(This is a preliminary draft. Please do not quote the results of the paper. Comments are most welcome!)

Government Budget, Public-Sector Wages, and Corporate Taxes in a Small Open Economy

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Abstract: This paper examines the welfare implications of adjustments in public sector wages and capital tax rates for a small open economy in a general equilibrium setting. The individually and jointly optimal wage and tax policies are derived and interpreted using a simple general equilibrium model. It is found that facing reductions in land sales, falls in foreign interest rates or deteriorations in the terms of trade, a cut in public workers' pay is needed for making their wage comparable to the private sector and a hike in capital taxes is recommended for budgetary considerations. The empirical part of the paper develops a computable general equilibrium model for Hong Kong. Together with a data set for Hong Kong, this model is used to numerically evaluate the various optimal policies. The numerical results not only confirm the main preposition of the paper, they also provide preliminary quantitative estimates of the various optimal policy variables.

1. Introduction

In many countries, wages and salaries of public-sector employees are institutionally set and hence less responsive to market situations as compared to those of the private sector. Generally, during economic booms, public-sector wages may be lower than wages of the private sector and vice versa during the period of economic woe. In some countries, especially in developing nations, perhaps out of governmental concerns for political stability, public-sector employees receive higher wages than the counterparts in the private sector. During economic downturns, this can lead to a fiscal problem for government in addition to inefficiency in the public sector activities. A vivid example is the current situation in Hong Kong in which the pay for government employees is higher than the private-sector workers, and about 70 percent of the government budget is made up for paying salaries and wages. During prosperous times, government spending can be financed by revenues collected from all sorts of taxes and public land leases in Hong Kong. However, during the recent years of economic downturns subsequent to the Asian financial crisis in 1997, shortfalls in government revenue have severely restricted government spending. In order to maintain a sound fiscal budgeting, the issue of cutting the wages of public-sector employees and instituting tax reforms for raising revenue have been heatedly discussed and debated.[1]

The purpose of this paper is to examine the optimal wage structure for public and private sectors and the consequent tax reforms to finance public spending. In our theoretical model, we assume that public spending is entirely on wage payments to its employees, who receive above-market salaries and wages. The financing of the public expenditure is constrained by the

[1]A 6 percent across the board pay cut for government employees and a 1 percent increase in corporate taxes in Hong Kong have been advocated. The proposed changes were implemented in 2004. The policy to raise tax in the time of economic difficulty apparently runs contrary to the tax cut policy adopted in other countries.

revenues from capital taxes and land sales/leases.[2] We will show that the optimal policy involves elimination of the inter-sectoral wage gap such that the public sector wages be reduced to be in line with the private sector wages. This will be coupled with an optimal capital tax rate, which depends on (i) the factors pertinent to revenue generation for the government, e.g. amount of available capital and land leases, and (ii) the attributes of the public good reflected by consumer's valuation of the public good and its production cost. Furthermore, the optimal capital tax rate can be affected by some external shocks, for example, changes in either land leases, world interest rates and/or terms of trade.

The above theoretical analysis is supplemented with numerical simulation results from a computable general equilibrium model specifically developed for tackling the issues of optimal public pay, capital tax, and external shocks. Using a data set for Hong Kong, the CGE model is deployed to numerically evaluate the optimal policies and to derive the needed adjustment to the optimal policies in responding to external shocks. These results will be used to verify the validity of the theoretical prepositions of the paper. It also provides a first preliminary numerical estimates that may be useful for the policy making process.

This paper is organized as follows. Section 2 sketches a three-sector general equilibrium model. Section 3 examines the welfare effects of adjustments in public-sector wages and capital taxes. Furthermore, the individually and jointly optimal wages and capital tax rates will be derived. Section 4 studies the impact of an exogenous change in each of the several external shocks on the jointly optimal policies. Section 5 lays out the structure of the CGE model and describes the data set used for numerical simulations. Section 6 reports simulation results on the optimal policies and the changes in the optimal policies in responding to various external shocks. Some concluding remarks are provided in section 7.

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[2] There is a substantial literature on the mix of taxes to finance public goods. For example, tariffs and consumption taxes are used in Michael et al. (1993) and income taxes and consumption taxes are considered in Michael and Hatzipanayotou (2001).

2. The Theoretical Model

Consider a small open economy that consists of two private sectors, X and Y, and a public sector, g. Private goods are traded internationally, whereas the public good is not. We assume that the economy exports good Y and imports good X. The former can be considered as light manufactures, while the latter is high value-added commodities. To simplify the analysis, the production of good Y requires labor only: $Y = Y(L_Y)$. On the other hand, good X is produced by using labor (L_X) and capital (K) together with a land-related factor (S) such as office or factory space: $X = X(L_X, K, S)$. Land is assumed to be government-owned, and capital is owned by domestic and foreign investors, i.e., $K = K_d + K_f$. Similar to the production of good Y, the production of the public good, g, needs labor only: $g = L_g$.

Choosing good Y as the numeraire, the domestic price of good X is p and the returns to labor, capital and land in the private sectors are denoted by w, r and v, respectively. The unit cost functions for goods X and Y are therefore: $c^X(w, r, v)$ and $c^Y(w)$. Under perfectly competitive equilibrium, factor and goods prices are linked by the zero-profit conditions: $c^X(w, r, v) = p$ and $c^Y(w) = 1$. The latter results in a constant wage rate w for the private sectors. Furthermore, capital in sector X is internationally mobile. This gives the equalization of capital returns between countries: $r = r^* + \tau$, where r^* denotes the given foreign rate of capital returns and τ is the domestic tax on foreign capital.[3] Hence, the land rent is a function of the good price and the capital rental, i.e., $v = v(p, r)$, where $v_p > 0$ and $v_r < 0$.[4] Finally, the institutionally set wage rate in the public-sector, $\overline{w}$, is assumed to be higher than the private-sector wage rate, i.e., $\overline{w} > w$.[5] To

[3] Since the wage and capital rental rates are given in this small open economy, the production of good X requires other sector-specific factors, such as land, in addition to labor and capital. See Jones (1971) for discussions on the properties of the general, specific-factor model.

[4] Namely, v_p $(= \partial v/\partial p) = 1/c_p^X > 0$ and v_r $(= \partial v/\partial r) = -c_r^X / c_v^X < 0$.

[5] Studies on sectoral wage differentials can be found, for example, in Batra and Scully (1971) and Khan (1982). A special case of sectoral wage differentials is the Harris-Todaro (1970) model, in

reduce public sector costs, the government imposes a pay cut on public wages by an amount of α. The *actual* public wage rate becomes: $\overline{w}$ - α.

The above mentioned supply-side information can be captured by the revenue function of the private sectors: $R(p, K, S, g) = \max \{pX(L_X, K, S) + Y(L_Y): L_X + L_Y = L - g\}$, where L is the domestic labor endowment. Letting subscripts in the revenue function be partial derivatives, we have: $R_g = - w$. Since w is a constant, we obtain: $R_{gg} = R_{gK} = 0$. In addition, since the supply price of capital of domestic and foreign investors face is $r^* + \tau$, we have: $R_K = r^* + \tau$.

As for the demand side of the economy, a government-provided public good in addition to the two private goods are available to consumers. Consumers, nonetheless, minimize the spending on the private goods subject to a utility constraint. This gives rise to the expenditure function, defined as: $E(p, g, u) = \min \{pC_X + C_Y: u = \varphi(C_X) + C_Y + h(g)\}$, where $\varphi'(\cdot) > 0$ and $h'(\cdot) > 0$. Note that the utility function is quasi-linear and hence $E_u = 1$.[6] In addition, by applying the envelope theorem, we have $E_g = - h'(g) < 0$, which expresses the marginal willingness to pay for the public good.

Using the above demand and supply information, we obtain the following budget constraint for the domestic economy:

$$E(p, g, u) = R(p, K, S, g) + (\overline{w} - \alpha)g - vS - \tau K - r^* K_f. \tag{1}$$

Equation (1) states that total spending on the private goods equals total revenue from the production of private and public goods, minus the land rents and capital taxes paid to the government and the returns received by foreign capital owners. The domestic government needs to finance the cost of producing the public good, and the financing provision comes from the land rents and capital taxes:

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which sectoral unemployment is allowed. See Beladi and Marjit (1992) and Gupta (1995) for recent studies.

[6] Applying the envelope theorem to the expenditure function $E(p, g, u)$, we have $E_u = \lambda = 1$ and $E_g = - \lambda h'(g) < 0$, where λ is the Lagrange multiplier. Furthermore, to simplify the analysis, we assume $h''(g) = 0$ and hence $E_{gg} = 0$.

$$(\overline{w} - \alpha)g = vS + \tau K. \quad (2)$$

Here, the government budget is balanced.

Let us now turn to the capital market. Since capital is internationally mobile, equilibrium requires the equality of the after-tax rates of returns between domestic and foreign capital markets:

$$R_K(p, K, S, g) - \tau = r^*. \quad (3)$$

For simplicity, the foreign capital tax is ignored in (3).

The economy, described by (1) – (3), consists of three unknowns, u, K and g, with two policy instruments, α and τ, and three exogenous variables, S, r^* and p. We will use this model to study the welfare effects of changes in the public-sector pay and capital taxes. Based on the welfare implications, we can derive the optimal levels of pay cuts and capital taxes and then examine the impacts of some external shocks on them.

3. The Analysis

We can analyze the above welfare issues by considering the changes of the equations in (1) – (3). Totally differentiating (1), the change in welfare becomes:

$$du = - gd\alpha + (\overline{w} - \alpha - B_g)dg - (Kd\tau + Sdv) - Mdp, \quad (4)$$

where $M = E_p - R_p$, is the imports of good X, and $B_g = E_g - R_g$, represents the difference of marginal benefit and marginal cost of the public good. Following Lahiri and Raimondos-Møller (1998), we assume $B_g < 0$.

The right hand side of the expression in (4) captures four key features of the economy: the above-market public pay, the provision of free public good, the tax and rent payments to government, and the terms of trade. Private welfare can be increased by: cutting the public-sector wage, providing more public good, reducing the payments to the government, or improving the terms of trade. Conversely, welfare will be decreased.

Consider the underlying determinants for the provision of the public good. We can differentiate (2) to obtain:

$$(\overline{w} - \alpha)dg = gd\alpha + Kd\tau + \tau dK + Sdv + vdS. \tag{5}$$

On the right hand side of (5), the first term expresses the cost effect of the public good production and the remaining four terms indicate the tax revenue effect from foreign capital and land rents.

Finally, the change in the inflow of foreign capital can be obtained from (3) as

$$R_{KK}dK = d\tau + dr^* - R_{Kp}dp - R_{Kg}dg - R_{KS}dS, \tag{6}$$

where $R_{KK} < 0$, representing the negatively sloped demand function for capital, and $R_{Kp} > 0$, denoting the positive price-induced impact of capital on the production of good X. Note that $R_{Kg} = R_{KS} = 0$ as w and v are independent of K. The intuition for (6) is straightforward. A hike in capital taxes raises the production cost of good X, thereby reducing the demand for capital. On the other hand, higher foreign capital returns or lower domestic prices in p lead to reduced inflows of foreign capital to the domestic economy.

We are now ready to determine the welfare implications of the two policy measures. Let us first examine the ceteris paribus welfare effect of changes in the public-sector pay. Solving (4) – (6), we obtain:

$$du/d\alpha = - gB_g/(\overline{w} - \alpha) > 0. \tag{7}$$

Recalling that $B_g < 0$, we obtain: $du/dt > 0$. A reduction in public-sector wages lowers the cost of producing the public good, thereby improving private welfare. Hence, the optimal amount of the public workers' pay cut, denoted by α^o, is the wage reduction that leads to an equality between the public and private sector wages:

$$\alpha^o = \overline{w} - w. \tag{8}$$

Since the private wage is a constant, the α^o schedule is depicted in Figure 1as a horizontal line in the space of α and τ.[7] If α is initially not equal to α^o, an upward adjustment of it towards α^o indicated by vertical arrows improves welfare.

We next examine the welfare effect of changes in capital taxes. From (4) – (6), we obtain:

$$du/d\tau = -[(K + Sv_r)R_{KK}B_g - \tau(\overline{w} - \alpha - B_g)]/R_{KK}(\overline{w} - \alpha). \quad (9)$$

Consider $\tau = 0$ initially. An introduction of a capital tax generates two conflicting effects. The capital tax raises (lowers) tax revenue when $K + Sv_r > (<) 0$. However, the tax levy reduces the capital inflow, thereby curtailing the production of good X and hence welfare. In general, the welfare effect of capital taxes as revealed in (9) is ambiguous. Nonetheless, by setting $du/d\tau = 0$, we can determine the optimal capital tax or subsidy rate, denoted by τ^o, as

$$\tau^o = (K + Sv_r)R_{KK}B_g/(\overline{w} - \alpha - B_g). \quad (10)$$

Since $R_{KK} < 0$ and $B_g < 0$, we have $\tau^o > (<) 0$ as $K + Sv_r > (<) 0$. We illustrate (10) for the case of capital taxes (i.e., $\tau^o > 0$) in Figure 1. The τ^o schedule is positively sloped, and for any given α, the value of τ^o gives the corresponding maximum welfare. This can be verified by checking the curvature of the welfare function. Deploying the technique originated with Neary (1993), we substitute τ^o in (10) into (9) to yield:

$$du/d\tau = [(\overline{w} - \alpha - B_g)/R_{KK}(\overline{w} - \alpha)](\tau - \tau^o). \quad (11)$$

Since $R_{KK} < 0$ in (11), we have $du/d\tau < (>) 0$ as $\tau > (<) \tau^o$. This implies that the welfare function is strictly concave with respect to capital taxes. Hence, a fall (rise) in capital taxes improves welfare when $\tau > (<) \tau^o$. In Figure 1, any horizontal adjustments in τ towards τ^o are welfare improving.

[7] This diagrammatic technique is adapted from Neary (1995) and is used in Chao and Yu (1996).

It is of interest to derive the jointly optimal policies for adjustments in public-sector wages , α^{oo}, and capital tax rates, τ^{oo}, for the economy. From (8) and (10), we have:

$$\alpha^{oo} = \overline{w} - w, \qquad (12)$$

$$\tau^{oo} = (K + Sv_r)R_{KK}B_g/(w - B_g). \qquad (13)$$

In Figure 1, these optimal values are depicted by the intersection of the α^{o} and τ^{o} schedules at point E. However, it is unlikely that the initial policy mix coincides with the values at point E. Suppose initially the economy adopts a higher public sector wage coupled with a relatively low capital tax rate, as represented by point A. The desirable policy will involve a pay cut in the public sector along with a hike in the capital tax rate. For an initial policy mix denoted by the point B, the policy reform will then involve a pay cut coupled with a reduced capital tax rate. If initially the public sector wage is below the market rate, the optimal policy will involve a pay hike coupled with an appropriate adjustment in the capital tax rate.

4. Optimal Policies and the Economy

As mentioned earlier, there are three exogenous variables in this economy. In this section, we examine how the optimal levels of public-sector pay cuts and capital tax rates are affected by changes in each of the three exogenous variables. Consider first the effect of land sales. Differentiating (13) with respect to S yields:

$$d\tau^{oo}/dS = v_r R_{KK}B_g/(w - B_g) < 0. \qquad (14)$$

It is clear that a reduction in land sales lowers government revenue. To finance the production of the public good, an increase in capital tax rates is needed. Conversely, when the land sales increase, a decrease in capital tax rates is desirable.

What about the effect of a change in the rate of foreign capital returns, r^*? Noting that, from (1), $dK/dr^* = 1/R_{KK} < 0$ and differentiating (13) with respect to r^*, we have:

$$d\tau^{oo}/dr^* = [R_{KK}B_g/(w - B_g)](dK/dr^*) < 0. \qquad (15)$$

Initially, a fall in the world rates of capital returns results in an increased inflows of foreign capital. In this situation, a levy of a higher capital tax to raise more revenue for public projects would be welfare improving.

Finally, let us consider the effect of an exogenous change in the price of good X. Again from (6) we have $dK/dp = - R_{Kp}/R_{KK} > 0$. Differentiating (13) yields

$$d\tau^{o}/dp = [R_{KK}B_{g'}/(w - B_g)](dK/dp) > 0. \tag{16}$$

As the production of good X requires foreign capital, a rise in the good price (i.e., a deterioration in the terms of trade) implies increased inflows of foreign capital, given the normal price-output response. Similar to the earlier case of a fall in foreign capital returns, levy of a higher capital tax is desirable.

On the basis of the above analysis, the following proposition is immediate:

Proposition: For a small open, capital-importing economy consisting of two private sectors along with a public sector financed by land sales and capital tax revenue, a cut in public workers' pay is needed for making their wage comparable to the private sector. In addition, a hike in capital taxes is recommended in the face of a decrease in land sales, a fall in the world rate of capital returns, and/or a deterioration in the terms of trade.

These results can be illustrated in Figure 1. The τ^{o} schedule is shifted to the right as a result of any of the following: a reduction in land sales, a fall in foreign interest rates or a deterioration in the terms of trade. Subsequently, the optimal capital tax rate rises from point E to E'.

5. The CGE model

The above preposition derived from the theoretical model can be illustrated numerically with a computable general equilibrium model. In this section we lay out the structure of a one-period, comparative static CGE model and describe the data set used for simulating the effects of public wage cuts and changing capital taxes under various scenarios.

While retaining all essential features of the theoretical model, the CGE model also contains several important deviations. First, following the traditions in CGE literature, we apply more general functional forms and nested production and demand functions in specifying the model. Second, we abandon the simplified assumption of two traded goods (an importable and an exportable). Instead, a structure that allows for “cross-hauling” of *n* goods (i.e. imports and exports of the same good) is introduced. The exact number of tradable goods is only constrained by data availability and computational capacity. Last, the production structure of the model corresponds to the data structure of a typical input-output table and it is therefore far more complicated than what is possible in the theoretical model. These differences are largely motivated by making the CGE model more empirically tractable, while not compromising the analytical capacity of the theoretical model. The following discussion will make these deviations apparent.

5.1 Demand specification: a nested CES utility function with public goods provision

Household A representative household is assumed to choose a consumption bundle consisting of *n* composite goods (each of which is a bundle of a domestic and an imported variant of the good) to maximize her utility subject to a budget that is constrained by incomes from wages and returns from household-owned capital, net of capital tax. The household utility function is specified as a Constant Elasticity of Substitution (CES) function, through which a composite private good index can be derived.

Government The government maximizes its own CES utility function by choosing a bundle of *n* public goods, subject to its revenue constraint. Each of the public goods is a composite of an imported and a domestic variant of the good. Domestic variants of public goods are "produced" by the government. Government revenues are derived from tariffs, output taxes and capital taxes. Through the CES utility function, a composite public good index can be derived.

Aggregate Utility The composite private good is combined with the composite public good through an aggregate CES utility function. At this level, there is no utility-maximization behavior as this utility function simply bundles the private and the public goods together (see Piggott and Whalley 1987). From the view of private households, public goods may be over or under-provided.

5.2 Production specification: private and public goods production with nested Leontief-CES technologies

Nested Leontief-CES technologies for domestic production of n private goods Cost minimizing privately-owned firms use *n* intermediate composite inputs (each of which is a CES composite of domestic and imported inputs. This is the so-called Armington structure (Armington, 1969)) and a value-added composite (which bundles imported and foreign capital and labor together) to produce each good in a Leontief fashion. These goods are produced to satisfy demands of domestic consumption, exports, investment, and two types of intermediate demands (by private firms and by the government).

Nested Leontief-CES technologies for producing n public goods The government engages in producing *n* public goods. The production structure of individual public good is similar to that of producing private goods. Primary factors and intermediates (both imported and domestically produced inputs) are used. We assume that all public goods are used only for public goods provision to households (i.e., these are all consumed). The level of production of each good is therefore determined by the maximization of the government utility function subject to the government revenue constraint.

5.3 Factor markets

Labor market: exogenous wage differentials There is only one type of homogenous labor. The supply of labor is fixed and is assumed to be fully employed and competed for by the private and public sectors. Wage rates in both the public and private sectors are endogenously determined. However, there is an exogenous wage difference between the two sectors, which can be viewed as a government policy variable. For example, the government of Hong Kong has recently reduced the wage differentials in order to balance its budget. All wages are assumed to be earned by private households.

Capital market: international capital mobility There is a fixed domestic capital endowment, which is used in the production of both private and public goods. The international rate of return on capital is assumed to be exogenous to this small open economy and the differential between domestic and international rates of return dictate the direction of capital inflow or outflow. That is, when the international rate of return is lower (higher) than the corresponding domestic rate, there will be a capital inflow (outflow) to the economy. In equilibrium, the domestic rate of return equals the international rate of return, net of the capital tax. In other words, capital tax is the wedge between the domestic rate of return and the international return on capital. In equilibrium, when the former is higher (lower), there exists a capital tax (subsidy).

It is worth noting that unlike the theoretical model, land is not a separate primary factor in the CGE model. This is largely a compromise due to the underlying dataset, which displays extremely low value of land rentals that can not match well with expenditures of the government of Hong Kong. Here, we lump land and capital together and make an *ad hoc* assumption that government-owned land and capital (or the combined capital) equal the difference between total government spending and total tax revenues. Since households are the other owner of capital, the remaining domestic capital is assumed to be owned by them.

5.4 International trade

Imports are used as intermediate inputs for private and public production, as domestic consumption, and as investment. All three types of imports of any given good share a common world market price, which is exogenous to the domestic users.

Instead of assuming perfect substitution between domestic and imported goods, we allow for imperfect substitution by applying the Armington structure specified in CES functions, whose substitution parameters dictate changes in imports due to changes in the price differentials between the domestic and foreign variants of the same product. A large (small) substitution parameter implies large (small) changes in imports due to any given price differential. In our theoretical model, we assume that the domestic price of the importable is determined by the world market, a situation that can be mimicked by applying an extremely large substitution parameter[8]. The advantage of applying Armington structure is mainly due to the empirical evidence that "cross-hauling" of products are common and that pure importables and exportables cannot be observed in international trade data compiled with commonly used classification standards. Also, in larger computational models, perfect substitutability may lead to computational difficulties due to possible dramatic shifts in trade and specialization patterns.

Exports of private goods (public goods are all assumed to be consumed domestically) are determined by a set of export functions that are characterized by limited adjustment of exports due to any domestic-world market price differentials. The price-differential induced adjustment in exports is governed by finite export elasticities, a treatment to prevent extreme adjustment. This is a similar structure to what is specified by the Armington structure for imports.

[8] It turns out that this parameter is indeed important as the simulation results obtained from the applied model depends critically on it. Some preliminary sensitivity analysis is provided in the result section. However, more experiments are needed to pinpoint the exact mechanism through which this parameter influences the simulation results on the optimal policies.

5.5 Investment, savings and macroeconomic closure

Savings is a residual part of the national income (net of households spending and government expenditure). It is assumed to be all spent as investment/depreciations. As mentioned earlier, investment is an Armington composite good of foreign and domestic goods. In this one-period static CGE model, investment does not enter into the capital stock in the current period. Further, the aggregate utility function does not include savings as an argument, thereby assuming away any inter-temporal choices. Trade balance in this model is assumed to be endogenous. However, due to Walras' Law, changes in trade balance should be zero if other markets are cleared.[9]

5.6 Benchmark equilibrium dataset

A benchmark equilibrium dataset for Hong Kong is extracted from the GTAP database version 5 (Dimaranan and McDougall 2002), which offers a snapshot of the world economy in 1997. There are three main components in the Hong Kong dataset. The first is an absorption matrix that shows how *n* domestic products and imports are absorbed by different agents in the economy (including producers, investors, households, exporters, and the government). The second component is the uses of primary factors (labor, land and capital) in the *n* industries. The last one is import tariffs and output taxes. All these flow data are in value terms (US dollars). So in the modeling work, we need to establish a price variable as the numeraire and model all other prices in relative terms to the numeraire.

In the dataset, there is no explicit account of public goods provision but data on government expenditures are available, which we can use as a proxy of public goods provision. Government expenditures are distributed to the consumption of both domestically produced and imported goods. These goods are also consumed by private households. Moreover, both the

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[9] See Devarajan, Lewis and Robinson (1990) for verification of this point in a simplified CGE model.

government and private households pay the same price for each good. This data structure would fit nicely into a theoretical structure in which a representative super-agent maximizes the economy-wide utility by optimally distributing homogenous consumption goods among different agents in the economy[10]. Our theoretical and CGE models, however, have the structure that the government engages in producing and provision of public goods. Therefore, we need to have a separate data structure of public goods production to support this model structure. To do so, we need to recalibrate the dataset by dividing total domestic intermediate inputs, total imported intermediate inputs, and total primary factors between public goods production and private goods production. This split is achieved by applying the value shares of government consumption in total domestic sales and in total imports. It can be shown that such a split maintains the balance of the dataset.

6. Numerical results from the CGE model

The two policy variables (capital tax and wage differentials) in the CGE model are shocked for the purposes of evaluating the optimal capital tax rate and public sector wage pay. Changes in the aggregate utility are used as the criteria for picking the optima. These changes are obtained by taking the difference between the utility level contained in the initial equilibrium data set and that in the post-simulation equilibrium data set.

First, we consider the effect of adjusting public sector pay. Starting with a base case that shows no wage differential between the public and private sectors[11], we conduct a series of experiments to find the optimal α that maximizes the welfare (i.e. the regional utility). Among the eighteen different shocks (ranging from a public pay cut of 7 percent to an increase of 1 percent),

[10] For example, the GTAP model specifies a Cobb-Douglas utility function that is defined over household consumption, government consumption, and savings (see Hertel 1997). There, the provision of public goods is mimicked by government spending. However, government revenue constraint is not enforced in the GTAP model.

[11] As stated earlier that only flow variables in dollar terms are reported in the data set, where no indication of wage differentials is presented.

a 2.5 percent cut of public pay generates the largest increase in the aggregate utility (see Figure 2). The optimality of the 2.5 percent cut can be illustrated by the lower utility levels achieved by cutting the same variable either more than or less than 2.5 percent.[12]

This result verifies the existence of an optimal public sector pay and shows that a higher or lower public sector pay would reduce the welfare of the economy. However, the numerically evaluated optimum is different from the corresponding result obtained from the theoretical model, which states that the optimum is attained when wage rates in the two sectors are equalized. This is possibly due to the fact that in the CGE model, exogenous product differentiation is introduced using the Armington specification of international trade, where imported goods are assumed to be different from their domestic counterparts. The greater the Armington elasticity is, the higher the substitutability between home and imported goods is. The Armington elasticity used in our CGE model is 600, a very high value in comparison to those adopted by many applied CGE model in practice. However, the perfect substitutability implied by the theoretical model suggests an infinitely large Armington elasticity. To verify the sensitiveness of the optimal public wage rate, we re-run the public wage rate experiments under several different values of the Armington elasticity (ranging from 500 to 900). As can be seen from Figure 2, the optimal wage differential cut is moving toward zero (recall that the two wage rates are equalized when the wage differential cut is zero, according to the assumptions in the data set) with larger Armington elasticity. Therefore, the numerical results reported here seem to be reconcilable with the theoretical predictions.

Second, we consider the optimal capital tax. Sixteen different capital tax shocks (ranging from a 0.3 percent cut to a 4.5 percent hike; all of which are conducted from an initial case of zero percent capital tax, as reflected in the base data set) are experimented for locating the optimal tax rate. Figure 3 shows that the optimal tax rate is between 2.4 and 2.8 percent, given the

[12] Strictly speaking, the optimal public pay cut is around 2.5 percent. A more precise result can be obtained by conducting more experiments for $\alpha \in \left[-3,-2.5\right]$.

specification of the model and the choice of parameters.[13] Any deviation from this interval would result in a lower level of utility. For example, a capital tax hike from the base case of zero percent would increase the welfare until the tax rate reaches the above mentioned interval. After that, the welfare would level off. When the tax rate exceeds 5 percent, introducing such a tax would reduce the welfare.

Third, the effects of land sales on the optimal policies are numerically evaluated. To verify the theoretical result contained in (14), two shocks are introduced: the first involving a 0.5 percent increase in land supply and the second involving a 0.5 decrease in land supply, both of which are conducted from the base level. In order to evaluate the effects on the optimal capital rate, these shocks are conducted in conjunction with different shocks to the capital tax rate. The resulting changes in utility in both cases are compared with the original optimal capital tax rate.

Table 1 reports the results obtained from the two cases as well as the original optimal case. Here, changes in optimal capital tax rates can only be revealed by refining the shocks to the capital tax in the range of 2.58 percent and 2.66 percent. It has been found that the original optimal capital tax is around 2.63 percent (column 1 in Table 1). The 0.5 percent increase in land supply results in a lower optimal capital tax of 2.62 percent (column 2), whereas the 0.5 percent decrease in land supply leads to a higher optimal capital tax of 2.64 percent (column 3). Therefore, the theoretical result in (14) is confirmed. Nevertheless, it is worth noting that the effect of land supply changes in the neighborhood of 0.5 percent on the optimal capital tax rate seems to be quite small. More numerical simulations are needed for drawing more convincing conclusions on the magnitude of the effects of changing land supply.

Fourth, the effect of changes in the international rate of capital returns on the optimal tax policy is investigated. Again, we consider how two changes in this variable of opposite signs affect the optimal capital tax. As can be seen from Table 2, a 3 percent increase in the international rate of returns reduces the optimal tax rate from 2.63 percent to 2.61 percent,

[13] As shown later in Tables 1 and 2, more precise experimentations reveal an optimal rate of 2.63 percent.

whereas a 3 percent decrease in the rate of return increases the optimal tax to 2.635 percent. These results verify equation (15).

Lastly, an exogenous change in the world market prices of the economy's exportable goods is considered. The dominant exportable from Hong Kong is services. Here, we consider a 0.1 percent increase as well as a 0.1 percent decrease in the world market price of services. Figure 4 plots the changes of utility in responding to a series of capital tax rates under the two world market prices as well as utility changes under constant world market prices. It can be seen that an increase in the world market price leads to a hike in the optimal capital tax rate from 2.63 percent to 2.9 percent. On the other hand, a decrease in the world market price results in a lower optimal capital tax rate of 2.3 percent. These confirm equation (16). Note that as compared to changes in international rate of capital returns and land supply, changes in world market prices seem to generate larger effects on the optimal capital tax.

In summary, the main propositions of the paper have been verified with numerical simulations of the CGE model, using a data set for Hong Kong. Moreover, it is shown that the formulation of optimal capital tax policy needs to be contingent on external shocks such as a slow down in the real estate market, a negative terms of trade shock, or a change in international rate of returns. Lastly, the adjustment in the optimal capital tax rate seems to be more responsive to terms of trade shocks than to either a shock in international rate of capital returns or a change in the supply of land.

7. Concluding Remarks

Using a general equilibrium model, this paper has examined the welfare implications of adjustments of public sector wages and capital tax rates. The individually and jointly optimal policies regarding public sector pay cuts and capital tax rate hikes are derived and interpreted. The impacts of external shocks, such as reductions in land sales, falls in foreign interest rates and deteriorations in terms of trade, on the optimal policies are also delineated. Specifically, during economic downturns, a public workers' pay cut is needed for making the level of the public wage comparable to the private sector and a hike in capital taxes is recommended for budgetary considerations.

The empirical part of the paper develops a computable general equilibrium model for Hong Kong. Together with a data set for Hong Kong, this model is used to numerically evaluate the various optimal policies. The numerical results not only confirm the main preposition of the paper, they also provide preliminary quantitative estimates of the various optimal policy variables.

There are a few limitations in this paper. Firstly, to simplify the theoretical analysis, it is assumed that the production of the exportable good uses labor only. This yields, for this small open economy with given goods prices, a constant wage for the private sector. However, this result may be at variance with the fact that private wages are generally flexible and adjusted according to changes in economic conditions. Nevertheless, this does not seem to affect the qualitative result of the paper. As can be seen from the numerical results, having a more sophisticated production structure and an endogenously determined wage rate in the private sector does not change the result. Secondly, the model considered in this paper is based on a simple one-period setting, in which the government budget is balanced. It is desirable to extend the setting to a two-period model by allowing for budget deficits in the first period. This would be an interesting topic for our future research. Third, the parameters employed in the CGE model have not been empirically tested and the numerically evaluated optimal policies seem to be sensitive to the parameterization of the model. Therefore, the preliminary numerical estimates provided here should be treated with great caution. Lastly, the data set underpinning the numerical analysis is taken from the GTAP data set, which is based on a rather old social accounting matrix (SAM) of the Hong Kong economy. To generate numerical results of real policy relevance, an updated SAM compiled in Hong Kong is no doubt needed.

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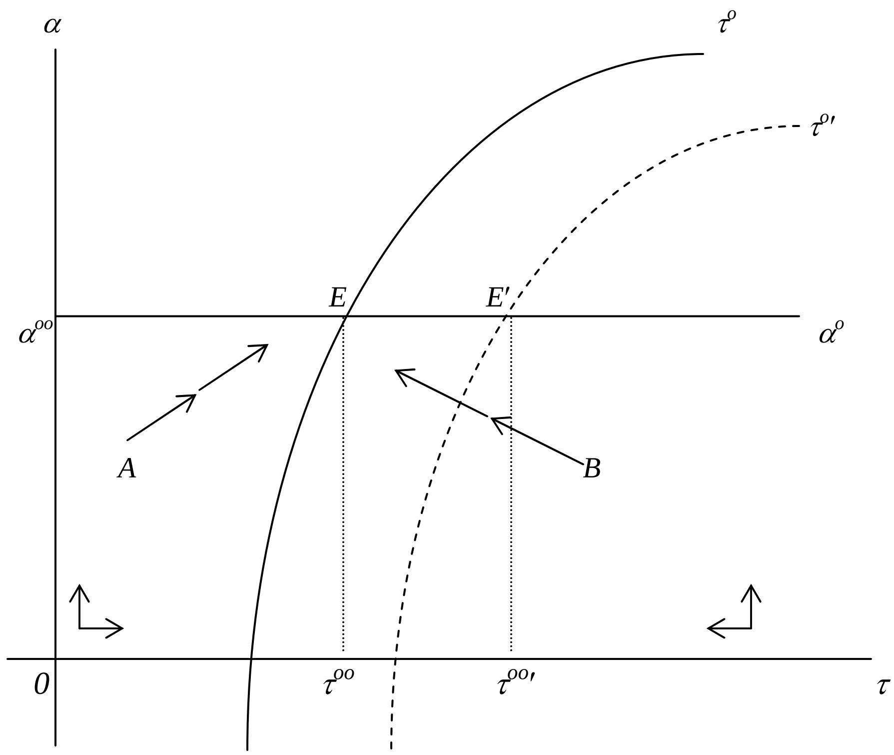

Figure 1. Optimal public-sector pay cuts and capital tax adjustments

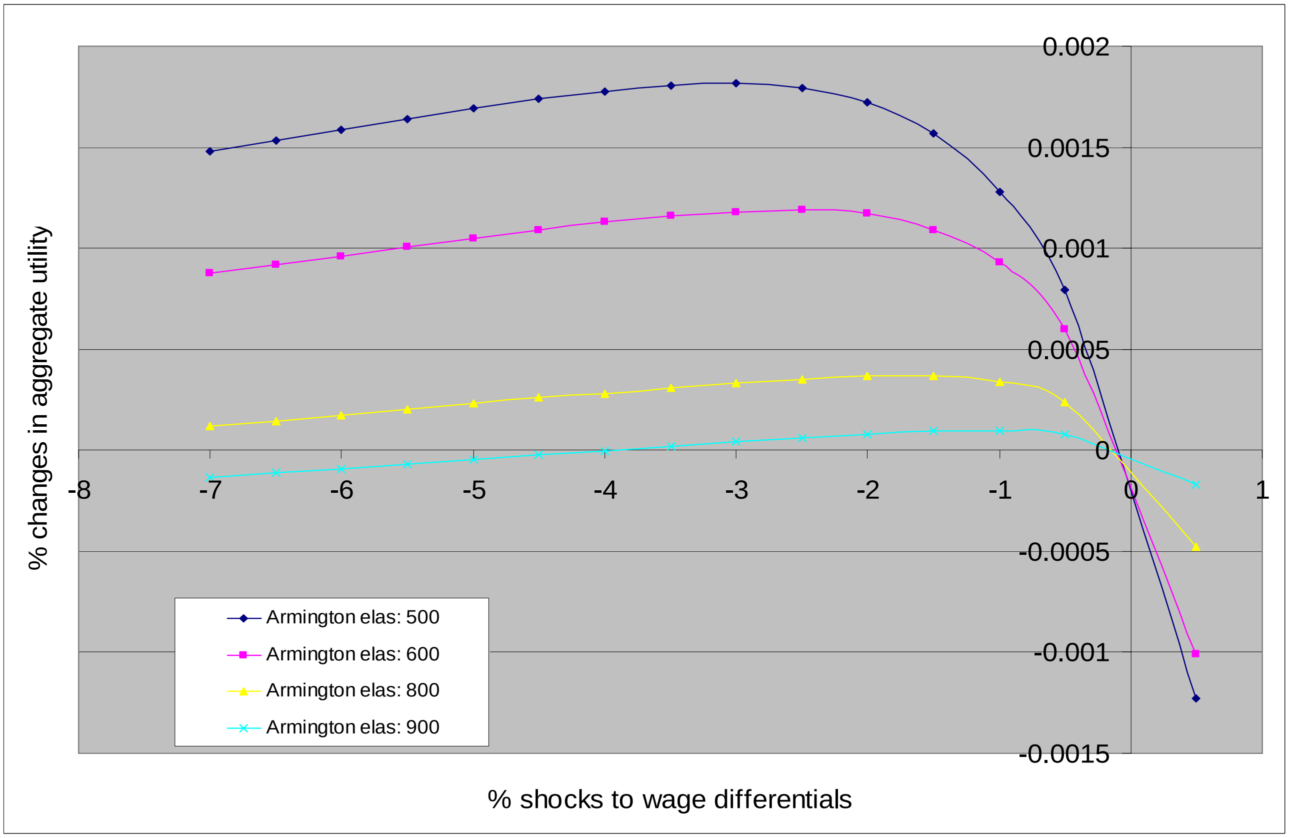

Figure 2. Optimal public-sector pay cuts and the economic welfare under alternative Armington elasticities

Note: the default Armington elasticity used in the paper is 600.

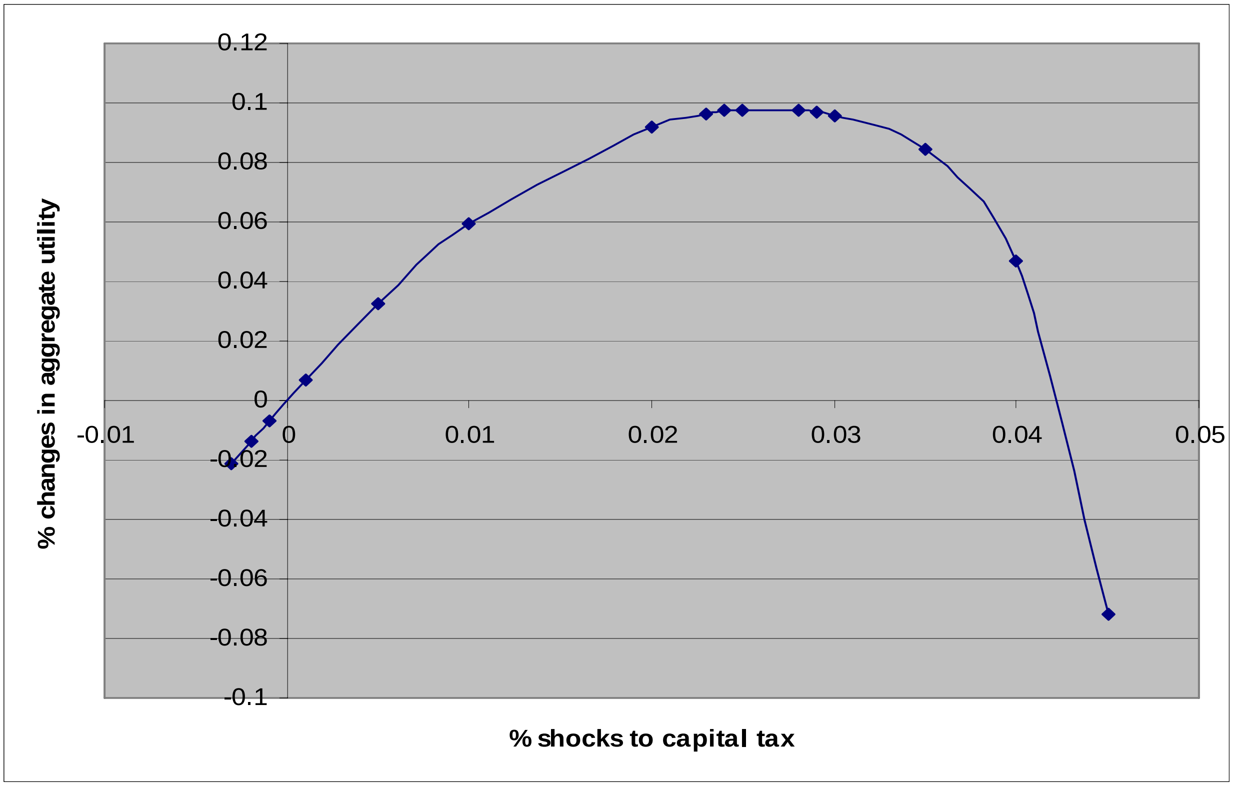

Figure 3. Optimal capital tax hike and the economic welfare

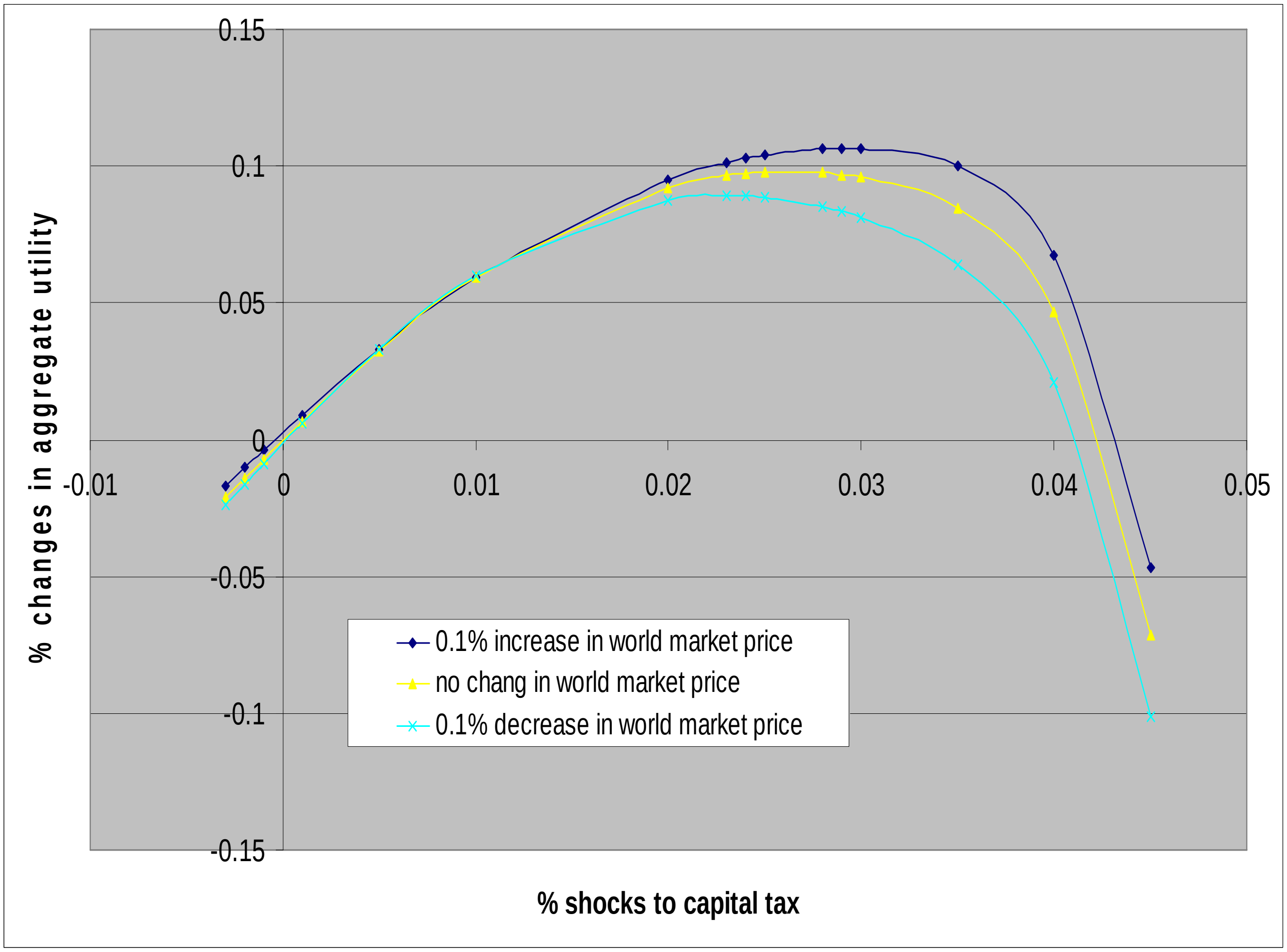

Figure 4. Changes in world market price of services and the optimal capital tax

Table 1. Changes in land supply and optimal capital tax

Capital tax rate	**% Changes in aggregate utility**		
	No change to land supply	**0.5% increase in land supply**	**0.5% decrease in land supply**
2.580%	0.0980300	0.329835	-0.133768
2.590%	0.0980440	0.329848	-0.133752
2.595%	0.0980500	0.329852	-0.133749
2.600%	0.0980500	0.329855	-0.133745
2.605%	0.0980550	0.329857	-0.133739
2.610%	0.0980580	0.329861	-0.133737
2.615%	0.0980610	0.329864	-0.133732
2.620%	0.0980610	**0.329864**	-0.133732
2.625%	0.0980620	0.329863	-0.13373
2.630%	**0.0980630**	0.329863	-0.13373
2.635%	0.0980600	0.329861	-0.133732
2.640%	0.0980600	0.32986	**-0.133732**
2.645%	0.0980570	0.329854	-0.133733
2.650%	0.0980530	0.329853	-0.133738
2.655%	0.0980500	0.329847	-0.133742
2.660%	0.0980430	0.329843	-0.133745

Source: simulation results.

Table 2. Changes in international rate of capital returns and optimal capital tax

Capital tax rate	**% Changes in aggregate utility**		
	No changes in international rate of return	**3% increase in international rate of capital return**	**3% decrease in international rate of capital return**
2.580%	0.0980300	0.0946470	0.1014210
2.590%	0.0980440	0.0946550	0.1014380
2.595%	0.0980500	0.0946600	0.1014440
2.600%	0.0980500	0.0946620	0.1014510
2.605%	0.0980550	0.0946640	0.1014570
2.610%	0.0980580	**0.0946660**	0.1014600
2.615%	0.0980610	0.0946650	0.1014630
2.620%	0.0980610	0.0946650	0.1014660
2.625%	0.0980620	0.0946640	0.1014690
2.630%	**0.0980630**	0.0946600	0.1014700
2.635%	0.0980600	0.0946590	**0.1014720**
2.640%	0.0980600	0.0946570	0.1014710
2.645%	0.0980570	0.0946500	0.1014680
2.650%	0.0980530	0.0946470	0.1014690
2.655%	0.0980500	0.0946410	0.1014650
2.660%	0.0980430	0.0946350	0.1014630

Source: simulation results.