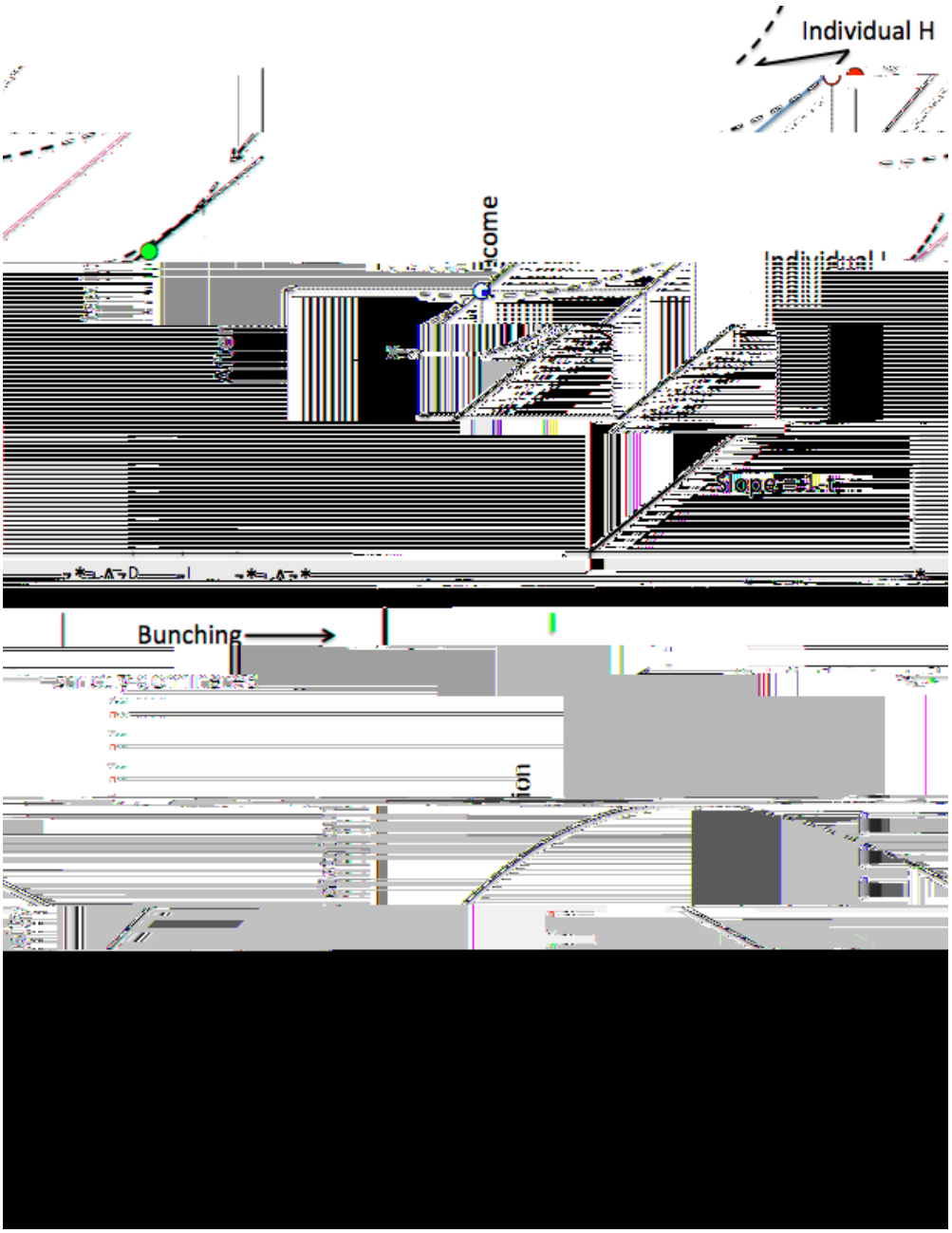
Alternative strategies, such as the panel data methods employed by Auten and Carroll (1999) and Gruber and Saez (2002), rely on different assumptions, namely that secular changes in income year to year can be controlled for, thereby allowing the researcher to estimate a difference-in-differences parameter for the effect of a tax change. These assumptions can prove problematic in the face of income inequality or mean reversion.

At first blush, studying behavior in the neighborhood of a discrete change in tax treatment

implication holds if we assume consumers make rational decisions and face no adjustment costs, an issue to which I return below.

To illustrate, refer to Figure 1 and consider the following notation drawn from Kleven and Waseem (2013). Imagine that individuals have quasi-linear and iso-elastic utility over before-

Figure 1.



By measuring the extent of bunching, one can deduce the implied price elasticity using a methodology similar to that used for kinks by Saez (2010). With a kink, a sudden change in relative prices at one point on the budget set induces a behavioral response: consumers on the affected budget segment substitute toward the kink, with many bunching exactly at

that point. One estimates the price elasticity

to occur. Then, she must choose a corresponding point on the tax-disfavored side of the notch where the 'hole' in the post-notch density of before-tax earnings ends. The former point is typically easier to visually identify than the latter. Kleven and Waseem (2013) exploit the fact that, absent frictions, the missing mass on the tax-disfavored side of the notch should equal the excess mass on the tax-favored side, and use this to pin down the upper bound of the excluded range.

3.2 Which Elasticity A

tax regime, and not one that may obtain in other contexts. Furthermore, Chetty (2009) argues that the implications for calculating deadweight loss differ depending on whether the response to a tax change derives from changes to labor supply or sheltering behavior because the latter is a transfer rather than a 'real' response.

3.2.2 Structural versus Nonstructural Elasticities

A further caveat to recovering structural estimates of elasticities from bunching at kinks or notches is the presence of optimization frictions. Individuals may desire to adjust their consumption to the notch

excess burden of avoidance as defined by Slemrod and Gillitzer (forthcoming). Substitution across elements of a surrogate tax base does not directly alter one's consumption basket although, through the function linking the surrogate tax base to the consumption basket, it may alter the effective relative prices of the latter and thereby change consumption choices.

The presence of notches in surrogate tax bases sheds light on the hierarchy of behavioral responses proposed by Slemrod (1990, 1992), which asserts that of behavioral responses, timing responses are the most elastic, followed by avoidance/accounting responses, with the least responsive being real responses such as labor supply and saving. Although much evidence is broadly consistent with the hierarchy hypothesis, a satisfactory explanation has not yet been offered. But now consider that the evidence cited in favor of a high elasticity of response, exemplified by the striking increase in capital gains realizations in advance of known increases in the capital gains tax, is response of a surrogate tax base (capital gains do not enter utility functions directly) around a notch, the notch in time at the end of a year. This largely reflects the response to effectively very high tax rates per day of postponement near the year-end notch, plus the fact that the sale itself does not constrain the time pattern of consumption. Thus the reduced-form estimates of capital gains realization elasticities do not provide direct evidence about any fundamental, or structural, parameters. The same is true for the high observed elasticity of response to sales tax holidays or expiring investment incentive provision,[28] where the durability of the consumer or investment good comes into play.

3.2.3 Why Does the Anatomy of Elasticities Matter from an ETI/ETB Perspective?

The foregoing discussion about *which* elasticity a notch analysis identifies is, at first blush, inconsistent with the spirit of the elasticity of taxable income, or tax base—that *all* behavioral responses to tax are symptoms of inefficiency, and so a decomposition of the overall behavioral response is not instructive.

This is only partially true. It is completely consistent to distinguish between short-term and long-term elasticities, a difference that will obtain in the presence of adjustment costs. This issue app4(i)-4n18W* na(se)-(no)11(e eEel)6(beh)9(av)9(i)-4(or)-3ion elastieenmofthrreareax bee o

Apparently notches are often implemented precisely because they stand out and are more comprehensible than a schedule with multiple kinks or with continuously changing marginal incentives, and precisely when these characteristics are deemed to matter. This suggests that the implicit price response (of those who are aware of the notch) may be greater than in other situations; after all, for small responses close to the kink, the implicit price approaches infinity.

The extreme local rewards (or penalties) generated by notched budget sets also provide large incentives to smooth the tax-triggering activity across accounting periods. Just as

on different segments, a notch creates widely varying effective relative prices depending on the size of the notch and the initial distance from the notch point.

The welfare cost, or gain, of a notched policy must be measured relative to the alternative

because: 'It is usually presumed that preferences are such that consumption is an increasing function of the wage. Then, earnings will be nondecreasing in skill. It follows that the optimal tax structure has nonnegative marginal rates…'

However, as mentioned earlier, no theorem rules out the possibility that a notch can be part of an optimal schedule when the flexibility of the income tax schedule is constrained, say to be linear. This possibility is in the same spirit as the argument made by Blinder and Rosen (1985) that, in cases where the objective is to encourage consumption of a particular activity (in their example, charitable giving), notch schemes may be more effective than per-unit subsidies. Compared to a constant per-unit subsidy that applies to all charitable donations, a notch grant that kicks in only for those whose consumption exceeds a certain amount limits the amount of subsidy for infra-marginal giving. In principle, when revenue is costly to collect, the ideal subsidy scheme would provide a subsidy only at the margin of favored consumption but, in the absence of personalized incentive schemes or other nonlinear consumption taxes or subsidies, a notch may increase welfare.[32] Whether a nonlinear consumption tax, and indeed an extreme version of a nonlinear consumption tax with a notch, could be part of an optimal tax system would depend on how flexible the income tax schedule can be.

5.2 Characteristic Notches

Canonical optimal tax theory, which ignores administration and enforcement costs, prescribes staggeringly complex tax features such as nonlinear, age-dependent income taxes, discretely different consumption taxes for each good and service, and tax liabilities that are a function of every available variable that is correlated with earning ability (ie height, genomic information). Policy does, and should, forego many such features.

Consider first commodity taxation. In a world with administration and enforcement costs, plus continual creation and disappearance of available goods, a large number of distinct tax rates would be too costly to administer (ie infeasible). As a result, commodity tax systems inevitably feature a small number of distinct tax rates based on observable characteristics, where the domain of each tax rate is delineated by a line, which causes a notch. Characteristics are a relatively natural and intuitive way to distinguish among commodities, and shared characteristics plausibly signal something about substitutability. Additionally, characteristics-based rules are broad enough to admit development of new goods without requiring creation of novel taxes for each.

The counterfactual to most characteristic notches—a smoothly changing tax base definition—depends on the characteristic considered. Consider 'When.' The exact time of ae2u-bch. Chaf ae2u-bc6Tmtreatbbf 6220s06en.1-3(ea)/ 0 0 1 207.77 3[(of)-3ne0 0 1 43-1n10at

enforcing it.[33] Discrete accounting periods, generally annual, have many advantages. Daily income, as measured by current means, would be a highly variable measure of ability to pay. Even absent policy changes from year to year, however, the graduated income tax system provides incentives for cross-year movement of taxable income. The realization system plus deferral limited loss offset provides incentives for capital gains transactions at year-end, and there are rules to limit this kind of behavior.

Similar arguments apply to 'Where.' Precise location is cheaply knowable, but is not now an argument to tax liability functions. There are advantages to the decentralization of political and economic authority that are beyond the scope of this paper. Once in place, though, decentralization provides incentives for movement of economic activity across borders, including but not limited to local borders.

The hardest issue is 'What,' which arises in all tax systems. Although standard optimal tax theory prescribes it, it is practically infeasible to levy as many tax rates as there are separate goods. So it is natural to think of grouping goods that are close substitutes with

The ubiquity of tax policy notches calls for further inquiry into their consequences for behavior and their role in an optimal tax system. The taxonomy of notches proposed here is a first step. The demonstration of their welfare inferiority absent considerations of administrative cost or salience suggests that the latter issues warrant attention. While they persist, taxpayer behavior in the presence of notches has the potential to provide information about behavioral response, a task complicated by the need to separate out preferences and technologies on the one hand from mitigating salience factors on the other. Finally, the indisputable evidence about behavioral response to notches, unsullied by the need for arguable identification assumptions, puts to rest serious discussion of whether taxes matter. They do.

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