Corporate-income Tax Incidence with the Furman Ratio

Model includes noncorporate capital.

TheoryGuru applications

Background

Obama administration economists Furman and Summers claimed that only a fraction of the revenue loss from a corporate-income tax cut benefits labor. But the standard supply and demand model says the opposite.

Summers, as well as Nobel Laureate Paul Krugman, rejected this result, asserting that it depends on "what share of the capital stock is even affected by the corporate tax rate."

The supply and demand model readily accommodates the fact that the statutory corporate rate does not apply to much of the nation's capital. Here a machine proves the supply-demand result, without assuming any functional form for the aggregate production function, and without restricting the share of capital that is subject to the tax (except that the share cannot be zero or negative). *k* denotes the aggregate capital stock, which is a composite of capital *k1* that is subject to the statutory rate and capital *k2* that is not.

Setup

In[1]:=
```
Get@"http://economicreasoning.com"
```

In[2]:=
```
SetOptions[TheoryGuru, method → "Parallel"];
(* these proofs run quicker in parallel mode, if available *)
```

Definitions

In[3]:=
```
k = k1 g[k2/k1]; (* k is a homogeneous aggregate of k1 and k2 *)
```

In[4]:=
```
taxablesh = k1/(k1 + k2);
```

In[5]:=
```
laborincome[k1_, k2_] = f[k] - f'[k] k
```

Out[5]=
$$f\left[k1\, g\left[\frac{k2}{k1}\right]\right] - k1\, g\left[\frac{k2}{k1}\right] f'\left[k1\, g\left[\frac{k2}{k1}\right]\right]$$

In[6]:=
```
lrcapitalequilibrium = (1 - τ) D[f[k] - δ k1 - δ k2, k1] == D[f[k] - δ k1 - δ k2, k2] == ρ;
```

In[7]:=
```
signconditions = {δ > 0, ρ > 0, k1 > 0, k2 ≥ 0, f'[k] > δ,
    0 ≤ τ < 1, f''[k] < 0, g[k2/k1] > 0, g'[k2/k1] > 0, g''[k2/k1] < 0};
```

In[8]:=
```
revenue[τ_, k1_, k2_] := τ (D[f[k], k1] - δ) k1
```

In[9]:=
```
furmanratio[τ_, k1_, k2_] := "∂laborincome[k1,k2]/∂τ" / "∂revenue[τ,k1,k2]/∂τ"
```

Interesting but not necessary assumptions

In[10]:=
```
elasticcapitaldemand = D[x f'[x], x] > 0 (* i.e.,
    more capital means more aggregate capital income *) /. x → k
```

Out[10]=
$$f'\left[k1\, g\left[\frac{k2}{k1}\right]\right] + k1\, g\left[\frac{k2}{k1}\right] f''\left[k1\, g\left[\frac{k2}{k1}\right]\right] > 0$$

In[11]:=
```
wrongsideoflaffercurve = ∂revenue[τ, k1, k2]/∂τ ≤ 0;
```

Results

Taxation reduces:

the stock of taxed capital,
total capital services,
the share of capital that is taxable, and
the amount of labor income.

In[12]:=
```
TheoryGuru[{Dlrcapitalequilibrium/Dτ, lrcapitalequilibrium,
  Dρ/Dτ ≥ 0 == Dδ/Dτ (* the tax does not increase the willingness
   to supply capital or affect the depreciation rate *),
  signconditions},
 Dk1/Dτ < 0 ∧ Dk/Dτ < 0 ∧ Dtaxablesh/Dτ < 0 ∧ Dlaborincome[k1, k2]/Dτ < 0]
```

Out[12]= True

Taxation reduces labor income more than it increases revenue

```
TheoryDifficulty = 5; (* helps run faster by not searching for easy proofs *)
```

In[14]:=
```
TheoryGuru[{Dlrcapitalequilibrium/Dτ, lrcapitalequilibrium,
  τ > 0, Dρ/Dτ ≥ 0 == Dδ/Dτ, signconditions},
 D(laborincome[k1, k2] + revenue[τ, k1, k2])/Dτ < 0]
```

Out[14]= True

In the neighborhood of a zero tax rate, this comes from the effect (if any) of the tax on ρ

In[15]:=
```
TheoryGuru[{Dlrcapitalequilibrium/Dτ, lrcapitalequilibrium,
  τ == 0, Dρ/Dτ ≥ 0 == Dδ/Dτ, signconditions},
 SameSign[D(laborincome[k1, k2] + revenue[τ, k1, k2])/Dτ, -Dρ/Dτ]]
```

Out[15]= True

Either the Furman ratio exceeds one or the tax is not raising revenue

In[16]:=
```
TheoryGuru[{D[lrcapitalequilibrium, τ], lrcapitalequilibrium, τ > 0, D[ρ, τ] == 0 == D[δ, τ],
  signconditions, elasticcapitaldemand, Not[wrongsideoflaffercurve]},

 furmanratio[τ, k1, k2] > 1]
```

Out[16]= True

From the aggregate perspective, the tax increases the required rate of return

The stock-weighted average marginal capital-income tax rate is *taxablesh* τ, where *taxablesh* is the share of capital that is taxable.
In order to have comparable average-marginal rate effects, let *d*x be a policy that raises τ in inverse proportion to *taxablesh.*

If all capital were uniformly taxed (taxablesh == 1), then a compensated reduction in time preference $\frac{d\rho}{dx} == -\frac{\rho}{1-\tau\ \text{taxablesh}}$ would keep capital services constant

In other words, an increase in the average marginal capital-income tax rate, without exempting any capital income from it, has the same effect on *k* as increasing the rate of time preference by $\frac{\rho}{1-\tau\ \text{taxablesh}}$.

In[17]:=
```
TheoryGuru[{D[lrcapitalequilibrium, x], lrcapitalequilibrium,
  D[ρ, x] == -(ρ/(1 - τ taxablesh)), D[δ, x] == 0, taxablesh "D[τ, x]" == 1,
  signconditions, taxablesh == 1},
 D[k, x] == 0]
```

Out[17]= True

If some of the capital is exempt from tax (*taxablesh* < 1), and $\tau > 0$, then the above compensation is not enough to keep capital services constant.

In[18]:=
```
TheoryGuru[{dlrcapitalequilibrium/dx, lrcapitalequilibrium,
  dρ/dx == -ρ/(1 - τ taxablesh), dδ/dx == 0, taxablesh "dτ/dx" == 1,
  signconditions, taxablesh < 1},

 SameSign[dk/dx, -τ]]
```

Out[18]= True

Achieving the same increase in the average marginal capital-income tax rate with an uneven rate change has a greater effect *k*.

The same argument applies to labor income

In[19]:=
```
TheoryGuru[{dlrcapitalequilibrium/dx, lrcapitalequilibrium,
  dρ/dx == -ρ/(1 - τ taxablesh), dδ/dx == 0, taxablesh "dτ/dx" == 1,
  signconditions, taxablesh < 1},

 SameSign[dlaborincome[k1, k2]/dx, -τ]]
```

Out[19]= True

Variable interpretations