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BeneÂĚfit Charges for Firms and Households for Maintenance of The Legal System

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Abstract

We present an aggregate four good model (consumption, investment and two government goods) in which the current flows of one government good are in part pure public intermediate goods. The other public goods has "final" services for households. We are interested in a benefit approach to charging for government services that includes government services flowing directly to firms. The legal system is our representative intermediate public good and benefit charges to firms should include part of the maintenance of the legal system.

- key words: public goods (intermediate); government charges for firms; cost of the legal system
- classification: H410; H190; H290; L23

1 Introduction

Suppose we were to role back the clock to an earlier century and then reflect on the flows of services from government. It is not unreasonable to reduce the service flows to two currents: protection of the residents from foreign invasion and associated violence (national defense) and protection of the state from internal disorder (from theft, fraud, sexual and family violence, muggings, and workplace disorder and violence). These are two fairly distinct flows of services which in modern parlance are two fairly distinct public goods. The first ("defense" of the state) might be said to benefit households principally. Defense can then be viewed as a final public good, a flow of services "consumed" by households. The second however involves consumption by firms or producers to a large extent. Firms need contract enforcement, dispute-resolution and protection of their buildings, machines and patents. Firms also need a legal framework with well-understood sanctions that sustains peace between managers and workers. Within the state then, "law and order" or the services of the legal system is a public good heavily "consumed" by firms and a lesser extent by households. Thus a minimalist theory of government would have government services as represented by two public goods, produced by government, "defense" consumed as final by households (the Samuelson (1954) formulation of an economy with public goods) and "contract enforcement and public order" with large benefits to firms and some benefits directly to households.[1] This makes "contract enforcement and public order" a public good that is significantly intermediate, "consumed" by firms, and only partly final when it is "consumed" by households. The point of this paper is to explore, largely in the abstract, a world in which both firms and households are joint consumers of "contract enforcement and public order", a public good of a Samuelson sort, under a benefit charging scheme. We view such a world as quite distinct from the traditional Samuelson one in which a public good is supplied only to households as a final good. The consumption of "contract enforcement and public order" with a large benefit stream to firms means that firms should be viewed as legitimate tax-revenue sources, jointly with households. Business or corporate taxes should not be viewed as back-door revenue streams but legitimate sources of revenues, along with "final" income earners.

We fill in the details of this "different economy" below. When we move up in our imaginations from the earlier times, we of course see gov-

[1] *Economist* May 5, 2011: "Spending on legal services grew from 0.4% of America's GDP in 1978 to 1.8% in 2003. The legal business grew four times faster than the economy."

ernments responsible for providing for much schooling for children; for providing sewers, roads, canals, ports and airports; and for co-ordination of protection against easily transmittable diseases.[2] Many governments in advanced nations also co-ordinate R&D activity that has some link to national defense. Schooling for children clearly benefits the children directly involved but the schooling also benefits firms which can count on workers with basic reading and numeracy skills. Schooling also enhances the stock of civic virtue which probably reduces social conflict and disorder. And the provision and maintenance of roads, canals, ports and airports no doubt benefits firms in a major way. In short, a more contemporary view of the role of government still suggests that firms are significant beneficiaries of government services. In a framework in which payments for government services are based on marginal benefits, there seems to be a role for large revenue streams to flow directly from firms to the government, qua supplier. However, we choose to focus on benefits to firms which are taken as a component of the "joint maintenance of the legal system".

Online[3], we learn that 40% of revenue accruing to law firms in the US derives from work for businesses rather than households. This 40% is net of work in the criminal sector which could of course include some work for businesses as well. Much of the legal activity in question would be private to agents, namely the hiring of lawyers and their staffs[4]. When a firm or household has a problem, it customarily engages a lawyer or

[2] It is not difficult to infer that the services associated with primary schooling and the provision of sewers, roads, canals, ports and airports are significantly private rather than public in the sense of joint consumption and could be charged to particular individuals and firms as with charging for the consumption of private goods like apples and books. Many essentially private goods get charged for indirectly because it is costly to set up systems for charging users directly. Roads are a good example.

[3] *Legal Finance Journal*, "Industry Resources and Statistics"

[4] *The Economist*, Sept. 3, 2011, cites and Brookings study: "They reckon that of the $170 billion spent on lawyers every year in America, some $64 billion is a premium produced by market distortions. The economy suffers another $10 billion in annual “deadweight” loss—economic activity stifled or deterred by the cost of the system."

law firm to assist in fixing the problem. The private part of the legal activity occurs in an framework of laws, juries, judges and enforcers and this environment is very much a public good that a plaintiff or defendent "consumes" when he or she pursues a problem via the "legal system". In fact this legal system can have an option value. The system is there when an agent needs to use it. One might view the lawyers as interacting on a stage with the legal system, clerks, legal writings, juries, judges and enforcers, as scenery. It is this latter that is the public good. Lawyers and assistants are private goods, paid for by plaintiffs and defendents. Hence the complete legal system comprises two distinct parts: one a private good and one a public good. It is clearly very difficult to quantify how much of the "legal system" *qua* public good one is "consuming" when one takes a problem to be sorted out within "the legal system". One pays for one's lawyer plus often "court costs". The latter would be a partial payment for supporting "the legal system". Nevertheless, it seems clear that the flow of services from "the legal system" is in part a public good in the Samuelson sense of being jointly consumed by many in a society. And when firms or businesses are "consuming" the services of "the legal system", they are "consuming" what is to households downstream, an intermediate good. The value of legal services, "consumed" by a firm gets embodied in the price of the good which the firm is producing and selling to households. "The huge costs of our legal system create an average "litigation tax" of 2.5 percent on every product we buy. The tab for our out of control legal system comes to about $1,200 per person per year.This figure is much higher for some products, such as step-ladders (30 percent) and vaccines (95 percent) that tend to attract lawsuits. The cost of litigation doubles the price of a football helmet, will add $500 to the sticker price of your next new car, and pumps up the cost of a heart pacemaker by $3.000." (Klayman (2002)). Another analysis by *The Economist* has an estimate of an 8%

markup on prices on average in the US to account for the legal costs to firms of doing business.[5]

We take up three simple, dynamic models in detail. First we take up the case of three goods: a consumption good, an investment good and a public good that is intermediate to households or "final" to firms. This is a version of the McMillan case.[6] We then present the Samuelson case with the public good consumed only by households. Thirdly, we take up a model with one public good that is jointly final to households and intermediate (final to firms; services of "the legal system"). We solve the first and third models numerically and in so doing provide a complete picture of each possibility.

In addition to our presentation of our models and the solution of each, we spend time with the national accounting representation of our model. This brief excursion allows us to make the case for a large-scale revision in the current practice of treating government in our modern economies and government in the national accounts, as the accounts are currently constructed.

2 The Model (intermediate public good)

There are three sectors, each operating under constant returns to scale:

$$q_C = f(K^C, N^C, q_G)$$
$$q_I = g(K^I, N^I, q_G)$$
$$q_G = h(K - K^C - K^I, N - N^C - N^I)$$

where K and N are current endowments to the economy of durable capital and labor. K^C and N^C are capital anc labor currently used in

[5] http://commitmentmatters.com/2011/08/08
/world-economic-crisis-the-us-legal-system
-is-a-target-for-reform/

[6] McMillan made quite extensive investigatiions of government flow supply as a public intermediate good. See McMillan, John (1978), Manning, Richard and John McMillan, (1979), and Manning, Richard, James R. Markusen, and John McMillan (1985). Early on McMillan was inspired by the work of Meade (1952) who discussed the introduction of costly "atmosphere" into economics models.

the consumer goods sector. q_G is the flow of government services. q_G is produced with the services of capital and labor and is "consumed" as an input by firms in the consumer and investment goods sectors. There are corresponding uses by the investment and government production sectors.

The price of consumption goods is set at unity.[7] Input-use efficiencies and prices are defined in

$$
\begin{aligned}
\frac{MP_K^C}{MP_N^C} &= \frac{MP_K^I}{MP_N^I}, \\
\frac{MP_K^C}{MP_N^C} &= \frac{MP_K^G}{MP_N^G}, \\
r &= w\frac{MP_K^C}{MP_N^C}, \\
q_C &= rK^C + wN^C + q_G MP_G^C \\
p_I q_I &= rK^I + wN^I + p_I q_G MP_G^I \\
p_G q_G &= r[K - K^C - K^I] + w[N - N^C - N^I]
\end{aligned}
$$

where r is the rental rate on a unit of K and w is the wage rate; p_I and p_G are respectively prices for a unit of investment good and government good. $\frac{MP_K^C}{MP_N^C}$ is the ratio of the marginal product of K in the production of consumption goods and the marginal product of N in the production of consumption goods. $\frac{MP_K^G}{MP_N^G}$ is the ratio of the marginal product of K in the production of government goods and the marginal product of N in the production of government goods. This analogous ratio is defined for the production of investment goods in $\frac{MP_K^I}{MP_N^I}$.

Demand equals supply for investment goods in

$$s[q_C + p_I q_I] = p_I q_I$$

where s is the exogenous savings rate. Observe that savings is based on FINAL demand. Intermediate goods do not enter the terms in square

[7] We could introduce a money demand relation and a money supply and endogenize the values of all prices, including one for a unit of consumer goods.

brackets. Demand equals supply for government output in $p_G q_G = q_G MP_G^C + q_G p_I MP_G^I$, or

$$p_G = MP_G^C + p_I MP_G^I. \tag{1}$$

This latter is the Samuelson condition for government product as an intermediate input rather than as a final goods flow to households.[8]

(We have not broken total product of each sector into product flow per firm in the respective sector. Clearly such a disaggregation is complicated in a model with each firm assumed to be producing under constant returns to scale. Thus in the absence of actual firms, our Samuelson condition is functioning as if each sector is operating with one giant firm producing under constant returns to scale. If there were for example α identical firms in the consumer goods sector and β identical firms in the investment goods sector, our Samuelson condition would emerge as $p_G = \alpha MP_G^i + p_I \beta MP_G^j$ where MP_G^i would be the marginal product of q_G for a firm in the consumer goods sector and MP_G^j would be the marginal product of q_G for a firm in the investment goods sector.)

Our model comprises 11 equations in q_C, q_I, $q_G, K^C, K^I, N^C, N^I, r$, w, p_I and p_G. The model, as an equilibrium system (the economy of a nation at a point in time), can be represented by the following accounting matrix (Table 1: row entries sum to the corresponding entry in the right column and column entries sum to the corresponding entry in the bottom row. Values for our numerical solution, reported on below, are in brackets.)

[8] Sandmo (1972) developed these "Samuelsonian" charges for firms consuming a public good as an intermediate input. Manning, Markusen and McMillan (1985) developed a charging scheme for public inputs as "atmosphere" and argue that Sandmo's approach fails for their case.

Table 1: ACCOUNTING MATRIX

$\frac{rK^C}{(0.706)}$	$\frac{wN^C}{(3.53)}$	$\frac{q_G MP_G^C}{(2.82)}$	$=\frac{q_C}{(7.059)}$
$\frac{rK^I}{(2.12)}$	$\frac{wN^I}{(0.303)}$	$\frac{q_G p_I MP_G^I}{(0.605)}$	$=\frac{p_I q_I}{(3.025)}$
$\frac{r[K-K^C-K^I]}{(2.126)}$	$\frac{w[N-N^C-N^I]}{(1.304)}$	$\frac{-p_G q_G}{(-.3.43)}$	$=0$
$=\frac{rK}{(4.95)}$	$=\frac{wN}{(5.14)}$	$=0$	

The sum of the entries in the right column is national product in numeraire units and the sum of the entries in the bottom row is current national income, also in numeraire units. (We have entered the numerical values for each expression, values solved for in our numerical run, reported below.) Clearly, the representation of an economy in the table is a large departure from conceptions derived from current practice. Current practice has government product a final good with the value of government services appearing explicitly in the value of aggregate final product. Most of the charges for government product are represented by taxes on households. In our table, all government product is intermediate and as such should be charged for to firms in the private sector. Our prices or charges for government product are marginal benefit entities. In addition, we have treated capital used in the production of government services as of equal value per unit as capital in the private sector. Our understanding of current practice of national accounting has capital used for producing government services treated rather differently from the way capital is treated in the private sector. Needless to say, valuing capital in use in the public sector is difficult but the best course is to try to value it as one does capital in the private sector. Any abstract accounting system calls out for a full valuing of the services of capital in the government sector in a way that makes such capital comparable to capital in the private sector.

For the case of the production functions for each of our three sectors Cobb-Douglas, we solve the 11 equation system of equations in Appendix 1. The production functions have the form

$$
\begin{aligned}
q_C &= [K^C]^{ack}[N^C]^{acn}[q_G]^{1-ack-acn} \\
q_I &= [K^I]^{aik}[N^I]^{ain}[q_G]^{1-aik-ain} \\
q_G &= [K - K^C - K^I]^{ag}[N - N^C - N^I]^{1-ag}.
\end{aligned}
$$

We solve the system with the following parameters: ack=0.1; acn=0.5; aik=0.7; ain=0.1; ag=0.62; s=0.3; N=20; and K=10. We obtain q_C =7.0586, q_I =3.8119, q_G =4.5761, K^C =1.4262, N^C =13.7471, K^I =4.2787, N^I =1.1783, r =0.4949, w =0.2567, p_I =0.7936, p_G =0.7492, $q_G MP_G^C$ =2.8235, $q_G p_I MP_G^I$ =0.6050. The sum of the last two values equals $q_G p_G$, the cost of producing the public good. We verify there that our model exhibits a homogeneity in aggregate: that is, proportionate changes in the values of K and N yield a new solution with the same values for prices. This homogeneity property is roughly speaking necessary if we are to obtain a balanced growth solution to a dynamic version of the model. If this static model above were a snapshot of the system in balanced growth, then the interest rate would be $i = r/p_I$.

3 Balanced Growth

Given a solution of the static model, we have a growth rate defined implicitly by q_I/K. We can proceed to define population growth rate n by this value and re-define all variables in PER CAPITA terms. We proceed to treat q_I as $K_{t+1} - K_t$ and make use of the equation

$$d\left[\frac{K}{N}\right]/dt = \frac{q_I}{N} - \left[\frac{K}{N}\right] n \text{ for } n \text{ defined by } \frac{dN}{dt}/N.$$

With k_t defined by $\frac{K_t}{N_t}$, we use the discrete analogue of this equation, namely

$$k_{t+1} = \frac{[q_I]_t}{K_t} + k_t - nk_t$$

and solve for all real variables above (excluding q_I now), in per capita realizations, plus k_{t+1} as a new variable. We solve a 12 equation system with Matlab in Appendix 2. The solution is

q_C/N =0.3529, q_I/N =01906, q_G/N =0.2288, K^C/N =0.0713, N^C/N =0.6874, K^I/N =0.2139, N^I/N =0.0589, r =0.4949, w =0.2567, p_I =0.7936, p_G =0.7492, and k_{t+1} =0.5000. The real variables are indeed the same as the real variables above but here divided by N equal to 20. The price variables are the same as those above.[9] And K_t and N_t are each growing at the same rate since k_{t+1} solves as equal to "input" k_t. "Price sharing" in the public goods sense (equation (1) does not disrupt a balanced growth behavior for our basic neo-classical aggregate model.

4 Samuelson Public Good with N Household-consumers

We turn to a static model with a classical public goods formulation: households alone consume the public good as a final good. This approach dates at least from Samuelson (1954). Static maximization of the utility sum $NU((q_C/N), q_G)$ for N persons[10] yields these 4 equilibrium conditions. ($f(K^C, N^C)$ is current production of the private good, with input levels K^C and N^C. $h(K - K^C, N - N^C)$ is current production of the government good, with input levels $K - K^C$ (=K^G) and $N - N^C$ (=N^G). We assume that our production functions $f(.)$ and $g(.)$ exhibit constant returns to scale and the price of the consumption good is unity.)

$$\begin{aligned}
\frac{NU_{q_G}}{U_{[q_C/N]}} &= f_{N^C}/h_{N^G}, \\
q_C &= f(K^C, N^C) \\
q_G &= h(K - K^C, N - N^C) \\
f_{K^C}/h_{K^G} &= f_{N^C}/h_{N^G}
\end{aligned}$$

$U_{[q_C/N]}$ is a person's marginal utility for her consumption of the private good. and f_{K^C} is the marginal product of K in the production of the

[9] We could depart from our assumption that the price of a unit of q_C is unity and introduce a money supply-demand relation. This would allow us to have all prices endogenous, including one for a unit of q_C.

[10] An alternative formulation would have each of our N workers with the same utility function and each consuming G.

private good. $\frac{U_{q_G}}{U_{[q_C/N]}}$ is the personalized price that each person is required to pay respectively for a unit of the public good. h_{K^G} is a marginal amount of the public or government good. Similarly with h_{N^G}. The above system is 4 equations in K^C, N^C, q_C, and q_G.

We endogenize prices p_G, r, and w with the following relations (3 equations):

$$\begin{aligned} r &= w\frac{f_{K^C}}{f_{N^C}}, \\ q_C &= rK^C + wN^C, \\ p_G q_G &= r[K - K^C] + w[N - N^C]. \end{aligned}$$

Our Samuelsonian system is 7 equations in 7 unknowns. It is static: K and N are unchanging parameters. Each person must pay $[U_{q_G}/U_{[q_C/N]}]q_G$ in order that the cost of the public good is covered off. $p_G q_G$ is the cost of producing level q_G of the public or government good. It follows that

$$N[U_{q_G}/U_{[q_C/N]}] = p_G.$$

This is the well-known Samuelson condition for households consuming a pure public good. We need investment goods to be produced so that K is growing and we need N to be increasing. We turn to the introduction of an investment goods sector and explicit savings. In addition we will introduce the assumption that N is growing exogenously.

5 An Investment Goods Sector Added

We can set the above model in a balanced growth framework by introducing an investment goods sector and a savings relation. I indicates the investment goods sector. The model becomes 11 equations in 11 unknowns (q_C, K^C, N^C, q_G, p_I, p_G, r, w, q^I, K^I, and N^I.) s is the exogenous savings rate.

$$
\begin{aligned}
\frac{NU_{q_G}}{U_{[q_C/N]}} &= f_{N^C}/h_{N^G}, \\
\frac{f_{K^C}}{f_{N^C}} &= \frac{h_{K^G}}{h_{N^G}}, \\
q_C &= f(K^C, N^C) \\
q_G &= h(K - K^C - K^I, N - N^C - N^I) \\
q_I &= g(K^I, N^I), \\
\frac{f_{K^C}}{f_{N^C}} &= \frac{g_{K^I}}{g_{N^I}} \\
r &= w\frac{f_{K^C}}{f_{N^C}}, \\
q_C &= rK^C + wN^C, \\
p_G q_G &= r[K - K^C - K^I] + w[N - N^C - N^I], \\
p_I q_I &= rK^I + wN^I, \\
s[q_C + p_G q_G + p_I q_I] &= p_I q_I.
\end{aligned}
$$

$U_{[q_C/N]}$ is a household's marginal utility for the private good and f_{K^C} is the marginal product of K in the production of the private good. The last equation involves the constant savings rate s and the equality of the demand and supply of investment goods. We assume no depreciation and thus $I = K_{t+1} - K_t$.

The model admits a balanced growth solution. One introduces an exogenous population growth rate n and investment set at $I/K_t = n$, given utility functions and production functions homogeneous of degree unity. One follows the steps we traversed above for the model with the public good purely intermediate. This model, with an investment goods sector added, contains the original Samuelson version of government goods as final or flowing to households as a type of consumption good. This model admits the fairly standard national accounts statement. See Table 2. A national account set out in the matrix below.

Table 2: Accounting Matrix

rK^C	wN^C	$= q_C$
rK^I	wN^I	$= p_I q_I$
$r[K - K^C - K^I]$	$w[N - N^C - N^I]$	$= p_G q_G \ (= q_G \frac{NU_{q_G}}{U_{[q_C/N]}})$
$= rK$	$= wN$	

Each row entry sums to the corresponding value on the right. Each column entry sums to the value in the corrsponding bottom row. The sum of entries in the right column is net national product and the sum of the entries in the bottom row is national income. Government product is accounted for here by costs of inputs: $r[K-K^C-K^I]+w[N-N^C-N^I]$. These costs sum to $p_G q_G$. The corresponding revenue is $q_G \frac{NU_{q_G}}{U_{[q_C/N]}}$, where $q_G \frac{U_{q_G}}{U_{[q_C/N]}}$ is the payment (tax charge) by a single household for the flow of services, q_G. Each household's personal "price" or charge per unit is a fraction of p_G. Heterogeneity of households would of course be associated with an array of heterogeneous charges for the same service flow q_G.

6 The Public Good both Intermediate for Firms and Final for Households

We turn to the case of the public good being both Samuelsonian ("consumed" as a final good by households) and intermediate ("consumed" as a pure intermediate public good by firms). This calls for a seeming minor re-write of our system above, namely inserting q_G as an input to "firms" in the consumer goods and investment goods sectors, and expanding the public good "pricing equation" to incorporate unit charges to firms for their use of the public good.

$$
\begin{aligned}
\frac{NU_{q_G}}{U_{[q_C/N]}} + MP_G^C + p_I MP_G^I &= p_G, & (2)\\
\frac{f_{K^C}}{f_{N^C}} &= \frac{h_{K^G}}{h_{N^G}}, & (3)\\
q_C &= f(K^C, N^C, q_G)\\
q_G &= h(K - K^C - K^I, N - N^C - N^I)\\
q_I &= g(K^I, N^I, q_G),\\
\frac{f_{K^C}}{f_{N^C}} &= \frac{g_{K^I}}{g_{N^I}}\\
r &= w\frac{f_{K^C}}{f_{N^C}},\\
q_C &= rK^C + wN^C,\\
p_G q_G &= r[K - K^C - K^I] + w[N - N^C - N^I],\\
p_I q_I &= rK^I + wN^I,\\
s[q_C + p_I q_I + q_G \frac{NU_{q_G}}{U_{[q_C/N]}}] &= p_I q_I.
\end{aligned}
$$

Equation (2) is novel since it has marginal benefits for both firms and households summing to the unit price of the public good. Note that the savings rate is multiplied by the value of final demand (sum of entries in the right-hand column of the accounts matrix below). The value of intermediate goods flows are not part of final demand. The above is eleven equations in q_C, q_I, q_G, K^C, N^C, K^I, N^I, r, w, p_I, p_G. We solved this system numerically with Matlab. We assumed that utility functions for our N households were the same and Cobb-Douglas: $U = [q_C/N]^{\xi}[q_G]^{1-\xi}$. We took the production functions for our three goods to be Cobb-Douglas and exhibiting constant returns to scale. See Appendix 3 for details. Numerical outputs are

q_C=8.4817, q_I=6.1641, q_G=8.0790, K^C=1.9059, N^C=11.8866, K^I=7.1472, N^I=1.2736, r=0.4450, w=0.3568, p_I=0.7371, p_G=0.7949.[11]

[11] We varied our inputs, K and N proportionately and verified that the equilibrium prices did not change.

See Appendix 3. Table 3 is the national account for this model economy. We have inserted the numerical values of entries based on our numerical solution below the corresponding "theoretical" entry. There is some rounding of the values entered in the Table. NNP is the sum of entries in the right column.

Table 3: National Account

$\frac{rK^C}{(0.848)}$	$\frac{wN^C}{(4.24)}$	$\frac{q_G MP_G^C}{(3.393)}$	$=\frac{q_C}{(8.482)}$
$\frac{rK^I}{(3.181)}$	$\frac{wN^I}{(0.454)}$	$\frac{q_G p_I MP_G^I}{(0.9087)}$	$=\frac{p_I q_I}{(4.544)}$
$\frac{r[K-K^C-K^I]}{(3.981)}$	$\frac{w[N-N^C-N^I]}{(2.44)}$	$\frac{-[MP_G^C+p_I MP_G^I]q_G}{(-4.302)}$	$=\frac{q_G \frac{NU_{q_G}}{U_{[q_C/N]}}}{(2.120)}$
$=\frac{rK}{(8.01)}$	$=\frac{wN}{(7.136)}$	$=0$	

In Table 3, the Samuelsonian portion of the value of the public good is present in NNP in the right hand column (value: 2.120 numeraire units). That is, 2.12 dollars of the public good is being paid for by household. In addition, however, there is a non-trivial value of the public good that is flowing to firms as an intermediate input (value: 4.302 numeraire units). The essential message is that households should be paying something for the flows of the public good which they are "consuming" AND firms should be paying non-trivial amounts for the flows of the pubic good which they are "consuming".

We verified in numerical runs that prices in our solution did not change when we made a small proportional change in our endowments of K and N. We also took I/K as the balanced growth rate, equal to exogenous population growth rate, n, and re-solved the model, normalized to be in per capita terms. Balanced growth numerical outputs followed. See Appendix 4.

7 Concluding Remarks

We have attempted to map out a reformulation of the economic view of government. We have argued that a substantial portion of "government production" is consumed directly by firms (much of the cost of the maintenance of the legal system) and thus, firms in the private sector should be viewed as proper units for being charged or taxed in order to support goverment production. We do not deny that firms are taxed currently in modern economies; rather we are presenting a new architecture of benefit charges for firms, an architecture that could assist in the formulation of systematic charges for government service "consumption" by firms.

APPENDIX 1: Static System Solved

The three production functions become

$$
\begin{aligned}
qc &= [Kc]^{ack}[Nc]^{acn}[qg]^{1-ack-acn} \\
qi &= [Ki]^{aik}[Ni]^{ain}[qg]^{1-aik-ain} \\
qg &= [K - Kc - Ki]^{ag}[N - Nc - Ni]^{1-ag}.
\end{aligned}
$$

We proceed to solve the 11 equation system in the text with a MATLAB program:

```
function f=nlesg(x)
% JAN 3 ...PRICE NEUTRALITY WITH PUBLIC INPUTS...
% govt is pure intermediate flow input.
ack=0.1;acn=0.5;aik=0.7;ain=0.1;ag=0.62;s=0.3;N=20*1.0;K=10*1.0;
qc=x(1);
qi=x(2);
qg=x(3);
Kc=x(4);
Nc=x(5);
Ki=x(6);
Ni=x(7);
r=x(8);
w=x(9);
pi=x(10);
pg=x(11);
% system is 3 real eqns
f(1)=qc-Kc^ack*Nc^acn*qg^(1-ack-acn);
f(2)=qi-Ki^aik*Ni^ain*qg^(1-aik-ain);
% THIS IS GOVT FLOW PRODUCTION... input into C good and
I good production
```

f(3)=qg-(K-Ki-Kc)^ag*(N-Nc-Ni)^(1-ag);

% re-working

f(4)=r-w*(ack/acn)*(Nc/Kc);

% two efficiency ratios

f(5)=(ack/acn)*(Nc/Kc)-(aik/ain)*(Ni/Ki);

f(6)=(ack/acn)*(Nc/Kc)-(ag/(1-ag))*(N-Nc-Ni)/(K-Kc-Ki);

% this is the Samuelson pub goods eqn for govt as input to production!!

f(7)=pg-(1-ack-acn)*qc/qg-pi*(1-aik-ain)*qi/qg;

% savings is based on only qc+qi*pi because qg is purely intermediate

f(8)=s*(qc+pi*qi)-pi*qi;

% three price-value equations

f(9)=qc-r*Kc-w*Nc-x(12);

f(10)=qi*pi-r*Ki-w*Ni-x(13);

f(11)=qg*pg-r*(K-Kc-Ki)-w*(N-Nc-Ni);

% these are values of govt flow to C goods and I goods production

f(12)=x(12)-qg*(1-ack-acn)*qc/qg;

f(13)=x(13)-pi*qg*(1-aik-ain)*qi/qg;

%

% 7.0586 3.8119 4.5761 1.4262 13.7471 4.2787 1.1783

% 0.4949 0.2567 0.7936 0.7492 2.8235 0.6050

%

%

% with K=10 and N=20 increased to 1.02

%

% 7.1998 3.8882 4.6676 1.4548 14.0220 4.3643 1.2019

% 0.4949 0.2567 0.7936 0.7492 2.8799 0.6171

APPENDIX 2: Balanced Growth for Above Model

....

Matlab program with outputs:

```
function f=nledg(x)
% DYNAMIC CHECK OF PUBLIC INPUTS MODEL (JAN 6, 2013)
% govt is pure intermediate flow input.
ack=0.1;acn=0.5;aik=0.7;ain=0.1;ag=0.62;s=0.3;N=20;K=10/N;
n=3.8119/10;NB=1;
qc=x(1);
qi=x(2);
qg=x(3);
Kc=x(4);
Nc=x(5);
Ki=x(6);
Ni=x(7);
r=x(8);
w=x(9);
pi=x(10);
pg=x(11);
KP=x(12);
% system is 3 real eqns
f(1)=qc-Kc^ack*Nc^acn*qg^(1-ack-acn);
f(2)=qi-Ki^aik*Ni^ain*qg^(1-aik-ain);
% THIS IS GOVT FLOW PRODUCTION... input into C good and I good production
f(3)=qg-(K-Ki-Kc)^ag*(NB-Nc-Ni)^(1-ag);
% re-working
f(4)=r-w*(ack/acn)*(Nc/Kc);
% two efficiency ratios
f(5)=(ack/acn)*(Nc/Kc)-(aik/ain)*(Ni/Ki);
f(6)=(ack/acn)*(Nc/Kc)-(ag/(1-ag))*(NB-Nc-Ni)/(K-Kc-Ki);
```

% this is the Samuelson pub goods eqn for govt as input to production!!

f(7)=pg-(1-ack-acn)*qc/qg-pi*(1-aik-ain)*qi/qg;

f(8)=s*(qc+pi*qi+pg*qg)-pi*qi;

% three price-value equations

f(9)=qc-r*Kc-w*Nc-qg*(1-ack-acn)*qc/qg;

f(10)=qi*pi-r*Ki-w*Ni-pi*qg*(1-aik-ain)*qi/qg;

f(11)=qg*pg-r*(K-Kc-Ki)-w*(NB-Nc-Ni);

% /////// these are values of govt flow to C goods and I goods production

f(12)=KP-qi-K+n*K;

% STATIC EARLIER RUNS

% 7.0586 3.8119 4.5761 1.4262 13.7471 4.2787 1.1783

% r=0.4949 w=0.2567 pi=0.7936 pg=0.7492

% **** 7.0586 3.8119 4.5761 1.4262 13.7471 4.2787 1.1783

% 0.4949 0.2567 0.7936 0.7492 *** RECHECK BASIC RUN Jan 6.

% use of g in c and i: 2.8235 0.6050

%

%

% with K=10 and N=20 increased to 1.02

%

% 7.1998 3.8882 4.6676 1.4548 14.0220 4.3643 1.2019

% 0.4949 0.2567 0.7936 0.7492 2.8799 0.6171

%

% DYNAMIC RUN soln values (jan 6, 2013): checks with K(t+1)/N=K(t)/N=20/10.

% 0.3529 0.1906 0.2288 0.0713 0.6874 0.2139 0.0589

% r=0.4949 w=0.2567 pi=0.7936 pg=0.7492 K(t+1)/N=0.5000

APPENDIX 3: Public Good Flow to Households and Firms Simultaneously

....

```
function f=nlesAg(x)
% March 13 SUCCESS... PRICE NEUTRALITY WITH PUBLIC INPUTS...
% govt is intermediate flow AND SAMUELSON pub good as well.
% Cobb Douglas utilities (zi) and CobbDouglas prod functions
ack=0.1;acn=0.5;aik=0.7;ain=0.1;ag=0.62;s=0.3;N=20*1.00;K=18*1.00;
zi=0.8;
qc=x(1);
qi=x(2);
qg=x(3);
Kc=x(4);
Nc=x(5);
Ki=x(6);
Ni=x(7);
r=x(8);
w=x(9);
pi=x(10);
pg=x(11);
% system is 3 real eqns
f(1)=qc-Kc^ack*Nc^acn*qg^(1-ack-acn);
f(2)=qi-Ki^aik*Ni^ain*qg^(1-aik-ain);
% THIS IS GOVT FLOW PRODUCTION... input into C good and I good production
f(3)=qg-(K-Ki-Kc)^ag*(N-Nc-Ni)^(1-ag);
% re-working
f(4)=r-w*(ack/acn)*(Nc/Kc);
% two efficiency ratios
```

f(5)=(ack/acn)*(Nc/Kc)-(aik/ain)*(Ni/Ki);

f(6)=(ack/acn)*(Nc/Kc)-(ag/(1-ag))*(N-Nc-Ni)/(K-Kc-Ki);

% this is the Samuelson pub goods eqn for govt (into prod and cons)

sB=((1-zi)/zi)*(qc/qg);

f(7)=pg-(1-ack-acn)*qc/qg-pi*(1-aik-ain)*qi/qg-sB;

% note savings is out of FINAL demand (intermediates excluded)

f(8)=s*(qc+pi*qi+qg*sB)-pi*qi;

% three price-value equations

f(9)=qc-r*Kc-w*Nc-qg*(1-ack-acn)*qc/qg;

f(10)=qi*pi-r*Ki-w*Ni-pi*qg*(1-aik-ain)*qi/qg;

f(11)=qg*pg-r*(K-Kc-Ki)-w*(N-Nc-Ni);

%

%

% Wed., March 13, with N demanders for G

% qC=8.4817 qI=6.1641 qG=8.0790 Kc=1.9059 Nc=11.8866 Ki=7.1472 Ni=1.2736

% r=0.4450 w=0.3568 pI=0.7371 pG= 0.7949

% RESOLVED WITH SMALL PROPORTIONATE CHANGE IN K and N: Same prices....

APPENDIX 4: Balanced Growth for Above static case

....

function f=nlesAg(x)

% March 13 SUCCESS... PRICE NEUTRALITY WITH PUBLIC INPUTS...

% govt is intermediate flow AND SAMUELSON pub good as well.

% Cobb Douglas utilities (zi and dl) and CobbDouglas prod functions

ack=0.1;acn=0.5;aik=0.7;ain=0.1;ag=0.62;s=0.3;N=1.00;K=18/20;

zi=0.8;n=6.1641/18;

qc=x(1);

qi=x(2);

qg=x(3);

Kc=x(4);

Nc=x(5);

Ki=x(6);

Ni=x(7);

r=x(8);

w=x(9);

pi=x(10);

pg=x(11);

KP=x(12);

% system is 3 real eqns

f(1)=qc-Kc^ack*Nc^acn*qg^(1-ack-acn);

f(2)=qi-Ki^aik*Ni^ain*qg^(1-aik-ain);

% THIS IS GOVT FLOW PRODUCTION... input into C good and I good production

f(3)=qg-(K-Ki-Kc)^ag*(N-Nc-Ni)^(1-ag);

% re-working

f(4)=r-w*(ack/acn)*(Nc/Kc);

% two efficiency ratios

f(5)=(ack/acn)*(Nc/Kc)-(aik/ain)*(Ni/Ki);

f(6)=(ack/acn)*(Nc/Kc)-(ag/(1-ag))*(N-Nc-Ni)/(K-Kc-Ki);

% REDO: this is the Samuelson pub goods eqn for govt as input to production!!

sB=((1-zi)/zi)*(qc/qg);

f(7)=pg-(1-ack-acn)*qc/qg-pi*(1-aik-ain)*qi/qg-sB;

% note savings is out of FINAL demand (intermediates excluded)

f(8)=s*(qc+pi*qi+qg*sB)-pi*qi;

% three price-value equations

f(9)=qc-r*Kc-w*Nc-qg*(1-ack-acn)*qc/qg;

f(10)=qi*pi-r*Ki-w*Ni-pi*qg*(1-aik-ain)*qi/qg;

f(11)=qg*pg-r*(K-Kc-Ki)-w*(N-Nc-Ni);

f(12)=KP-qi-K+n*K;

%

%

% Wed., March 13, with N demanders for G

% qC=8.4817 qI=6.1641 qG=8.0790 Kc=1.9059 Nc=11.8866 Ki=7.1472 Ni=1.2736

% r=0.4450 w=0.3568 pI=0.7371 pG= 0.7949

%

% RESOLVED WITH SMALL PROPORTIONATE CHANGE IN K and N: Same prices....

%

% Dynamics (bal-growth) Output:

%

% 0.4241 0.3082 0.4039 0.0953 0.5943 0.3574 0.0637

% 0.4450 0.3568 0.7371 0.7949 (K/N)t+1=0.9000

% prices are reproduced and (K/N)t+1=(K/N)t. Quantities are each divided by

% N=20.

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