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Thursday Solution

Published
by
Steve Landsburg
on June 21, 2012
in Economics and Puzzles
. 22 Comments

Last week, I challenged readers to reconcile two apparently contradictory statements, both of which are frequently made in economics textbooks:

- To minimize distortions, all goods should be taxed equally.
- To minimize distortions, inelastically demanded goods should be taxed more heavily. (This is sometimes called the Ramsey rule, after Frank Ramsey, who plays a major role in the final chapter of *The Big Questions*).

I'll give you the answer in a minute. The executive summary is that a) "Inelastically demanded goods should be taxed more heavily" is true only in very special circumstances; in general a much more complicated formula is needed, b) When all goods can be taxed, that complicated formula does in fact tell you to tax them all equally, and c) a lot of textbooks give incredibly misleading accounts of all this.

The more detailed answer follows; if you prefer a more mathematical account, click here. To keep things manageable, I've assumed all supply curves are perfectly elastic.

First, "inelastically demanded goods should be taxed more heavily" is a gross oversimplification of the Ramsey rule. To see why it can't be correct as stated, suppose you demand only two goods: Peanuts and root beer. You use your $20 income to buy 3 root beers, regardless of the price (at least as long as you can afford them) and spend the rest on peanuts. Then root beer is inelastically demanded. But it's crystal clear that as far as your behavior goes, a tax on root beer and a tax on peanuts are equivalent — either way, you'll keep right on buying 3 root beers plus as many peanuts as you can afford. In other words, no rule that says it's better to put a higher tax on root beer can be correct in this example.

The correct statement of the Ramsey rule places heavier taxes not on the goods that are inelastically demanded, but on those goods whose prices lead to the fewest distortions (in a sense that can be made precise) not just in their own markets but in others as well. If the price of root beer affects your peanut consumption, that goes into the calculation. If the price of butter affects your bread consumption, so does that.

If you'll forgive a little jargon, then, the correct statement is that the optimal mix of taxes depends on a very complicated formula involving not just own-price elasticities but cross-price elasticities. Only in very special circumstances does this reduce to the cartoon version that says "inelastically demanded goods should be taxed more heavily".

Second, once you write down the correct (quite complicated) version of the Ramsey rule, you discover that as long as all goods can be taxed, the Ramsey rule **does** tell you to tax them all equally. Thus it gives the same answer as the usual argument using indifference curves.

Third, if only some goods can be taxed, then it's not in general optimal to tax them all equally. The Ramsey rule (correctly stated) tells you how to tax them.

Fourth, leisure counts as a good. If you can't tax leisure (or equivalently subsidize labor) then it's not in general optimal to tax everything else equally. However, if labor is supplied inelastically (as the labor economists tell us is more or less the case) then the tax-everything-equally result is restored, even when leisure can't be taxed.

And fifth: A great number of elementary textbooks either get this wrong or present it so misleadingly that it might as well be wrong. Students beware.

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22 Responses to "Thursday Solution"

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1. 1 Andy
June 21, 2012 at 3:58 am

I feel duped… I got the impression that the two statements were to be taken as absolute truths, but I guess this was jus
the point that many economics courses are a bit crap ;)

2. 2 Bill Bethard
June 21, 2012 at 5:01 am

As an aside, Frank Ramsey was also the first Sixth Man in basketball and highly esteemed by his Cambridge-Boston (
Russell and A. "R." Auerbach.

3. 3 Harold
June 21, 2012 at 6:34 am

I am not sure if I have this, or my understanding is too simplistic.

The simple version of the Ramsey rule – tax inelastic goods more – I am OK with. This reduces deadweight loss because the little triangle in the supply / demand graph is smaller. The full version should include the effect on other goods – the cross elasticity – i.e. it should account for the increase in size of all the other little triangles. That seems fine.

If labor is inelastic, income is effectively fixed. If prices rise, people will not for whatever reason just work more to raise income to compensate.

When we include cross-price elasticities, we are in the root-beer and peanuts situation. Even perfectly inelastic goods will have high cross-elasticity; taxing them reduces consumption of other things proportionately. Equal taxation is optimum.

If labor were elastic, then we reduce the cross-elasticity with other taxed goods. In response to tax people have a choice. They can reduce leisure (increase income) and maintain consumption of the elastic goods, or reduce consumption and maintain leisure. With tax on the inelastic good only, if they choose to reduce leisure and maintain consumption, then there are no little triangles for the elastic goods as there is no tax on them. However, if we tax everything equally, then when they trade off between leisure and elastic goods, they are introducing the deadweight loss for the elastic goods. So taxing inelastic goods allows a trade off between leisure and goods without introducing distortions.

This is why taxing inelastic goods is best if everything cannot be taxed. Or is it?

4. 4 Ken B
June 21, 2012 at 9:56 am

Steve: Since you hit me with Euler-Lagrange before my morning coffee I feel justified in being a bit obtuse here. So some questions and complaints.

1. When M is square it is invertible iff it has nullity 0. You assert M has co-rank 1 but invert it. So what am I missing?

2. I think you should define Uj

3. What individual maximization? Ditto budget constraint.

4. You maximize sum Ti*Xi subject to U constant. From the puzzle I'd say the more natural understanding of "what's the best tax mix" is maximizing U given a fixed net tax revenue. How to make people best off given we need to raise N dollars. Am I missing an equivalence?

5.  5 Steve Landsburg
June 21, 2012 at 12:09 pm

Ken B: I don't know how that "corank 1″ comment slipped in there; I've deleted it.

As for 4, yes, you are missing an equivalence.

Individuals maximize U(X1,…Xn) subject to the constraint sum(PiXi) = Income, which is taken to be fixed.

6.  6 martin henner
June 21, 2012 at 12:28 pm

The analysis given seems to imply that all funds will be spent on goods. Whatever is left over after rootbeer is spent on peanuts.

But what if that is not the case, and the changes in price just leads to more or less money put into savings, rather than purchases.

7.  7 nobody.really
June 21, 2012 at 1:01 pm

Yea! Screw immigration; let's talk public finance.

> The correct statement of the Ramsey rule places heavier taxes not on the goods that are inelastically demanded, but on those goods whose prices lead to the fewest distortions (in a sense that can be made precise) not just in their own markets but in others as well. If the price of root beer affects your peanut consumption, that goes into the calculation. If the price of butter affects your bread consumption, so does that.
>
> If you'll forgive a little jargon, then, the correct statement is that the optimal mix of taxes depends on a very complicated formula involving not just own-price elasticities but cross-price elasticities. Only in very special circumstances does this reduce to the cartoon version that says "inelastically demanded goods should be taxed more heavily".

I'm not following this.

Does it make sense to talk about cross-elasticities of demand for things with inelastic demand? Imagine that peanut butter consumption has cross-elasticity with both jelly consumption (positively correlated) and baloney consumption (negatively correlated). As any parent knows, demand for peanut butter is inelastic. So if we tax peanut butter, consumption of it does not change (except due to income effects – that is, people simply cannot afford it anymore). Thus the tax would also not affect consumption of the things with which it has cross-elasticities (again, except for the result of the income effect).

So what is the consequence of taxing things with inelastic demand on things with ELASTIC demand? The demand for left shoes is cross-elastic with the demand for right shoes. If we increase the tax on peanut butter, the only effect on the demand for left and right shoes I can anticipate is the income effect.

Can anyone think of an example in which we increase the tax on something with an inelastic demand, and it leads to some distortion (other than a distortion related to the income effect)?

> If you can't tax leisure (or equivalently subsidize labor) then it's not in general optimal to tax everything else equally.

Is it possible to avoid the distortions of taxation by subsidizing (paid) labor to keep it as attractive as leisure, while also taxing (sold) goods? Again I confront the idea that we each have 24 hrs/day to spend, and that we

> However, if labor is supplied inelastically (as the labor economists tell us is more or less the case) then the tax-everything-equally result is restored, even when leisure can't be taxed.

First, we should acknowledge that the labor/leisure trade-off is not the only challenge in the effort to tax everything equally.

But more importantly, I wonder if we're again wandering into the "so misleadingly that it might as well be wrong" territory when we suggest that the supply of labor is inelastic. I understand that phrase to mean that we can't produce skills instantaneously to respond to increased demand. But this phrase does not refer to the supply of unskilled labor. Nor to the idea that, at that margin, taxes might discourage laborers (including skilled laborers) from working.

Believe me, I'd be only too happy to argue that we can tax labor without consequence to the labor supply, if only I could find support for that idea.

8.  8 Ken B
June 21, 2012 at 1:34 pm

@Steve:

re 4 “Individuals maximize U(X1,…Xn) subject to the constraint sum(PiXi) = Income, which is taken to be fixed.”

I still don’t see your equivalence. I am saying “it looks like you maximize tax revenue given a fixed value for U, but isn’t that backwards, aren’t we maximizing U given a fixed level of taxation?” To belabor:
It looks to me like you are maximizing the wrong thing. Your latest comment suggests your contraint problme is “U and sum Pi*Xi fixed, find max Ti*Xi” Mine is “sum Pi*Xi fixed and sum Ti*Xi fixed, find max U”
So why is your problem equivalent, or if different, the correct one?

9. 9 Neil
June 21, 2012 at 2:34 pm

The most general form of the Ramsey rule, and the one I like the best, is that the price effects of taxes (that is, the compensated effects) should result in an equiproportional reduction in the consumption of all taxed goods. In the case where the demands for taxed goods are independent this implies the inverse elasticity rule if leisure is not taxable and not fixed. But this statement of the Ramsey rule is more general because it holds when taxed goods are not independent as well. To me, it also expresses a more general form of tax neutrality. We know that tax systems reduce consumptions of taxed goods, and the general Ramsey rule says this reduction should happen uniformly across all taxed goods. If leisure is taxable or fixed, this uniform reduction can be accomplished by uniform tax rates. But it is the uniform effects of taxation on consumptions that is the general meaning of tax neutrality.

10. 10 nobody.really
June 21, 2012 at 3:30 pm

> We know that tax systems reduce consumptions of taxed goods, and the general Ramsey rule says this reduction should happen uniformly across all taxed goods. If leisure is taxable or fixed, this uniform reduction can be accomplished by uniform tax rates. But it is the uniform effects of taxation on consumptions that is the general meaning of tax neutrality.

To the extent that I understand this, I disagree with it.

As far as I can tell, the conceptually ideal tax is the lump-sum tax. This tax, as any tax, makes people poorer, but does not alter marginal cost price signals.

Now, how do I respond to price signals? That depends on my preferences and resources. If I’m rich, I may respond by eating steak; if I’m poor, I may substitute hamburger.

Compared to a hypothetical world in which I receive government services for free, I’m poorer in a world in which I must pay for government services. Would an efficient tax system prompt me to maintain the consumption patterns of a rich person, but reduced on a uniform basis to fit my new income (e.g., continuing to eat steak, but smaller steaks)? Or would it simply leave me with a lower income, and let me decide how to modify my consumption patterns to compensate (e.g., substituting hamburger for steak)? I propose the latter.

11. 11 Neil
June 21, 2012 at 3:54 pm

nobody.really

The optimal tax problem presumes lump-sum head taxes are not possible, and that taxes have to be levied on economic activities. Why else would we be asking about how tax rates should be set?

12.  12 Steve Landsburg
June 21, 2012 at 3:57 pm

Martin henner — think of savings as just another good

13. 13 nobody.really
June 21, 2012 at 4:06 pm

> The optimal tax problem presumes lump-sum head taxes are not possible, and that taxes have to be levied on economic activities.

I think of taxation on goods for which the demand is inelastic as the equivalent of a lump-sum tax, in that it extracts funds but does not distort marginal cost.

14. 14 Neil
June 21, 2012 at 4:11 pm

If there were a perfectly inelastic good, that is right and you'd get all your revenue from taxing it alone. The Ramsey problem applies to the case where goods have variable degrees of elasticity, not just the case where there is a good that is perfectly inelastic and the equivalent of a lump-sum tax is possible. In short, the Ramsey problem asks "how should we tax when lump-sum taxes are not possible?"

15. 15 nobody.really
June 21, 2012 at 4:25 pm

> In short, the Ramsey problem asks "how should we tax when lump-sum taxes are not possible?"

Great; that's a more interesting question anyway.

My main point was to question whether we should structure taxes in a way to defeat a person's natural tendency to substitute inferior goods for superior goods as taxes increase. Yes, an efficient tax will minimize the "distortion" in people's behavior caused by changes in marginal price signals. I'm not persuaded that substitutions due to wealth effects count as a distortion.

16.  16 Mike H
June 21, 2012 at 8:16 pm

@KenB

If I minimise x+y subject to fixing xy=1, I get x=y=1 (assuming x,y>0)

If I maximise xy subject to x+y=2, I get x=y=1. Same solution. The problems are equivalent.

In general, any problem of the form "optimise U subject to keeping T fixed" is equivalent to a problem of the form "optimise T subject to keeping U fixed" – the solutions are the same.

Or think about it this way. Suppose things aren't optimal. The tax department could look, and say "hey, we could change the tax rates, get more money, without hurting anyone!", likewise, the voter could say "hey, the government could change the tax rates, still have the same money, and we'd all be better off!"

If things are optimal, the tax department says "ok, if we want more money, we can't do it by shuffling tax rates without making the voters unhappy" and the voters say "ok, if we want better tax rates, we can't do it without worsening the deficit"

The optimal solution for maximising U subject to T is the same as the optimal solution for maximising T subject to U.

17.  17 Mike H
June 21, 2012 at 8:18 pm

@Steve

thanks for posting this puzzle and the solutions (technical and non-)

I learned something new this week :-)

18.  18 Steve Landsburg
June 21, 2012 at 8:31 pm

Neil: Your comment starting "The most general form of the Ramsey rule…." is terrific. Thanks for it.

19. 19 Ken B
June 22, 2012 at 8:55 am

@Mike H: Maximize the perimeter holding the area fixed. Cannot be done. Maximize the area holding the perimeter fixed: circle.

You can give the first problem a solution by adding constraints like convex shape and a maximum diameter, but the problems still don't give the same answer.

20.  20 Mike H
June 22, 2012 at 9:20 am

@Ken B

no, but "Minimize the perimeter holding the area fixed." can be done, and gives a circle.

For f=x+y and g=xy, at the optimum, for infinitesimal changes in x and y, as f goes up, g also goes up. Hence, minimisation on g is the same as maximisation on f and vice-versa.

For areas and perimeters, at the optimum, for infinitesimale changes in shape, as A goes up, P also goes up. Hence, minimisation of perimeters is the same as maximisation of areas, and vice-versa.

For tax take and utility, at the optimum, for infinitesimal changes in the tax rates, as T goes up, U goes down. Hence, maximisation of T is the same as maximisation of U.

If you want to analogise this problem into areas and perimeters, then maximisation of U (keeping -T fixed) is the same as minimisation of -T (keeping U fixed).

Or, if you prefer, write down the lagrangian for the two problems. On the one hand, you have T+aU. On the other, you have U+bT. Letting a=1/b, you see that the one problem is eqivalent to the other, unless a or b is 0.

21.  21 Al V.
June 22, 2012 at 11:45 am

So, thinking about real world application, perhaps the most inelastically demanded resource is (drum roll) health care. Is the implication that we should tax health care/health insurance at the same rate as other products?

If savings are just another good, then shouldn't we tax savings at the same rate? Doesn't that imply that capital gains should be taxed at the same rate as other income? From the perspective of a person making an investment, the investment is just a form of savings – a purchased good, where the good I am purchasing is the return on my investment.

22.  22 iceman
June 22, 2012 at 1:44 pm

Al V – I expect the answer on savings would be yes, absent an income tax. It seems an income tax is a sort of tax on all goods (whether optimal or not), including savings, and an additional tax on the return to savings distorts the intertermporal preferences.

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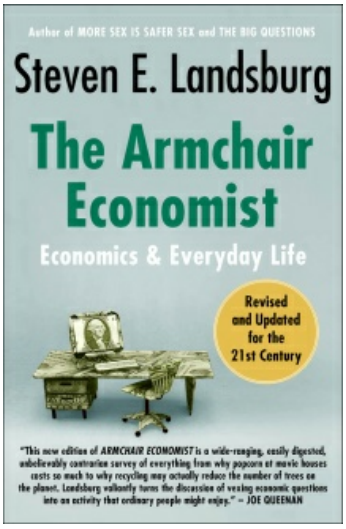

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