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Income Taxes as Reciprocal Tariffs

by

W. Michael Cox, Research Department
Federal Reserve Bank of Dallas

David M. Gould, Research Department
Federal Reserve Bank of Dallas

Roy J. Ruffin, Research Department
Federal Reserve Bank of Dallas
and University of Houston

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W. Michael Cox
Federal Reserve Bank of Dallas

David M. Gould
Federal Reserve Bank of Dallas

Roy J. Ruffin
University of Houston and
Federal Reserve Bank of Dallas

Abstract

In this paper we show that there is a formal equivalence between the theory of tariffs in international trade theory and the basic theory of income taxation in a simple neoclassical model that allows for household production. Many insights from international trade theory can thus illuminate important aspects of public finance. Income taxes, which are like international tariff wars, dramatically reduce specialization within an economy. Income taxes (tariffs) hurt low income people (small countries) more than high income people (large countries). As in tariff theory, the costs of income taxes are small only if they succeed in raising revenue; thus it really hurts an economy to be on the downward portion of the tax revenue (Laffer) curve. Income taxes (tariffs) have more of a negative welfare impact the larger is the value of market income (trade) compared to total production (GDP) or, that is, the more heterogeneous the society.

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Income Taxes as Reciprocal Tariffs

The value of home production (excluding leisure) equals about one-third of measured output (Eisner, 1989, p. 56). Although the partial equilibrium analysis of household production has been subject to considerable analysis, beginning with Becker (1965), the general equilibrium treatment of household production and taxation has received very little attention. Boskin (1975) uses a two-sector model in which the household sector and the market sector both use capital and labor, but labor is untaxed in the household sector and capital is lightly taxed. Apps (1981) has used the analogy between models of household production and tariff theory to explore issues involving inequality between the sexes. Sandmo (1990) examines optimum tax structures in a Beckerian-style model of household production, but employs the assumption that households must make market purchases.

There is really no difference between the neoclassical treatment of home production in international trade theory and household production in the domestic economy. The purpose of this paper is to show the formal equivalence between the theory of tariffs in international trade and the basic theory of income taxation in a simple model of household production. Insights from trade theory may thus illuminate public finance and, perhaps, create a dialogue between these two venerable branches of economics. Unlike Apps (1981), Boskin (1975) and Sandmo (1990), we show that with sufficient taxation the entire output of the economy can be reduced to household production. We take the point of view that each agent can produce an array of goods, some of which are imported and some of which are exported. Which goods are "exported" or "imported" by the individual is determined by comparative advantage. With household production, some income is earned that is nontaxable. In the usual proof of equivalence between sales taxes and income taxes it is assumed that all consumption or

production is taxed.[2] Thus, in effect, we show the equivalence of sales taxes and income taxes when there is home production.

The advantage of our formulation is that we can highlight how taxes directly interfere with the division of labor. As pointed out by Sandmo, once household production is recognized production efficiency is no longer feasible because "taxes on households are in fact tariffs on their trade with the rest of the economy." (Sandmo, 1990, p. 89). It is well-known, of course, that income taxes shift production from market work to home production. For example, Sweden, a country with one of the highest marginal income tax rates in the world, is also a leader in time spent doing home improvements. Swedish men averaged over 4 hours per week doing home improvement activities in 1984. In contrast, men in the United States averaged 2.8 hours and Japanese men less than 1 hour (Juster and Stafford, 1991). The effect of taxes on the division of labor has been succinctly stated by the distinguished trade theorist, Ivor Pearce (1977):

> "The striking growth of do-it-yourself activity in recent years is neither an accident nor a change in basic preferences. Tax is avoided on work for self. Work for an employer is heavily taxed. The cheapest way to get something done is to do it yourself, contrary to the principle of the division of labour on which our high present standards of living depend. The whole structure of industry is deeply affected (Pearce, 1977, pp. 105-106)."

Once it is realized that income taxes are just like tariffs, the entire machinery of tariff theory can be brought into play. Income taxes (tariffs) hurt low income people (small countries) more than high income people (large countries). Income taxes, which are like international

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[2] See Mieszkowski (1967, p. 251) for a lucid statement of the equivalence between income taxes and sales taxes in a world without home production.

tariff wars, dramatically reduce specialization within an economy. As in tariff theory, the costs of income taxes are small only if they succeed in raising revenue; thus it really hurts an economy to be on the downward portion of the tax revenue (Laffer) curve. Income taxes (tariffs) should have more of a negative impact on welfare the larger is the value of market income (trade) compared to total production (GDP) or, that is, the more heterogeneous the society.

I. Income Tax Theory

Consider two agents, or households, 1 and 2, producing two goods, 1 and 2. Let x_j^i and c_j^i denote the output and consumption of good j by household i has the utility function

$$u^i(c_1^i, c_2^i), \tag{1}$$

and its production transformation function is

$$T^i(x_1^i, x_2^i) = 0. \tag{2}$$

We let $MRS^i = u_2^i / u_1^i$ and $MRT^i = -T_2^i / T_1^i$ denote the appropriate marginal rates of substitution or transformation in consumption and production. The market price of good 2 in terms of good 1 is p. Household i sells good i and buys good j ($i \neq j$).

Taxing household production or consumption is simply not possible. As a result, the government can only impose a sales tax (duty) or an income tax on transactions with the market. We now examine the effects of and income tax τ which levied ad valorem on each household as a proportion of its net dollar sales. Net dollar sales are market income. As a benchmark for the analysis, we assume that all income tax receipts, R_τ^i, are directly rebated back to each household by the amount paid to the government, but the household treats this as a lump-sum amount independent of any decisions it might make. This assumptions allows us to abstract

from the redistributive effects of fiscal policy and is a convienent starting point for evaluating income taxes.

We present the model in detail because this may be an unfamiliar formulation of income tax theory. The budget constraints of each household are:

$$R_\tau^1 + (x_1^i - c_1^1)(1-\tau) = p(c_2^1 - x_2^1) \tag{3}$$

$$R_\tau^2 + (x_2^2 - c_2^2)p(1-\tau) = (c_1^2 - x_1^2). \tag{4}$$

Household 1 chooses (x_j^1, c_j^1) to maximize the Lagrangian

$$\mathcal{L}^1 = u^1(\bullet) + \lambda T^1(\bullet) + \mu[R^1 + (x_1^1 - c_1^1)(1-\tau) - p(c_2^1 - x_2^1)],$$

which yields the first order conditions

$$MRS^1 = MRT^1 = p/(1-\tau). \tag{5}$$

Household 2 chooses production and consumption to maximize

$$\mathcal{L}^2 = u^2(\bullet) + \lambda T^2(\bullet) + \lambda [R^2 + (x_2^2 - c_2^2)p(1-\tau) - (c_1^2 - x_1^2)],$$

yielding

$$MRS^2 = MRT^2 = p(1-\tau). \tag{6}$$

The remaining equations are the transformation function (2) and market clearing:

$$\Sigma_i c_2^i = \Sigma_i x_2^i . \tag{7}$$

Now we rebate to each household the exact revenue collected by the government. Hence,

$$R_\tau^1 = \tau(x_1^1 - c_1^1) \tag{8}$$

$$R_\tau^2 = \tau p(x_2^2 - c_2^2). \tag{9}$$

Substituting (8) and (9) into (3) and (4), respectively, yields the tax-free budget constraints

$$x_1^i + px_2^i = c_1^i + pc_2^i. \tag{10}$$

Equations (2), (5), (6), (7), and (10) consist of nine equations and nine variables for determining for the levels of household production, consumption, and p.

II. Tariff Theory

This section summarizes the traditional theory of tariffs (see Jones, 1969; Ruffin, 1979) in a form that is useful for comparison with income tax theory.

Countries 1 and 2 produce goods 1 and 2. Country i exports good i. The world price of good 2 in terms of good 1 is p. The domestic relative price of good 2 is p^i. Country i imposes the ad valorem tariff rate t^i on the point-of-origin price (Lerner, 1936). Since country 1 imports good 2, the domestic price of good 2 is higher than the foreign price:

$$p^1 = p(1 + t^1). \tag{11}$$

Since country 2 exports good 2, the domestic relative price is lower than the world price:

$$p^2 = p/(1 + t^2). \tag{12}$$

Renaming households as countries we can use the same notation as before for describing utility in country i and production possibilities.

We make the usual assumption in tariff theory that all tax revenues are redistributed in lump-sum form to consumers. We could proceed as before, but we simply note that this assumption is automatically captured if the appropriate rates of substitution or transformation

are set equal to the domestic price ratio and the value of exports equal the value of imports at world prices or, equivalently, the value of production equals the value of consumption at world prices. Thus, the fundamental equations of tariff theory are:

$$x_1^i + px_2^i = c_1^i + pc_2^i \tag{13}$$

$$MRS^1 = MRT^1 = p(1 + t^1) \tag{14}$$

$$MRS^2 = MRT^2 = p/(1 + t^2) \tag{15}$$

$$\Sigma_i c_2^i = \Sigma_i x_2^i \tag{16}$$

$$T^i(\bullet) = 0. \tag{17}$$

Equation (13) describes the spending constraints, equations (14) and (15) set out the private optimization conditions, equation (16) gives the market clearing conditions, and equation (17) relates the supply constraints. There are nine independent equations [two each for (13), (14), (15), and (17)] to solve for the nine variables.

Table 1 compares the theory of income taxation with the theory of tariffs. It is obvious that they are formally equivalent provided

$$(1 + t^i) = 1/(1 - \tau). \tag{18}$$

Of course, the theory of tariffs can be interpreted as the theory of sales taxation if "countries" are interpreted as "households." Thus, we have proven that sales taxes are equivalent to income taxes even in the presence of household production.

Income taxes work heavily against home production because they act like reciprocal tariffs: on each "country" or "household" is imposed the same duty or tariff rate. Table 2 uses equation (18) to show the reciprocal tariff equivalents to different income tax rates. While a 10

percent income tax is the same is like a 11 percent reciprocal tariff, a modest income tax of 33.33 per cent is like a reciprocal tariff of 50 percent. A 50 percent income tax is like a 100 percent tariff! This suggests rather large anti-specialization effects of income taxation. Indeed, income taxes are the domestic counterpart of international tariff wars.

III. Welfare

In this section, we analyze the welfare implications of income taxes in the simple way economists examine tariff theory (see Jones, 1969). As a benchmark for the analysis, we maintain the assumption that all income tax receipts are directly rebated back to each household by the amount paid to the government. Let $E_j^i = c_j^i - x_j^i$ be household i's excess demand for good j. Use $p^i = MRS^i = MRT^i$ to denote household i's opportunity cost of good 2. Household i's change in real income is defined as

$$dy^i = dc_1^i + p^i dc_2^i. \tag{19}$$

Differentiating the budget constraint (10), using (19), and noting that along the production transformation curve $dx_1^i + p^i dx_2^i = 0$, we obtain

$$dy^i = (p^i - p)dE_2^i - E_2^i dp. \tag{20}$$

If household i is a net buyer of good 2 (i.e., imports good 2 because $p^i > p$), then the change in welfare is simply its personal dividend or profit, $(p^i - p)dE^i_2$, on extra purchases minus the increase in the cost of its old purchases, $E^i_2 dp$.

Several important welfare implications of income taxes can be derived from this relationship. The first, and perhaps most straightforward result, is that income taxes will have more of a negative impact on welfare the larger is the value of market income or, that is, the more heterogeneous the society. The more heterogeneous the society, the larger will be the

gains from trade (which means larger excess demands, E^i_2). Since $(p^i - p) = -\tau p$, from equation (20) we can see that, for a given income tax, larger excess demands ($dE^i_2 > 0$) will imply a larger welfare loss.

Another important implication is that an equal change in income taxes across all households will not necessarily affect everyone in the same manner. These differential effects can occur because a change in the income tax rate, τ, has an ambiguous effect on the terms of trade, p. As income taxes are increased, the terms of trade changes are ambiguous because the offer curves of both households shift in the same inward direction. If households are not identically different in terms of their production possibilities and preferences, then the terms of trade, p, will change as the offer curves shift inward at different rates.

Indeed, when households are not identically different, some households will experience an improvement in their terms of trade and, hence, will find their welfare increasing over a range of income taxes. In other words, just as a large country can gain at the expense of a small country by imposing an optimal tariff to improve its terms of trade, here some households may gain at the expense of other households. Income taxes are like a government sponsored tit-for-tat tariff war between households. The proof of this proposition is rather straightforward. Starting from zero income taxes, $(p^i - p)=0$, equation (20) shows us that an improvement in the terms of trade for household i ($dp<0$ and $E^i_2 > 0$ or, $dp>0$ and $E^i_2<0$) will enhance its welfare

$$dy^i|_{\tau=0} = -E^i_2 dp > 0.$$

And, working backwards from autarky, we see that welfare is increasing as taxes are reduced.

$$dy^i|_{E^i_2=0} = (p^i - p)dE^i_2 > 0.$$

Or, in other words, welfare is falling as we increase taxes and approach autarky. Consequently, since welfare is increasing as income taxes are raised above zero, but welfare is falling as income

taxes approach autarky levels, there must be an optimal income tax rate (for housholds with improving terms of trade) between autarky and free trade. Unlike a unilateral optimal tariff argument, however, where a large country can gain at the expense of a small country, here the country as a whole is made worse off because the terms of trade improvement for some households is more than offset by the terms of trade loss to the other households that experience a fall in their terms of trade. For the country as a whole there is no free lunch.

This result also has important and interesting implications for international trade theory. Any tit-for-tat trade war between unequally matched countries (no matter how small the difference may be) *will always be won by the larger country.* In fact, this result holds for any asymmetry between countries that generates a movement in the terms of trade. This is a more general result than that of Kennan and Riezman (1988). They show that a Nash trade war (each country acts as though the other country does not respond to its tariffs) will only be won by a *sufficiently* large country.

Another result is that increases in income taxes hurt the most when the economy is on the downward-side of the tax revenue (Laffer) curve. Without loss of generality, we can look only at household 2 where $(p^2 - p) = -p\tau$. Taxes paid (and rebated) to this household are $R^2 = (p^2 - p)E_2^2$. The change in revenue is

$$dR^2 = (p^2 - p)dE_2^2 + (dp^2 - dp)E_2^2. \tag{21}$$

Substituting (20) into (21) yields the basic equation

$$dy^2 = dR^2 - dp^2E_2^2. \tag{22}$$

Any increase in τ will reduce the net price of good 2 to household 2 when it sells the good in the market, so $dp^2 < 0$. Because household 2 is a net seller of good 2, its excess demand for the good is negative, so the second term in (22) is negative (the product of three

negatives). This shows that when there is any change in income taxes, and taxes payments are rebated lump-sum, then welfare can only increase if the lump-sum payment increases. In other words, increments in the income tax hurt the most when the economy is on the downward-side of the tax revenue function. If tax revenues are maximized, at say, τ = . 20, then doubling τ from .05 to .10 will have a smaller impact on welfare than increasing τ from .20 to .25.

III. Conclusion

Traditionally, income taxes have been seen as lowering society's output through the household's labor-leisure tradeoff. Income taxes lower the after-tax wage rate and thus encourage people to work less and enjoy more leisure. This traditional approach, however, ignores probably the most important way in which income taxes reduce society's output--by reducing specialization. Income taxes discourage individuals from specializing in activities that reflect their comparative advantage. They encourage everyone to avoid taxes and become a "jack-of-all-trades." Indeed it is likely that income taxes have their most damaging effects *not* by causing individuals to work less, but by causing them to work more in activities where their talents do not lie.

As long as it is necessary to raise revenue, there is really no way to avoid the autarkic tendencies of income taxes, sales taxes, or VAT taxes. The only solution would be to minimize them by lump-sum supplements to these anti-specialization taxes. But, as the experience of the Thatcher government in the United Kingdom illustrates, even small poll taxes are highly unpopular. Income taxes are thus likely to remain the primary source of government revenue.

Nevertheless, we must recognize and fully appraise the damaging effects that income taxes have on aggregate production and welfare. With home production equal to one-third of measured GDP, the relevant margin of substitution for households is evidently not only that

between labor and leisure, but also that between market and non-market forms of labor. By focusing on the labor-leisure issue (the slope of "the" labor supply curve) policy makers may have grossly understated the damaging effects which income taxes have on an economy.

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TABLE 1

TARIFF THEORY VS. INCOME TAX THEORY

Tariffs	Income Taxes
Different Equations	
$MRS^1 = MRT^1 = p(1 + t^1)$	$MRS^1 = MRT^1 = p/(1 - \tau)$
$MRS^2 = MRT^2 = p/(1 + t^2)$	$MRS^2 = MRT^2 = p(1 - \tau)$
Common Equations	

$$\Sigma_i c_2^i = \Sigma_i x_2^i$$

$$x_1^i + px_2^i = c_1^i + pc_2^i$$

$$T^i(x_1^i, x_2^i) = 0$$

TABLE 2

RECIPROCAL-TARIFF EQUIVALENTS TO INCOME TAXES

Income Tax Rate	Reciprocal Tariff Equivalent
.1	.11
.2	.25
.25	.333
.333	.5
.5	1.00

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