Discussion Paper

No. 47

February 1990

A Note On The Short Run Versus Long Run Welfare Gain From A Tax Reform

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Abstract

This note discusses the welfare implications of the phenomenon that the long-term response to a tax reform is often much stronger than the impact in the short run. As a polar case a beneficial revenue-neutral reform is considered whereby the tax is increased on the consumption of a commodity that is fixed in the short run, but flexible in the long run. The message of this note is that the welfare gain may be greater in the short run. The reason is that the larger long-term response can be socially undesirable because it represents a distortionary effect.

1   Introduction

There are at least two reasons why a tax reform may have long-run effects that differ from the short-run effects. There may be transition costs and administrative costs involved in implementing a tax reform. These costs will have an impact only in the short run. And the behavioural response of economic agents may be different in the long run than in the short run. In the present context I shall abstract from the former category, and focus on differences in economic behaviour.[1]

A typical case is that changes that are possible in the long run are not feasible in the short run. A striking example is the composition of capital. In the short run a stock of capital may be considered as fixed, determined by investment decisions of the past. A tax on the capital will have no immediate impact on the stock of capital, but will only affect the rate at which it is accumulated or allowed to depreciate, and hence the future stock of capital. Let us now have a case of this sort in mind. To make things simple we may think of the stock of capital as a durable consumption good, housing for instance. Our focus is then on the trade-off between this consumption and consumption of other goods, while we abstract from total savings. Assume that historically the tax on this category has been too low from the point of view of long-run optimum taxation taking the elasticities of long-run behaviour into account. A reform which increases this tax is therefore launched.[2] To isolate a pure change in the tax structure, other taxes are assumed to be adjusted to keep total tax revenue unchanged.

An interesting question is then whether the long-run or short-run benefit from the tax reform is the stronger one. A more specific reason why the question is interesting is that in many analyses the economic variables are assumed to adjust instantaneously so that there is no difference between the short-run and the long-run effect. This is usually the case when general equilibrium models are used to estimate the welfare gains from a tax reform. (For a survey of the use of general equilibrium models, see e.g. Shoven and Whalley (1984)). An equilibrium of a long-run type is assumed to be established immediately in the wake of the reform. This is a useful simplification. But it would also be useful to know whether the welfare gain is over- or underestimated. If the short-run effect on welfare is lower than the long-run effect, then clearly the welfare gain is overestimated if the long-run equilibrium is assumed to be effective immediately.

It seems that the long-run effect is often assumed to be the stronger one. The reason is that the purpose of a tax reform is to change the way in which economic behaviour is affected by taxes, and hence the allocation of resources. The new effects are believed to be less adverse than those of the old system. Then it is tempting to believe that if behaviour in the short run is changed less away from the initial one, welfare is also increased less in the short run. But this is a too simple argument.

To understand why, it is important to observe that even though the long-run response to the new tax system is less adverse than the long-run response to the old system, it is not clear that the long-run response to the new system is less distorted than the short-run response to this new system. And it is this comparison which is relevant when comparing short and long term welfare gains.

An analysis of this problem is presented in Section 2 and illustrated with a numerical example in Section 3. A brief concluding comment is given in Section 4.

2   An informal analytical discussion

A simple economic framework may bring out more precisely the structure of arguments. Let us assume that the problem is to choose the composition of consumption in each period. Assume further that there are three commodities. There is an untaxed commodity which is used as the numeraire. The quantity is denoted by x_0. There is a taxed commodity of which the quantity consumed, x_1, can be changed immediately. Finally, there is a taxed commodity of which the consumption, x_2, can only be changed in the long run. Let the unit tax rates be denoted by t_1 and t_2, respectively.

Let us suppose that initially commodity 2 has been taxed at a too low rate, while commodity 1 has been taxed too harshly as compared to the long-run optimum. A tax reform is launched whereby t_2 is changed immediately to the optimum value. One will then set the value of t_1 so that the government's tax revenue requirement is satisfied. For this purpose different values of t_1 are required in the short run and in the long run since the tax proceeds from commodity 2 will change over time as x_2 is adjusted. It will presumably be the effect of the tax reform to reduce the consumption of commodity 2. But this will only happen in the long run as x_2 is fixed in the short run.

Let us now consider the welfare effects that are relevant in the short run and in the long run. To start with it is useful to note that because of the taxes there is a distortion between x_1 and x_0 and between x_2 and x_0. The implication is that an *increase* in x_1 or x_2 at the expense of x_0 will *increase* welfare. Hence the *primary* purpose of a tax reform cannot be to reduce x_2, but rather to increase x_1. By assumption the initial distortion between x_1 and x_0 is too big while the distortion between x_2 and x_0 is too small by the standards of optimum *second best* taxation. It is by changing the relative distortions that a welfare gain can be achieved. Hence a welfare gain is obtained in the long run *not* because x_2 is reduced, but because x_1 will increase sufficiently to dominate the adverse effect of a reduction in x_2.

This latter effect is an inescapable part of the reform. The partially beneficial aspect of this effect is that when x_2 is reduced resources are made available for the desired increase in x_1.

In the short run the crucial thing is that some of the tax burden is shifted from x_1 to x_2 to stimulate x_1 without lowering x_2. Since x_2 remains at the higher level in the short run, the taxation of this commodity also contributes more to the tax revenue in the short run. This effect makes it possible to keep a lower tax on x_1 in the short run. Hence there is a stronger incentive for substitution from x_0 to x_1 in the short run, and because of the initial distortion this is a beneficial effect. It may now seem that the positive effects on welfare are always stronger in the short run since x_2 is not reduced and there is a stronger incentive to increase x_1. But we cannot be sure that the consumer's willingness to substitute x_1 for x_0 is as strong as when x_2 is allowed to vary. If there is a weaker response to a stronger incentive the net effect is ambiguous.

3 A numerical example

I shall present a very simple numerical example. A single consumer with a fixed endowment of resources is considered. The consumer is conceived of as the representative agent of a large population of homogeneous individuals. The resource endowment can be transformed into three different goods at constant rates of transformation. One good cannot be taxed while the two remaining goods are taxable. A unit tax is imposed on each of these goods. The goods are consumed in quantities x_0, x_1, and x_2, respectively. Com-

modity 0 is the numeraire which is untaxed. By proper normalizations the pretax prices of all three commodities are set equal to unity. The tax rates are denoted by t_1 and t_2 and the consumer prices by q_0, q_1 and q_2, where $q_0 = 1$, and

$$q_i = 1 + t_i \quad i = 1, 2. \tag{1}$$

The resource endowment is denoted by y and the tax revenue requirement by r. It follows that

$$y = x_0 + q_1 x_1 + q_2 x_2, \tag{2}$$

and

$$r = t_1 x_1 + t_2 x_2. \tag{3}$$

Preferences are assumed to be described by a Cobb-Douglas (direct) utility function

$$u = \alpha_0 \log x_0 + \alpha_1 \log x_1 + \alpha_2 \log x_2, \tag{4}$$

where the α's are positive coefficients and $\alpha_0 + \alpha_1 + \alpha_2 = 1$. The Cobb-Douglas specification is chosen to make the numerical example as simple as possible, but is not essential for the general conclusion of the analysis. The assumption of constant rates of transformation, implying that producer prices are constant, is also a simplifying assumption that I shall not comment on in this short note.

3.1   The initial and long-term situation

As usual in normative tax analysis optimization at two levels is considered. There is a private optimization and a government optimization. The private optimization is to maximize the utility function (4) subject to the budget constraint (2) taking consumer prices as given:

$$\max u \ w.r.t. \ x_0, x_1 \ and \ x_2 \ subject \ to \ y = x_0 + q_1 x_1 + q_2 x_2$$

This leads to the demand functions

$$x_i = \alpha_i y / q_i \quad i = 0, 1, 2, \tag{5}$$

and the indirect utility function

$$v = \sum \alpha_i \log \alpha_i + \log y - \alpha_1 \log q_1 - \alpha_2 \log q_2. \tag{6}$$

We may note that the consumer is not concerned with the tax revenue requirement. It is the responsibility of the government to set tax parameters and thereby prices so that the requirement is met.

Three situations will be considered. Initially the consumer is optimally adjusted to the initial tax system. Then a tax reform is carried out, and in the long run the consumer will respond optimally to an optimum tax system. The short run after the tax reform will be described below. The relation between the tax rates is written as

$$t_2 = \Theta t_1 + \Theta - 1, \tag{7}$$

so that

$$q_2 = \Theta q_1, \tag{8}$$

where Θ is a positive parameter. The initial tax system is characterized by a value of Θ equal to Θ^0 that is not assumed to be optimal. The optimum tax structure is the one that solves the problem of maximizing the consumer's indirect utility function subject to the tax revenue constraint (3):

$$\max v \ w.r.t. \ t_1 \ and \ t_2 \ s.t. \ r = t_1 x_1 + t_2 x_2 \ and \ (5).$$

As is well known the optimum tax system with the utility function (4) is characterized by uniform taxation so that $\Theta = 1$. (See e.g. Atkinson and Stiglitz (1980, lecture 12).)

Making use of (1), (2), (3), (5), (7) and (8), we find that

$$t_1 = \frac{r + \alpha_2 y(1 - \Theta)/\Theta}{(\alpha_1 + \alpha_2)y - r}. \tag{9}$$

Then t_2 follows from (7), and

$$q_1 = \frac{(\alpha_1 + \alpha_2)y + \alpha_2 y(1 - \Theta)/\Theta}{(\alpha_1 + \alpha_2)y - r} = \frac{y(\alpha_1 + \alpha_2/\Theta)}{(\alpha_1 + \alpha_2)y - r} \tag{10}$$

and

$$q_2 = \frac{(\Theta \alpha_1 + \alpha_2)y}{(\alpha_1 + \alpha_2)y - r}. \tag{11}$$

The values at the initial tax system and the optimum system are found by setting $\Theta = \Theta^0$ and $\Theta = 1$, respectively. In the latter case we find that the long-run utility level at optimum taxation is

$$v^* = \sum \alpha_i \log \alpha_i + \log y - (\alpha_1 + \alpha_2) \log \frac{(\alpha_1 + \alpha_2)y}{(\alpha_1 + \alpha_2)y - r}. \tag{12}$$

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3.2 Comparison with the short run

Now we want to compare this situation with the situation prevailing in the short run after the tax reform. The following assumptions are then made to distinguish between the short run and the long run. In the short run x_2 is fixed, while x_0 and x_1 can be adjusted instantaneously. This means that in the short run $x_2 = x_2^0$, which was the optimal value of x_2 under the initial tax system. From (5) and (11) we have that

$$x_2^0 = \alpha_2 y \frac{(\alpha_1 + \alpha_2)y - r}{(\Theta^0 \alpha_1 + \alpha_2)y} = \bar{x}_2. \tag{13}$$

Let the symbols nought, bar and asteriks indicate initial values, short-run values and long-run values of variables, respectively. By the tax reform the new long-run optimum value of t_2 is introduced, so that $\bar{t}_2 = t_2^*$. Since we consider a pure structural change with the tax revenue being the same in all periods, the short run value of t_1, $\bar{t}_1$, must be the one that satisfies the tax revenue requirement

$$r = \bar{t}_1 \bar{x}_1 + t_2^* x_2^0. \tag{14}$$

The tax rate $\bar{t}_1$ is a temporary one which is different from both t_1^0 and t_1^*.

With x_2 fixed the expenditure left for buying x_0 and x_1 is $y - q_2^* x_2^0$, and the consumer will maximize utility subject to this budget constraint. Hence the private optimization problem in this case is

$$\max u \;\; w.r.t. \;\; x_0 \; and \; x_1 \;\; s.t. \;\; x_0 + q_1 x_1 = y - q_2^* x_2 \;\; and \;\; x_2 = x_2^0.$$

It follows that the optimum value of x_1 is

$$\bar{x}_1 = \frac{\alpha_1(y - q_2^* x_2^0)}{\bar{q}_1(\alpha_0 + \alpha_1)}. \tag{15}$$

Also using that $\bar{q}_1 = 1 + \bar{t}_1$, (14) and (15) can be solved for $\bar{t}_1$ and $\bar{q}_1$, and we get

$$\bar{t}_1 = \frac{(\alpha_0 + \alpha_1)(r - t_2^* x_2^0)}{\alpha_1(y - q_2^* x_2^0) - (\alpha_0 + \alpha_1)(r - t_2^* x_2^0)} \tag{16}$$

$$\bar{q}_1 = \frac{\alpha_1(y - q_2^* x_2^0)}{\alpha_1(y - q_2^* x_2^0) - (\alpha_0 + \alpha_1)(r - t_2^* x_2^0)} \tag{17}$$

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Then from (15)

$$\bar{x}_1 = \frac{\alpha_1(y - q_2^* x_2^0) - (\alpha_0 + \alpha_1)(r - t_2^* x_2^0)}{\alpha_0 + \alpha_1} \tag{18}$$

and

$$\bar{x}_0 = \frac{\alpha_0(y - q_2^* x_2^0)}{\alpha_0 + \alpha_1} \tag{19}$$

Let us now consider the following numerical example:

$$
\begin{array}{llll}
\alpha_0 = 0.4 & y & = & 100 \\
\alpha_1 = 0.3 & r & = & 30 \\
\alpha_2 = 0.3 & \Theta^0 & = & 0.5
\end{array}
$$

Using (12) we get

$$v^* = 1.347 \text{ (when log } 10 = 1).$$

The short run utility level is

$$\bar{v} = \alpha_0 \log \bar{x}_0 + \alpha_1 \log \bar{x}_1 + \alpha_2 \log x_2^0.$$

Using the assumed numerical values,

$$
\begin{array}{llll}
q_2^* & = & 2 & \quad \bar{q}_1 & = & 1.636 \\
t_2^* & = & 1 & \quad \bar{x}_0 & = & 34.286 \\
x_2^0 & = & 20 & \quad \bar{v} & = & 1.363 \\
\bar{x}_1 & = & 15.72 &
\end{array}
$$

Thus the short-run utility level is higher than the long-run utility level. To obtain the same utility level in the long run an increase in the long run resource endowment of approximately 4 percent would be required.

4   Conclusion

This note has discussed some aspects of long-run effects as opposed to short-run effects of a tax reform. As example has been used the following case. A commodity is taxed too leniently by optimum second best standards. By a reform the tax is increased, but the quantity consumed is inelastic in the short run, while responding to the tax reform in the long run. Other taxes are

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adapted to keep total tax revenue constant both in the short run and in the long run. It was demonstrated that the favourable effect on welfare may very well be greater in the short run than in the long run. This may be a useful message as the opposite conclusion may appear more appealing to intuition. It is the purpose of a tax reform to change the allocation of resources. A short-term constraint on adjustments may appear undesirable from this point of view. On the other hand the private response to taxes is usually socially undesirable. This is in fact the basic reason for tax distortions. That the private response is constrained in the short run can therefore make it socially preferable to the complete adjustment that is possible in the long run.

The consumption bundle that each consumer is stuck with in the short run is not optimal from a private point of view when the consumer becomes free to change his consumption. This means that taking prices as given, the consumer can achieve a higher utility level by selecting a different consumption bundle. But when everybody does that, a different tax policy must be chosen to maintain the tax revenue, and prices will change. The consumer may then eventually find himself worse off when choosing the best available consumption bundle at the new prices. We should observe that this outcome is neither due to stupidity nor ignorance on the part of the consumer. Even if each consumer is perfectly aware of what will happen, it is not rational for each single individual to behave differently. The micro behaviour is perfectly rational when each consumer cannot influence the decisions of others. By unilateral action each consumer can only make himself worse off without preventing a suboptimal social outcome.

No general conclusion has been drawn about how short-run welfare effects of a tax reform compare with long-run effects. The special features of each reform have to be analyzed. The purpose has rather been to contribute to the general insight into the nature of second best tax reforms.

Footnotes

1. As a third catecory we might list the case in which the very purpose of the tax reform is to change the trade-off between the short run and the long run, for instance by encouraging savings. In that case the difference between the short run and the long run is trivial. The whole idea of the tax reform is that by sacrificing some consumption and welfare in the short run, a more than compensating gain will be attained in the long run. The concern of this paper is the allocation in each period rather than the intertemporal one. The focus is on the composition of capital and consumption.

2. Two alternative options might have been considered. The government might have declared that the tax will only be raised at some date in the future, and the economic agents would respond to that decision from now on. Such a tax reform would essentially be a preannounced future reform and would not entail the kind of distinction between the short run and long run that will be addressed in this paper. Even more important is that this is not the normal way a tax reform is introduced in practice even though the decision process and preparations may take some time.

   A different option would be to levy a temporary high tax, while announcing that the future tax will be set at a low rate. Such a policy would exploit the differences between short term and long term elasticities as prescribed by optimum tax theory. However, such a policy would neither be dynamically consistent nor credible.

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