scottish institute for research in economics

SIRE DISCUSSION PAPER

SIRE-DP-2010-96

Subsidies as Optimal Fiscal Stimuli

Hassan Molana,

Catia Montagna

Chang Yee Kwan

University of Dundee

Subsidies as Optimal Fiscal Stimuli

Hassan Molana
University of Dundee and SIRE

Catia Montagna
University of Dundee and SIRE
GEP (University of Nottingham)

Chang Yee Kwan
University of Dundee

Abstract

In the theoretical macroeconomics literature, fiscal policy is almost uniformly taken to mean taxing and spending by a 'benevolent government' that exploits the potential aggregate demand externalities inherent in the imperfectly competitive nature of goods markets. Whilst shown to raise aggregate output and employment, these policies crowd-out private consumption and hence typically reduce welfare. In this paper we consider the use of 'tax-and-subsidise' instead of 'tax-and-spend' policies on account of their widespread use by governments, even in the recent recession, to stimulate economic activity. Within a static general equilibrium macro-model with imperfectly competitive good markets we examine the effect of wage and output subsidies and show that, for a small open economy, positive tax and subsidy rates exist which maximise welfare, rendering no intervention as a suboptimal state. We also show that, within a two-country setting, a Nash non-cooperative symmetric equilibrium with positive tax and subsidy rates exists, and that cooperation between trading partners in setting these rates is more expansionary and leads to an improvement upon the non-cooperative solution.

Corresponding Author: Hassan Molana, Economic Studies, University of Dundee, Dundee DD1 4HN, UK.
Tel: +44(0)1382 384375. E-Mail: h.h.molana@dundee.ac.uk

1. Introduction

The use of imperfectly competitive market structures in macroeconomic models which are designed to study policy effectiveness is nowadays a routine practice. In the goods market, this is usually done by assuming a monopolistic competition structure *à la* Dixit and Stiglitz (1977) model of horizontal product differentiation. A well-known feature of this type of good markets is that they give rise to an inefficient equilibrium resulting from the suboptimality of the number of product varieties. Since in such a situation exogenous interventions can be designed to reduce this inefficiency—either by stimulating new entry and raising the number of varieties or by raising the output level of incumbents—the underlying framework has been used intensively to study the role of fiscal policy.

In the macroeconomics literature, fiscal policy is almost uniformly taken to mean taxing and spending by a 'benevolent government' that exploits the potential for aggregate demand externalities inherent in the imperfectly competitive nature of goods market; specifically, an exogenous rise in government expenditure, spent on the differentiated good, is shown to raise aggregate output and employment. There are, however, two serious caveats associated with this type of exercise. First, in almost all cases the welfare effect of such a fiscal expansion, measured by the change in consumers' utility, happens to be negative. This is because private consumption is always crowded out by the rise in public expenditure—to the extent that even allowing private and public expenditure complementarity does not usually prevent the welfare loss—and consumers' leisure is reduced as a result of the change in the real wage and the shift in the aggregate supply. In this respect, therefore, the conventional fiscal expansion does not seem to lend itself to a clear optimal or 'efficient' policy agenda in this context since the resulting positive fiscal multiplier goes hand in hand with a welfare loss.[1] The second caveat stems from the choice of fiscal policy: given that the underlying inefficiency is entirely due to the specific market structure, an aggregate demand expansion cannot be the best way to tackle the resulting suboptimality; as Dixit and Stiglitz originally pointed out, the use of a subsidy which directly targets firms cost and profitability would be a better way to combat the problem.

In this paper we propose the use of 'tax-and-subsidise' instead of 'tax-and-spend' and show that it is possible to design an optimal policy which raises the level of economic activity

---

[1] Reinhorn (1998) shows that, in this context, the optimal policy is zero government expenditure. See Costa and Dixon (2009) for a recent survey. There is also an additional shortcoming due to using an identical CES aggregation for the private and public bundles when the latter too consists of expenditure on the differentiated good (as otherwise the analysis becomes intractable) but this simplifying assumption totally eliminates the distinction between the public and private goods which would only be acceptable when output is homogenous. Moreover, this type of government expenditure will prove to be problematic when considering an open economy under free trade since a typical CES bundle will consist of both domestic and foreign varieties—but it is not always feasible (or plausible) to spend tax revenue on foreign produced varieties.

(output and employment) while maximising consumers' welfare. The use of subsidy in the presence of horizontal product differentiation is not entirely new in the literature and various studies have examined its role as an effective policy instrument. However, the focus in this literature is almost entirely on how the subsidy policy affects the particular sector or industry and/or interacts with the volume of trade.[2] The use of a tax-and-subsidise policy has not been explored within the context of conventional general equilibrium macroeconomic models that examine the effectiveness of fiscal policy. Doing so, and within an open economy setting, is of relevance given the widespread use of tax-and-subsidise policies in most economies as a means to sustain employment—and their use has recently intensified as policy authorities in different countries have been combating the recent recession: e.g., direct job subsidies, wage subsidies or reductions in payroll taxes have been used in a number of countries to stimulate labour demand.[3]

In order to examine the effectiveness of tax-and-subsidise policy, we develop a standard static general equilibrium model *à la* Startz (1989) and extend it to allow for the role of international trade both within small-open-economy and a two-country setting.[4] Specifically, we examine the effect of a wage subsidy as well as of a subsidy given to the produces for each unit of output produced and find in both cases that optimal positive tax and subsidy rates exist that maximise welfare, rendering no interaction as a suboptimal state. One of the key messages of this finding is that distortionary fiscal policies (which affect relative prices) can work well when the market structure entails a distorted equilibrium. For the two-country setting we show that a Nash non-cooperative symmetric equilibrium with positive tax and subsidy rates exists which can be improved upon by cooperation. This is in line with the received wisdom that calls for fiscal policy coordination and goes against the (somewhat counterintuitive) findings that show non-cooperative fiscal policies tend to be more expansionary relative to the corresponding cooperative outcome outcomes—e.g., Chari and Kehoe (1990).

---

[2]   Some of the papers in Brakman and Heijdra (Eds, 2004) discuss the role of subsidy but none in the same context as discussed here. Lin (1996) shows how export subsidy can counteract consumption distortions under monopolistic competition and improve welfare.

[3]   On average, this type of programmes amount to about 25% of total expenditures on active labour market policies in OECD countries (OECD, 2003). The use of such subsidies was endorsed as a means to accelerate jobs recovery by the recent ILO-IMF (2010) Conference on "The Challenges of Growth, Employment and Social Cohesion". Many countries (including e.g. Germany, France, Japan, Finland, Sweden, Ireland) have increased reliance on these programmes during the recent recession.

[4]   The majority of macroeconomic models on the subject are cast in closed economy framework. It is however recognised that openness to trade can have a substantial (negative) impact on the effectiveness of fiscal policy; for instance, Cooper (1985) argues that the expansionary domestic effects of fiscal policy is reduced due to the demand leakage. The open economy models which addressed fiscal policy usually focussed on tax policy coordination and did not involve goods market imperfections—see, amongst others, e.g., Turnovsky (1988), van der Ploeg (1987, 1988) and Devereux (1991).

The rest of the paper is organised as follows. Section 2 outlines the model in a small-open-economy setting and analyses the role of wage subsidy. Starting with no subsidy, we find that introducing a small subsidy—financed by taxing consumers' income—increases both welfare and the level of economic activity by raising entry, and go on to show that an optimal policy outcome with positive tax and subsidy rates exists. In Section 3, we modify the model to show that (i) using a subsidy per unit of output does not change the result qualitatively although in this case the gain is achieved by raising each firm's level of output; and (ii) the optimality result holds for the two-country case and cooperation in setting the optimal level of subsidy improves upon the non-cooperative outcome. Section 4 concludes the paper.

2.   The small-open-economy model

The economy consists of two industries, one imperfectly competitive and one perfectly competitive, respectively producing a horizontally differentiated and a homogeneous commodity. Both products are freely traded with the rest of the world. Labour, the only factor of production, is perfectly mobile between the two industries but is immobile internationally.

2.1.   The demand side

On the demand side, the utility function for the aggregate representative consumer is defined over the two consumption goods and leisure time, whose quantities are respectively denoted by D, A and ℓ. To obtain closed-form solutions, we adopt the commonly used utility function

$$U = \frac{A^{1-\mu}D^{\mu}}{(1-\mu)^{1-\mu}\mu^{\mu}} + \frac{\phi\ell^{1-\gamma}}{1-\gamma}, \quad 0 < \mu < 1, \quad \gamma > 0, \quad \phi > 0. \tag{1}$$

Denoting labour supply, the wage rate and the price of the differentiated good respectively by L, w and P and using the homogenous good as the numeraire (hence normalising its price to unity), the time and budget constraints facing the consumer are

$$L + \ell = 1 \tag{2}$$

and

$$A + PD = (1-\tau)wL, \tag{3}$$

where τ is the income tax rate. Maximising (1) subject to (2)-(3) yields

$$L = 1 - \left(\frac{(1-\tau)w}{\phi P^{\mu}}\right)^{-1/\gamma}, \tag{4}$$

$$A = (1-\mu)(1-\tau)wL, \tag{5}$$

$$D = \frac{\mu(1-\tau)wL}{P}. \tag{6}$$

D is a CES bundle of domestically produced and imported varieties whose quantities are denoted by y and x_f, respectively. Let (p_i, N) and (p_{i_f}, N_f) represent the price and mass of varieties of the differentiated good produced domestically and abroad respectively. In the absence of transport costs, the CES price and quantity indices then are

$$P = (N + N_f)^{(\lambda-1)/(1-\sigma)} \left(\int_0^N p_i^{1-\sigma} di + \int_0^{N_f} p_{i_f}^{1-\sigma} di_f \right)^{\frac{1}{1-\sigma}}, \tag{7}$$

$$D = (N + N_f)^{-(\lambda-1)/(1-\sigma)} \left(\int_0^N y_i^{1-1/\sigma} di + \int_0^{N_f} x_{i_f}^{1-1/\sigma} di_f \right)^{\frac{1}{1-1/\sigma}}, \tag{8}$$

where the constant parameter $\lambda \in [0,1]$ captures the extent to which the CES bundle explicitly incorporates the so-called "*love of variety*"; $\lambda=0$ and $\lambda=1$ correspond to the two extreme cases of "*no love*" and of "*maximum love*" respectively—see Benassy (1996) and Molana and Montagna (2000) for details. Together with (6), the above imply the variety-level demand functions

$$y_i = (N + N_f)^{\lambda-1} \frac{\mu(1-\tau)wL}{P} \left(\frac{p_i}{P} \right)^{-\sigma}, \quad i \in [0,N], \tag{9}$$

$$x_{i_f} = (N + N_f)^{\lambda-1} \frac{\mu(1-\tau)wL}{P} \left(\frac{p_{i_f}}{P} \right)^{-\sigma}, \quad i_f \in [0,N_f]. \tag{10}$$

By virtue of the small-open-economy setting, we should treat the number of foreign varieties available for consumption and their prices, N_f and p_{i_f}, as being exogenous and not affected by any domestic developments. By the same argument, we also assume the foreign expenditure on domestically produced varieties, E_f, to be exogenous. Thus, further assuming that foreign and domestic consumers have identical tastes (and hence the same elasticity of substitution between varieties), the foreign demand facing the domestic firm producing variety i can be modelled as

$$x_i = E_f p_i^{-\sigma}, \quad i \in [0,N], \tag{11}$$

where x_i is the quantity of variety i demanded by the 'rest-of-the-world'.

2.2. The supply side with wage subsidy

In the differentiated good sector, firms use labour as the only input to produce one variety of the good according to an increasing returns to scale technology that is homogenous across firms. Each domestic variety of the differentiated good is produced by one domestic firm only. A typical firm i's labour demand is

$$l_i = \alpha + \beta z_i, \qquad i \in [0, N], \tag{12}$$

where z is the total production (supply) of variety i, and α and β are the fixed and marginal labour requirements respectively. The profit of firm i therefore is

$$\pi_i = p_i z_i - (w - s) l_i, \qquad i \in [0, N], \tag{13}$$

where w is the wage rate and $s<w$ is the subsidy that the firm receives from the government for each unit of labour it employs. The firm chooses its price to maximise profit ignoring the effect of its action on the industry price index. This yields the optimal price rule as a mark-up on marginal cost,

$$p_i = \frac{\sigma \beta (w - s)}{\sigma - 1}. \qquad i \in [0, N]. \tag{14}$$

Imposing the zero-profit condition that results from free-entry and using (14) we obtain

$$z_i = \frac{\alpha (\sigma - 1)}{\beta}, \qquad i \in [0, N], \tag{15}$$

which is the familiar constant optimal firm scale. Thus the subsidy is partly passed on to the consumer by lowering the price of the good and it does not affect the firm's optimal scale of operation.

The homogenous good is produced under perfectly competitive conditions using a constant returns technology with unit labour requirement,

$$L_A = A^s, \tag{16}$$

where L_A is the labour demand of this sector and the superscript s denotes supply. The constant returns to scale technology, the zero-profit condition in the homogenous good sector and free mobility of labour across the two domestic sectors imply the equality between the wage rate and the price of the homogeneous good, i.e. $w = 1$.

2.3. The equilibrium

The market equilibrium condition for a variety i of the differentiated good is

$$y_i + x_i = z_i \, . \tag{18}$$

The labour market equilibrium requires

$$L_A + Nl_i = L \, . \tag{19}$$

The government budget constraint which equates the subsidy bill to the tax revenue is

$$sNl_i = \tau L \, . \tag{20}$$

Given the assumed symmetry between firms, the price index of the differentiated good in (7) can be re-written as $P = \left(N + N_f \right)^{(\lambda-1)/(1-\sigma)} \left(N p_i^{1-\sigma} + N_f \, p_{i_f}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$. Finally, the general equilibrium requires the trade balance condition, $\left(A - A^s \right) + \left(N_f \, p_{i_f} \, x_{i_f} - N p_i x_i \right) = 0$, which can be shown to hold when markets clear.

2.4. *The optimal policy*

Of the two policy instruments, the subsidy rate s and the tax rate τ, the government can use one and let the other adjust to clear the resulting budget deficit or surplus. Suppose that, starting from an initial equilibrium position where $s = \tau = 0$, the government stimulates the economy by raising s. The immediate impact of this is to (i) raise N by encouraging entry, and (ii) reduce p_i as the subsidy reduces the unit labour cost. These imply a reduction in P and an increase in the real wage that stimulates labour supply (which is absorbed by the new firms, whose entry shifts up the labour demand); other things equal, the resulting increase in income will raise aggregate demand for goods. However, in order to compensate the fiscal deficit caused by the subsidy, the tax rate will need to be allowed to rise until the resulting tax revenue pays for the deficit. It can be shown that this only partially crowds out the initial impact of the subsidy and the net effect is an increase in the level of economic activity.[5]

The possibility of optimal policy in the context of the above model arises if the government can choose one of its policy instruments to maximise an adequately defined welfare function for the economy, letting the other policy variable adjust to satisfy its budget constraint. Given that profits are wiped out by entry, we proxy the welfare function by the indirect utility function,

---

[5]   This result holds as long as the fall in P dominates the rise in τ so that the net real wage and hence labour supply rises; see equation (4) above recalling that $w = 1$.

$$U = \frac{(1-\tau)L}{P^{\mu}} + \frac{\phi(1-L)^{1-\gamma}}{1-\gamma}, \qquad (1')$$

which is obtained by substituting (2), (5) and (6) in (1) and imposing $w=1$.[6]

Suppose that the government chooses the tax rate τ to maximise welfare, letting the subsidy rate s be determined freely. To derive the optimal τ in this context, we first solve the model treating τ as exogenous (and s as endogenous) and obtain the solution for all the endogenous variables in terms of the parameters and exogenous variables—namely α, β, γ, λ, ϕ, μ, σ, p_{i_f}, E_f, N_f and τ. This solution portrays an *ad hoc* equilibrium which can be shown to be unique and stable for all feasible value of the parameters and exogenous variables. To find the optimal value of τ we first substitute in (1') for L and P their *ad hoc* equilibrium solution and then maximise the resulting function with respect to τ. Because the algebraic expressions are analytically intractable, we illustrate the existence of an optimal tax rate as follows. Imposing $w=1$ on equation (4) we can totally differentiate it to obtain

$$sign\left(\frac{dL}{d\tau}\right) = -sign\left(1 + \frac{\mu(1-\tau)}{\tau}\varepsilon_{P,\tau}\right), \qquad (21)$$

where $\varepsilon_{P,\tau} = \frac{\tau}{P}\frac{dP}{d\tau}$ is negative as long as the tax revenue is used to subsidise firms—which raises the number of domestically produced varieties and reduces their price. Given that $\varepsilon_{P,\tau}$ is finite, at a very small level of τ (sufficiently close to zero) the second term in parentheses on the right-hand-side dominates, making $dL/d\tau > 0$. However, as τ rises this term becomes smaller resulting eventually in $dL/d\tau < 0$ and making L a concave function of τ. Therefore, positive levels of tax and subsidy exist at which the economy reaches the maximum level of economic activity. In Figure 1, we use a numerical calibration of the model[7] to plot what we refer to as the *ad hoc* equilibrium values of L and the corresponding U against τ in order to illustrate the above concavity which enables exercising optimal taxation policy.

---

[6]   It is worth noting that for all $\gamma>0$, welfare is monotonically increasing in L. To see this, use (4) to eliminate $(1-\tau)/P^{\mu}$ from (1'), obtaining $U = \phi(1-\gamma)^{-1}(1-\gamma L)(1-L)^{-\gamma}$ which implies $dU/dL = \phi\gamma L(1-L)^{-(1+\gamma)} > 0$. Hence, given that as the only factor of production L represents the level of economic activity, this result simply shows that welfare is a monotonically increasing function of the level of economic activity.

[7]   In all calibrations, the bench solution is based on the following values: α=1/120, β= 0.08, γ=2/3, λ=1, ϕ= 4.64, μ=2/3, σ=5, p_{i_f}=0.1, E_f= .0002, N_f=8 and τ=0. Note that the small size of E_f reflects its relative magnitude and $0<\gamma<1$ is imposed to ensure that the leisure effect does not dominate in the utility function when L is close to unity (although relaxation of this does not affect the results). Sensitivity analyses show that the numerical solution is robust.

In the model outlined above welfare is maximised since the wage effect in the utility function dominates, making the indirect utility an increasing function of L (see the explanation in footnote 6). However, we wish to emphasise that an optimal tax rate in this context also exists even if we assume an exogenous labour supply and eliminate leisure from the utility function. It is straightforward to show that while in such a model the level of economic activity (which is fixed by the exogenous labour supply) is no longer affected by the tax-and-subsidise policy, it is still possible to find an optimal level of tax which reallocates economic activity between the two sectors such that the indirect utility is maximised. Clearly, when the level of economic activity is fixed exogenously by inelastically supplied factors of production which are fully employed, the tax-and-subsidise policy only corrects the consumption distortion[8]; in the model outlined in this paper, the policy does both, enabling the economy to reach its optimal level of aggregate economic activity and the best allocation of this activity across the two sectors.

The above model is also sufficiently general to examine how welfare is affected by consumers' love-of-variety, availability of imported varieties and the foreign demand for domestic varieties—captured by λ, N_f and E_f respectively. Figures 2 to 4 show these effects. In particular:

(i) A fall in λ reduces welfare via the love-of-variety effect and also tightens the channel through which the variety effect acts on the price index; hence a reduction in love-of-variety reduces the expansionary effect of the policy. Some studies in the macroeconomics literature have chosen to completely switch off the love-of-variety effect on the grounds that the CES aggregator should be such that in a symmetric equilibrium (with identical firms) there should be no distinction between the aggregate price level and the price of a variety. For instance, Startz (1989) shows that the effect of an expansionary fiscal policy is crowded out entirely when it is financed by lump-sum taxes and $\lambda=0$ is imposed. While our finding that the effectiveness of the policy is increasing in λ is qualitatively consistent, in our framework the policy is still expansionary and welfare improving even when $\lambda=0$.

(ii) A reduction in N_f lowers welfare directly via the variety effect as well as diminishing the effectiveness of the policy due to a reallocation of economic activity across the two sectors which is enhanced by international trade.

---

[8] In these type of economies, the extent of product diversity which prevails in free entry market equilibrium is sub-optimal and consumers are forced to consume too much of the 'other good'—i.e., the homogenous good used as numeraire. Hence any policy intervention that corrects this type of distortion can be welfare improving—see Spence (1976), Dixit and Stiglitz (1977) and Matsuyama (1995) for various explanations.

(iii) Qualitatively, the welfare effect of a fall in E_f is the same as that of N_f. However, the channel of impact differs in the two cases, as E_f contributes to aggregate demand and hence to the level of economic activity directly. As a result, while the tax rate, and the implied subsidy rate, at which welfare is maximised is lower when N_f falls, these rates are both higher when E_f is reduced. In the context of the model sketched above, the fall in E_f can be interpreted as a negative exogenous shock (e.g. due to a contraction in the rest of the world), with the results pointing to the optimality of raising the level of stimulus to tackle an exogenous fall in demand.
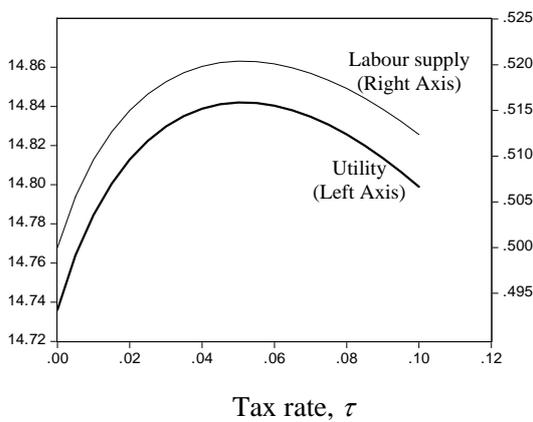

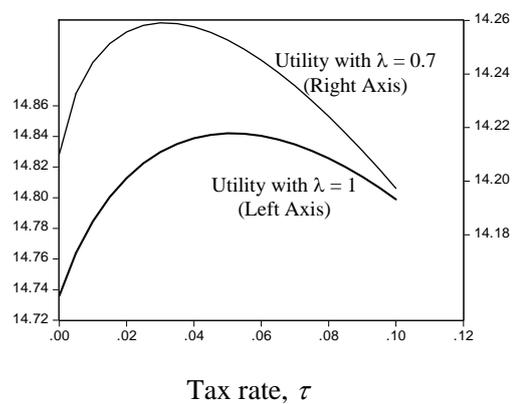**Figure 1: Utility and labour supply**
(*wage subsidy case*)

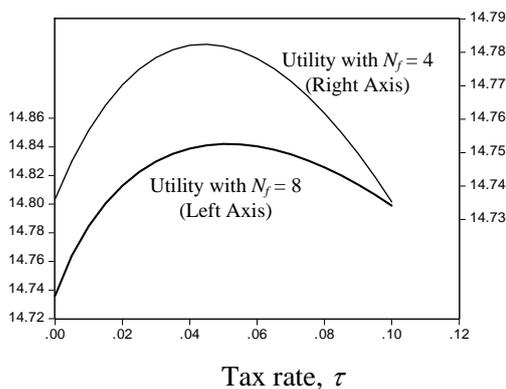**Figure 2: Effect of love of variety on utility**
(*wage subsidy case*)

Figure 3: Effect of mass of variety on utility
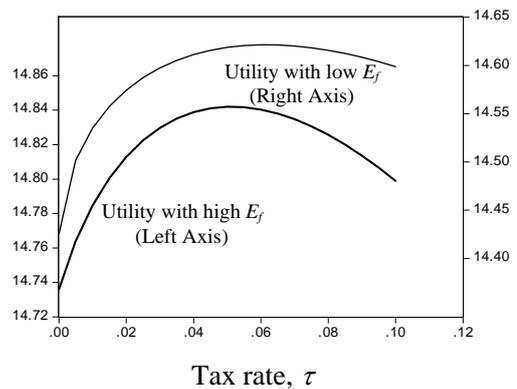(*wage subsidy case*)

Figure 4: Effect of foreign demand on utility
(*wage subsidy case*)

3.   Extensions

3.1.   *The nature of the subsidy*

In the above analysis, we have examined the impact of a wage subsidy. It is interesting to compare how the results change if the subsidy was given to the firm for each unit of the good produced rather than for each unit of labour used. The modification involves only equations (13)-(15) and (20) which are rewritten below to incorporate a per-unit subsidy:

$$\pi_i = (s + p_i) z_i - w l_i, \qquad i \in [0, N], \tag{13'}$$

$$p_i = \frac{\sigma(\beta - s)}{\sigma - 1}, \qquad i \in [0, N], \tag{14'}$$

$$z_i = \frac{\alpha(\sigma - 1)}{\beta - s}, \qquad i \in [0, N], \tag{15'}$$

$$s N z_i = \tau L. \tag{20'}$$

It is worth noting that in this set up a per-unit subsidy affects both price and output scale of the firm since the firm experiences a fall in marginal cost—whereas a wage subsidy could be interpreted as a reduction in the firm's average cost (due to the fact that labour is used as both fixed and variable input). Compared to the previous case, the firm now charges a relatively lower price and produces a higher quantity but its revenue remains unchanged—i.e., $p_i z_i = \alpha \sigma$. Recall that in the previous case subsidy reduced the firm's revenue since $p_i z_i = \alpha \beta \sigma (1 - s)$; the respective ratio of price, quantity and revenue to those in the previous case are $(\beta - s) / \beta (1 - s)$, $\beta / (\beta - s)$, and $1 / (1 - s)$. Hence, these two types of subsidy have different effects on the composition of the industry – with the per-unit subsidy resulting in larger and hence more efficient firms. It is in this sense that a per-unit subsidy can be an interesting alternative policy. However, the effect of this policy on welfare and employment turns out to be qualitatively identical to the wage subsidy as illustrated in Figures 1 to 4.

The fact that both types of subsidies yield qualitatively similar results leads to an important policy strategy in circumstances where international policy institutions/rules such as WTO/GATT advocate against 'distorting' traded goods prices. The unit revenue subsidy outlined here is a good example of one such distortion. But, in principle, subsidising employment is very much seen in the context of national welfare programmes when governments need to take steps to secure employment levels when economic activity falls below its optimal level. It is worthwhile to conclude the discussion of small open model implications by noting that the results obtained above undermine the conclusion by Flam and Helpman (1987)

who establish that a small economy may be harmed by subsidising its exports because the subsidy cost exceeds the benefit it generates by counteracting consumption distortion; we find exactly the opposite result.

3.2. *Relaxing the small country assumption*

From a policy point of view, it is worthwhile casting the model in a standard two-country setting in which countries trade freely in final goods and are equally significant players in the integrated goods markets. Using a similar setting, Lin (1996) addresses the role of export subsidy coordination and shows that it can improve welfare at both a national and a global level. Lin's focus is on trade policy and the role of bilateral export subsidies in counteracting consumption deficiencies when goods are horizontally differentiated, and does not consider the effect of this policy on the level of economic activity. Within a 'New Keynesian' macroeconomic model, our focus is instead on fiscal policy and we are primarily interested in the impact of tax-and-subsidies policy when the authorities can coordinate their action. In the existing literature, the question of policy coordination has been addressed in similar contexts but with different market structure and trade pattern. As mentioned above, these studies—e.g., Chari and Kehoe (1990) or Turnovsky (1988)—usually find a somewhat counterintuitive result that cooperation is less expansionary that the non-cooperative outcome. This is explained by the so-called 'beggar thy neighbour' effect where in the non-cooperative solution the fiscal expansion which raises demand for domestically produced goods causes a demand switch from foreign to domestic goods, resulting in an improvement in the terms of trade and the real income of the country which expands; this phenomenon is absent in a cooperative setting which results in a smaller expansion. Recently, Andersen (2007) has addressed this point showing that once the market structure is modified to allow for a more flexible trade pattern, which he implements using the horizontal product differentiation structure, the outcome is reversed and the cooperative solution entails a larger fiscal expansion.[9] In what follows we show the same result to hold for tax-and-subsidise policy.

To analyse the role of policy coordination, let us assume the world to consist of two economies identical to that described above, which freely trade both final goods (but rule out cross-border labour mobility as before). The necessary modifications of the equations are explained in the Appendix. Consider first the situation where each country pursues its optimal policy independently, i.e. the Nash non-cooperative outcome. Referring to the countries as home

---

[9]   Andersen defines fiscal expenditure as 'public sector wage bill'—paid to employees who produce a public good— so as to avoid the problem of spending tax revenue on foreign good (see footnote 1 for details).

and foreign and denoting them by the subscripts h and f respectively, let $RF_h\left(s_h, s_f\right) = 0$ be the locus, in $\left(s_f, s_h\right)$ space, of the optimal level of s_h for each level of s_f – i.e., RF_h is the home government's reaction function. Analytically, this is derived as follows. Treating s_h and s_f as exogenous (policy tools), we solve the model for the free entry symmetric '*ad hoc*' equilibrium where τ_h and τ_f are now allowed to adjust to clear the respective government budget constraint. We then find the welfare function for the home country by substituting this solution in the utility function. RF_h is the derivative of this utility function with respect to s_h (for each s_f that satisfies the '*ad hoc*' equilibrium). In other words, analytically, $RF_h = 0$ is the first-order-condition for maximising the home country's indirect utility function subject to its own constraints and equilibrium conditions, assuming that the foreign government does not alter s_f.

Clearly, a 'well-behaved' reaction function exists if such an optimisation has a solution. If so, the slope of RF_h in the $\left(s_f, s_h\right)$ space informs the way the two countries' policies affect each other: a positive (negative) slope indicates strategic complementarity (substitutability). Given the results obtained in the previous section, one would expect *a priori* to find a policy externality and hence strategic complementarity. Again, due to algebraic complexity of the expressions, we use numerical solutions based on the initial calibration (see footnote 7) to illustrate $RF_h\left(s_h, s_f\right) = 0$. This is shown in Figure 5. As expected, the model gives rise to strategic complementarity since RF_h is positively sloped. Also, the fact that RF_h is flatter than the 45° line establishes the existence of a stable symmetric equilibrium at the intersection between the two lines (which corresponds to the symmetric Nash non-cooperative solution). This result shows that in a two-country setting too a policy intervention is welfare improving even if each country chooses to act independently.

To see whether cooperation leads to a bigger intervention (a larger subsidy) and improves upon the non-cooperative outcome, we evaluate the home country's utility function extending the symmetry to policy and imposing $s_f = s_h$. Figure 6 plots this utility function and shows that the cooperative policy is welfare improving and leads to a larger subsidy rate; by opting for the cooperative solution both countries benefit from higher levels of welfare.[10] This result is consistent with the findings in both Andersen (2007) and Lin (1996) and lends support to

---

[10] Note that since the non-cooperative solution is fully symmetric, the value of the utility function at the non-cooperative solution will be identical to that in Figure 6 at the subsidy rate of around 0.03 which is implied in Figure 5. It is worth noting that in this model the cooperative policy will also raise the level economic activity in both countries.

arguments in favour of formulating cooperative fiscal intervention when—as, for instance, emphasised by the IMF (2002)—the bigger share of trade between industrialised countries involves those commodities which are highly substitutable for domestically produced goods.
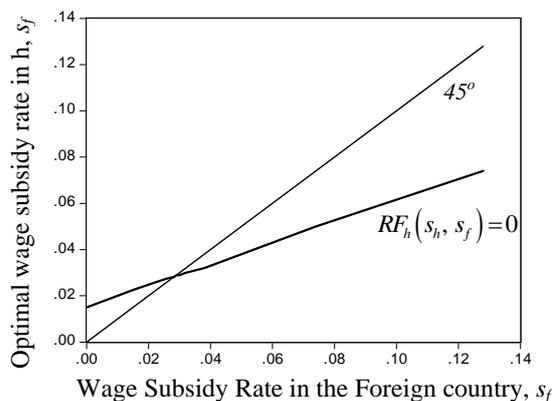

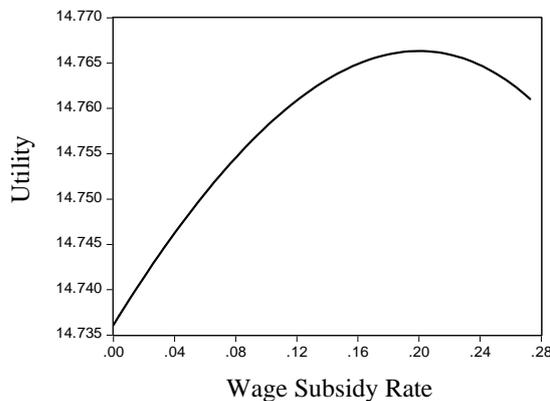**Figure 5: The non-cooperative solution**
(***tow-country model***)

Figure 6: The cooperative solution
(***tow-country model***)

4.   Conclusions

The effectiveness of fiscal policies is sensitive to the structure of goods markets. If the aim of a fiscal intervention is to raise welfare, then policies other than tax-and-spend—whether it is a 'benevolent government' directly spending on privately produced goods to raise aggregate demand, or the tax revenue is used to generate public sector employment to produce some public good or service—should also be considered. This point becomes even more pertinent in the context of an open economy with free trade since, by definition, a fiscal expansion ought to be targeted to stimulate domestic production only. In a small-open-economy setting with free trade in horizontally differentiated goods, this would require defining an ad hoc CES aggregation for the public good over domestic varieties only. But in a two-country setting where fiscal policies are interdependent this is not plausible as it presupposes a 'home bias' which is an obstacle to cooperation.

In this paper we argue that tax-and-subsidise policies act as optimal fiscal stimuli when the market structure is monopolistically competitive. Subsidising firms' employment is after all a practical policy that has been adopted by various governments.[11] We show, in a stylised

---

[11]   For a recent discussion see OECD (2009) on German Kurzarbeitergeld employment subsidy scheme. The Irish government also has introduced a temporary employment subsidy scheme while Japan has augmented her Employment Adjustment Subsidy Programme by multiple stimulus packages.

macroeconomic model, that such a policy can be employed optimally and that it raises the level of economic activity and improves welfare. We also examine the consequences of policy coordination within a two-country setting when the authorities adopt a tax-and-subsidise policy and show that, compared to the non-cooperative outcome, cooperation improves welfare. The relevance of this result is stressed in a situation where product markets are becoming integrated internationally and the significant volume of trade involves imported products that are close (albeit imperfect) substitutes to those produced domestically.

It is worth noting that a tax-and-subsidise intervention may, at least on the surface, appear to be closer in nature to an industrial policy targeted to industries or even firms within an industry. In this respect, therefore, one may argue that this type of policy ought to be considered in parallel with (and not as an alternative to) conventional aggregate demand policies. This paper clearly shows that these policies can be effective as a means of stimulating domestic aggregate demand directly if subsidy is paid to firms to create new or to sustain existing employment as practised recently by governments in tackling the recession—for further details see ILO-IMF (2010) and OECD (2009).

Finally, in this paper we have endogenised the level of economic activity by assuming that labour supply is endogenous. Expansionary fiscal policy is typically concerned with interventions aimed at reducing the level of unemployed resources. Whilst our results can qualitatively shed light on the effectiveness of policy in the presence of underemployment, allowing for involuntary unemployment and labour market imperfections is certainly an interesting direction for future research.[12]

Appendix: The two-country model

To extend the small-open-economy model to a two-country one, we distinguish between the variables of the two countries by subscripts h and f referring to 'home' and 'foreign' respectively. The equations of the model will be as follows:

(i) equations (1) to (6) should now be for both countries;

(ii) equation (7) is common to both countries since P will be the same;

(iii) the equivalent of equations (9) and (10) should be added for the foreign country, namely

---

[12] The results obtained in this paper are qualitatively consistent with those of Molana and Montagna (2006) who examined the effects of optimal unemployment benefits in a two country settings in the presence of unionised labour markets.

$$y_{i_f} = \left(N_h + N_f\right)^{\lambda-1} \frac{\mu\left(1-\tau_h\right)w_f L_f}{P}\left(\frac{p_{i_f}}{P}\right)^{-\sigma}, \quad i_f \in [0, N_f], \tag{9'}$$

$$x_{i_h} = \left(N_h + N_f\right)^{\lambda-1} \frac{\mu\left(1-\tau_f\right)w_f L_f}{P}\left(\frac{p_{i_h}}{P}\right)^{-\sigma}, \quad i_h \in [0, N_h]; \tag{10'}$$

(iv) equation (11) is dropped since it is replaced by (10′);

(v) equations (12) to (20) should now be for both countries; (v) the trade balance equations will now be

$$\left(A_h - A_h^s\right) + \left(N_f p_{i_f} x_{i_f} - N_h p_{i_h} x_{i_h}\right) = 0,$$
$$\left(A_f - A_f^s\right) + \left(N_h p_{i_h} x_{i_h} - N_f p_{i_f} x_{i_f}\right) = 0,$$

which, again, can be shown to correspond to the market equilibrium condition for the homogenous good and should hold by Walras law.

References

Andersen, M.T. (2007), Fiscal Policy Coordination and International Trade, *Economica*, 74, 294, 235-257.

Benassy, J-P. (1996), Taste for variety and optimum production patterns in monopolistic competition, *Economics Letters*, 52, 41-47.

Brakman, S. and Heijdra, B.J. (2004), The Monopolistic Competition Revolution in Retrospect, Cambridge University Press.

Chari, V.V. and Kehoe, P.J. (1990), International coordination of fiscal policy in limiting economies, *Journal of Political Economy*, 98, 617-36.

Cooper, R. (1985), Economic interdependence and coordination of economic policies. In R.W. Jones and P.B. Kenen (eds.), Handbook of International Economics, Vol. 2. Amsterdam: North-Holland.

Costa, L.F. and Dixon, H. (2009), Fiscal Policy under Imperfect Competition: A Survey, Mimeo, Cardiff Business School.

Devereux, M.B. (1991), The terms of trade and the international coordination of fiscal policy, *Economic Inquiry*, 29, 720-36.

Dixit, A.K. and Stiglitz, J.E. (1977), Monopolistic Competition and Optimum Product Diversity, *American Economic Review*, 67, 2, 297-308.

Flam, H. and Helpman, E. (1987), Industrial Policy under Monopolistic Competition, *Journal of International Economics*, 22, 1-2, 79-102.

ILO-IMF (2010), The Challenges of Growth, Employment and Social Cohesion, Proceedings of the Joint International Labour Organization and International Monetary Fund conference (in cooperation with the office of the Prime Minister of Norway), 13 September 2010, Oslo, Norway available at http://www.osloconference2010.org/discussionpaper.pdf.

IMF (2002), World Economic Outlook, September, Washington: International Monetary Fund.

Lin, H.C. (1996), Coordinating Bilateral Export Subsidies under Monopolistic Competition, *Journal of International Trade and Economic Development*, 5, 3, 319-339.

Matsuyama, K. (1995), Complementarities and Cumulative Processes in Models of Monopolistic Competition, *Journal of Economic Literature*, 33, 2, 701-729

Molana, H. and Montagna, C. (2000), Market Structure, Cost Asymmetries and Fiscal Policy Effectiveness, *Economics Letters*, 68, 101-107.

Molana, H and Montagna, C. (2006), Aggregate Scale Economies, Market Integration, and Optimal Welfare State Policies, *Journal of International Economics*, 69, 321-340.

OECD (2003), Employment Outlook, OECD Employment Analysis and Policy Division.

OECD (2009), Employment Outlook, OECD Employment Analysis and Policy Division.

Reinhorn, L. (1998), Imperfect competition, the Keynesian cross, and optimal fiscal policy, *Economics Letters*, 58, 331-337.

Spence, A.I. (1976), Product selection, fixed costs, and monopolistic competition, *Review of Economic Studies*, 43, 2, 17-36.

Startz, R. (1989), Monopolistic competition as a foundation for Keynesian macroeconomic models, *Quarterly Journal of Economics*, 104, 737-752.

Turnovsky, S.J. (1988), Coordination of optimal taxation in a two-country equilibrium model, *Journal of International Economics*, 25, 117-27.

van der Ploeg, R. (1987), Coordination of optimal taxation in a two-country equilibrium model, *Economics Letters*, 24, 279-85.

van der Ploeg, R. (1988), International policy coordination in interdependent monetary economies, *Journal of International Economics*, 25, 1-23.