Internalities and Paternalism: Applying the Compensation Criterion to Multiple Selves across Time

Social Choice and Welfare, 38(4): 601-615 (2012)

15 April 2008

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Abstract

One reason to call an activity a vice and suppress it is that it reduces a person's future happiness more than it increases his present happiness. Gruber & Koszegi (2001) show how a vice tax can increase a person's welfare in a model of multiple selves with hyperbolic preferences across time. An interself analogy of the compensation criterion can justify a vice ban whether preferences are hyperbolic or exponential, but subject to the caveat that the person has a binding constraint on borrowing. The puzzles that intrapersonal altruism raises, however, lend support to using the "Marshallian" wealth maximization criterion of Friedman (1988) instead of the Kaldor-Hicks criterion.

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Keywords: Internalities, sin tax, moral regulation, Kaldor-Hicks criterion, time inconsistency, hyperbolic preferences.

I thank Kevin Du and participants in seminars at Bath, Bern, and East Anglia for their comments, and Nuffield College, Oxford, for its hospitality.

1. Introduction

A common justification for using taxes or bans to discourage vice is that although the activity makes a person happy in the present it will cause him even more unhappiness in the future. Gruber & Koszegi (2001) formalize this argument in the context of smoking and show how cigarette taxes can raise welfare. They build a model of multiple selves linked across time by altruism and the addictive consequences of smoking– called "internalities" between different time-selves of the same person in analogy to "externalities" between individuals. Their model assumes hyperbolic discounting and as a welfare criterion it maximizes the utility of the first of the multiple selves, though they recognize that even Pareto optimality could justify paternalistic intervention.

In this paper I will show that neither hyperbolic discounting nor that particular welfare criterion is necessary for the idea of discouraging vice to protect future selves to be valid. I will use a simple model of one person who is divided into three selves across time. A key assumption will be that the person cannot borrow against future income. Given that assumption, suppression of the vice combined with a transfer from a future self to a present self results in a Pareto improvement. In a context where the transfer cannot be made, there is still a Kaldor-Hicks improvement.

What is most important in Gruber & Koszegi (2001) is not the hyperbolic discounting but the idea of the multiple selves and the inefficiency that can arise from internalities. If we are prepared to accept a multiple selves model and the idea of basing a welfare function on multiple selves across time, then paternalism can be desirable even if the person's discounting is orthodoxly exponential.

The argument has important caveats, because the Kaldor-Hicks argument depends on transfers between the selves that have their own internalities. It depends on whether the future self has enough income under his control to compensate the present self and on whether the present, vice-tempted, self is is willing to accept a compensating transfer that will increase present consumption at the expense of future consumption.

After laying out the ideas of multiple selves and time preference and discussing the previous literature, I will construct a simplified model of the

situation in Gruber & Koszegi (2001) and show how with quasi-hyperbolic preferences and their social welfare function a ban on smoking raises welfare. I will then show how the same result can be obtained with the Pareto criterion and exponential discounting. All this will be done in a model without borrowing or saving. When these are introduced and are unconstrained, non-exponential discounting does become necessary to justify paternalism under the Kaldor-Hicks criterion. The Kaldor-Hicks criterion itself, however, becomes somewhat dubious as a measure of efficiency, and so I discuss the alternative of using willingness to receive transfers from (or make them to) anonymous third parties instead of known trading partners.

2. Hyperbolic Discounting and Multiple Selves: The Ideas and the Literature

Before setting out the model, it will be useful to discuss hyperbolic discounting in general and how it can justify paternalism.

People commonly have positive time preference: they prefer to consume more now rather than more later. The standard way to include this in economic analysis is by having a positive personal discount rate in the utility function so that consumption earlier adds more to utility than consumption later, e.g. $U_{2000} = C_{2000} + \delta_{2001}C_{2001} + \delta_{2001}\delta_{2002}C_{2002} + \delta_{2001}\delta_{2002}\delta_{2002}C_{2003}$, where $\delta_t < 1$ and we could but need not assume a constant discount factor $\delta_t = \delta$. This functional form is an example of exponential discounting, whose key feature is that the time subscripts for the discount factors are objective years rather than "years in the future". As a result, if we view the person's decisions starting one year in the future his utility function will be: $U_{2001} = C_{2001} + \delta_{2002}C_{2002} + \delta_{2002}\delta_{2003}C_{2003}$.

A nice property of exponential discounting is that a person's consumption path will be time consistent, meaning that if the person maximizes his utility at time 2000 by the choices $(C^*_{2000}, C^*_{2001}, C^*_{2002}, C^*_{2003})$ then he will maximize them at time 2000 by the same values $(C^*_{2001}, C^*_{2002}, C^*_{2003})$ given his reduced wealth as the result of the consumption in 2000. The person may regret consuming so much in the year 2000, so his decisions across time are not consistent in the sense of being the choices he would make ex post, but the 2000 consumption is a sunk decision by 2001 anyway. For positive analysis, we can see what behavior comes from maximizing U_{2000} and ignore

the later utility functions, at least in a world of certainty. For normative analysis, we do the same.

An alternative way a person might have time preference is to have discount factors whose levels depend not on the year itself– 2000, 2001, 2002– but on how many years in the future the consumption will occur– now, one year from now, two years from now. Looking at the decision made in year 0, the functional form could be exactly the same, e.g. $U_0 = C_0 + \delta_1 C_1 + \delta_1\delta_2 C_2 + \delta_1\delta_2\delta_3 C_3$, where $\delta_t < 1$. At time 1 (year 2001) however, the person would maximize $U_1 = C_1 + \delta_1 C_2 + \delta_1\delta_2 C_3$, not $U_1' = C_1 + \delta_2 C_2 + \delta_2\delta_3 C_3$. This is just one of many ways time preference could be non-exponential (see Rasmusen [2008] for further explanation) but if the form it take is not exponential, the person's decisions become time inconsistent. The optimal choices $(C^*_{2000}, C^*_{2001}, C^*_{2002}, C^*_{2003})$ from the 2000 utility function will not match the optimal choices using the 2001 utility function, $(C^{**}_{2001}, C^{**}_{2002}, C^{**}_{2003})$. This difference between the effects of absolute time and relativistic time discounting has many implications. For example, it may be that the person is expecting a big income bonus in 2001. In year 2000, he might want to choose to spread that income's consumption between 2001 and 2002 because though he highly values year 0 consumption, he is relatively indifferent between years 1 and 2. By the time 2001 arrives, however, year 2001 *is* year 0, and he would want to consume the entire bonus immediately.

Much real world behavior seems well explained by this kind of time inconsistency. Predictions using non-exponential utility functions are more complicated, since now we need to carry out the maximization problem separately for each time period. In addition, a rational person will foresee at time 0 that his future self will disregard his earlier wishes, so the problem becomes one of dynamic programming with an eye to strategically manipulating future selves. It is clear how the analysis should proceed, however, except perhaps for whether the analyst should assume that the person is rational enough to realize that he should act strategically. The analyst should work backwards from the last decision made, using that as the reaction function for the decisions in the next- to-last period.

What to do about normative analysis is less clear. Although prominent past economists and modern philosophers disagree (see Broome (1994), Parfit (1986), and Ramsey (1928)), modern economists generally accept positive

time preference as a taste like any other in a utility function, at least in exponential utility functions. Non-exponential utility raises problems, though. When a person's utility function changes so that he would make different decisions as time passes, which utility function should be used as the welfare function? The social planner has to choose between the consumption level the person would have chosen for 2001 in 2000, what he would have chosen in 2001, or some compromise between the two. Moreover, this is a context in which welfare analysis is particularly important. Quite possibly the laissez faire choices made by solving the dynamic programming problem are optimal under neither the time 0 utility function nor any of the utility functions maximized later, because optimality would require commitment to avoid the time 0 optimal choice paths being undone later.

A useful way to think of the puzzle that time inconsistency introduces is to treat a person as a series of multiple selves across time, an idea used in the first article on time inconsistency, Strotz (1955).[1] Think of the single person as a series of different persons: Self 0, Self 1, Self 2, and so forth, depending on the time period. Time preference is then interpreted as the degree of altruism, with the assumption that people care less about people more distant in the future. Naturally people will make different choices and the social planner must somehow compromise between their different desires. We are accustomed to making such tradeoffs among different individuals, so perhaps we can apply this within the individual too.[2]

[1]The question of what "self" means has received much attention in philosophy. In the Symposium, Plato has Diotima say, in speaking of immortality, "For only a short time can a living individual be said to be the same individual. For although a human being is said to be the same person from childhood to old age, yet even though he is called the same, he does not at any time possess the same properties. He is continually becoming a new person, loosing parts, portions of hair, flesh, bones, blood, and all the rest of the body. We observe this not only of his body, but also of his psyche. His habits, his character, his beliefs, his desires, his pleasures, his pains, his fears, none of these remain the same. Some flourish, while others vanish." David Hume wrote in *An Enquiry Concerning the Principles of Morals* (1751, p. 253), "What ... gives us so great a propension to ascribe an identity to these successive perceptions, and to suppose ourselves possest of an invariable and uninterrupted existence thro' the whole course of our lives?" Parfit (1982, 1984) developed the problem considerably. See chapter 2 of Frederick (1999) for an overview of work on identity.

[2]Another possibility is to model a person as having multiple selves simultaneously in time. In Cowen (1991) an impulsive self struggles with a "rational" self. In Fudenberg & Levine (2006) a single long-term self plays a game with a series of short-run selves across

The obvious welfare criterion to apply is what I will call intraself Pareto optimality: Pareto optimality applied across selves. A pattern of choices is optimal if no change can be made which would make some self better off without making some other self worse off according to the particular selves' utility functions. This has frequently been applied to multiple selves models (e.g. in Bernheim & Rangel (2007)), since it seems unobjectionable, if weak. It does have some bite, though, and can justify intervention when, for example, Self 0 does not save because because Self 1 would consume all the saving, leaving nothing for Self 2. Self 1 might welcome being constrained to not consume the entire amount saved by Self 0 so that Self 0 would save a positive amount.

A stronger normative approach is what I will call the "precommitment criterion": maximize Self 0's utility by seeing what would happen if he could directly commit to a future course of action, rather than having to try to manipulate his future selves. An attraction of this criterion is that it is the same as our standard method for exponential utility, simply adding the recognition that the social planner will have to somehow constrain the future selves so that they act in accord with Self 0's wishes. This is what is most used in the literature, almost always in connection with decisions about consumption and savings (see, e.g. Laibson (1997), Harris & Laibson (2001), and Krusell & Smith (2003)).

Gruber & Koszegi (2001) use a model of a divided self to look at whether smoking should be taxed– a model focussing not on consumption, but on vice. In their model, a person lives for a finite number of periods and must decide the amount of smoking and other consumption for each period. Smoking is addictive, so smoking more now lowers future utility. Discounting is quasi-hyperbolic rather than exponential, so decisions are time inconsistent; in period 1 the person would deviate from the period 1 smoking level he thought was best in period 0. They use the precommitment criterion, maximizing Self 0's utility and show that a large tax on cigarettes is optimal. O'Donoghue & Rabin (2003) also looks at sin taxes with time-inconsistent consumers to make the point that time-consistent consumers may be hurt very little and time-inconsistent consumers helped a great deal by sin taxes. Caplin & Leahy (2004) and Whitman (2006) criticize this focussing on the welfare of the "long-run " or earliest self– the "dictatorship of the present". In

time. Here, the self's desires will be unambiguous at any one point in time.

effect, focussin on the early self what would happen if a person could commit himself to future actions (in this case, cigarette smoking), and then looking at how government taxes could bring consumption closer to that outcome when direct commitment is not possible. For individual consumers they use the Self 0 utility function; in their comparison of different types of consumers they are implicitly using the Kaldor-Hicks criterion. Bhattacharya, & Ladkdawalla (2004) look instead at Pareto improvements that can result from government smoking policy. They suggest the use of voluntary smoking licenses that a person could purchase to constrain his future smoking. These licenses would subject the future self to high cigarette taxes, but would also entitle the future self to a lump-sum transfer that would make him better off overall. We will come back to this later in the paper.

The precommitment criterion is attractive in contexts where we think that someone's judgement is best long before a difficult decision needs to be made. It seems reasonable that I will make a better decision about whether to take up smoking if I have to make the decision a year before I can actually start smoking. But it is equally unattractive in other examples. We would think it wise for someone to commit to climbing Mount Everest without oxygen a year in advance despite the danger, discomfort, and cost, just so that he can boast about it at a party tonight. Commitment is perhaps too powerful an instrument. At least when discounting is exponential we are letting each self decide on his own period's consumption. The precommitment criterion makes Self 0 a dictator over all the selves. One might argue for that on the grounds that hyperbolic discounting is the result of loss of self- control, so a person should never decide his own period's consumption– the opposite conclusion of the freedom argument– but that is to introduce a new consideration of some preferences being illegitimate.

A third possibility is to convert the person's hyperbolic utility function to an exponential one and do what maximizes the utility of Self 0. Since discounting will now be exponential, time inconsistency will vanish. This criterion accepts ordinary time preference with its exponential discounting, but rejects hyperbolic discounting as a normative guide, while admitting it as a positive predictor of behavior. This would be the right thing to do if one considers hyperbolic discounting the result of lack of self- control over immediate decisions, something of a technological constraint. If a person's hand automatically picks a cigarette up and lights it without conscious intent,

we do not want to give his action normative significance. Rather, in our welfare maximization we want to see how we can reduce the damage from his mistakes. Bernheim & Rangel (2005) make the point well:

> American visitors in London suffer numerous injuries and fatalities because they often look only to the left before stepping into streets, even though they know traffic approaches from the right. This is a systematic pattern; one can't dismiss it as an isolated incident. A literal application of the revealed preference compels us to conclude either that these people simply have a very strong preference look left, or that they're masochistic. If we use these revealed preferences for welfare analysis, there's no legitimate basis for preventing someone from stepping in front of a truck. And yet, it's safe to say that, after recognizing the purpose of the intervention, anyone would be grateful. The pedestrian's objective – to cross the street safely – is clear, and the decision is plainly a mistake.

How precisely to convert the person's hyperbolic utility to an exponential one would depend on the particular model. In models such as the quasi-hyperbolic one we will use below in which some one parameter represents the degree of closeness to exponential discounting it would be natural simply to set that parameter equal to one. We will not use this criterion in the present paper, since we wish to focus on what to do if we retain the idea of consumer sovereignty, but it is a natural one if we really believe the person's choices are "wrong" and in effect their utility function needs correcting.

A fourth criterion, closely related to intraself Pareto optimality, is what I will call the intraself Kaldor-Hicks criterion: the Kaldor-Hicks criterion applied across selves. This applies our standard criteria for looking at welfare across individuals to welfare within the individual by asking whether any change is possible which has bigger dollar gains to winners than dollar losses to losers.

Equivalently, the intraself Kaldor-Hicks criterion asks whether a Coasean bargain is conceivable in which Self X would agree to transfer wealth to Self Y in exchange for Self Y agreeing to changing his behavior. The word "internality" is used in analogy to the "externality" for spillovers across individuals. It must be a "real" internality for intervention to be helpful under the intraself

Pareto optimality and Kaldor-Hicks criteria, because some spillovers across selves are purely distributional and would not give rise to Coasean potential gains from trade. Unlike Pareto optimality, however, Kaldor- Hicks does not require the bargain to be actually carried out in full.

An advantage of the intraself Kaldor-Hicks criterion is that it fully accepts consumer sovereignty and the legitimacy of hyperbolic discounting. It takes a technique which is standard in analysis across individuals and merely applies it to a new context. Its motivations, whether utilitarian or that the social planner is merely replacing missing markets, can be carried over to the new context, where they perhaps fit even better, since here we are not trading off utility between individuals, just across time. A complication, however, is that the earlier self cares about the later self's consumption and so is not necessarily helped by receiving a transfer from the later self. As we will see later, this helps expose a problem for the motivation of the Kaldor-Hicks criterion.

The intraself pareto optimality and Kaldor-Hicks criteria use the same analysis to discover if laissez faire is optimal. The difference comes in what is regarded as an improvement, a difference that is crucial in practice. A person's future self might be willing to pay 20,000 dollars for his earlier self not to indulge in a vice that the earlier self values at only 5,000 dollars. Kaldor-Hicks says that taxing the vice or banning it would be an improvement, but Pareto optimality says it would not, because the earlier self is hurt. Both criteria would support banning the vice, taxing the future self, and subsidizing the present self.

One might question whether it is necessary to add the word "intraself" to these names. They are, after all, just applying the old criteria to a new context. That is true, but the application is controversial, and contradicts the standard definitions. A situation that is Pareto optimal in the usual sense is not necessarily intraself Pareto optimal, and vice versa.

Closely related to the Kaldor-Hicks criterion is the idea of using a social welfare function to determine what is optimal. A welfare weight could be assigned to each self, and actions and consumption chosen to maximize the sum of the weighted utilities. The outcome will be one of the intraself pareto optima. Unlike the Kaldor-Hicks criteria, the social welfare function does not take into account an initial allocation of decision rights to the various selves.

Instead of specifying the property rights over actions, the analyst specifies the welfare weights. Constraints on allocating property rights (e.g., borrowing not allowed, so the first self cannot consume everything) can be introduced as constraints on the social planner. Caplin & Leahy (2004) take this approach in their article on optimal discounting, in addition assuming that people care about and discount past consumption, not just future. We will use the Kaldor-Hicks approach here using the natural assumption that each self controls decisions made during his own existence, but we will also discuss the initial allocation of property rights. We will not, however, be questioning the legitimacy of the rates of time preference, Caplin & Leahy's main interest. Rather than the allocation of felicity generally or of consumption, we will focus on possibly suboptimal actions that have a direct effect across perios.

3. The Model

A person lives for three periods labelled 0, 1, and 2. He receives an endowment of W in each period.We will denote his consumption of the single good by C_0, C_1, and C_2. Our person can save at interest rate r, but he cannot borrow. We will denote wealth in each period as W_0, W_1, W_2, where $W_0 = W$ and the later wealths depend on earlier saving.

In period 1, the person chooses between smoking ($X = 1$) or not smoking ($X = 0$). We will assume smoking costs no money, for simplicity.[3] If the person chooses to smoke he receives 1 unit of utility in period 1 and loses α in period 2, where we assume that $\alpha > 1$ so the loss is bigger than the gain.

Total utility is given by the following function of the three consumption choices and the smoking choice:

$$U_0 = U(C_0) + \beta\delta(X + U(C_1)) + \beta\delta^2(-\alpha X + U(C_2)), \tag{1}$$

with $0 \leq \beta < 1$ and

$$0 \leq \delta < \frac{1}{1+r}. \tag{2}$$

This "consume-early" assumption (2) ensures that the person's rate of time preference is greater than the interest rate, an assumption useful for the first

[3]The reader dissatisfied with smoking having no effect on consumption may replace smoking with a juvenile, self-inflicted, tattoo or with a disease-prone sexual practice.

part of this paper, when we will focus on what happens when the person does not save any of his income. A later section will briefly examine the opposite, "consume-late" assumption.

We will assume for the first part of the paper that utility is linear in consumption ($U(C) = C$). Relaxing this assumption and the assumption of equal endowments W later will introduce the complication of "bequests" motivated by consumption smoothing.

The utility function is quasi-hyperbolic in the style of Laibson (1997): our person has an exponential discount factor of $0 \leq \delta < \frac{1}{1+r}$ (so his rate of time preference is greater than the market interest rate) and a hyperbolic adjustment parameter of $0 \leq \beta < 1$. If $\beta = 0$ he does not care at all about the welfare of his future self; if $\beta = 1$ he has a standard exponential-discounting utility function.[4]

A common distinction in the behavioral economics literature is between sophisticated consumers, who are fully aware that they are time-inconsistent and adjust their behavior for that, and naive consumers who are not aware that their future self may choose differently. The model here is simple enough for the knowledge of time-inconsistency not to matter, but we will assume that consumers do have rational beliefs about what future consumers will do.

We will view this person as consisting of three people, Self 0, Self 1, and Self 2. Self 0's utility function, defined over the present and future decisions viewed from Period 0, we have just seen. Self 1 and Self 2 have the following utility functions:

$$U_1 = X + U(C_1) + \beta\delta(-\alpha X + U(C_2)), \tag{3}$$

and

$$U_2 = -\alpha X + U(C_2). \tag{4}$$

The motivation for the model is to set up as simply as possible three periods when smoking: (a) has no immediate effect on utility (Period 0),

[4]Phelps & Pollack (1968) had used the quasi-hyperbolic form to discount generations of people over time. Laibson (1997) applied it to within the self and named it "quasi-hyperbolic". True "hyperbolic" discounting, proposed by Chung & Herrnstein (1961) in connection with a particular theory of behavior, has similar qualitative features but is more complicated to work with. See Angeletos, Laibson, Repetto, Tobacman & Weinberg (2001) for a good brief explanation of the differences.

(b) has a positive effect (Period 1), and (c) has a negative effect (Period 2). Thus, Self 0 is close to what some would call "the long-run consumer" who has preferences but chooses no action, except that he does choose his own consumption.

The utility functions I have just defined assume that Self 0 cares about Self 1 only through actions that occur in Self 1's period, and about Self 2 only through actions that occur in Self 2's period. Self 0 does not care that Self 1 derives utility from Self 2's consumption. If he did, Self 2's consumption would count double in Self 0's utility function. That is plausible if Self 0's utility arises from thinking of how happy he will feel in the future instead of from thinking of how happy particular actions will be making him in the future. Caplin & Leahy (2004) cite Loewenstein (1992) as saying this is the Jevons approach to utility. Here, we are instead using what he calls the Samuelson Sameuelson approach to utility. The difference could be interpreted in terms of discount factors. Here, I take the Samuelson approach as better reflecting the idea that each self is like a person deciding on his future actions, and because the Jevons approach makes most sense when memory as well as anticipation affect utility (as Caplin& Leahy [2004] do assume).

Memory yields no utility in our utility function here. In period 1 the person derives no pleasure from remembering his consumption in period 0. For our purpose of looking at the amoking decision, including memory would make little difference, so long as we assume that memory yields less utility than the event remembered, though it would add many extra terms to the equations. It would make smoking somewhat more attractive, since in Period 2 the person would derive utility from Period 1's pleasure from smoking.

Positive Analysis: The Laissez Faire Equilibrium Choices

Before thinking about welfare, we must work out what choices our three selves will make. Self 0 controls the value of C_0, Self 1 controls X and C_1, and Self 2 controls C_2. In a sense, this distribution of power, not the equal endowments across time, is the true distribution of property rights.

Self 2 would consume his entire wealth, so $C_2 = W + (1 + r)(W_1 - C_1)$. If he could choose variables from earlier periods, he would choose $X = 0$, $C_0 = 0$, and $C_1 = 0$: a ban on smoking, and zero consumption in the earlier

periods so he would have more consumption himself.

Self 1 would maximize (3) by choice of X and C_1 subject to the constraint that $C_2 = W + (1+r)(W_1 - C_1)$. Under our assumption that utility is linear the first order solution would not apply, because he would have a corner solution and he would choose to consume his entire wealth: $C_1 = W_1$. He derives utility from Self 2's consumption, but it is discounted by $\beta\delta$, which is less than $1/(1+r)$ by the consume-early assumption. He would choose $X = 1$ if $1 - \beta\delta\alpha > 0$, i.e. if

$$\alpha < \frac{1}{\delta\beta}, \tag{5}$$

which we will henceforth assume.

If he could control C_0 and C_2, Self 1 would choose $C_0 = 0$ to increase his own consumption, and he would choose $C_2 = W_2$.

Self 0, like Self 1, is subject to the consume-early assumption and so will choose $C_0 = W$.

If Self 0 could control C_1 he would set $C_1 = W$, just as Self 1 would because of the consume-early assumption. He would choose $X = 1$ if $\beta\delta - \beta\delta^2\alpha > 0$, i.e. if $1 - \delta\alpha > 0$. so he would choosing smoking for period 1 if

$$\alpha < \frac{1}{\delta} \tag{6}$$

To sum up: in equilibrium Self 0 would choose $C_0 = W$, Self 1 would choose $C_1 = W, X = 0$ if $\alpha \geq 1/(\delta\beta)$ and Self 2 would choose $C_2 = W$. Consumption would be equal in all periods and Self 1 would smoke.

4. Welfare Analysis: The Precommitment Criterion

We have seen that the three selves have contradictory preferences for the smoking and consumption choices. When Selves 0 and 2 want to ban smoking but Self 1 wants to use it, what should the social planner do?

One approach is to privilege the earliest self. The social planner's role is then to act to allow the person to commit to all his future actions and thereby avoid the consequences of time inconsistency. We will call this the

precommitment criterion.[5]

The Precommitment Criterion: A change in the value of the choice variables is an improvement if it increases the utility of Self 0.

Using the precommitment criterion, the laissez faire outcome fails to maximize welfare if $\alpha \in (1/\delta, 1/\delta\beta)$ because Self 0's optimality condition (6) and Self 1's optimality condition (5) conflict. The optimality conditions differ whenever there is hyperbolic discounting and $\beta < 1$.

Self 1 trades off the present period 1 against the future period 2 at the high rate of 1 to $\beta\delta$, whereas Self 0 trades off the future period 1 against the far-future period 2 at the lower rate of δ. The problem is not that sensations further in the future should not be treated as less important– a low δ by itself would not introduce a reason for paternalism– but quasi-hyperbolic discounting makes the present period count too heavily.

If discounting is exponential, i.e. $\beta = 1$, then there is no time inconsistency and the precommitment criterion will not call for a paternalistic ban on smoking. Self 1 will make the correct smoking decision even without coercion. It is still true that smoking hurts Self 2, possibly by much more than it helps Self 1, but if discounting via the exponential discount rate δ is heavy enough that Self 1 would choose smoking then it is heavy enough that Self 0 cares much more about period 1 utility from smoking than period 2 disutility.

The precommitment criterion can also be applied to consumption rates, but it would suggest no change from laissez faire. The positive analysis above showed that Self 0 wants zero savings and $C_0 = C_1 = C_2 = W$ anyway, which precommitment is unnecessary to attain. Borrowing would be a different matter, but that is ruled out for the moment by assumption.

[5]There are two variants of the precommitment criterion. In one, it is literally the earliest self whose utility is maximized. In the other, the modeller creates a "long-run self" who exists before Self 0 and who derives no utility from present sensations, only from future sensations. The long-run self approach can be attractive in the context of quasi-hyperbolic utility when the first "real" self is making consumption decisions, because the long-run self is effectively a self with exponential utility (he might have a β term in his utility function, but since he takes no immediate actions his present-orientedness is irrelevant). In our present context, the difference between the two variants is unimportant, since the smoking action occurs in Period 1, after Period 0.

Thus, using the precommitment criterion, a paternalistic ban on smoking might be desirable to avoid the consequences of the high value placed on present satisfaction. Self 0, like Self 1, places high value on present satisfaction, but the smoking decision is in period 1, so Self 0 wishes to override Self 1's desires because of the harm they cause Self 2.

The objection to the precommitment criterion is that to follow the desires of Self 0 is arbitrary. If followed literally, it is no use at all: one period later, Self 1 will have become "Self 0" and the social planner would have to undo the earlier decisions to follow the desires of the new current self. Of course, the cirterion is not meant to be taken literally: what is special about Self 0 is that he is making a choice about something before it becomes a present decision. The idea is that the present-time orientation of a hyperbolically discounting person is illegitimate and we are willing to override consumer sovereignty. That is not an unreasonable argument, but it an uncomfortable one for an economist. We do not ordinarily say that tastes are illegitimate. It moreover disregards the desires of Self 2, the post-action self, except insofar as Self 0 cares about them.

5. Welfare Analysis: The Kaldor-Hicks Criterion

As we have seen, a smoking ban can be optimal under the precommitment criterion in a multiple selves model. Once we have adopted the idea of multiple selves, however, defending the precommitment criterion becomes a challenge. An alternative is to apply our standard welfare criteria, but to within the self. First, we can require Pareto optimality: that a change is an improvement only if it benefits all the selves. Second, we could apply the Kaldor-Hicks criterion: requiring that a change would benefit all selves if appropriate cash transfers were made, but not requiring the transfers themselves. If we accept this logic for policy consequences between different individuals, it seems all the more acceptable within one individual, since we are no longer trading off utilities interpersonally.

The Intraself Pareto Optimality Criterion: A change in the value of the choice variables is an improvement if it increases the utility of at least one self and reduces the utility of none.

The Intraself Kaldor-Hicks Criterion: A change in the value of the choice variables is an improvement if it could be combined with money transfers

such that the combined changes would increase the utility of at least one self and reduce the utility of none.

The intraself Kaldor-Hicks criterion takes the laissez faire outcome as the base and asks whether the winners from a change would be willing to compensate the losers.[6] This captures the idea with which we started that a vice causes more future disutility than it causes present utility.

Like the precommitment criterion, the intraself Kaldor-Hicks criterion does not suggest changing consumption from laissez faire. There is no way to hypothetically raise the utility of any two of our sequential persons by requiring them to save for a future self.

The smoking choice X adds $(X - \beta\delta\alpha X)$ to Self 1's utility and $-\alpha X$ to Self 2's. Would Self 2 pay enough to change Self 1's decision? Selves 1 and 2 never meet, so the transaction is not possible, but Kaldor-Hicks only requires a potential Pareto improvement, not an actual one. There is a complication, however: Self 1 cares about Self 2's consumption level, so a dollar payment from Self 2 to Self 1 raises Self 1's utility by less than one dollar. Moreover, Self 0's utility is affected by any transaction between Self 1 and Self 2.

Since Selves 0 and 2 both might benefit from the smoking ban, let us imagine both of them making payments to Self 1 in exchange for the ban, payments P_0 and P_2 as measured in giving-period dollars. If we recognize that $U(C_t) = W_t$ for each period, the differences between the utility functions when the smoking bargain is made and when it is not are

$$U_0 = \left\{[W - P_0] + \beta\delta\left(W + (1+r)P_0 + \frac{P_2}{1+r}\right) + \beta\delta^2(W - P_2)\right\} - \{W + \beta\delta(W+1) + \beta\delta^2(W-\alpha)\} \tag{7}$$

$$U_1 = \{W + (1+r)P_0 + \frac{P_2}{1+r} + \beta\delta(W - P_2)\} - \{W + 1 + \beta\delta(W - \alpha)\} \tag{8}$$

[6] This is the version of Kaldor (1939) version; in the version of Hicks (1939) we ask whether the losers would be unwilling to pay the winners to prevent the change; in Scitovsky (1941) a change must pass both tests. The idea is even older. See Chipman & Moore (1978) for discussion of its history, including, e.g., discussion of Pareto's and Pigou's views. The answers in the model will change depending on which version is used, as we will discuss below.

and

$$U_2 = \{W - P_2\} - \{W - \alpha\}. \tag{9}$$

Self 0's net benefit from the bargain to ban smoking is

$$Net\ Benefit(Self\ 0) = -P_0 + \beta\delta\left((1+r)\,P_0 + \frac{P_2}{1+r} - 1\right) + \beta\delta^2(-P_2 + \alpha) \tag{10}$$

Self 1's net benefit is

$$Net\ Benefit(Self\ 1) = (1+r)P_0 + \frac{P_2}{1+r} - 1 + \beta\delta(-P_2 + \alpha) \tag{11}$$

Self 2's is

$$Net\ Benefit(Self\ 2) = -P_2 + \alpha \tag{12}$$

We can find the necessary and sufficient condition for a Pareto improvement by picking P_0 and P_2 to make Selves 1 and 2 indifferent about the bargain and then seeing if Self 0's utility rises under the resulting P_0. Self 2 would be indifferent if

$$P_2 = \alpha. \tag{13}$$

Substituting for P_2 from (13) into Self 1's net benefit equation (11), we would find that Self 1's net benefit was zero if Self 0 paid him

$$P_0 = \frac{1 + r - \alpha}{(1+r)^2}. \tag{14}$$

Substituting these values of P_0 and P_2 into Self 0's net benefit equation, (10) tells us that Self 0 will derive higher utility from paying P_0 to ban smoking than from blocking the transaction if

$$\alpha > 1 + r. \tag{15}$$

Unlike the precommitment criterion, the intraself Kaldor-Hicks criterion does not rely on conflicting time preferences to justify helping a future self, but on low interest rates. It is relying not on the altruism of earlier selves

to generate utility, but on the willingness of the future self to sacrifice consumption. The altruism of earlier selves still helps make a smoking ban more attractive, but it is no longer a necessary condition. This can be seen by setting $\beta = 0$, so the earlier selves care nothing for the later self. The precommitment criterion no longer has anything to say about a smoking ban, since Self 0 cares nothing about either Self 1 or Self 2. The intraself Kaldor-Hicks criterion, however, would ban smoking if $\alpha > 1 + r$, which is to say if Self 2 loses more from Self 1's smoking than can be made up for by the rate of interest.

We can think of there being market failure within the self, a missing market for trade of future money for present abstention. If the social planner created that market, he would create gains from trade, and both buyer and seller would benefit when Self 1 sells a smoking ban to Self 2.

We have just seen that if $\alpha > 1 + r$ then Self 2 would be willing to compensate Self 1, with the aid of Self 0. What if Self 2 had to compensate Self 1 without the aid of Self 0? In that case $P_0 = 0$, and Self 1's net benefit from agreeing not to smoke is, from equation (11),

$$Net\ Benefit(Self\ 1) = \frac{P_2}{1+r} - 1 + \beta\delta(-P_2 + \alpha) \tag{16}$$

This solves to a necessary payment of

$$P_2 = \frac{(1+r)(1-\alpha\beta\delta)}{1-\beta\delta(1+r)}. \tag{17}$$

This necessary payment illustrates three effects of a transfer by Self 2 to Self 1 to stop smoking. First, Self 1 must be compensated for the direct effect of not smoking, a loss of 1 to himself that is partly compensated for by the $\alpha\beta\delta$ in utility to himself from Self 2's benefit. Second, if P_2 is measured in period 2 dollars, we must multiply it by $(1 + r)$ to get the value in period 1 dollars. Third, Self 1 suffers disutility from the reduction in Self 2's utility that results from Self 2's making the payment, and Self 2's payment to him must be inflated by $\frac{1}{1-\beta\delta(1+r)}$ to compensate for that. Note that if Self 1 cares only about the present ($\beta\delta = 0$) then the necessary payment is simple: $P_2 = 1 + r$. The complexity arises from Self 1's concern about period 2 consumption.

What condition on the harm from smoking α is necessary for Self 2 to be willing to pay the entire compensation to Self 1? Self 2 is willing to pay so long as $P_2 \geq \alpha$. Setting $P_2 = \alpha$ in equation (17) and solving for α, however, yields

$$\alpha = 1 + r,$$

exactly the same as the critical value for banning smoking when Self 0 also paid compensation.

Why is it that Self 0's benefit from banning smoking has no effect on when smoking should be banned? One would think that if α is slightly too small for Self 2 to be willing to pay enough to Self 1 to stop smoking then Self 0's additional contribution would tip the balance. Remember, though, that Self 0 only benefits from a smoking ban if $\alpha > \frac{1}{\beta\delta}$. Thus, the interval of α for which banning smoking would be optimal but Self 2 is unwilling to pay the entire compensation is $[\frac{1}{\beta\delta}, 1 + r]$. This, however, is an empty interval, because by the consume-early assumption, $\frac{1}{\beta\delta} > 1 + r$. Thus, whenever Self 2 is unwilling to pay enough to Self 1 for him to stop smoking, Self 0 is unwilling to pay him anything at all.

Conversely, shouldn't Self 0's benefit from smoking affect the optimality condition for smoking? Couldn't it happen that a bargain helps Selves 1 and 2, but to the detriment of Self 0, who does want Self 1 to smoke if $\alpha < \frac{1}{\delta}$? This cannot happen, because Self 0 also benefits from Self 2's payment to Self 1. If the payment of P_2 adds $\frac{1}{1+r}$ to Self 1's consumption utility but takes away 1 from his smoking utility, the net effect is not only zero for Self 1, but for the discounted period 1 values that enter Self 0's utility function, $\beta\delta(X + C_1)$.

What is efficient under the intraself Kaldor-Hicks criterion does depend on the distribution of wealth– that initial allocation of decision rights described above. In the transaction just described, Self 2 pays $\frac{(1+r)(1-\alpha\beta\delta)}{1-\beta\delta(1+r)}$ to Self 1. If it is Self 2 alone who pays Self 1, this requires that Self 2's income be large enough: $W \geq \frac{(1+r)(1-\alpha\beta\delta)}{1-\beta\delta(1+r)}$. Otherwise, Self 2 would not pay Self 1 enough to compensate for Self 1's loss of utility from smoking. If it is both Selves 0 and 2 who pay Self 1, then if Self 2 reaches his budget constraint Self 0 must be able to pay the remainder.

If, however, Selves 0 and 2 do have sufficient wealth to compensate

Self 1, we have shown that the internality of harm to Self 2 from Self 1's smoking can justify paternalism under the Kaldor-Hicks criterion even if $\beta = 1$ so discounting is exponential. The parameter β simply doesn't matter to whether smoking should be banned.

Result 1: In a multiple selves model, the intraself Kaldor-Hicks criterion can justify paternalistic banning of a vice even if discounting is exponential.

The intraself Pareto optimality criterion and the Kaldor- Hicks criterion are not the same as their conventional analogs, so we must be careful not to misinterpet Result 1. The conventional analogs of the criteria are implicitly based on the precommitment criterion.

Suppose that $\beta = 0$, so that Self 0 is indifferent about Selves 1 and 2. It is then Pareto optimal for Self 1 to smoke, because in maximizing utility according to Self 0's utility function, which is what is required by conventional Pareto optimality, $X = 0$ or $X = 1$ both result in the same utility. Smoking is not intraself Pareto optimal, however, because both Self 1 and Self 2 can have higher utility if $X = 0$ and a suitable transfer is made from Self 2 to Self 1.

Conversely, an outcome that is intraself Pareto optimal might not be Pareto optimal. Under $\beta = 0$ and linear utility, the outcome $(C_1 = W, C_2 = W, C_3 = W, X = 0)$ is intraself Pareto optimal, but it is not Pareto optimal because Self 0's utility would be higher if all the consumption were transferred to C_0.

6. Should the Social Planner Permit Borrowing?

I have assumed borrowing was impossible. What if the social planner could replicate borrowing across selves by a system of age-dependent taxes and transfers? Under laissez faire, each self consumed his entire endowment rather than save. Would they now borrow?

The precommitment criterion says that the social planner should permit borrowing, which would transfer all consumption to period 0. Self 0 would choose to consume all three selves' endowments because of the assumption that the rate of time preference is high and the utility functin is linear in consumption.

The intraself Pareto and Kaldor-Hicks criteria lead to a different result: they would not instruct the government to replicate borrowing. Permitting borrowing would help Self 0, but hurt Selfs 1 and 2. Moreover, there is no exchange of goods for money on which to base a potential Pareto improvement. These criteria are concerned with the production and allocation of goods, not with their distribution.

This illustrates that the multiple selves paradigm is a bigger change from standard normative economics than one might realize. The paradigm provides a plausible reason for banning smoking, but it weakens a conventional economic argument against usury laws. The argument for banning smoking is that the ban hurts the present self less than it helps the future self. If the two could bargain across time, they would do so and both would be better off. The conventional argument against usury laws is that if someone accepts a loan, he must think that the benefit in current consumption is worth the loss in future consumption. That is just to say that Self 0 benefits from borrowing, however, despite the loss to Self 1 and Self 2. A usury law banning borrowing would hurt Self 0 but benefit Selves 1 and 2, so under the intraself Kaldor-Hicks criterion, we cannot say that the change is either a gain or a loss.

The Effect of Borrowing on the Optimality of Smoking

I just discussed the implications of borrowing for consumption, but borrowing has implications for the optimality of smoking too. If borrowing possible, that affects whether a Kaldor-Hicks improvement can be made in the smoking decision. This is due to the income effect created by the possibility of borrowing, which alters the wealth controlled by each self and thus affects their willingnesses to pay for smoking changes.

Let us start from a position in which borrowing is possible without intervention by the social planner: Selves 0 and 1 may borrow against future income for present consumption. We will assume they borrow at the same rate r at which they can lend.

The laissez faire result is that Self 0 would borrow and consume the entire endowment. Selves 1 and 2 would consume zero, and Self 1 would smoke. The extreme consumption result occurs because of the assumptions of linear utility and the rate of time preference being higher than the interest

rate.

Under the precommitment criterion, the laissez faire outcome of zero consumption for Selves 1 and 2 is optimal, but not the outcome of Self 1 smoking (except in the extreme case of $\beta = 0$, at which Self 0 is indifferent about Self 1 smoking). If β is positive Self 0 would still borrow and consume all of the endowments, but would use the same critical value of $\alpha > 1/\delta$ as before to ban smoking.

The intraself Pareto improvement and Kaldor-Hicks criteria, agree with the precommitment criterion in not requiring any change from zero consumption by Selves 1 and 2. Any such change would harm Self 0, and the harm to Self 0 would be exactly balanced by benefit to the other two selves, a matter of redistribution rather than any improvement in social surplus.

What is more surprising is that unlike when borrowing was impossible, the Kaldor-Hicks criterion now does not require a ban on smoking whenever the present value of utility harm exceeds the utility benefit ($\alpha > 1 + r$).

There is no scope for mutually beneficial trade of wealth for wealth. But the possibility of borrowing has also eliminated the possibility of mutually beneficial trade of wealth for a smoking ban. As a result of Self 0's borrowing, Selves 1 and 2 have zero wealth. Self 2 cannot offer any wealth to Self 1 in exchange for the smoking ban. Self 0 can. Would he offer enough?

The effect on Self 0's utility of a bargain in which he gives P to Self 1 in exchange for a smoking ban is

$$-P + \beta\delta(-1 + P) + \beta\delta^2\alpha \tag{18}$$

The minimum P that Self 1 would accept is $P = \frac{1-\beta\delta\alpha}{1+r}$. Substituting that P into the expression for Self 0's utility change and solving for α yields the condition for Self 0's utility to rise from the bargain:

$$\alpha > \frac{1 + \delta\beta r}{\beta\delta(1 - \beta\delta + \delta(1 + r))} \tag{19}$$

This condition is stronger than the precommitment criterion's condition of $\alpha > 1/\delta$, but weaker than Self 1's condition for not smoking, $\alpha > 1/(\beta\delta)$.

If $\beta = 1$, it is equivalent to $\alpha > 1/\delta$, and regulation is unnecessary because Self 1 will abstain from smoking whenever Self 0 would be willing to pay him not to smoke.[7]

Result 2: If the person borrows enough against his future income, the Kaldor-Hicks criterion might support a smoking ban only if discounting is quasi-hyperbolic.

Allowing borrowing has changed the distribution of wealth. Before, Selves 0, 1, and 2 each controlled W under laissez faire (as well as Self 1 controlling the value of X, a property right which is part of his economic wealth). Now, Self 0 controls all three incomes by being able to borrow them. Self 1 only controls the value of X and what income Self 0 lets him control control; Self 2 only controls what income Self 1 lets him control. Thus, Self 2 is too poor to participate in any Coasean bargain, though Self 0 can still do so.

It is interesting to think about what would happen if we reallocated economic wealth by allocating the property right of the smoking decision to Self 2 instead of Self 1 (a purely hypothetical re-allocation, since Self 2 does not exist at the time of the decision).[8] Then smoking would not occur under laissez faire because it would not maximize Self 2's utility. The intraself Kaldor-Hicks criterion would be satisfied, because Self 1 would have no money with which to buy $X = 1$ from Self 2. Nor would Self 1 wish to buy it if he did have W in money, because the value of smoking to him is less than its cost to Self 2. Similarly, if Self 0 started by controlling the decision (as he would, in effect, under the precommitment criterion), Self 1 would be unable to buy the right to smoke from Self 0, and Kaldor-Hicks would accept a smoking ban as optimal– though in that case, if Self 1 had the funds, he would be willing to buy the right from Self 0 and Self 0 would be willing to

[7] The right-hand-side is less than $1/\beta\delta$ because $(1 + \delta\beta r)\beta\delta < \beta\delta(1 - \beta\delta + \delta(1 + r))$ because $\beta\delta < \beta\delta(1 - \beta\delta + \delta$ and $(\delta\beta r)\beta\delta < \delta\beta r$. The right-hand-side is at least as great as $1/\delta$ because $(1 + \delta\beta r) \geq \beta(1 - \beta\delta + \delta(1 + r))$ because $1 \geq \beta(1 - \beta\delta + \delta)$ because that reaches a maximum at$\beta = 1$, when $\beta(1 - \beta\delta + \delta) = 1$.

[8] xxx Note to author's self: "If you asked a random group of economists how to assign property rights in a new society with a literate population so as to maximize the prices (time quantities), explicit and implicit ("shadow"), asking and offer, in the society they would almost certainly begin by giving each mentally competent adult the property rights to his own labor." (Posner, 1985, p. 93)

sell. The criterion's recommendations thus depend on the initial allocation of property rights. [9]

What if the Endowments Are Saved?

Suppose we drop the consume-early assumption and replace it with a "consume-late" assumption:

$$\delta\beta > \frac{1}{1+r}. \tag{20}$$

In equilibrium Selves 0 and 1 would save their entire income under laissez faire, a result that neither the precommitment criterion nor Kaldor-Hicks would change.

Self 1 would, however, still smoke, because the effect of smoking on Self 2's utility is unaffected by the rate of interest. And the precommitment criterion would still ban smoking.

Foreshadowing Result 3 below, however, Kaldor-Hicks would no longer support a smoking ban. That is because in our hypothetical transaction, Selves 1 and 2 transfer consumption to Self 1, but now Self 1 would find this undesirable, a penalty rather than a reward. Under the consume-late assumption, Self 1 gains utility of 1 from his own consumption of 1 unit of income, but utility of $\frac{1+r}{\delta\beta} > 1$ from Self 2's consumption. Self 0 would be passing along his entire endowment to Self 1 anyway, and so could not credibly condition the payment on Self 1 not smoking. Hence, potential gains from trade are absent.

7. The Model with Concave Utility and Money Transfers across Time

So far we have established that internalities can justify paternalistic regulation in a particular model in which borrowing was exogenously constrained, but that allowing borrowing eliminated the argument for regulation

[9] xxx Note to author's self: It is their lung too. Inheritance taxes==wealth taxes. In traditional societies, a man could not alienate his land. It was his descendants too. Like multiple selves. Entail and Je3wish law.

by leaving the future self without wealth. Under a different assumption, all wealth was saved, and the motive for regulation was eliminated because the present self did not want to reduce the future self's consumption. Those cross-time consumption decisions were corner solutions because of the assumption of linear utility. What if we introduce a motive for partial, interior- solution "bequests" from one self to a later self?

One might guess from Barro (1974) and Becker (1974) that bequests would have an important effect. Barro (1974) applies the idea of "Ricardian equivalence" to intergenerational debt. If the government taxes a future generation to pay a pension to the present generation, the direct effect is to make the present generation consume more and the future generation less. If the present generation cared enough to leave a bequest to the future generation, however, then when the pension is introduced the bequest will simply be increased to take account of the increase in future taxes. Becker (1974) introduces the "Rotten Kid Theorem" that even an non-altruistic member of a family will act to increase family income if the family's altruistic head gives transfers to every member of the family.

Barro's model is simply about transfers of wealth, on which the Kaldor-Hicks criterion is silent, but he makes the point that bequests can undo the effect of government intervention. Becker (1974, p. 1078) goes further. Besides his best- known proposition that each family member will maximize family income if some altruistic member makes transfers to everyone, this paper includes what we might call the nightlight problem. Imagine an altruistic husband who must decide whether to read in bed at night, when he knows that his wife would pay ten dollars if he didn't and he would pay no more than six dollars for the right to read. Being altruistic, he cares about his wife's utility enough to be making monetary transfers to her. Given that he is going to reduce his own utility to increase his wife's, he wants to do it as efficiently as possible. He will refrain from reading at night, because if he doesn't mind inflicting ten dollars of harm on his wife, he can do it by giving her ten dollars less to spend.[10] The nightlight problem is like our smoking ex-

[10]Becker also looks at the nightlight problem from the point of view of the wife, in a closer analogy to the Rotten Kid Theorem's result that even a selfish child will act to increase family income. If the wife controls the nightlight decision, she will allow the husband to read at night if that is efficient, because he will compensate her for her lower utility with a bigger cash transfer.

ample. Bergstrom (1989) has shown that the efficiency conclusion and other extensions of the Rotten Kid Theorem to more than one consumption good require caveats. If the wife chooses the amount of nightlight in Bergstrom's example, she will choose an inefficiently small amount of light because she knows the husband's choice of monetary transfer will depend on her choice and she acts strategically.

To see what happens when consumption decisions are interior solutions, let us now give Self 0 an endowment of $(W + K)$ instead of W and make the utility of consumption strictly concave, a function $U(C)$ with $U' > 0$, $U'' < 0$. Let us assume that borrowing is limited to an amount B in borrowing period dollars.

We will be able to establish the main result without analyzing the consumption and saving decisions fully, because Self 1's decisions are what matter to the result. Let us imagine a Kaldor-Hicks transfer of P from Self 2 to Self 1 to ban smoking, with P measured in period 2 dollars. This payment will cost Self 2 P and benefit Self 1 by $P/(1 + r)$. In addition, Self 1 may be borrowing amount B, which will cost Self 2 amount $(1+r)B$ in consumption.

First let us look at Self 2's consumption. If Self 1 borrows the full amount B from Self 2, then Self 2's consumption will be

$$C_2 = W - (1 - X)P - (1 + r)B \tag{21}$$

If Self 1 borrows amount $B_1 < B$ or saves, then Self 2's consumption will be

$$\begin{aligned} C_2 &= [W - X(1 - X)P - (1 + r)B_1] + [1 + r][W_1 + B_1 + \tfrac{(1-X)P}{1+r}] \\ &= W + (1 + r)(W_1 - C_1). \end{aligned} \tag{22}$$

Self 1 is constrained to spend no more than his income on present consumption, so

$$C_1 \leq W_1 + B + \frac{P}{1 + r}. \tag{23}$$

If this is binding, then Self 1 is borrowing the full amount B from Self 2, and Self 2's consumption is given by equation (21). If it is not binding, then Self

1 is saving or is borrowing less than B and Self 2's consumption is given by equation (22).

Self 1's maximization problem is therefore to choose X, C_1, and C_2 to maximize

$$U_1(C_1, C_2, X) = X + U(C_1) + \beta\delta(-\alpha X + U(C_2)) \tag{24}$$

subject to the constraints

$$\begin{aligned}
&(a) \quad C_1 \;\; \leq W_2 + B + \tfrac{(1-X)P}{1+r} \\
&(b1) \quad C_2 \;\; = W - (1-X)P - (1+r)B \quad \text{if } C_1 = W_1 + B + \tfrac{P}{1+r} \\
&(b2) \quad C_2 \;\; = W + (1+r)(W_1 - C_1) \qquad \text{if } C_1 < W_1 + B + \tfrac{P}{1+r}.
\end{aligned} \tag{25}$$

The first possible case is when constraint (a) is binding at the solution to Self 1's problem, so he borrows the full amount B. In that case, we can substitute for C_2 from constraint (b1) and write the problem as to maximize, by choice of X,

$$X + U(C_1) + \beta\delta(-\alpha X + U(W - (1-X)P - (1+r)B) \tag{26}$$

By definition of the case we are considering, $C_1 = W_1 + B + \frac{(1-X)P}{1+r}$. As for the optimal choice of smoking, Self 1 will choose to smoke ($X = 1$) if

$$1+U(W_1+B)+\beta\delta(-\alpha+U(W-(1+r)B) > U(W_1+B+\frac{P}{1+r})+\beta\delta U(W-P-(1+r)B). \tag{27}$$

When utility was linear, the marginal utility of income was 1 and the payment P had to equal $\frac{(1+r)(1-\alpha\beta\delta)}{1-\beta\delta(1+r)}$, in equation (17). Now that the marginal utility of income is not constant, the necessary payment P must reflect the fact that for both Self 1 and Self 2 the marginal utility of income is changing with income. Thus, no simple expression is available for the P necessary to persuade Self 1 to not smoke.

The second case is the more interesting: what if Self 1 finds it optimal to save, or to borrow less than B? Then we can substitute for C_2 from

constraint (b2) and write the problem as to maximize by choice of C_1 and X

$$X + U(C_1) + \beta\delta(-\alpha X + U(W + (1+r)(W_1 - C_1)). \tag{28}$$

The problem needs no budget constraint, because by definition of the case, income does not constrain the choice of C_1. Rather, the desire to save constrains it.

In this problem, the condition for choosing $X = 1$ is that

$$1 - \beta\delta\alpha > 0, \tag{29}$$

and the first order condition with respect to C_1 is

$$U'(C_1) + \beta\delta(1+r)U'(W + (1+r)(W_1 - C_1) = 0 \tag{30}$$

The price P appears in neither of these two optimality conditions. Hence, Self 2's offer of P in exchange for the smoking ban makes no difference. Either Self 1 would abstain from smoking anyway, or he would not be persuaded by the offer of money from Self 2. If discounting is exponential, then it is only Self 2 who would be willing to offer money to Self 1 in exchange for not smoking, because Self 0 shares Self 1's incentives, as we saw earlier. Thus, Kaldor-Hicks no longer can support a smoking ban.

What if discounting is hyperbolic? Then Self 0 would be willing to pay something to Self 1 for a smoking ban. He would not, however, pay enough. In equilibrium, Self 0 has chosen a particular level of saving such that the marginal utility of a dollar consumed equals the marginal utility from saving that dollar. The loss to Self 1 from a smoking ban is $(1 - \beta\delta\alpha)$ but the gain to Self 0 is the smaller amount $(\beta\delta - \beta\delta^2\alpha)$. Thus, even if Self 0 viewed the marginal utilities of dollars consumed versus dollars saved as equal, he would be unwilling to make the payment.

Result 3: If discounting is exponential and a person is saving a positive amount or his borrowing is unconstrained, then the intraself Kaldor-Hicks criterion does not support a paternalistic smoking ban.

If Self 1 cares enough about Self 2 to pass savings along to him, then the intraself Kaldor-Hicks criterion does not require Self 1 to give up smoking for the sake of Self 2. If Self 1 is selfish enough not to save, the criterion does require him to give up smoking.

The intuition behind Result 3 is that when Self 1 is saving, the marginal dollar of saving results in period 2 consumption that gives him as much utility (discounted though it is) as if he spent that dollar on period 1 consumption. He would be hurt by anything that transferred that consumption back to period 1. Thus, if he consumes the Kaldor-Hicks payment given him by Self 2, he is actually worse off.

Similarly, if Self 1 is borrowing less than the limit, he has decided that though overall he would like to reduce Self 2's consumption to increase his own, at the margin, once he has borrowed the appropriate amount, his utility is the same from having Self 2 consume a little as from having himself consume more.

What if discounting is hyperbolic and the person is passing along savings? The general expression for the effect on Self 0's utility of an increase in saving beyond laissez faire is too complex to be illuminating, since it would affect Self 1's saving behavior and Self 2. A numerical example will illustrate how regulation can be optimal even when there is savings. Assume that $W = 1$, $K = 6$, $r = 0$, $B = .2$, and that the utility function has marginal utilities of

$$\begin{aligned} U'(C) &= 2 \quad \text{if} \quad C < 2 \\ &= 1 \quad \text{if} \quad C > 2. \end{aligned} \tag{31}$$

This person has some incentive to arrange the consumption path so that consumption equals at least 2 in each period. We will retain the assumption that smoking yields 1 in utility to Self 1 and costs $\alpha \in (1, \frac{1}{\beta\delta})$ in utility to Self 2.

(1) Suppose $\beta\delta < .5$. In that case, high time preference overrides the incentive to smooth consumption. There is no saving, and Self 2 will pay Self 1 not to smoke. The laissez faire outcome will be $C_0 = 7.2, C_1 = 1, X = 1$, and $C_2 = .8$. If Self 0 or 1 deviates by saving more, he will lose utility at a rate of 1 per reduced consumption unit and gain it at only a rate of $2\beta\delta$ from his successor's increased consumption. Thus, Self 0 will borrow up to the limit of $B = .2$ from Self 1, and Self 1 will borrow up to the limit from Self 2. Self 1 will smoke because smoking raises his utility by 1 directly and reduces it only by $\beta\delta\alpha$ through its effect on Self 2.

The Kaldor-Hicks Criterion can support a smoking ban if $\beta\delta < .5$ even

if $\beta = 1$ because Self 1 would accept as little as $(.5 - \beta\delta\alpha$ to stop smoking (.5 rather than 1 because his marginal utility of consumption is 2, whereas smoking only increases utility by 1) and Self 2 would be willing to pay up to $\alpha/2$, an amount greater than .5 since $\alpha > 1$. We do not need to resort to payments from Self 0.

(2) Suppose instead that $.5 < \beta\delta < 1$, in which case consumption smoothing outweighs discounting to some extent. The laissez faire outcome will be $C_0 = 5, C_1 = 2, X = 1$, and $C_2 = 2$. If Self 0 or 1 deviates by saving more, he will lose utility at a rate of 1 per increased consumption unit and gain it at the lower rate of $\beta\delta$ from his successor's increased consumption. If he deviates by saving less, he will gain utility at a rate of 1 per increased consumption unit and lose it at the higher rate of $2\beta\delta$ from his successor's reduced consumption.

Under laissez faire, Self 1 will smoke because it adds $(1 - \beta\delta\alpha)$ to his utility.

There is no payment by Self 2 that will persuade Self 1 to stop smoking. A payment of P by Self 2 will have a net effect of $(P - 2\beta\delta P) < 0$ on Self 1's utility, so Self 1 would refuse the payment even if it were not contingent on not smoking.

Self 0, on the other hand, could pay P to Self 1 in addition to the laissez faire bequest of 3 and Self 1 would have no objection. The effect on Self 0's utility would be to add

$$-P + \beta\delta(-1 + P) + \beta\delta^2(\alpha). \tag{32}$$

Self 1 would accept a payment of as little as $P = (1-\beta\delta\alpha)$ to not smoke. Substituting that for P in expression (32) tells us that Self 0's utility would rise after making that payment to stop smoking if

$$\alpha > \frac{1}{\delta\beta(1 - \beta\delta + \delta)}, \tag{33}$$

an expression similar to what we found in conjunction with Result 2 that even with borrowing hyperbolic discounting could justify a smoking ban under the Kaldor-Hicks criterion.

We have assumed that $\alpha < \frac{1}{\delta\beta}$, but since $(1 - \beta\delta - \delta) > 1$, the critical value of α for Self 0 to be willing to pay to stop smoking is feasible. There is a range of values of α– though narrow one– for which Self 1 would not abstain from smoking unilaterally but would after a payment that Self 0 would be willing to pay. This does rely on hyperbolic discounting, since if $\beta = 1$ our condition for Self 0 being will to make the payment reduces to $\alpha > 1$, the same condition as for Self 1 to unilaterally abstain from smoking when $\beta = 1$. Thus we have Result 4.

Result 4: If discounting is hyperbolic and a person is saving a positive amount or his borrowing is unconstrained, then the intraself Kaldor-Hicks criterion can still support a paternalistic smoking ban.

8. Why Do We Use the Kaldor-Hicks Criterion?

The multiple selves model is a fascinating change of perspective for libertarians, or, indeed, for anyone who cares about either freedom of choice or equality. It is relatively easy to dismiss a multiple self model in which there are two more present selves whose desires conflict. That model reduces to the old problem of whether a person's actions should be constrained for his own sake or not, and our affection for equality hardly enters– we don't feel bad about an impulsive self not being able to consume as much as a disciplined self, who in any case will share the same pleasurable sensations. The multiple selves we have been considering, however, do not exist simultaneously, do not have moral ranking, and do not share the benefits and costs equally.

This application has stretched the Kaldor-Hicks criterion considerably. The problem is this. The present self might be willing to accept an anonymous payment of $3,000 to not smoke, and the future self might be willing to pay $4,000 in present-period dollars. The present self is *not* willing, however, to accept $3,000 from the future self, because he is altruistic and prefers that the future self spend that money, not himself. Thus, because the present self cares so much about the future self, he refuses to help him. In the end, though since the compensation is not actually paid, his concerns about the decline in the future self's consumption don't matter anyway.

This is a little-known problem,[11] but it is well known that the founda-

[11] Though see Friedman (1988), which makes the same point in connection with whether

tions of the compensation criterion—indeed, of the entire idea of economic efficiency and cost-benefit analysis– are poorly developed. I am not here thinking of the more superficial problems of whether we use the Kaldor test or the Hicks test, or of the Scitovsky Paradox. Rather, why do we think that it is good to remove a tariff that is worth $1 million to producers but which consumers would pay $10 million to remove? If the consumers actually paid producers $5 million, there would be a Pareto improvement, and we consequentialist economists would have good reason to support the change.[12] If the compensation is not paid, the tariff removal is helping some people at the expense of others. Why are we willing to do that?

One answer is that by removing the tariff we have moved from a pareto inferior allocation to a Pareto optimum. That, however, begs the question. If compensation truly cannot be paid, then the original situation is pareto optimal too. Certainly removal of the tariff is not a pareto improvement.

A second answer is that by removing the tariff we have moved one step closer to a Pareto improvement, and it is better to be closer than further away. Why it is better to be closer is unclear, however, an example illustrates. Suppose Smith has a dog, which he likes, but he'd like a cat better. Jones has a cat, which he likes, but he'd like a dog better. Neither wants to have both a cat and a dog, because the dog will fight the cat. A Pareto improvement would be for Smith to send his dog to Jones's house, and Jones to send his cat to Smith's. If we stop after Smith sends his dog to Jones's house, though, both Smith and Jones are strictly worse off. Going partway to the pareto improvement is a pareto worsening.

A third answer is that it is wrong to focus on just one policy change. If we use the compensation criterion for public policy generally, everyone will be better off than if we did not (see, e.g., Zerbe (2001)). This argument is much like the contractarian argument for involuntary submission to government power: everyone is better off overall with a government, even if they grumble about particular government policies.

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transfers from an altruist to someone else will be inefficiently small.

[12]Even Pareto optimality is challenged by non-consequentialists. Someone might believe that the producers have a right to the tariff and that process is important: they must not only benefit from its removal but must formally agree to it. We need not investigate that here.

A problem with this third answer is that it relies on a bundling of use of the compensation criterion for all policies. Why not, for example, use the compensation criterion for all policies except for those involving a person's multiple selves over time? Self 1 in our model would applaud this, since he never wins from application of the compensation criterion.

A fourth answer is to fall back on utilitarianism (or common sense?) and assert that other things equal the world is better if one group of people gains $10 million and another loses $1 million. This answer abandons the traditional claim that economics does not admit interpersonal comparisons of utility, but this claim has always been dubious. We make such comparisons constantly in our daily interactions with family and friends. The economist's ability to persuade people that efficiency should influence public policy is perhaps based on this too.

The utilitarian explanation, however, does not require that the payment to the losers from a policy change be made by the winners. If the objective is to measure willingness to receive instead of to advance towards a pareto improvement, it should not matter whether the payment comes from the policy winner, from the government, or from some randomly selected victim.

In our multiple selves model, or any model with altruism, it is much simpler to calculate how much the loser would accept from an anonymous third party than from a winner towards whom he is linked by altruism. Whether there is saving, borrowing, or neither, all that would matter is the gains and losses from smoking.[13] Thus, I would advocate dropping the Kaldor-Hicks criterion for the Marshall criterion defined below.[14]

The Intraself Kaldor-Hicks Criterion: A change in the value of the choice variables

[13]It is important not to think of the test as an auction between winners and losers, however. If Self 1 was saving and valued Self 2's consumption, then he would want to win an auction in competition against Self 2 partly to avoid Self 2's having to pay the auctioneer and reduce consumption.

[14]I name this "Marshallian" following Friedman (1988). Marshall says in his discussion of consumer surplus in Book III, Chapter 6 of *The Principles of Economic Analysis*, "In the same way if we were to neglect for the moment the fact that the same sum of money represents different amounts of pleasure to different people, we might measure the surplus satisfaction which the sale of tea affords, say, in the London market, by the aggregate of the sums by which the prices shown in a complete list of demand prices for tea exceeds its selling price."

is an improvement if it could be combined with money transfers such that the combined changes would increase the utility of at least one self and reduce the utility of none.

The Intraself Marshall Criterion: A change in the value of the choice variables is an improvement if the winners would be willing to pay more to the social planner to implement it than the losers would be willing to pay to prevent it.

Our standard use of the term "efficiency" does not distinguish between these two criteria. The term "wealth maximization" as used in law and economics, and, notably, by Richard Posner (1979, 1985) is usually framed as what I call the Marshall criterion, following Friedman (1988). It is a simpler idea than the Kaldor-Hicks criterion when altruism enters the picture, and better represents the utilitarianism that I think lies behind efficiency's attractiveness.

9. Concluding Remarks

This this paper I have asked whether applying a version of the Kaldor-Hicks criterion to a multiple selves model provides a justification for intervention by a benevolent social planner. It does provide a justification, with caveats. A first requirement is that the activity cause more immediate harm than it creates future benefit. If so, this has a ripple effect under dynamic inconsistency because not only does the far future self suffer more than the near future self benefits, but the present self suffers sympathetically with the far future self. A second requirement is that the extent of the harm outweigh the real cost of transferring consumption to earlier in time, which is the interest rate (r in the model). A third requirement is that if discounting is exponential the the person not be saving between the time he engages in the harmful activity and the time the harm occurs, or not be borrowing the maximum possible. Otherwise, the earlier self would not value transfers to himself from the future self, and there are no potential gains from trade. Even if the person engaged in the harmful behavior is making a bequest, however, if discounting is hyperbolic the Kaldor-Hicks criterion can justify restricting his behavior for the sake of selves prior to himself in time who care more than he does for consequences in the far future.

Thus, we may conclude that hyperbolic discounting and the precommitment condition of maximizing the utility function of the pre-action self

are not essential for paternalistic arguments for regulating internalities. For someone who is impatient and constrained in his borrowing, the intraself Kaldor-Hicks criterion can justify regulation even if the person's discounting is exponential. Regulators often are most concerned to regulate the young and poor because they may have poorer information and self-control. The present model suggests a quite different reason: that they are credit constrained and would be willing to accept payment from their future selves to abstain from vice.

Even if the person is saving, the intraself Kaldor-Hicks criterion can justify regulation if discounting is hyperbolic, but for a narrower range of parameters and for a different reason. The two reasons for regulation have different motives. When discounting is exponential, regulation is balancing the vice's harm to the future self against his willingness to give up consumption. If discounting is hyperbolic, regulation is adjusting for the pre-vice self's lack of present-orientedness in balancing the interests of the future selves. Even under hyperbolic discounting, however, the intraself Kaldor-Hicks criterion justifies regulation more narrowly than the precommitment criterion does, because Kaldor-Hicks requires potential compensation to the regulated self.

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