Local capital tax competition and coordinated tax reform in an overlapping generations economy

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ABSTRACT

We extend the classic capital tax competition model to an overlapping generations economy and study the effects of a coordinated reform where capital tax rates across all locations are increased to alleviate the policy externality. Welfare across generations is examined and several new effects are derived. Simulations calibrated to US data indicate these effects may be as large as the spending effect of the classic model. The initial old generation, however, may not be better off, and an additional transfer from the initial young to the initial old may be required for the reform to be a Pareto improvement.

1. Introduction

We extend the literature on the horizontal capital tax competition problem to an overlapping generations economy (OGE), where capital is accumulated and the economy may evolve along an expansion path that differs from the optimal path. Each local government (LG) competes for a mobile capital tax base over time and local public spending is too low because of the policy externality. The impact of a coordinated local capital tax rate increase on the economy in the short run, on the transition path, and in the long run steady state, is studied. We also derive several new welfare effects of the reform and provide a simple sufficient condition so that all generations are made better off as a result of the reform. We simulate the steady state of the model and calibrate it to US data. The results indicate the new effects can be of the same order of magnitude as the welfare effect derived from the classic capital allocation model. However, the initial old generation may be worse off since the interest rate falls in response to the reform. An additional transfer from the initial young generation to the initial old generation may be required for the reform to be a Pareto improvement.

The static capital allocation model of Zodrow and Mieszkowski (1986), Wilson (1986), and Wildasin (1988, 1989) is the workhorse model in the tax competition externality literature. There are a fixed number of locations and capital is mobile across locations, while labor is not. Consumers are endowed with a fixed amount of capital and some labor and firms use local capital and labor to produce output. Local governments impose a source-based tax on mobile capital, use the revenue to finance local spending, and essentially compete for the mobile tax base. The main result of the model is that local competition for mobile capital puts downward pressure on local public spending. In addition, welfare improves unambiguously because of a spending effect if all local governments raise their capital tax rate under a coordinated tax reform and increase local spending accordingly. Ceteris paribus. As a corollary, the coordinated tax rate increase is completely capitalized into the interest rate, which falls one-for-one with the tax rate, since the supply of capital is fixed. See Appendix A for a quick derivation of this result.

Krelove (1992) first extended these results to a two period setting where savings, and hence the supply of capital, is endogenous.

1 See Wilson (1999) and Wilson and Wildasin (2004) for summaries of the tax competition literature. The capital allocation model is quite popular and versions of the model still provide insight and intuition on a variety of issues.
2 A number of extensions of the classic model that can reverse the main results have been studied. For example, if some of the local tax burden can be exported to foreigners this may raise local public spending since some of the tax burden is shifted abroad. See the surveys in footnote 2. Sometimes the spending effect is labelled the tax base effect instead. If the budget is balanced, as is true in almost all analyses in this literature, and true for most states in the US, for example, it can also be thought of as a spending effect.
3 For recent work using the two period model, see Keen and Kotsogiannis (2002, 2003, 2004).
Consumers are endowed with some income in the first period and they save for the second period. In the second period they are endowed with labor which they supply in exchange for a wage. The saving of the first period becomes capital in the second period and consumers allocate their capital across locations at the beginning of the second period. Local governments impose their policy at the beginning of the first period taking into account the response of savings in the first period and the allocation of capital in the second period. Tax competition for the mobile base leads to lower public spending and a coordinated tax reform announced and implemented at the beginning of the first period will improve welfare because of the spending effect, but the reform is not completely capitalized if savings respond. It has not been pointed out, however, that if the reform comes as a surprise at the beginning of the second period, the supply of capital is fixed, and the results of the two period model revert to those of the one period model. The main welfare implication still holds, however; the spending effect unambiguously causes an improvement in welfare under a coordinated capital tax reform even if undertaken as a surprise at the beginning of the second period.

We extend these results to an OGE. First, we show that a tax reform involving a permanent, coordinated capital tax rate increase across all locations is completely capitalized into the interest rate in the first period of the reform since the supply of savings is fixed by past savings decisions, i.e., the interest rate falls one-for-one with the tax rate in the first period of the reform. Savings respond in the second period after the reform and the reform is no longer completely capitalized as the wage begins to fall. The interest rate and wage continue to fall on the transition path and in the steady state. In terms of the indirect welfare effects of the reform, the tax increase causes a wage effect, an interest income effect, and a future spending effect for the agent when old, in addition to the current spending effect when young that is comparable to the same effect in the static and two periods models. The interest income effect generally works in the opposite direction of the other effects. For the initial old generation there is only a positive spending effect and a negative interest income effect and their welfare may fall in response to the reform if the interest rate is produced by a well behaved, constant returns technology according to \( f(k_t) \), where \( k_t \) is capital per worker, and where a location subscript has been omitted. The private good can be converted into a local public good on a one-for-one basis and the public good does not confer any spillover effects across locations.

Identical firms produce the private good. The firm chooses \( k_t \) to maximize profit per worker, \( f(k_t) = (r_t + 6 + r_t)k_t - w_t \), where \( r_t \) is the real interest rate, \( \delta \) is the depreciation rate, \( r_t \) is the local source based capital tax rate, and \( w_t \) is the local wage. Thus, \( f_k(k_t) = df / dk_t = r_t + 6 + r_t = r_t \).

The response of the wage to the net user cost of capital is given by \( w_t = f(K(r_{nt})) - r_tK(r_{nt}) = W(r_{nt}) \).

The well-behaved utility function of the consumer is \( U^1(c_{1t}, c_{2t+1}, g_t, s_{1t}) \), where \( c_{1t} \) is consumption in the first period of life at time \( t \), \( c_{2t+1} \) is second period consumption, and \( g_t \) is the local public good available at time \( t \). Utility is additively separable so savings does not depend on the public good. Partial derivatives are denoted with a subscript, e.g., \( \partial U / \partial c_{1t} = U_{1t} \), and so on. The consumer’s budget constraints are \( w_t - c_{1t} - s_{1t} = 0 \) and \( (1 + \tau_{1t})k_t - c_{2t+1} = 0 \), where \( s \) is retirement savings. The consumer chooses consumption and savings to maximize utility subject to the budget constraints. The first order condition is \( U_1 = U_2 = (1 + r_t) \) and the solution is a savings function, \( S(w_t, r_{t+1}) \). Savings is increasing in labor income if consumption in both periods is a normal good, \( \partial s / \partial w = s_{nt} \geq 0 \). Savings is increasing in the interest rate if the substitution effect dominates, \( \partial s / \partial r = s_{rm} \geq 0 \). The indirect utility function of the consumer is defined as, \( v_t^2 = U(w_t - S(w_t, r_{t+1}, (1 + r_{t+1})S(w_t, r_{t+1}, g_t, s_{t+1}) = 0 \), and has the usual derivative properties. The marginal willingness-to-pay for the public good when young and old, respectively, is \( m^1_1 = U_{1t} / U_t \) and \( m^2_2 = U_{2t} / U_{2t} \).

There are \( N_0 \) initial old agents in the first period at each location. Each is endowed with \( s_0 \) units of capital, which is fixed at \( t = 1 \). Utility is represented by a well behaved function, \( u(c_{2t}, g_t) \). The indirect utility function is then given by \( u^2 = u(1 + r_{t+1})s_{2t} \), where \( s_{2t} = (1 + r_{t+1})s_{nt} \).

4 It is straightforward to show that if the cross partial derivative \( u_{g_t} \) is non-negative, consumption is a normal good. It follows immediately that savings is increasing in first period income and decreasing in second period income. This certainly follows for the additively separable case.

2. The model

Time is discrete and the economy lasts forever. There are \( J \) identical locations. Capital is perfectly mobile, while labor is not. \( N_t \) identical agents are born at each location at time \( t \), population grows at rate \( 1 + n_t \), each agent lives for two periods, and is endowed with one unit of labor in the first period, which is supplied to the labor market in exchange for a wage, \( w_t \). Output per worker of the private good at time \( t \) is produced by a well behaved, constant returns technology according to \( f(k_t) \), where \( k_t \) is capital per worker, and where a location subscript has been omitted. The private good can be converted into a local public good on a one-for-one basis and the public good does not confer any spillover effects across locations.

Identical firms produce the private good. The firm chooses \( k_t \) to maximize profit per worker, \( f(k_t) = (r_t + 6 + r_t)k_t - w_t \), where \( r_t \) is the real interest rate, \( \delta \) is the depreciation rate, \( r_t \) is the local source based capital tax rate, and \( w_t \) is the local wage. Thus, \( f_k(k_t) = df / dk_t = r_t + 6 + r_t = r_t \).

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There are \( N_0 \) initial old agents in the first period at each location. Each is endowed with \( s_0 \) units of capital, which is fixed at \( t = 1 \). Utility is represented by a well behaved function, \( u(c_{2t}, g_t) \). The indirect utility function is then given by \( u^2 = u(1 + r_{t+1})s_{2t} \), where \( s_{2t} = (1 + r_{t+1})s_{nt} \).

4 It is straightforward to show that if the cross partial derivative \( u_{g_t} \) is non-negative, consumption is a normal good. It follows immediately that savings is increasing in first period income and decreasing in second period income. This certainly follows for the additively separable case.
The supply of capital in the first period is fixed by the endowment of the initial old generation. This gives us the following condition for the initial old generation,
\[ \sum s_j = (1 + n) \sum K_j (r_1 + \delta + \tau_j). \] (3)
where the sum is across locations indexed by \( j \). For the young generation, equilibrium in the capital market for \( t \geq 1 \) must satisfy
\[ \sum \tau_j s_j W_j (r_t + \delta + \tau_j), r_{t+1} = (1 + n) \sum K_j (r_{t+1} + \delta + \tau_{j+1}). \] (4)

In a steady state equilibrium under symmetry we have the following capital market clearing condition,
\[ S(W(r + \delta + \tau), t) = (1 + n)K(r + \delta + \tau). \] (5)
At time \( t \), the social welfare function used by the LG at the representative location is \( \Omega = \nu^{-1} + \nu \). In a steady state this is equivalent to the representative agent’s indirect utility function, \( \Omega = \nu \). The LG’s budget constraint is
\[ \tau_j K(r_1 + \delta + \tau_1) = g_j. \] (6)

The LG chooses its policy to maximize social welfare subject to its budget constraint. All agents expect future governments to choose policy in the same manner.

We can define the equilibrium in the following way. A Nash policy equilibrium is an infinite sequence of interest rates \( \{ r_t \} \), and local government policies \( \{ \tau_j, g_j \} \), such that

i. The savings function \( S(W_j, r_{t+1}) \) solves the representative consumer’s decision problem for \( j = 1, ..., J, t = 1, 2, ..., \); ii. The capital demand function \( K_j (r_t + \delta + \tau_j) \) solves the decision problem of the representative firm and \( w_m = W_j (r_t + \delta + \tau_j) \) for \( j = 1, ..., J, t = 1, 2, ..., \); iii. The policy \( \{ \tau_j, g_j \} \) solves the LG’s decision problem and satisfies Eqs. (6); for \( j = 1, ..., J, t = 1, 2, ..., \); and iv. The capital market clears so Eq. (3) holds for the initial generation for \( j = 1, 2, ..., J \), and Eq. (4) holds for \( j = 1, 2, ..., J \), \( t = 1, 2, ..., \).

We will make the standard assumptions that a stable equilibrium exists and is unique.

A symmetric, steady state, Nash policy equilibrium is an interest rate \( r \), and a policy for the representative LG, \( \{ \tau, g \} \), such that: i. consumers behave optimally, as described above; ii. firms behave optimally, as described above; iii. the LG’s chooses their policies optimally, as described above; and iv. the capital market clears so Eq. (5) holds.

3. Optimal policy rules

It is instructive to derive the rules that characterize the first-best optimum in the long run. The social planner chooses the allocation to maximize social welfare \( \sum([1 + n] / [1 + \rho])U_j \), where \( \rho > n \) is the social discount rate, subject to the following resource constraint under symmetry,
\[ f(\kappa_1) + (1 - \delta)\kappa_1 = (1 + n)(\kappa_{t+1} - (c_{1t} + c_{1t} / (1 + n)) - g_t = 0. \]

The first order conditions in a steady state imply the following,
\[ m_1 + m_2 / (1 + n) = 1. \] (7a)
\[ f_k = n + \delta. \] (7b)
\[ U_1 / U_2 = 1 + n. \] (7c)

Eq. (7a) is the first-best rule governing the provision of the local public good. Eq. (7b) is the golden rule governing the long run growth path of the planned economy. Finally, Eq. (7c) is Samuelson’s (1958) biological interest rate result where intertemporal consumption is chosen so the marginal rate of substitution is set equal to the gross growth rate of the economy.\(^5\)

The rules governing the optimal second-best allocation in the long run will generally differ from those of the first-best for a number of reasons. The rule for the local public good will reflect the use of distorting taxes to finance public spending. The derivation is again straightforward and is given by the following formula in a symmetric, steady state, Nash policy equilibrium,
\[ m_1 + Rm_2 = (1 - \theta c_1)^{-1}, \] (8)
where \( \theta = \tau / n < 1 \), and \( c = - (r_0 / k)K_0 > 0 \) is the user cost of capital elasticity.\(^7\) This generalizes the result of Zodrow and Mieszkowski (1986) to include the benefit of the public good enjoyed by the young generation, or alternatively, the benefit enjoyed by the young when they are old discounted back to when they were young.\(^8\) Second, the decentralized economy may not evolve along the golden rule path. Third, the firm’s capital decision is distorted by the tax at the margin. Finally, there may be no mechanism that ties the interest rate to the gross growth rate, and hence, \( U_1 / U_2 = 1 + r - \theta < 1 + n \). As is well known, it is possible to accumulate too much capital in the OGE.

It is important to keep in mind that a policy that causes the path of the economy to shift may cause some generations to be made better off and some to be made worse off in the short run and the transition, as well as in the steady state. For example, the initial old generation may be made worse off if a policy reform causes a drop in the interest rate.

4. Response to the coordinated tax reform experiment

We assume the economy is in a symmetric, steady state, Nash policy equilibrium where \( g, \tau = 0 \) at each location and all LGs simultaneously raise their capital tax rate. The response of the economy to the reform is given by the following proposition.

Proposition 1. Consider a capital tax reform such that \( \Delta \tau_f = \Delta \tau_r > 0 \) for all \( j \) and all \( t \geq 1 \). The response to the reform is the following.

(i) The capital tax rate increase is completely capitalized into the interest rate in the first period, \( \Delta dr_t / \Delta \tau_r = -1 \), and the local wage rates in the first period are unaffected;
(ii) The interest rate and local wage rates fall in the second period and the tax reform is not completely capitalized;
(iii) The interest rate and local wage rates fall in the steady state and the tax reform is not completely capitalized in the long run;
(iv) The interest rate falls on the transition path but the magnitude diminishes. Wage rates also fall but the magnitude increases as the response converges to the steady state response. The tax reform is not completely capitalized on the transition path.

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\(^5\) See chapter two in de la Croix and Michel (2002) on optimality.

\(^7\) Estimates of the user cost elasticity by Caballero et al. (1995) using US data range from 0.01 to 2.0 depending on the industry. Hassett and Hubbard (2002) give a range of 0.5 to 1.0. Schaller (2006) estimates the long run user cost elasticity for equipment to be well above one in magnitude and essentially zero for structures using Canadian time series data and cointegration techniques. If \( \theta_c < 1 \), \( (1 - \theta_c)^{-1} > 0.5 \). Schaller's (1993) estimates are one in magnitude and still have the condition hold.

\(^8\) One important extension of the static model is to include a wage tax, assume that the wage tax cannot finance total local spending so that a tax on mobile capital is necessary. The following rule generalizes the rule in Eq. (8) to this case, \( m_1 = (1 - \delta) \theta c_{1t} - \theta c_{1t} / (1 + n) \) for the LG at location \( j \), where \( m_3 = \theta c_{1t} / (1 + n) \). Another interesting extension is to allow the LG to take into account its influence on the interest rate. The second-best rule in that case becomes \( m_3 = (1 - \delta) \theta c_{1t} - \theta c_{1t} / (1 + n) \). None of the comparative static responses or new welfare effects derived in Sections 4 and 5 below are affected by either extension. I am grateful to a helpful referee for these points.
This proposition combines the results of the capital allocation model and the two period extension and extends them to the transition path and the steady state. In the first period the supply of capital is fixed and the reform is completely capitalized, as in the capital allocation model. The local wage in the first period is unaffected as a result of the complete capitalization of the tax policy reform since the direct effect of the reform that works through the tax rate cancels the indirect effect that works through the interest rate. To see this note that the local wage is given by \( w_i := W(r_i + \gamma_i + \delta) \) and the response to the reform is \( dw_i / dr_i = - k(1 + dr_i / dr) \). The first term in parentheses is the direct effect while the second term in \( dr_i / dr \) is the indirect effect.

In the second period savings responds to the change in factor prices and the reform is no longer fully capitalized. This is similar to the two period model. In addition, the local wage falls as well, \( dw_2 / dr = - k(1 + dr_2 / dr) < 0 \) since \( 1 + dr_2 / dr > 0 \). These responses continue on the transition path as the economy converges to the steady state response. Both the wage and the interest rate fall in the steady state. It is shown in the Appendix that the response of the interest rate in the transition follows a first order difference equation that is easily solved to obtain

\[
dr_t / dr = dr / dr - (1 + dr / dr) B^{1-1},
\]

where \( dr / dr \) is the steady state response, and \( 0 < B = kS / D < 1 \). As \( t \) increases, the term in \( B \) decreases in magnitude and the sequence converges to the steady state response. We have the following result,

\[-1 = dr_t / dr < dr_2 / dr < ... < dr / dr < 0.\]

The response of the local wage is also negative on the transition path,

\[
dw_i / dr = - k(1 + dr_2 / dr) = - k(1 + dr / dr) \left( 1 - \theta^{1-1} \right) < 0.
\]

from Eq. (9). The magnitude of the response increases, however, as the sequence converges to the steady state response, giving us the following result,

\[0 = dw_1 / dr < dw_2 / dr < ... < dw / dr.\]

5. Welfare effects of the coordinated capital tax reform

In the Appendix, we derive the following proposition. All of the welfare responses are evaluated at the initial symmetric equilibrium. The focus is on the indirect effects that work through the interest rate since the direct effects drop out when use is made of the optimal policy rule and the envelope theorem is applied.

**Proposition 2.** Suppose the capital tax rate increases at all locations for all periods, \( dr_p = dr > 0 \) for \( j = 1, \ldots, J; t = 1, 2, \ldots \). If the following conditions hold

(i) \( \delta m_j > 1 + n \) for \( j = 1, 2, \ldots, J \); and for t = 0, 1, 2, ...; 

(ii) \( \delta m_j = 1 + n \) for \( j = 1, 2, \ldots, J \) in the steady state; when evaluated at the initial Nash policy equilibrium, then everyone in the initial young and old generations, generations on the transition path, and those living in the steady state, are better off as a result of the coordinated reform.

Let \( \Omega_j = U^0 + U^t \) represent social welfare in the first period of the reform. We derive the following formula in Appendix C depicting the initial impact of the reform,

\[
dU_1 / dr = k \left[ m_2^0\theta e - (1 + n) U_j^0 - k \left( m_1^0\theta e + 1 \right) \right] - \left( m_2^0\theta e - (1 + n) R(d_r / dr) U_j^0 \right),
\]

where the welfare effect of the reform on the initial old generation is captured by the first expression in Eq. (11),

\[
\left( 1 / U_j^0 \right) \left( du / dr \right) = k \left[ m_2^0\theta e - (1 + n) \right].
\]

The welfare effect of the reform on the initial old generation is captured by the first expression in Eq. (11),

\[
\left( 1 / U_j^0 \right) \left( du / dr \right) = k \left[ m_2^0\theta e - (1 + n) \right].
\]

The first term captures the future spending effect, \(- km^0\theta e (dr / dr) = km^0\theta e > 0\), while the second term, \( (1 + n) k (dr / dr) = (1 + n) k > 0\), captures the income interest effect due to the decrease in the interest rate in the first period of the reform. If condition (i) of Proposition 2 holds for \( t = 0 \) and all \( j \), the initial old generation is better off as a result of the reform. However, it is possible for this condition to be violated implying that the initial old generation is worse off because of the reform.

The welfare impact on the initial young generation is given by the second expression in Eq. (11),

\[
\left( 1 / U_j^1 \right) \left( du / dr \right) = k \left[ m_2^1\theta e + 1 - \left( m_2^1\theta e - (1 + n) \right) R (dr / dr) \right].
\]

The welfare effect of the reform when young and is positive. The second term, \(- k (dr / dr) = k\), captures the indirect effect of the reform on the local wage. When the reform occurs the wage responds according to \( dw_1 / dr = - k(1 + dr_1 / dr) \). The first term, \(- k\), is the direct impact of the reform while the second term, \(- k (dr / dr)\), is the indirect effect that works through the interest rate. The direct effects drop out of the welfare comparison when we apply the optimal rule for the public good, Eq. (8), leaving only the indirect effects. The intuition for the indirect effect is that a decrease in the interest rate favors capital relative to labor and causes the firm to increase its use of capital. This in turn raises the wage indirectly making labor and hence the young agent better off.

The second expression in Eq. (13) captures the future spending effect when old, \(- km^0\theta e R (dr / dr) > 0\), and the interest income effect for the young agent when he is old, \( k(1 + n) R (dr / dr) < 0\). It takes the sign of condition (i) of Proposition 2 for \( t = 1 \). If the condition holds for all \( j \), the initial young generation is better off because of the reform. However, it is possible for this condition to be violated. This reduces the welfare gain of the reform, and if the interest income effect is large enough, can reverse it.

Define \( \Omega_2 \) in the same manner as \( \Omega_0 \). It is then straightforward to derive the more general result for the young agent on the transition path,

\[
\left( 1 / U_j^1 \right) \left( du / dr \right) = k \left[ m_2^1\theta e + 1 \right] (dr / dr) + \left[ m_2^1\theta e - (1 + n) \right] R (dr / dr)\right].
\]

This captures the four effects mentioned earlier. The current spending effect, \(- km^0\theta e R (dr / dr)\), the wage effect, \(- k (dr / dr)\), and the future spending effect, \(- km^0\theta e R (dr / dr)\), are positive, while the interest income effect, \( k(1 + n) R (dr / dr)\), is negative. Condition (i) is sufficient to imply that welfare improves, although it is not necessary.

Finally, we have the steady state impact on welfare,

\[
\left( 1 / U_j^2 \right) (du / dr) = - k (m_1^0 + m_2^0) \theta e + (r - n) R (dr / dr).
\]

This includes the four effects mentioned previously, where we have combined the two spending effects and the factor price effects. By using Eqs. (1) and (7b), we can write the second expression in the factor price effects as

\[
k (n - r) R (dr / dr) = k \left[ f_k (k^0) - f_k (k^2) \right] + r] R (dr / dr).
\]

This captures the impact of the reform on savings and hence the long run steady state expansion path of the economy relative to the optimal path, \( k f_k (k^2) - f_k (k^2) R (dr / dr)\), and a distortion effect of the path due to the source based capital tax, \( k R (dr / dr)\). The distortion
effect is unambiguously negative. However, the path effect can be positive or negative depending on whether the economy is under or over capitalized relative to the golden rule path. The interest rate falls with the reform and this indirectly increases demand for capital. If the decentralized economy is under (over) capitalized, this effect is positive (negative).

6. Simulation results of the reform

In this section we simulate the symmetric steady state Nash policy equilibrium and the long run social optimum, and provide estimates of the terms in the welfare formula of Eqs. (15) and (16). We also provide some information on the welfare effects on the generations alive in the initial period of the reform as well. As it turns out, the initial young are better off because of the reform, while the initial old are worse off.

We assume utility is isoelastic, \( U = \left[ c_{t}^{1-\sigma} + \beta k_{t+1}^{1-\sigma} + \gamma g_{t}^{1-\sigma} + \left[g_{t+1}^{\sigma} + 1\right]/\left(\alpha\right)\right]^{1/\sigma} \), where \( \beta \in (0, 1) \) is the discount factor, and \( \gamma = 0 \) is the taste parameter for local public spending. The technology for production of the private good is Cobb–Douglas, \( y = AK^{\alpha}L^{1-\alpha} \). The parameters for the simulations are chosen to match several features of the US economy and local government spending.9 The basic parameters used in both sets of simulations are \( \alpha = 0.35, A = 5, \beta = 0.2813, \delta = 1, \gamma = 0.1799, \delta = 0.72, \) and \( n = 0.455 \). Labor's share of output is 0.65 because the product is in

\[
\begin{array}{c|c|c|c|c}
\hline
\text{Current spending effect} & \text{Wage effect} & \text{Future spending effect} & \text{Interest income effect} & \text{Total effect} \\
\hline
\text{Initial old} & 0.0684 & 0.0174 & -0.0958 & -0.0274 \\
\text{Initial young} & 0.0764 & 0.0158 & -0.0222 & 0.0159 \\
\text{Steady state} & 0.0563 & -0.0077 & 0.0158 & 0.0341 \\
\text{Steady state} & 0.0563 & -0.0077 & 0.0158 & 0.0341 \\
\hline
\end{array}
\]

There are several points of interest. The interest income effect dominates the current spending effect for the initial old generation making them worse off as a result of the reform. The initial young generation are better off, however. A simple transfer from the initial young to the initial old could easily be designed to make the initial old better off. Second, the magnitude of the new effects is similar to the current spending effect. Third, the capital tax distortion of the investment decision is small in magnitude. This is similar to results found by other researchers, e.g., Parry (2003) and Sorenson (2004). Fourth, the initial young in the second generation are also better off because of the reform. They experience a larger increase in welfare than the initial young generation for two reasons. First, they experience a positive wage effect, and second, the negative interest income effect falls in magnitude since the magnitude of the decline in the interest rate diminishes in the transition to the steady state. Finally, the agent living in the steady state is also better off, and the path effect contributes about 35% to the increase in welfare.

7. Conclusion

We extended the literature on tax competition to a dynamic overlapping generations economy where the LG in each country imposes a source-based tax on mobile capital to finance local spending. We studied the impact of a coordinated capital tax reform where all local governments raise their capital tax rate and spend the proceeds in an attempt to overcome the policy externality problem. A number of new effects are uncovered including a wage effect, an interest income effect, and a future spending effect, in addition to the spending effect in the current period. The factor price effects in a steady state can be reinterpreted as a distortion effect and a path effect comparing the expansion path of the decentralized economy to the long run optimum. We derive sufficient conditions such that all generations are better off with the reform. We calibrated the model to US data and discovered that future generations and the initial young generation are better off when the effects are combined. However, the initial old generation may be worse off due to the reduction in interest income when the reform is introduced. Capital tax coordination may require an additional transfer from the initial young to the initial old in order for the reform to be a Pareto improvement.

Appendix A. Capital allocation model and its two period extension

A.I. The capital allocation model

There are \( F \) identical locations, capital is mobile, labor is not, and the private good is produced by a CRS technology. Firms maximize profit and capital demand is \( K(r + \tau) \). The consumer is endowed with \( k \) units of capital. Utility is \( u(c, g) \), where \( c \) is private consumption, and \( g \) is a local public good. The constraint is, \( c = w + (1 + r)k \), where \( w \) is the local wage, and indirect utility is \( u(w + (1 + r)k, g) \). The LG's budget is \( \tau k(r + \tau) = g \). The equilibrium \( r \) is given by \( \frac{2k^{0.6}}{3(r + \tau)} \). This condition can be solved for \( r, r(r + \tau), \ldots, \tau \).
The LG chooses \((\tau, g)\) to maximize local indirect utility taking \(r\) as given. Hence, the rule for \(g\) is \(m = (1 - \beta c) - 1\), where \(m = u/c, \theta = \tau/\tau + \tau, \alpha = s = -(\tau + \tau)k/k\). This can be generalized to the case where LGs impose a wage tax, the wage tax cannot finance all local spending, and the capital tax is imposed because of this. The budget constraint is \(c = w(r + \tau)/1 - \alpha + \eta k^\theta\), where \(\alpha\) is the wage tax, and the government's constraint is \(g = r/k(r + \tau) + \alpha/\tau + \tau\). The rule becomes \(m = (1 - \alpha)/1(\alpha + \beta) + (1 + \beta)/\tau - \tau\).

Under a coordinated reform, \(dr/\tau = -\Sigma Kt/\Sigma Kt - 1\), under symmetry, for \(dr = 0\). The welfare effect of such a reform when \(r\) is taken as given and \(\alpha = 0\) is

\[
(1/\alpha)(dr/\tau) = (m(1 - \beta c) - 1 + (k^\theta - k + \eta k\eta)\eta (dr/\tau)k
\]

evaluated at the second-best, symmetric equilibrium where \(m(1 - \beta c) = 1 \text{ and } k^\theta = k\). This result is not affected if the LG takes into account its influence on \(r\) or uses a wage tax as long as the capital tax is used at the margin.

A.2. The two period extension

Consumers live for two periods. Each is endowed with \(k^\theta\) in the first period and one unit of labor in the second. If \(s\) is saved in the first period, \((1 + r)s\) is available in the second period. Utility is \(u(c_1) = b\mu(c_2) + u^G(g_2), c_1 = k^\theta - s\) and \(c_2 = w + (1 + r)s\). \(S(w, r, k^\theta)\) solves the consumer's decision problem. Indirect utility is \(u(k^\theta - S, w, r, k^\theta) + b\mu(w + (1 + r)s)S(w, r, k^\theta)\) solves the government's budget constraint. The equilibrium condition is \(s^1 = \Sigma Kt/\Sigma Kt\). The response to the reform, \(dr = \tau - 1\), is \(dr = -1 + S_t / (1 - kS_t - K_t)\). Complete capitalization only occurs if savings does not respond to \(r\). The second-best rule for the public good and the welfare effect of a coordinated reform in the first period is the same as in A.1. Under symmetry if the reform occurs as a surprise at the beginning of the second period, \(\Sigma k^\theta\) is fixed and the response reverts to the same as in A.1, \(dr/\tau = -1\).

Appendix B. Response to the capital tax policy reform in the OGE

B.1. Initial response to the reform

Eq. (3) for \(t = 1\) determines \(r_t\). Under symmetry, \(dr_t/\tau = -1\), and \(w_1\) is unaffected by the reform, \(dw_1/\tau = -k(1 + dr_t/\tau)/\tau = 0\). The young in the first period face Eq. (4) for \(t = 1\). Differentiate and solve,

\[
dr_t / \tau = -1 + S_t / D - 0. \tag{B1}
\]

where \(D = S_t - (1 + n)K_t > 0\), and where we have used \(dr_t/\tau = -1\). It follows that \(0 < S_t / D < 1 < K_t\). When \(S_t > 0\), it also follows, \(1 = dr_t/\tau < dr_t/\tau = 0\). The wage rate in the second period, \(W(r_2 + \sigma + \tau_2), \) responds according to \(dr_2 / \tau = -k(1 + dr_t/\tau) = -kS_t / D < 0\), where we have used \(w_2 = k\).

B.2. Steady state response

To derive the steady state responses, totally differentiate Eq. (5) to obtain,

\[
dr / \tau = \tau((1 + n)K_t + kS_t)/E = -1 + S_t / E < 0. \tag{B2}
\]

where \(E = D - kS_t\). The steady state is stable if \(E < 0\). Since \(D > E\), we have, \(dr_t/\tau < dr_t/\tau < 0\). The local wage \(w = W(r_2 + \sigma + \tau)\) responds to the reform according to

\[
dw / \tau = -k(1 + dr_t/\tau) = -kS_t / E < 0.
\]

B.3. Transition response

Differentiate Eq. (4) and rearrange, \(dr_{t+1}/\tau - B(dr_t/\tau) = A\), where \(A = ((1 + n)K_t + kS_t)/D = (S_t - E)/D \) and \(B = kS_t / D < 1\). Solve to obtain,

\[
1 / (1 + n) A = 1 / (1 - B) + ((dr_t/\tau - A) / (1 - B))B^{-2} < (dr / \tau) + ((dr_t/\tau) - (dr_t/\tau)B^{-2}) \%
\]

from Eq. (B2). Using Eqs. (B1) and (B2),

\[
1 / (1 + n) A = (1 - B^{-1}) - 1.<dr_t/\tau < \ldots < dr_t/\tau < 0.
\]

Since the wage responds according to

\[
dw / \tau = -k(1 + dr_t/\tau) = -k(1 + dr_t/\tau) < (1 - B^{-1}) < 0,
\]

from Eq. (B3). Thus, the wage decreases and the response increases in magnitude as it converges to the steady state response, \(dw_1/\tau = 0 > dr_2 / dr_2 > dw_3 / dr_3 > \ldots > dr_2 / dr_2\).

Appendix C. Welfare effects of the coordinated local capital tax reform in the OGE

C.1. Initial generations

The per capita sum of the utility of the agents alive in the first period of the reform is, \(\Omega_t = (U^0 + U^1)\). Substitute the LG’s budget constraint for \(g_1\) and \(g_2\) into \(\Omega_t\) and differentiate,

\[
d\Omega_t / dr_t = \left(U^1 + U^1 + \frac{1}{2}K_t + s^1U^1 + U^1 - U^1, (dr_t/\tau) + \left(s^1U^1 + U^1, K_t (dr_t/\tau)ight)\right).
\]

where it is recalled that \(1 + dr_t/\tau = 0\), and where we have used (BBB). Use the definitions of \(\theta, \varepsilon, m^{1-2}, \) and \(m^{1-2}, dr_t/\tau = -1\) and note that \(s_0 = (1 + n)K_t\), to obtain,

\[
d\Omega_t / dr_t = \{m^{1-2}, \theta, 1\}U^1 + \frac{1}{2}U^1 - 1 + n\}U^1 = \Omega^1 + \{m^{1-2}, \theta, 1\}U^1.
\]

The initial old agent is affected according to

\[
1 / (U^0) \left(du^0 / dr_t\right) = \left(k(1 + n) - m^{1-2}, \theta, 1\right)(dr_t / \tau),
\]

while the young agent is affected as

\[
1 / (U^1) \left(du^1 / dr_t\right) = -k\{m^{1-2}, \theta, 1\}(dr_t / \tau) - \left(k(1 + n) - m^{1-2}, \theta, 1\}R(dr_t / \tau) / \tau^2
\]

C.2. Welfare effects on the transition path

Define \(\Omega_t\) in the same manner as \(\Omega_t\). It is then straightforward to derive the more general result,

\[
d\Omega_t / dr_t = \{m^{1-2}, \theta, 1\}U^1 - 1 + n\}U^1) (dr_t / \tau) + \left(k(1 + n) - m^{1-2}, \theta, 1\}U^1 (dr_t / \tau)
\]

The old agent at time \(t\) is affected according to

\[
1 / (U^2) \left(du^2 / dr_t\right) = \left(k(1 + n) - m^{1-2}, \theta, 1\right)(dr_t / \tau),
\]

while the young agent is affected as

\[
1 / (U^1) \left(du^1 / dr_t\right) = -k\{m^{1-2}, \theta, 1\}(dr_t / \tau) - \left(k(1 + n) - m^{1-2}, \theta, 1\}R(dr_t / \tau) / \tau^2
\]
C.3. Steady state welfare effects

Per capita steady state welfare is given by \( \Omega = U \). Differentiate

\[
\frac{dU}{dr} = (U_1 + U_4)\tau K_r - kU_1 + sU_2)(dr/dr).
\]

We can write this as,

\[
\frac{1}{U_1}(\frac{dU}{dr}) = -k \left( (m_1 + Rm_2)\theta c + 1 - (1 + n)R \right)(dr/dr)
\]

\[
= -k \left( (m_1 + Rm_2)\theta c + (r - n)R \right)(dr/dr).
\]

References


