Welfare State, Market Imperfections, and International Trade

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June 2003

Abstract

Within a two-sector-two-country model of trade with aggregate scale economies and unionisation, a move to a more generous welfare state in one country increases welfare in that country and can have positive spill-over effects on the other. Furthermore, synchronised expansions of social security are more welfare enhancing than unilateral ones. Our results counter the fears that a race to the bottom in social standards may result from the 'shrinking-tax-base' entailed by international capital mobility. While affecting trade patterns and income distribution, capital mobility interacts with welfare state policies in increasing welfare, *even* when capital flows out of the country that started the shock.

Keywords: welfare state; circular causation; international trade

JEL Classification: E6, F1, F4, H3, J5

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The British Academy Research Grant (Ref SG-32914) is gratefully acknowledged.

1. INTRODUCTION

This paper studies how welfare state policies affect specialisation patterns and welfare within a two-country model of international trade, with and without international capital mobility.

Large-scale public provision of social insurance and progressive systems of redistributive taxation, which have been a defining characteristic of advanced industrial economies for all the second post-war period, are increasingly seen as being incompatible with economic globalisation. The conventional wisdom holds that, in an environment characterised by deep trade integration, government intervention in general and welfare state policies in particular are bound to have adverse effects on a country's economic performance vis-à-vis its competitors. Additionally, the credible threat of exit of increasingly mobile capital and firms in response to more favourable tax treatments supposedly lessens national control over both volume and structure of the tax revenue, by leading to a shrinking of the tax base and to pressures to shift the burden of taxation on to less mobile factors such as labour. These views appear to be shared even by those (e.g. Rodrik, 1997; 1998) who warn against the danger of a race to the bottom in social and labour standards as countries compete with each other to attract and/or retain industry – pointing out that globalisation, by increasing insecurity and income inequalities, strengthens the demands for social insurance.

This conventional wisdom, however, is somewhat at odds with some of the existing evidence. Overall tax burdens in advanced industrial economies between the mid-1960s and the mid-1990s do not appear to have significantly reduced despite the growing market integration and, although labour income taxes as a proportion of government revenue have grown faster than capital taxation, the average effective tax rate on capital has increased in many OECD countries (OECD 1996; Baldwin and Krugman, 2000; Garrett and Mitchell, 2001; Swank, 2002). Furthermore, there is, to our knowledge, no strong and convincing evidence suggesting that the increased extent of goods and capital market integration during the last decades has contributed systematically to the retrenchment of mature welfare states. For example, despite wide diversity in spending levels amongst the European Union countries, welfare states in most of these countries have increased up until the mid 1990s; subsequent reforms have generally been limited to a restructuring of expenditure and whilst some areas of social protection have modestly declined others have enjoyed stability or even a slow growth (European Commission, 2002). This can partly be explained by the *'compensation hypothesis'* whereby resistance to the rolling back of welfare states might have been heightened by the rising needs for social insurance and income redistribution

stemming from internationally generated risk and economic dislocations – see for instance Garrett (1998) and Rodrik (1997, 1998).

An alternative, and perhaps more fundamental, approach in the literature interprets the above mentioned evidence as casting doubts on the incompatibility between welfare states and high degrees of economic integration. As some political scientists have argued convincingly, the extent to which the economic and political pressures stemming from globalisation are translated into welfare state retrenchment will typically depend on country-specific factors, such as: (i) the institutional features of the socio-political representation system (e.g. type of electoral and interest representation); (ii) the nature of the welfare state (e.g. its degree of universalism); and (iii) the characteristics of the labour market (e.g. the degree of centralisation of the wage setting process). Along these lines, Garret (1998) asserts that social democratic corporatism is the main way to reconcile the need for social insurance with the pressures that an increasingly integrated world economy exerts on governments' ability to pursue welfare state policies: in exchange for social protection, 'encompassing' corporatist unions will in fact offer wage moderation, thus limiting the distortionary effects of the welfare state. Seen in this light, the current trend towards decentralisation of wage bargaining in most – albeit not all – European countries (as documented for instance by Boeri *et al.*, 2001) would predict the unavoidability of the collusion course between globalisation and welfare states.

In this paper we contend that there may be more eminently economic reasons for the compatibility of welfare state policies and globalisation, and we argue that these reasons lie in the imperfectly competitive nature of goods and factor markets. Given that in a second best world – which is at the very core of the rationale behind the existence of the welfare state – economic policy can be welfare improving, we suggest that welfare state may complement rather than conflict globalisation forces in improving economic performance. Contrary to that implied by the conventional wisdom, we argue that international trade openness and capital mobility do not inevitably lead to a race to the bottom in social standards via a reduction of the revenue raising capacity of governments. Our analysis does not counter the importance of institutional factors, such as the specific nature of the wage setting process, but suggests that these factors are not necessarily needed for reconciling the needs for social insurance with the pressures stemming from economic openness.

We construct a model of international trade between two countries characterised by vertical linkages between sectors, unionised labour markets and welfare state policies in the form of unemployment benefits financed via proportional factor income taxation. In each

country there are two industries. One industry produces a homogenous final consumption good under perfectly competitive conditions. The other industry is imperfectly competitive and produces horizontally differentiated goods that are used both by final consumers and by producers in the perfectly competitive sector as intermediate inputs of production. The labour market is unionised. One of the current stylised facts about European labour markets is a tendency towards segmentation in union coverage and decentralisation in collective bargaining. Consistently, in this paper we assume that wages are set by sector-specific monopoly unions.

Our findings suggest that welfare state policies can be compatible with trade openness and need not hinder a country's 'competitive' position vis-à-vis trading partners whose governments offer lower degrees of social protection. In the presence of market imperfections, an increase in the generosity of welfare state provision in one country is shown to have positive welfare effects in that country: with vertical linkages, the increase in the demand for final goods triggered by the policy results in a correction of the sub-optimal provision of intermediate inputs, thus leading to a rise in aggregate efficiency and real aggregate income. We also find that that such a policy can have positive spill-over effects that benefit the trading partner; furthermore, the positive welfare effects are typically not weakened by capital mobility. In this respect, therefore, our results counter the fears that a race to the bottom in social standards may inevitably emerge from the 'shrinking-tax-base' that is presumably entailed by international capital mobility. The latter, while affecting the pattern of specialisation and the distribution of the welfare gains amongst factors of production, interacts with welfare state policies in increasing welfare, *even* in those cases when capital flows out of the country that initiates the policy shock.

The rest of the paper is organised as follows. The model is set out in Section 2. Section 3 describes the general equilibrium. Sections 4 and 5 examine the effects of more generous welfare state policies in the absence and presence of capital mobility respectively. Section 6 concludes the paper. An appendix at the end of the paper gives the technical details.

2. THE MODEL

2.1. The theoretical framework

There are two countries – Home and Foreign, denoted by H and F, respectively – that we assume to be identical in every respect (tastes, technologies, institutional features and factor

endowments). Thus, for expositional simplicity, we shall limit the description of the model to country H, noting that the same set-up applies to country F. Whenever necessary, we shall denote the variables of country F with an asterisk superscript.

There are two sectors in each country: in sector *x*, a mass of monopolistically competitive firms supply horizontally differentiated goods under conditions of internal increasing returns to scale; in sector *y*, firms produce a homogenous good under perfectly competitive conditions. There are vertical linkages between the two sectors[1]. Sector *x*, serving as the upstream-sector, supplies 'highly specialised goods-and-services' which are not only used by final consumers but also by firms in the down-stream sector *y* as intermediate inputs. Sector *y* produces what can be thought of as a more 'traditional' homogenous final consumption good. The products of both sectors are freely traded. In both countries, labour markets are unionised and the government is a provider of welfare protection in the form of unemployment benefits financed via proportional factor income taxation. The deep division of labour and the complex inter-industry linkages typical of industrial economies are known to result in high degrees of specialisation and, to some extent, in some sector specificity of factors of production[2]. To reflect this, we assume that labour is used directly only in sector *x*, while sector *y* employs labour only indirectly, via its use of intermediates as inputs.

2.2. Final consumers

The preferences of the representative consumer are characterised by the utility function

$$U = \left(\frac{X_c}{\mu}\right)^{\mu}\left(\frac{Y_c}{1-\mu}\right)^{1-\mu} + (1-\xi)\tilde{V}, \qquad (1)$$

where $0<\mu<1$, X_c and Y_c are the consumption of the goods produced by sectors *x* and *y* respectively, and $\tilde{V}$ is the utility of leisure. The individual is endowed with one unit of labour and supplies it inelastically in the labour market; $\xi = 1$ if the individual is employed and $\xi = 0$ otherwise. Constrained optimisation of (1) yields the demand functions

[1] Inter-industry connections are an important source of external returns to scale in manufacturing, see Bartelsman, *et al.* (1994) for evidence, and they have been extensively acknowledged by the theoretical literature, e.g. Eithier (1982), Matzuyama (1995) and Venables (1996).

[2] Economic history documents that whilst the technological advances in the early phases of industrialisation (whereby capital and unskilled workers were substituted for artisan skills) led to an increase in inter-sectoral labour mobility, starting from the 1920s – albeit to different extents in different countries – the growing complementarity between skills and technology led to an increase in sector specificity of labour. For a discussion of these issues see for instance Hiscox (2002).

$$X_c = \mu \frac{M}{P_x}, \tag{2}$$

$$Y_c = (1-\mu) \frac{M}{P_y}, \tag{3}$$

where P_x and P_y are the prices of the two goods and M is nominal disposable income to be defined later.

We assume that the differentiated good is freely traded internationally and is aggregated into a CES basket defined over the goods produced in both countries, that is

$$X = \left(\int_{i \in N} x_i^{\frac{\sigma-1}{\sigma}} di + \int_{i \in N^*} x_i^{*\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}}, \tag{4}$$

where x_i is the quantity of a typical variety of the good produced in sector x, σ>1 denotes the elasticity of substitution between varieties, N is the mass of available varieties and an asterisk refers to the corresponding '*Foreign*' variables. The industry price index dual to (4), common to both countries, will therefore be:

$$P_x = P_x^* = \left(\int_{i \in N} p_i^{1-\sigma} di + \int_{i \in N^*} p_i^{*1-\sigma} di \right)^{\frac{1}{1-\sigma}}, \tag{5}$$

where p_i and p_i^* are the prices of a typical variety i produced in H and F respectively.

2.3. Producers

There are two primary inputs in the economy that we call labour and capital, denoted by L and K, whose rates of returns are w and r, respectively. It is assumed that L is specific to sector x while K is used in both sectors.

The horizontally differentiated product in sector x is produced by an endogenously determined (via free-entry and exit) mass of identical firms according to an increasing returns to scale technology which uses – both as variable and fixed input requirement – a Cobb-Douglas basket of capital and labour $I_i = \left(\frac{l_i}{\alpha}\right)^{\alpha} \left(\frac{k_i}{1-\alpha}\right)^{1-\alpha}$, where l_i and k_i are firm i's inputs of labour and capital and $0<\alpha<1$ is a constant. The production function and the total cost of a typical firm i are given respectively by $x_i = I_i - \phi$, where ϕ>0 is assumed to be the same for

all firms, and $c_i = w_i l_i + rk_i$. Given the production technology, the minimum total cost of producing x_i will be $c_i = \eta_i(x_i + \phi)$ and the corresponding input demands are given by

$$l_i = \alpha \frac{\eta_i}{w_i}(x_i + \phi), \tag{6}$$

$$k_i = (1-\alpha)\frac{\eta_i}{r}(x_i + \phi), \tag{7}$$

where $\eta_i = w_i^{\alpha} r^{1-\alpha}$. The existence of a fixed input requirement gives rise to an incentive to specialisation and results in a one-to-one correspondence between the mass of firms and that of available varieties. The firm's profit therefore is $\pi_i = p_i x_i - c_i$, or

$$\pi_i = p_i x_i - \eta_i(\phi + x_i). \tag{8}$$

Firms in sector *y* are perfectly competitive and produce a homogenous final consumption good using capital and a basket of the intermediate varieties produced in sector *x*. The latter is a composite input assumed to be assembled according to the CES aggregator in (4). Labour is therefore not used directly in sector *y* but is embodied in *X*. For any given mass of intermediate varieties, the sector's production technology is a constant returns to scale Cobb-Douglas, $Y = AX_y^{\lambda} K_y^{1-\lambda}$, $0 < \lambda < 1$. The CES nature of *X* however implies that there are increasing returns to the range of available varieties since the productivity of the intermediate basket, and hence total factor productivity in sector *y*, is increasing in (N+N^*). Clearly, given that the intermediate good is freely traded internationally, these external economies of scale are not country (or location) specific, i.e. there are 'international returns to scale'. Furthermore, the increase in the average productivity of factors stemming from a given rise in (N+N^*) will be higher the smaller is the elasticity of substitution between varieties, σ. The total cost of producing *Y* is $C_y = P_x X_y + rK_y$. Given the production function and normalisation $A = \lambda^{-\lambda}(1-\lambda)^{\lambda-1}$, the minimum cost function will be $C_y = \left(P_x^{\lambda} r^{1-\lambda}\right)Y$. Since the industry is perfectly competitive, the production level is determined by the equality between price and average cost,

$$P_y = r^{1-\lambda} P_x^{\lambda}. \tag{9}$$

Finally, the constant returns to scale technology and the perfect competition assumption imply that input demands by the sector are

$$X_y = \lambda Y \frac{P_y}{P_x}, \tag{10}$$

$$K_y = (1-\lambda) Y \frac{P_y}{r}. \tag{11}$$

2.4. Factor markets

In the first instance we shall assume that both primary factors of production, *L* and *K*, are internationally immobile and later analyse the consequences of allowing for capital mobility. In both countries, the market for capital is assumed to be perfectly competitive with *r* adjusting to satisfy the resource constraint,

$$K_y + \int_{i \in N} k_i \, di = \overline{K}, \tag{12}$$

where $\overline{K}$ is the country's endowments of capital.

In both countries, the labour market is unionised. One of the stylised facts about current European labour markets is a tendency towards segmentation in union coverage and decentralisation in collective bargaining (Boeri *et al*, 2001). Consistently, we assume that wages are set by decentralised monopoly unions, with employment being determined by firms (this aspect of the model is based on Alesina and Perotti, 1997; and Molana and Montagna, 2002). More precisely, we assume there to be a number of identical unions, denoted by *J*; a large (small) *J* indicates a large (small) number of small (large) unions. Each union's membership consists of both employed and unemployed workers. A typical union *j* will have a mass of members $\overline{L}_j = \overline{L} / J$, where $\overline{L}$ is the total labour force in the country, and will embrace the workers of, and set wages for, a mass of firms $N_j = N/J$.[3] Unionisation implies that involuntary unemployment persists in equilibrium and that each union will have some unemployed members[4] – i.e. $L_j < \overline{L}_j$ where L_j is the union's mass of employed members. The objective function of a typical union *j* can be obtained from (1) and is given by the expected utility of its typical member,

$$V_j = \frac{L_j}{\overline{L}_j} \frac{(1-t) w_j}{P} + \frac{\overline{L}_j - L_j}{\overline{L}_j} \frac{b w_j}{P} + \frac{\overline{L}_j - L_j}{\overline{L}_j} \tilde{V}, \tag{13}$$

[3] For a given *J*, the fixed labour endowment implies that the membership of each union is constant. Hence, despite the fact that the mass of firms covered by each union varies with *N*, its size is constant and changes in *N* have no implications for the assumption of decentralised union behaviour.

[4] We follow the literature in assuming that unemployed workers from other unions cannot be employed in a given union's sector before the latter's unemployed members are hired.

where t is the labour income tax rate, the benefit received by an unemployed worker is assumed to depend on the wage rate by a factor of proportionality b that is determined by the government, and

$$P = P_x^{\mu} P_y^{1-\mu} \tag{14}$$

is the consumer price index. For simplicity, unemployment benefits are not taxed and are therefore net transfers. As will be explained later, the union will choose w_j to maximise (13) subject to the relevant constraints. Finally, given the assumption of symmetry between firms in sector x, it follows that the wage set by a union is the same for all the firms it covers, i.e. $w_{i \in N_j} = w_j$.

2.5. Government sector and aggregate income

In each country, the government is a provider of welfare protection in the form of unemployment benefits financed via proportional factor income taxation. Noting that $\overline{L} = \sum_{j=1}^{J} \overline{L}_j \geq L = \sum_{j=1}^{J} L_j$, the government budget constraint is given by

$$\sum_{j=1}^{J} b w_j (\overline{L}_j - L_j) = \sum_{j=1}^{J} t\, w_j L_j + q\, r \overline{K}\,, \tag{15}$$

The right-hand-side of equation (15) is the total tax revenue extracted from the primary factors, where q is the capital income tax rate, and the left-hand-side of the equation gives the total unemployment benefit bill.

Aggregate income M is determined by total returns to primary factors and transfers between the public and private sectors,

$$M = \sum_{j=1}^{J} \left[(1-t)\, w_j L_j + b w_j (\overline{L}_j - L_j) \right] + (1-q)\, r \overline{K}\,. \tag{16}$$

3. GENERAL EQUILIBRIUM

Given the assumed preferences and technologies, the total expenditure in country H on the varieties of good X, produced in both countries, is given by

$$E_x = \mu M + \lambda Y\,. \tag{17}$$

The two terms on the right-hand-side of (17) respectively give expenditure by the country's consumers and firms in sector *y*. The demand functions for the variety facing a typical firm *i*, in countries H and F, are

$$\begin{cases} x_i = \dfrac{E_x}{P_x}\left(\dfrac{p_i}{P_x}\right)^{-\sigma} + \dfrac{E_x^*}{P_x^*}\left(\dfrac{p_i}{P_x^*}\right)^{-\sigma}, \\ x_i^* = \dfrac{E_x}{P_x}\left(\dfrac{p_i^*}{P_x}\right)^{-\sigma} + \dfrac{E_x^*}{P_x^*}\left(\dfrac{p_i^*}{P_x^*}\right)^{-\sigma}, \end{cases} \tag{18}$$

where $P_x^* = P_x$ is given by (5). The representative firm in sector *x* maximises the profit function in (8) subject to (5) and its demand in (18) and taking the total expenditure $\left(E_x + E_x^*\right)$ and the wage set by the union as given. The optimal price rule for a typical firm *i* covered by union *j* therefore is

$$p_{i\in N_j} = \frac{\sigma}{\sigma - 1}\eta_{i\in N_j}, \tag{19}$$

where now $\eta_{i\in N_j} = w_j^{\alpha} r^{1-\alpha}$.

The mass of firms in sector *x* in each country is endogenously determined via free-entry and exit. Hence, at the free-entry equilibrium, all firms in both countries will break even. Substituting (19) into (8) and setting the resulting equations equal to zero, we obtain the equilibrium output scale of a typical firm in sector *x*,

$$x_{i\in N_j} = \phi(\sigma - 1). \tag{20}$$

As equation (20) indicates, in the symmetric equilibrium the optimal output scale is the same for all firms and is constant[5].

The wage rates are determined by the monopoly unions. A typical union *j* maximises its objective function in (13) subject to the labour demand it faces,

$$L_j = \int_{i\in N_j} l_i \, di, \tag{21}$$

as well as taking account of the effect of its action on the price level – using (5), (14),

[5] The constant elasticity of substitution assumption and the lack of strategic interaction between firms imply that the extent to which each firm exploits internal increasing returns to scale depends only on the elasticity of substitution between varieties and is unaffected by the size of the market.

demand facing the firms in (18) and firms' mark-up rule in (19). It can be shown that the wage setting equation resulting from this optimisation is

$$\frac{w_j}{P} = \frac{\tilde{V}}{(1-t-b)-\varepsilon_j\left(1-t-b+b\frac{\bar{L}_j}{L_j}\right)} \quad , \tag{22}$$

where $\varepsilon_j = (1-\varepsilon_{jP})/\varepsilon_{jL}$ gives a measure of unions' monopoly power, with $\varepsilon_{jL} > 0$ and $0 < \varepsilon_{jP} < 1$ respectively denoting the wage elasticity of labour demand facing the union and the elasticity of the consumer price index with respect to the wage set by the union (see A1 in the Appendix for the derivation of (22), ε_{jP} and ε_{jL}).

Equation (22) can be interpreted as a behavioural rule according to which unions set the (real) wage of their members by a mark-up over the reservation wage, $\tilde{V}$. A number of points are worth noting at this stage. First, it is clear that the optimal real wage is positively related to both labour income tax rate and unemployment benefit: i) a ceteris paribus increase in *t*, by reducing the after tax wage, induces the unions to bid up the nominal wage; ii) a higher unemployment benefit rate, by reducing the utility difference between being employed and unemployed, persuades the unions to increase their wage demands. Moreover, the real wage is negatively related to ε_{jL}: as the wage elasticity of labour demand facing the union increases, its monopoly power and hence its rent extracting ability falls, thus leading it to restrain its wage demands. The real wage is also negatively related to the sensitivity of the consumer price index to the wage set by the union, ε_{jP}, which determines the extent to which an increase in wage reduces, ceteris paribus, the purchasing power of union members. Finally, it is easy to verify that a sufficient condition for $\partial(w/P)/\partial J < 0$ is that σ should not be too close to unity (see A1 in the Appendix).

Given the assumed symmetry between firms, unions and countries, we drop the subscripts *i* and *j* from the equations and set $\bar{K}^* = \bar{K}$, $\bar{L}^* = \bar{L}$, $\tilde{V}^* = \tilde{V}$, and $J^* = J$. Also, in the rest of the paper we use good *Y* as numeraire and set $P_y = P_y^* = 1$. The equations of the model for both countries are, for convenience, repeated in Table 1 which also includes the balance of payment equation and the equilibrium conditions in markets for goods *Y* and *X*, i.e.

equations (23), (24) and (25) respectively[6]. Note also that in the capital market equilibrium condition and labour demand, equations (12) and (21), the left-hand-sides are now replaced by the appropriate demand components, and (21) is now for the aggregate economy rather than the union level of employment. The model can be solved to determine the endogenous variables N, x, Y, L, w, p, P_x, P, r, M, E_x, their Foreign counterparts, and the policy instrument that the government of each country chooses to let vary in order to balance its budget. The latter are one of (t, q, b) and (t^*, q^*, b^*) respectively but, given our purpose, country H is always assumed to choose its benefit rate exogenously.

Table 1 here

3.1. Characteristics of the model

Before proceeding to the policy analysis, it is useful to highlight some of the properties of the model (see A2 in the Appendix for details). The symmetric nature of the two countries implies that

(3.1.1) In any equilibrium, all prices are equalised, i.e. $p^* = p$; $P_x^* = P_x$; $P^* = P$; $r^* = r$; and $w^* = w$.

(3.1.2) In any equilibrium, the optimal output scale and employment level are the same for all Home and Foreign firms in sector x, i.e. $x^* = x$ and $(L^* / N^*) = (L / N)$.

(3.1.3) An increase in the employment ratio L / L^*, from one equilibrium to another, is accompanied by:

(i) a fall in the monopoly power of unions in H, ε;

(ii) a rise in the monopoly power of unions in F, ε^*;

(iii) a rise in the ratio of mass of firms in sector x, N / N^*, and hence the ratio of the corresponding production, $(N x)/(N^* x^*)$;

(iv) a rise in the ratio of both nominal incomes, M / M^* and real incomes, $(M / P)/(M^* / P^*)$; and

(v) a fall in the ratio of production in sector y, Y / Y^*.

All properties described above are preserved under capital mobility except point (v) in 3.1.3, which ought to be modified as follows to take account of capital flow between the countries (see A2 in Appendix):

[6] These three equations are reported for completeness; it is easy to show that they can be obtained from the other equations using Walras' law.

(v′) When capital flows from F to H, $K/K^* > 1$, and a sufficient condition for $Y/Y^* > 1$ is $L/L^* = 1$, but $Y/Y^* > 1$ can also result even if $L/L^* > 1$. When capital flows from H to F, $K/K^* < 1$, and $Y/Y^* < 1$ will follow if $L/L^* \geq 1$.

4. POLICY ANALYSIS

The aim of this section is to examine the effects on the two economies of a move by the government of one of the countries to a more generous welfare system defined by an increase in the unemployment benefit rate. At the end of the section we shall briefly examine the case of symmetric policy shocks, where both governments increase the unemployment benefit by the same amount.

International trade flows imply that the two economies are interdependent and that policy changes in one country have budgetary implications for both governments. Hence, starting from an initial fully symmetric equilibrium (see A3 in the Appendix), a given policy shock initiated in country H – i.e. a rise in *b* – will correspond to a number of different cases depending on which instrument is chosen by each government to offset the ensuing budgetary imbalances – i.e. t or q in H and t^*, q^* or b^* in F. In each case, the policy multipliers are measured by the (total) effect of the shock (a change in *b*) on the variables of interest when in each country one of the policy instruments is allowed to vary. Given the complexity of the algebra involved in determining the signs and comparing the magnitudes of these multipliers, we do not provide the analytical expressions for them in the paper and only give graphs which plot their numerically simulated values (see A.5 in the Appendix for details).

As a benchmark case, we first present the analysis of the effect of a rise in *b* when both governments use the tax rate on labour income, t and t^*. Also, given that in the absence of capital mobility the use of the tax rate on capital is less interesting, in this section we only analyse the use of t by the Home government, and postpone the use of q to the next section where we allow for capital mobility.

4.1. Effects of a rise in *b* when budgetary impacts are offset by *t* and t^*

When the tax rate on capital income is kept intact, $q^* = q$ will continue to hold. Given the results in section 3.1, the model can be easily reduced to two equations describing the relative position of the two countries. One equation is obtained using the government budget constraints; since $w^* = w$ and $q^* r^* \overline{K} = qr\overline{K}$ should always hold, the two equations in (15) in Table 1 imply

$$b(\bar{L}-L)-tL=b^{*}(\bar{L}-L^{*})-t^{*}L^{*}. \qquad (26)$$

We have sketched the graph of (26) in Figure 1 below as the G_oG_o curve which depicts combinations of equilibrium values of t/t^{*} and L/L^{*} that satisfy both governments' budget constraints when $b=b^{*}$. It is easy to show that the G_oG_o curve is downward sloping. Starting from point E_o which corresponds to the initial symmetric equilibrium where both governments have a balanced budget, a ceteris paribus rise in L will take us above the curve to a point such as A where – as a result of the increased tax base – the Home government's budget is in surplus. The domestic tax rate will have to fall for the budget to be brought into balance, hence moving down to a point such as C. It is also easy to verify that a ceteris paribus increase in b will shift the G_oG_o curve outwards: the higher unemployment benefits will throw the Home government's budget into deficit and, for any given level of L, a higher tax rate t will be required to offset the deficit.

Figure 1 here

The second equilibrium relationship is obtained from the wage setting equations. Given that $w^{*}=w$ and $P^{*}=P$ always hold in equilibrium and hence the real wages are also equalised, the two equations in (22) in Table 1 imply

$$t+b+\varepsilon\left(1-t-b+b\frac{\bar{L}}{L}\right)=t^{*}+b^{*}+\varepsilon^{*}\left(1-t^{*}-b^{*}+b^{*}\frac{\bar{L}}{L^{*}}\right). \qquad (27)$$

The graph of (27) is sketched in Figure 1 as the U_oU_o curve which depicts combinations of equilibrium values of t/t^{*} and L/L^{*} that satisfy the equality of the real wages in the two countries when $b=b^{*}$. The U_oU_o curve is upward sloping; starting from the initial symmetric equilibrium point E_o, a ceteris paribus increase in t will imply a lower utility level for the Home unions, with the original wage now being sub-optimal. For the unions to be as well off as before at the higher tax rate, employment must rise, e.g. moving to point B. Also, it is easy to verify that a ceteris paribus increase in b will shift the curve to the right; since at the higher benefit rate the income of the unemployed will be larger, a higher L is needed if the real wage is to remain constant.

Solving equations (26) and (27) determines the general equilibrium values of t/t^{*} and L/L^{*}[7]. This is shown graphically in Figure 1 where the initial symmetric equilibrium occurs at point E_o at the intersection of the G_oG_o and U_oU_o curves, where $t/t^{*}=L/L^{*}=b/b^{*}=1$. An

[7] The functional forms of the two equations ensure existence and uniqueness of equilibrium for plausible ranges of parameter values.

exogenous increase in the rate of unemployment benefit at Home (corresponding to a rise in b/b^*) will then shift both curves to the right, hence resulting, unambiguously, in a higher L/L^* which may even be accompanied by a fall in t/t^*. In other words, the policy may entail a shift from the initial equilibrium E_o to a new equilibrium such as E_1, where country H is characterised by a higher relative employment level and a lower relative tax rate. Furthermore, as highlighted in section 3.1, a rise in L/L^* implies a larger $(M/P)/(M^*/P^*)$ and $(Nx)/(N^*x^*)$ and a smaller Y/Y^*. Hence, starting from a completely symmetric pattern of production and with trade being entirely intra-industry, the asymmetry that the policy shock in H generates between the two countries leads to a divergence in production structures and to the emergence of inter-industry trade, with country H becoming a net exporter of good *X* and country F exporting good *Y*.

To gain more insight into the consequences of a unilateral increase in unemployment benefit by the government in country H and the role of vertical linkages in transmitting the effects of the policy, we refer to the numerical multipliers in the left panel of Figure A5.1 in the Appendix. These shows that, consistently with the above analysis: **(i)** country H specialises in the production, and becomes a net exporter, of good *X* (*L* and *N* increase in H and may fall in F); **(ii)** country F specialises in the production, and becomes an exporter, of good *Y*; **(iii)** nominal and real incomes increase substantially in H and do not fall in F; **(iv)** the tax rate on labour income (used as the instrument) falls in both countries but substantially more in H; **(v)** the nominal wage falls in both countries; and **(iv)** welfare gains are positively related to the extent of vertical linkages.

The intuition underlying these effects may be described as follows. For a given mass of firms ($N+N^*$), a unilateral increase in *b* in country H will initially prompt the unions in that country to set higher nominal wages. This will have two effects. First, as firms markup their prices, the higher domestic wage translates into a higher price for each of the domestic varieties of the differentiated good, thus raising the price index of this good both in H and in F. This triggers a substitution of *Y* for *X* in consumption and *K* for *X* in the production of *Y*; hence this first effect works towards a reduction of the aggregate demand for *X*. Second, the increase in the benefit rate and the subsequent rise in the wage rate in H raises aggregate nominal income and stimulates Home consumers' demand for *Y* and *X* (which, in the absence of trade barriers, consists of demand for all varieties of the intermediate good produced in both H and F). In addition, the higher demand for *Y* will, via the vertical linkages in production, lead to a further increase the demand for *X*. It can be shown that of these two

immediate – i.e. before mass of firms, employment levels and other prices adjust – impacts of the policy, the latter dominates (see A4 in the Appendix), generating a net increase in the demand for *X* and triggering entry into sector *x*.

Although, given the absence of trade barriers, both countries experience a symmetric increase in the demand for *X*, the extent of entry of new firms into the sector will be different in the two economies. This is because the higher wage and the resulting higher price for each variety in H implies that while the industry price index increases for both countries, p/P_x increases in H but p^*/P_x falls in F. As a result, whilst the monopoly power of unions falls in H, it increases in F – i.e. ε falls and ε^* increases, see point (*IV*) in A2 in the Appendix – thus prompting the unions to bid down (up) the nominal wage in H (in F), with opposite consequences on firms' costs in the two countries.

It is worth noting that because the aggregate scale economies generated by sector *x* are *fully international*, it is irrelevant to sector *y*'s producers where the intermediate varieties are produced – i.e. the returns to scale are not country or location specific. Therefore, both countries will equally benefit from the positive pecuniary externality brought about by the overall expansion of product variety in sector *x* which will – ceteris paribus – reduce P_x in both countries and lead to: **(i)** a higher productivity of the intermediate goods which will reduce the cost of production of good *Y*; **(ii)** a lower consumer price index that will foster demand for final goods via the real income effect; and **(iii)** a substitution of *X* for *Y* by consumers, and of *X* for *K* by sector *y*'s producers, that will further stimulate demand for *X*. The combined effects of these forces will strengthen the increase in demand for *X*, and will give rise to a virtuous circle of entry of new firms into the intermediate industry, higher employment and higher aggregate efficiency.

The expansion of sector *x* implies a shift of resources from sector *y* to that sector. Clearly, this shift in resources will be larger in H whose *x* sector experiences a relatively bigger expansion. In particular, the larger mass of firms in H will draw considerably more on the country's limited endowment of capital. As a result, in comparison to F, less capital remains available for the production of good *Y* in H where return to capital will also be relatively higher. Therefore, this triggers a specialisation pattern whereby country H specialises in sector *x*, and country F is left to meet the excess demand for good *Y*. The growth in production of *Y* in F occurs by shifting capital from sector *x* which will not come to a halt until the return to capital in F and H are equalised.

Given the expansionary consequences of the policy, its budgetary impacts do not lead to higher tax rates. In fact, the tax rate falls in both countries. In H, the net effect of an increase in L and b and of a fall in w is to reduce the unemployment benefit bill. The government tax revenue, however, increases since the proportional increase in L exceeds the proportional fall in w, and r rises. Hence, the government affords to reduce t considerably despite the increase in b. In F, the rise in capital income (since $r^*\bar{K} = r\bar{K}$) and employment turn out to be sufficient to more than compensate for the reduction in labour income tax revenue due to the fall in the wage rate, hence leading to a moderate reduction in t^*.

Albeit to different extents, both countries benefit from the unilateral policy action undertaken by the government in H. The sources of these welfare gains are in: (**i**) the partial correction of the sub-optimal production of intermediate varieties, and (**ii**) the specialisation in production and trade brought about by the temporary divergence in relative factor prices, both of which are induced by the policy. As is evident from the multipliers in the left panel of Figure 4, ceteris paribus, the degree of specialisation (measured by the extent of divergence between the two countries' production structures) is higher the stronger are the vertical linkages between sectors (measured by λ). In fact, the larger is λ, the greater will be: **(i)** the increase in the demand for intermediates following the rise in aggregate demand in H, **(ii)** the entry of new firms in sector x, and **(iii)** the pressure that the entry of new firms in sector x exerts on the country's capital endowments – forcing it to specialise in sector x. The strength of the vertical linkages and the degree of specialisation in production and trade will also influence the welfare effects of the policy: the larger is λ the bigger will be the increase in real income in country H[8].

In sum, starting from a completely symmetric situation, the country that raises its unemployment benefit rate becomes relatively specialised in the production of good X, experiences an unambiguous increase in its employment and income, and its trading partner may also benefit from positive spill-over effects. These results question the robustness of the conventional wisdom which regards welfare state generosity and international openness as incompatible. It may of course be argued that the crucial factor behind the clash between globalisation and welfare states is the international mobility of capital which, by leading to a shrinking tax base, makes it more difficult for governments to support programmes of income redistribution. In Section 5 we extend the model to allow for capital mobility and examine

[8] Finally, note that the degree of trade specialisation is higher at lower values of α. When the production of X is relatively intensive in capital, in fact, the expansion of sector x will draw more heavily on the country's endowment of this factor, less of which will remain available for the production of good Y.

whether it reverses the results obtained above. Before doing so, however, it is interesting to examine the cases in which the Foreign government chooses an instrument other than the tax rate on labour income to offset the effect of the shock.

4.2. Policy effects when the Foreign government uses q^* or b^*

The multipliers for the cases in which the government in country F uses q^* are given in the right panel of Figure A5.1 in the Appendix. A comparison between these multipliers and those of the previous case – in the left panel of Figure A5.1 – shows that the main results are qualitatively unaltered; both countries experience welfare gains as a result of the unilateral increase in unemployment benefit in country H.

It is useful to illustrate the qualitative effects of this policy graphically by using the GG and UU curves, as we did in the previous case. The UU equation remains as in the previous case, hence raising b shifts the UU curve outwards, shown by U_1U_1 in Figure 2 below. But when the tax instruments used are (t, q^*), the equation underlying the GG curve becomes:

$$b(\overline{L} - L) - tL = b^*(\overline{L} - L^*) - t^*L^* + (r/w)(q - q^*)\overline{K}\,. \qquad (26')$$

Thus, although as before after the rise in b the GG curve shifts outwards (to the dotted curve), now a fall in q^* and/or a rise in (r/w) will shift the curve back inwards, to G_1G_1. To see why q^* can be reduced, rewrite the government budget constraint in country F as

$$b^*(\overline{L} - L^*) = t^*L^* + q^*\overline{K}(r^*/w^*)\,: \qquad (16')$$

clearly, given that L^* and r^* increase and w^* falls, q^* needs to fall to satisfy the government budget constraint.

Figure 2 here

The multipliers for the case in which the government in F uses b^* to offset the budgetary implications of the shock are given in the left panel of Figure A5.2 in the Appendix. Whilst the pattern of specialisation is unaltered and employment and welfare are raised in H, in this case there are negative welfare spill-over effects and country F experiences a fall in employment and real income. Contrary to the previous cases, the effects of the policy shock on the Foreign government's budget constraint now requires a *reduction* in its unemployment benefit rate. In other words, in terms of provision of welfare protection, the policy is *contractionary*. Inspection of (16′) shows that as a result of the fall in employment, b^* will have to fall if the increase in interest rate is not sufficient to generate an

increase in capital income which is large enough to compensate for the lower labour income tax revenue and higher welfare bill, $b^*(\bar{L} - L^*)$. This case is illustrated graphically in Figure 3 below. The equations for GG and UU curves are unaltered and are given by (26) and (27). Thus, as *b* increases, both GG and UU first shift to the dotted positions. The fall in *b**, however, shifts both curves further to the right, their final position being shown by G_1G_1 and U_1U_1.

Figure 3 here

4.3. Symmetric policy shocks

The process of globalization, perhaps due to the growing interdependence of the integrating economies, has been accompanied by a tendency towards a convergence in the volume and composition of government expenditures. This convergence has been found to be particularly strong amongst EU countries whose economies, bound by the Stability and Growth Pact, are characterized by more similar production and government preference structures (see Sanz and Velázquez, 2003). This evidence begs the question of how a synchronized – as opposed to unilateral – policy affects the economies of highly integrated countries. To address this issue, we therefore conclude this section by examining the effects of a fully symmetric policy when *both* governments increase their welfare provision, offsetting the budgetary effect of the policy shock by adjusting the tax rate on labour income (this case therefore is directly comparable to the benchmark case described in 4.1 above).

The multipliers obtained for an equal increase in *b* and b^* are illustrated in the right panel of Figure A5.2 in the Appendix. As expected, a fully harmonised policy preserves symmetry in all respects and leads to identical improvements in aggregate efficiency and performance in both countries. Also, comparing these multipliers with those associated with asymmetric policies suggests that a symmetric expansion of the system of welfare protection leads to stronger positive welfare effects, thus dominating a unilateral expansion – regardless of the tax instruments used to finance the latter. It therefore follows that the negative effects of a joint contraction of the welfare state would be stronger than those resulting from a unilateral contraction. In other words, were governments to follow the conventional wisdom and *both contract* their unemployment insurance provision, both countries would experience welfare losses that would be larger than if only one government unilaterally decided to reduce its welfare state provision.

5. CAPITAL MOBILITY

One of the fundamental features of the current wave of globalisation is the high degree of capital market integration which is purported as posing a particular threat to the sustainability of governments' independent redistributive policies. In this section we allow for capital mobility and examine the robustness of this conventional wisdom within the context of the model developed above.

With capital mobility, the stock of capital available to a country can exceed or fall short of its endowment, $\overline{K}$, as capital flows in or out of the country. Assuming homogeneity and free mobility of capital, the capital demand equations in (12) in Table 1 will now be replaced by

$$\begin{cases} K = \dfrac{(1-\alpha)N\,px + (1-\lambda)Y}{r}, \\ K^* = \dfrac{(1-\alpha)N^* p^* x^* + (1-\lambda)Y^*}{r^*}, \\ K + K^* = 2\overline{K}. \end{cases} \tag{12′}$$

Using the source principle as tax rule, so that the income generated by an inflow of capital is taxed before it is repatriated, the two countries' government budget constraints in equations (15) in Table 1 are now modified as follows

$$\begin{cases} bw(\overline{L} - L) = twL + qrK, \\ b^* w^* (\overline{L}^* - L^*) = t^* w^* L^* + q^* r^* K^*. \end{cases} \tag{15′}$$

Hence, arbitrage in the international capital market ensures that the interest parity condition holds whereby the net of tax interest rates are equalised across the two countries,

$$(1-q)r = (1-q^*)r^*. \tag{28}$$

Finally, the balance of payment equations, i.e. (23) in Table 1, will have to be modified to take account of interest payments,

$$\begin{cases} \left(Y - (1-\mu)M\right) + \left(N\,px - E_x\right) + (1-q)r(\overline{K} - K) = 0, \\ \left(Y^* - (1-\mu)M^*\right) + \left(N^* p^* x^* - E_x^*\right) + (1-q^*)r^*(\overline{K} - K^*) = 0. \end{cases} \tag{23′}$$

The rest of the equations are as in Table 1[9] and the characteristics of the model outlined in subsection 3.1 hold. In addition, given that $r^* = r$ is always restored, the interest parity condition in (28) also implies that $q^* = q$ must also hold in equilibrium. As a result, with free capital mobility the governments lose their control over the capital income tax rate as an independent fiscal instrument.

5.1. Effects of a rise in *b* when budgetary impacts are offset by *t* and *t**

Starting from a symmetric initial equilibrium, in this section we examine the effects of an increase in unemployment benefit in country H when both governments use the labour income tax rates to offset the budgetary implications of the shock. The multipliers associated with this case are illustrated in the left panel of Figure A5.3 and suggest that:

(i) Capital flows from country F to country H.

(ii) The level of employment and the mass of firms in sector *x* rise in *both* countries and this expansion in sector *x* is *symmetric* i.e. $L^* = L$ and $N^* = N$ hold in the new equilibrium.

(iii) Contrary to the no-capital-mobility case, country H becomes relatively specialised in sector *y*.

(iv) Both countries experience an increase in aggregate welfare, but the increase in real income is much larger in country H.

(v) The labour income tax rate falls in country H and increases in country F.

Figure 4 illustrates this case graphically. Since equation (27) is not affected by capital mobility, the U_oU_o behaves exactly as before and a rise in *b* moves it to U_1U_1. With capital mobility, however, the equation for the GG curve becomes

$$b(\bar{L} - L) - tL = b^*(\bar{L} - L^*) - t^*L^* + q(r/w)(K - K^*). \qquad (26'')$$

Thus, starting from an initial symmetric equilibrium represented by the U_oU_o–G_oG_o intersection, where $K = K^*$, the GG curve initially shifts outwards to the dotted curve due to a rise in *b*. However, a capital inflow ($K > K^*$) causes the GG curve to shifts inwards, offsetting the initial outward shift. Clearly, the size of the backward shift depends on both the relative factor price (*r/w*) and the size of the capital inflow $(K - K^*)$. As emerges from the

[9] Note that given the interest parity condition in (28), the two countries' income equations do not change and are still given by (16).

numerical multipliers, the extent of the backward shift is such that the new equilibrium occurs at $L/L^{*}=1$, with the full burden of adjustment falling on the relative tax rates, t/t^{*}.

Figure 4 here

As in the no-capital-mobility case, in country H the rise in *b* leads to an increase in aggregate demand for final goods that translates into a higher demand for primary factors and intermediate varieties. This, together with the fact that the initial entry into sector *x* happens to be bigger in H than in F, implies a stronger excess demand pressure on capital in H – that gives rise to an initial, incipient, positive interest rate differential in favour of H, i.e. $r > r^{*}$. With capital mobility, this results in capital flowing from F to H, thus altering the way in which the policy shock affects the pattern of international specialisation. Capital mobility, by relaxing (tightening) the resource constraint on capital in H (F), will weaken (strengthen) substitution of *L* and *X* for *K* – in sector *x* and *y* respectively – thus reducing (increasing) the extent to which the demand for *X* rises. In country H (F), a shift of resources from sector *x* (*y*) to sector *y* (*x*) will follow, which ultimately reflects a shift of resources from country F to country H *within* sector *y*. The growth of sector *x* in F dampens the expansion of this sector in H (where the sector expands less than when capital is not mobile), with the two countries experiencing the same growth in employment and number of firms. Thus, in a fashion somewhat consistent with Ethier's complementarity theorem, the policy induced international transfer of capital from F to H generates an inequality in the two countries' factor endowments which changes the pattern of trade from one (in the initial symmetric equilibrium) which is entirely intra-industry, to one (in the post policy-shock equilibrium) that is inter-industry, with intra-industry trade in sector *x* and with country H now being an exporter of good *Y*.

Finally, two points are worth noting. First, as in the no capital mobility case, the degree of specialisation in production and trade is higher the stronger are the vertical linkages in production; the larger is λ, the greater will be **(i)** the increase in the demand for intermediates following the initial rise in aggregate demand in H, **(ii)** the ensuing upward pressure on the return to capital; and **(iii)** the larger will be the flow of capital from F to H and the ability of country H to increase its production of good *Y*. Second, the tax rate in country F will rise if the shrinking tax base it experiences as a result of the capital outflow more than compensates the positive spill-over effects of the policy on the country's (real) income.

The results so far suggest that the introduction of capital mobility does not hinder the sustainability of welfare state programmes. Even with capital mobility, a unilateral increase in welfare protection in one country increases its welfare, brings in capital *and* is typically beneficial for the trading partner, despite the fact that the latter may experience a shrinking tax base. In addition, contrary to what is suggested by the dominant analysis of the effects of globalisation, the outflow of capital from country F stems from an *expansion* and *not* a *retrenchment* in F's trading partner's welfare state.

It may be argued that when capital is mobile, in response to the spill-overs of the policy shock in country H, the government of country F may attempt to prevent the exit of capital by adjusting its capital income tax rate. Therefore, we next examine the policy effects in this context, first when H and F respectively use t and q^*, and next when they use q and q^*, as policy instrument.

5.2. Effects of a rise in *b* when budgetary impacts are offset by *t* and q^*

Starting from a symmetric initial equilibrium, when governments in H and F respectively use t and q^* to offset the budgetary implications of an increase in unemployment benefit rate in country H, the new equilibrium will again be characterised by full price equalisation (see subsection 3.1 above). Hence, although the equality $q^* = q$ is likely to be violated during the transition period, it will have to be restored in the new equilibrium where $r^* = r$ and the interest parity condition in (28) hold. Thus, $dq^*/db = 0$ and it follows that, by choosing to keep q intact, the government in H ultimately divests its trading partner of is 'long-run' control on q^*. However, in this case too an initial rise in r/r^* leads to an outflow of capital from F, resulting in the same qualitative effects as when the two governments use t and t^*. The multipliers for this case are given in the right panel of Figure A5.3 and suggest that,

(i) Capital flows from F to H and employment rises in both countries, but more substantially in H, hence in the new equilibrium $L>L^*$.

(ii) Sector x always expands in H (i.e. N rises) and, for sufficiently strong vertical linkages, it will shrink in F (i.e. N^* falls).

(iii) Sector y shrinks in F and expands in H – since in this case $r(K-K^*)$ sufficiently dominates $w(L-L^*)$ (see A2 in the Appendix). As a result, country H becomes an exporter of good Y and a net importer of good X.

(iv) Aggregate welfare, measured by real income, increases considerably (marginally) in H (F).

The rise in income in H enables its government to reduce the tax rate on labour income (used as policy instrument). In contrast, the choice of capital income tax rate as policy instrument by the government in F implies that the policy cannot affect that rate, as q^* is ultimately bounded by q. This policy, nevertheless, limits the outflow of capital from F. As a result, because the shift of resources – both between the two countries and between the two sectors – will be limited, compared to when the two governments use t and t^*, a less enhanced pattern of international specialisation will emerge.

Figure 5 illustrates this case graphically. The equation for GG curve in this case is given by (26″) above. The rise in b shifts the GG curve outwads to the dotted position, but as $(K - K^*) > 0$ ensues, the curve shift back to G_1G_1. The equation for UU does not change, hence the UU curve shifts to U_1U_1 due to the rise in b. In this case, the adjustment in $(r/w)(K - K^*)$ turns out to be such that sector x in the two countries expand asymmetrically, hence $L/L^* > 1$ as now t can fall but t^* is fixed, hence $t/t^* < 1$, and q^* ought to return to its original value such that $q = q^*$ holds.

Figure 5 here

5.3. Effects of a rise in *b* when budgetary impacts are offset by *q* and *q**

We now consider what may be loosely interpreted as a situation of 'tax competition', where *both* governments use the tax rate on capital (the mobile factor) to offset the impact of the policy shock on their budgets. Again, given the interest parity condition in (28) and the fact that in the new equilibrium all prices are equal (see subsection 3.1), $q = q^*$ must ultimately result. But q may diverge from q^* in the transition period and, unlike the previous case, their new (common) equilibrium value can now be different from that in the initial symmetric equilibrium. The multipliers for this case are illustrated in the left panel of Figure A5.4 and show that:

(i) Capital flows from H to F and employment rises in both countries, but more substantially in H, hence in the new equilibrium $L > L^*$.

(ii) Sector x always expands in H (i.e. N rises) and, for sufficiently strong vertical linkages, it will shrink in F (i.e. N^* falls).

(iii) Sector y shrinks in H and expands in F.

(iv) Aggregate welfare, measured by real income, increases in both countries, but more so in H.

(v) The rise in income enables both governments to reduce the tax rate on capital income.

Figure 6 illustrates this case graphically. The equation for UU does not change, hence the UU curve shifts to U_1U_1 due to the rise in *b*. The equation for GG curve is given by (26″). Hence, as *b* is raised, GG initially shifts outwards to the dotted position but, as capital flows from H to F, it shifts further out to G_1G_1. Clearly, the adjustment in $(r/w)(K-K^*)$, q and q^* should be such that in the new equilibrium both $t=t^*$ and $q=q^*$ hold (the former is maintained throughout the adjustment process as these tax rates do not change and the latter is restored in the new equilibrium since the interest parity condition in (28) must hold and interest rates are equalised). It follows that employment rises more in H, i.e. $L/L^*>1$, which in turn implies $N/N^*>1$ and $Y/Y^*<1$, i.e. sector *x* (*y*) expands relatively more in H (F). The pattern of trade, therefore, reverts to the no-capital-mobility case, with country H becoming a net exporter (importer) of good *X* (*Y*).

In this case too, the usual adjustment process following a rise in *b* implies that country H initially experiences a positive interest rate differential. The resulting incipient inflow of capital will however be halted and reversed by the reduction of q^* in country F. This will lead to an expansion of sector *y* in F that – via vertical linkages – will result in an increase in the demand for good *X* that will be satisfied by imports. The tax rate on capital eventually falls in both countries – as the welfare bills are reduced and incomes rise – and the policy will have adverse redistributive effects on the immobile factor (i.e. labour) whose real rate of return (*w/P*) falls. Despite this, however, in both countries (albeit more in country H) aggregate real income increases and the positive aggregate welfare effects are the highest amongst the 'unilateral' cases whereby only one country changes the generosity of its welfare system.[10]

Figure 6 here

The main conclusion that emerges from these results is that the move to a more generous protection against unemployment is more welfare enhancing when there is capital mobility and governments use the tax rate on capital income as their budgetary policy instrument. Although – consistently with the conventional wisdom – this policy favours capital and has adverse redistributive effects for labour, these findings do not lend support to the race-to-the-bottom implications of globalisation for social policies.

[10] In H, total net real wage income – i.e. $(1-t)wL/P$ – increases since the policy leads to a sizable increase in employment, *L*, which more than offsets the effect of the fall in the real wage rate. In F, the increase in welfare is driven by the increase in production efficiency stemming to the international returns to scale and by the capital inflow that results in a large expansion of sector *y*.

5.4. Symmetric policy shock with tax competition

Analogously to what we found when capital was internationally immobile, in this case too a synchronised *expansion* of unemployment protection generates symmetric welfare gains that are greater than those stemming from unilateral policies. The right panel in Figure A5.4 illustrates the multipliers resulting from a symmetric increase in unemployment benefit rates when both governments use the capital income tax rates as instrument, and shows that both sectors expand symmetrically in both countries, and that the welfare gains dominate all other cases described above, with and without capital mobility.

6. SUMMARY AND CONCLUDING REMARKS

This paper has examined the role of welfare state policies in determining the pattern of specialisation and the level aggregate welfare within a two-sector-two-country model of international trade that allows for economy-wide increasing returns to scale. Our analysis lead to three major conclusions summarised below.

(1) Social insurance policies and international openness in both goods and capital markets may complement each other in increasing welfare, thus facilitating the provision of a more generous welfare protection. Hence, a race to the bottom in social standards does not inevitably emerge from the 'shrinking-tax-base' that is an expected consequence of international capital mobility. Despite the fact that capital mobility affects the pattern of specialisation and the distribution of the welfare gains amongst factors of production, it interacts with welfare state policies in increasing welfare, *even* in those cases when capital flows out of the country that initiates the policy shock. Therefore, although the overall effects of the policy depends on the policy mix adopted by the two governments and on the strength of the vertical linkages between sectors, the major qualitative results of the paper are robust and casts doubt on the universality of the conventional wisdom according to which the pressures of globalisation can only be met by a retrenchment of social transfer programmes.

(2) Unilateral attempts to roll back the welfare state would be welfare reducing for the country which implements the policy and will typically have negative welfare spill-over effects on its trading partners. Synchronised retrenchments would yield even larger welfare losses for both economies.

(3) Welfare state policies affect the income distribution across factors and the pattern of specialisation in production and trade. Empirical work is required, to extract the stylised facts from an appropriate cross-country dataset, in order to throw light on the exact nature of this influence. However, despite the differences in the theoretical set-up – which prevent direct comparability of the results – our conclusions are broadly consistent with those studies that pinpoint the role of social protection in determining the sectors in which a country specialises (e.g. Estevez-Abe, Iversen and Soskice, 2001, where the welfare state affects skill formation).

Our findings, which are consistent with and help explaining the evidence that goods and capital markets integration has not led to *significant* reductions in welfare state provision and in tax burdens in OECD countries, rest on the imperfectly competitive nature of the economy. In the labour market, unionisation implies that wages are positively related to unemployment benefit and income tax rates. In the goods market, monopolistic competition leads to a suboptimal production of varieties and (with vertical linkages) to the emergence of increasing returns to the range of available intermediates. The existence of vertical linkages and imperfect competition generates pecuniary externalities associated with the links between upstream producers and their customers – i.e. the downstream industry and final consumers. We show that, in this second best world, the interaction between unions and government policy can lead to the extraction of the rents associated with these pecuniary externalities and can thus enable the policy authorities to alleviate the market failure that stems from the interaction between economies of scale and imperfect competition and results in a sub-optimal provision of varieties. As a result of the redistributive policy, these rents are ultimately passed on to the consumers of the country which initiates the policy – via a higher aggregate productivity, lower prices and higher incomes – as well as benefiting to some extent the 'foreign' consumers – via the existence of international returns to scale and free trade.

It is important to stress that unionisation is not necessary for the above results to emerge. Any form of labour market imperfection (e.g. efficiency wages) that gives rise to a positive link between wages and policy instruments is very likely to lead to similar conclusions.

Finally, our analysis does not intend to suggest that welfare state and redistribution policies are the best way to trigger the virtuous process of cumulative causation described above. It may well be the case that other policies (e.g. industrial policies) may be better

suited to tackle the type of market imperfections characterised in this model. This issue, nevertheless, does not diminish the relevance of our analysis. The welfare state has played a specific social and political role in advanced industrial economies and attempts to retrench it are being met by opposition that could lead to a backlash against trade and capital markets liberalisation. Our concern in this paper has been to shed light on the issue of whether openness and this type of policies are incompatible and our findings suggest that this needs not be the case.

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Table 1. Equations of the model in the symmetric equilibrium without capital mobility

(5)	$P_x = \left(Np^{1-\sigma} + N^* p^{*1-\sigma}\right)^{\frac{1}{1-\sigma}} = P_x^*$	
(9)	$r^{1-\lambda} P_x^{\lambda} = 1$	$r^{*1-\lambda} P_x^{*\lambda} = 1$
(12)	$\overline{K} = \frac{(1-\alpha)N\,px + (1-\lambda)Y}{r}$	$\overline{K} = \frac{(1-\alpha)N^* p^* x^* + (1-\lambda)Y^*}{r^*}$
(14)	$P = P_x^{\mu}$	$P^* = P_x^{*\mu}$
(15)	$bw(\overline{L} - L) = twL + qr\overline{K}$	$b^* w^* (\overline{L} - L^*) = t^* w^* L^* + q^* r^* \overline{K}$
(16)	$M = bw(\overline{L} - L) + (1-t)wL + (1-q)r\overline{K}$	$M^* = b^* w^* (\overline{L} - L^*) + (1-t^*)w^* L^* + (1-q^*)r^* \overline{K}$
(17)	$E_x = \mu M + \lambda Y$	$E_x^* = \mu M^* + \lambda Y^*$
(18)	$x = \left(E_x + E_x^*\right) P_x^{\sigma-1} p^{-\sigma}$	$x^* = \left(E_x + E_x^*\right) P_x^{*\sigma-1} p^{*-\sigma}$
(19)	$p = \frac{\sigma}{\sigma-1} w^{\alpha} r^{1-\alpha}$	$p^* = \frac{\sigma}{\sigma-1} w^{*\alpha} r^{*1-\alpha}$
(20)	$x = \phi(\sigma - 1) = x^*$	
(21)	$L = \alpha N \frac{px}{w}$	$L^* = \alpha N^* \frac{p^* x^*}{w^*}$
(22)	$\frac{w}{P} = \frac{\tilde{V}}{(1-t-b) - \varepsilon\left(1-t-b+b\frac{\overline{L}}{L}\right)}$	$\frac{w^*}{P^*} = \frac{\tilde{V}}{\left(1-t^*-b^*\right) - \varepsilon^*\left(1-t^*-b^*+b^*\frac{\overline{L}}{L^*}\right)}$
(23)	$\left(Y - (1-\mu)M\right) + \left(N\,px - E_x\right) = 0$	$\left(Y^* - (1-\mu)M^*\right) + \left(N^* p^* x^* - E_x^*\right) = 0$
(24)	$Y + Y^* = (1-\mu)\left(M + M^*\right)$	
(25)	$E_x + E_x^* = N\,px + N^* p^* x^*$	

Figure 1. Effects of a rise in b/b^* (no capital mobility) when t and t^* are used as policy instruments

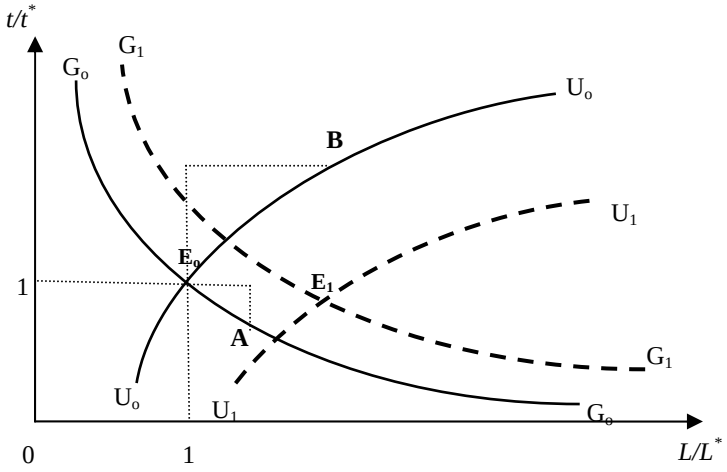


Figure 2. Effects of a rise in b/b^* (no capital mobility) when t and q^* are used as policy instruments

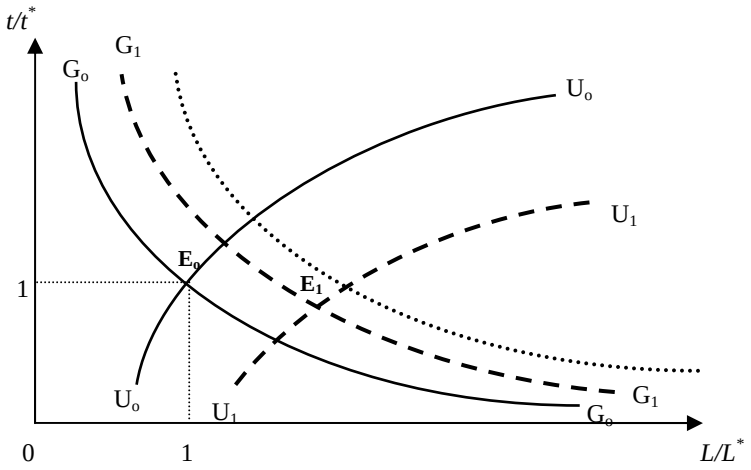


Figure 3. Effects of a rise in b/b^* (no capital mobility) when t and b^* are used as policy instruments

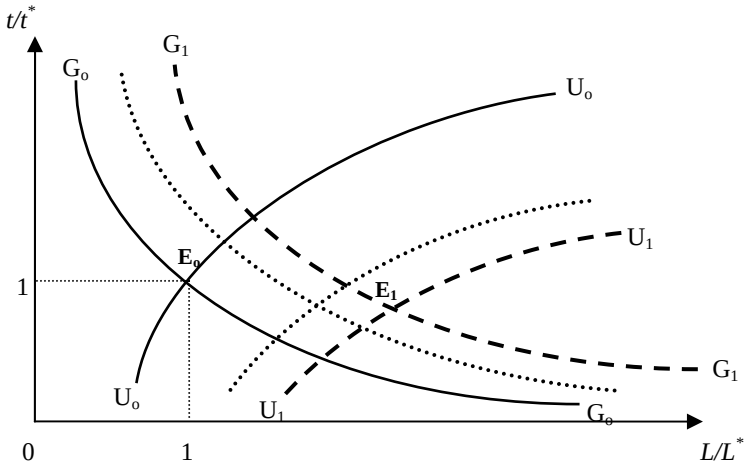


Figure 4. Effects of a rise in b/b^* (capital mobility) when t and t^* are used as policy instruments

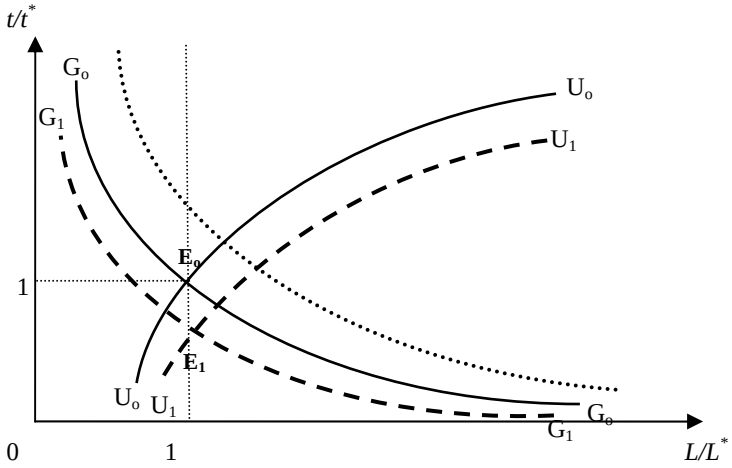


Figure 5. Effects of a rise in b/b^* (capital mobility) when t and q^* are used as policy instruments

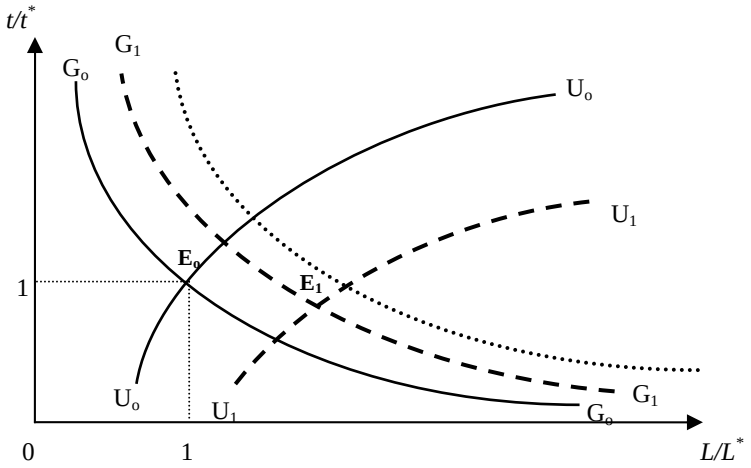
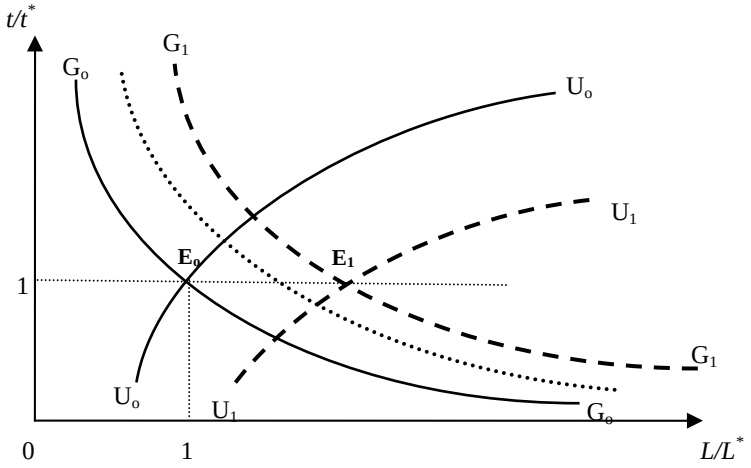


Figure 6. Effects of a rise in b/b^* (capital mobility) when q and q^* are used as policy instruments



Appendix:

A1. Derivation of the unions' wage setting rule, equation (22), and measure monopoly power, ε.

The wage setting equation for a typical union in country H is derived by choosing w_j to maximise the objective function in equation (13). The first order condition is

$$\frac{dV_j}{dw_j} = \frac{1}{\bar{L}_j}\left[\left((1-t)L_j + b\left(\bar{L}_j - L_j\right)\right)\left(\frac{1}{P} - \frac{w_j}{P^2}\frac{dP}{dw_j}\right) + w_j(1-t-b)\frac{dL_j}{dw_j} - \tilde{V}\frac{dL_j}{dw_j}\right] = 0,$$

which can be rearranged as

$$\frac{1}{P}\left((1-t-b)L_j + b\bar{L}_j\right)\left(1-\varepsilon_{jP}\right) - L_j(1-t-b)\varepsilon_{jL} + \tilde{V}\frac{L_j}{w_j}\varepsilon_{jL} = 0, \qquad \text{(A1.1)}$$

where

$$\varepsilon_{jL} = -\frac{w_j}{L_j}\frac{dL_j}{dw_j} = \frac{d\log L_j}{d\log w_j}, \qquad \text{(A1.2)}$$

and

$$\varepsilon_{jP} = \frac{w_j}{P}\frac{dP}{dw_j} = \frac{d\log P}{d\log w_j}. \qquad \text{(A1.3)}$$

Equation (22) is obtained by solving (A1.1) for $\frac{w_j}{P}$. The equivalent terms for country F can be derived in the same way.

The expressions on the right-hand sides of ε_{jP} and ε_{jL} are evaluated as follows. First, from the definition of consumer price index – i.e. equation (14), $P = P_x^{\mu}$ – we obtain $\varepsilon_{jP} = \mu\frac{d\log p_x}{d\log w_j}$. Next, rearranging the CES price index in equation (5) to separate the prices set by the firms whose workers belong to union *j* in country H from the rest of the prices, i.e. $P_x = \left(\int_{i\in N_j} p_i^{1-\sigma}di + \int_{i\notin N_j} p_i^{1-\sigma}di + \int_{i\in N^*} p_i^{*1-\sigma}di\right)^{\frac{1}{1-\sigma}}$, and differentiating the result with respect to w_j gives $\frac{dP_x}{dw_j} = \left(\int_{i\in N_j}\left(\frac{p_i}{P_x}\right)^{-\sigma}\frac{dp_i}{dw_j}di\right)$, where we have assumed that each union is sufficiently small so that its action does not lead to a reaction from others. In the symmetric equilibrium, therefore, $\frac{dP_x}{dw_j} = \frac{N}{J}\left(\frac{p_i}{P_x}\right)^{-\sigma}\frac{dp_i}{dw_j}$, or

$$\frac{d\log P_x}{d\log w_j} = \frac{N}{J}\left(\frac{p_i}{P_x}\right)^{1-\sigma}\frac{d\log p_i}{d\log w_j}. \qquad \text{(A1.4)}$$

Finally, from the price setting rule in (19), $p_{i\in N_j} = \frac{\sigma}{\sigma - 1} w_j^{\alpha} r^{1-\alpha}$, we have $\frac{d \log p_i}{d \log w_j} = \alpha$. Using these we obtain $\varepsilon_{jP} = \frac{\alpha \mu N}{J} \left(\frac{p_i}{P_x} \right)^{1-\sigma}$, which, dropping the subscripts in the symmetric equilibrium, can be written as

$$\varepsilon_P = \frac{\alpha \mu N}{J} \left(\frac{p}{P_x} \right)^{1-\sigma} . \tag{A1.5}$$

Similar algebraic calculations can be used to show that

$$\varepsilon_P^* = \frac{\alpha \mu N^*}{J^*} \left(\frac{p^*}{P_x^*} \right)^{1-\sigma} . \tag{A1.6}$$

Clearly, given equation (5), $N \left(\frac{p}{P_x} \right)^{1-\sigma} < 1$ and $N^* \left(\frac{p^*}{P_x^*} \right)^{1-\sigma} < 1$ and it follows that $0 < \varepsilon_P < 1$ and $0 < \varepsilon_P^* < 1$. It is also worth noting that we can obtain the following in same way as we did (A1.4):

$$\frac{d \log P_x^*}{d \log w_j} = \frac{N}{J} \left(\frac{p_i}{P_x^*} \right)^{1-\sigma} \frac{d \log p_i}{d \log w_j} , \tag{A1.7}$$

$$\frac{d \log P_x}{d \log w_j^*} = \frac{N^*}{J^*} \left(\frac{p_i^*}{P_x} \right)^{1-\sigma} \frac{d \log p_i^*}{d \log w_j^*} , \tag{A1.8}$$

$$\frac{d \log P_x^*}{d \log w_j^*} = \frac{N^*}{J^*} \left(\frac{p_i^*}{P_x^*} \right)^{1-\sigma} \frac{d \log p_i^*}{d \log w_j^*} , \tag{A1.9}$$

To evaluate the right-hand-side (A1.2), to obtain an expression for ε_{jL}, first differentiate the labour demand facing union *j* in county H, i.e. equation (21), $L_j = \int_{i \in N_j} l_i \, di$, with respect to w_j to get $\frac{dL_j}{dw_j} = \int_{i \in N_j} \frac{dl_i}{dw_j} di$. In the symmetric equilibrium, for each *j* and for all $i \in N_j$, we have, $L_j = \frac{N l_i}{J}$ and hence $\frac{dL_j}{dw_j} = \frac{N}{J} \frac{dl_i}{dw_j}$, which, substituting in (A1.2) yields

$$\varepsilon_{jL} = -\frac{w_j}{l_i} \frac{dl_i}{dw_j} = -\frac{d \log l_i}{d \log w_j}$$

Now, recalling that firms' labour demand in equation (6) can be written as, $l_i = \frac{\alpha(\sigma - 1)}{\sigma} \frac{p_i}{w_j} (x_i + \phi)$, the above equation becomes

$$\varepsilon_{jL} = 1 - \left(\frac{d \log p_i}{d \log w_j} + \frac{x_i}{x_i + \phi} \frac{d \log x_i}{d \log w_j} \right). \qquad \text{(A1.10)}$$

In order to evaluate the right-hand-side of (A1.10), note that:

i) x_i is determined by demand, i.e. equation (18), $x_i = \left[E_x + E_x^*\right] P_x^{\sigma-1} p_i^{-\sigma}$. Unions take expenditure $\left[E_x + E_x^*\right]$ as given, hence $\frac{d \log x_i}{d \log w_j} = -\sigma \frac{d \log p_i}{d \log w_j} + (\sigma - 1) \frac{d \log P_x}{d \log w_j}$.

ii) From the firms' mark-up in (19), $\frac{d \log p_i}{d \log w_j} = \alpha$.

iii) From (A1.4), $\frac{d \log P_x}{d \log w_j} = \frac{N}{J} \left(\frac{p_i}{P_x} \right)^{1-\sigma} \frac{d \log p_i}{d \log w_j}$.

iv) From the zero profit condition in (20), e $\frac{x_i}{x_i + \phi} = \frac{\sigma - 1}{\sigma}$.

Substituting the above in (A1.10), simplifying the result and dropping the subscript *j*, we obtain

$$\varepsilon_L = 1 + \alpha(\sigma - 2) - \frac{\alpha(\sigma - 1)^2 N}{\sigma J} \left(\frac{p}{P_x} \right)^{1-\sigma}, \qquad \text{(A1.11)}$$

It is worth noting that $\varepsilon_L > 1$ is very likely if $\frac{N}{J} \left(\frac{p}{P_x} \right)^{1-\sigma}$ is sufficiently small and $\sigma > 2$. Similar calculations show that

$$\varepsilon_L^* = 1 + \alpha(\sigma - 2) - \frac{\alpha(\sigma - 1)^2 N^*}{\sigma J^*} \left(\frac{p^*}{P_x^*} \right)^{1-\sigma}, \qquad \text{(A1.12)}$$

Finally, we are interested to see how a ceteris paribus rise in the number of unions, *J*, affects the wage each union sets, i.e. find $\partial w / \partial J$ implied by equation (22) which is repeated below for convenience

$$\frac{w}{P} = \frac{\tilde{V}}{(1 - t - b) - \varepsilon \left(1 - t - b + b \frac{\overline{L}}{L} \right)} \quad . \qquad \text{(A1.13)}$$

The sign of $\partial w / \partial J$ is the same as that of $\partial \varepsilon / \partial J$. Given that that $\varepsilon = (1 - \varepsilon_P) / \varepsilon_L$ and using the expressions derived above for ε_P and ε_L, it can be shown to the sign of $\partial \varepsilon / \partial J$ is same as the sign of $\left[\mu \left(1 + \alpha(\sigma - 2) \right) - (\sigma - 1)^2 / \sigma \right]$, which will be negative if, for any given σ, μ is sufficiently small (or, alternatively, if or any given μ, σ is sufficiently large).

A2. Characteristics of the model

The equation numbers in the following refer to those in Table 1.

(I) Symmetric properties:

Given free trade,

$$P_x^* = P_x, \tag{A2.1}$$

holds by definition, as imposed in equation (5). It then follows that, equations (9), (14), (20), (18) and (19) respectively imply:

$$r = r^*, \tag{A2.2}$$

$$P^* = P, \tag{A2.3}$$

$$x^* = x, \tag{A2.4}$$

$$p^* = p, \tag{A2.5}$$

and

$$w^* = w. \tag{A2.6}$$

(II) Links between factor incomes and expenditure:

From equations (16) and (17) we obtain

$$\begin{cases} M = wL + r\overline{K} \\ \\ M^* = w^* L^* + r^* \overline{K} \end{cases}. \tag{A2.7}$$

From equations (17) and (24) it follows that

$$E_x + E_x^* = \mu\left(M + M^*\right) + \lambda(1-\mu)\left(M + M^*\right),$$

which can be written as

$$E_x + E_x^* = \beta\left(M + M^*\right), \tag{A2.8}$$

which, together with (25) implies

$$N\,px + N^* p^* x^* = \beta\left(M + M^*\right). \tag{A2.9}$$

(A2.9) and (21) yield

$$wL + w^* L^* = \alpha\beta\left(M + M^*\right). \tag{A2.10}$$

Finally, from (A2.7) and (A2.10) we obtain

$$r\overline{K} + r^*\overline{K} = (1-\alpha\beta)\left(M + M^*\right). \tag{A2.11}$$

It is easy to verify that the above results are not affected by capital mobility.

(III) Asymmetric changes:

Given that from (A2.7)

$$\frac{M}{M^*} = \frac{r\overline{K} + wL}{r\overline{K} + wL^*}, \tag{A2.12}$$

(A2.2) and (A2.6) imply that an increase in L/L^* will result in a higher Home to Foreign nominal ratios; (A2.3) then implies that the ratio of real incomes follows the same pattern. Also, from the capital resource constraint in (12) and given (21), we obtain

$$\frac{Y}{Y^*} = \frac{(r/w)\overline{K} - \frac{1-\alpha}{\alpha}L}{(r/w)\overline{K} - \frac{1-\alpha}{\alpha}L^*}, \tag{A2.13}$$

where it can be easily verified that the expressions appearing the numerator and denominator on the right-hand-side remain positive. Thus, given (A2.2) and (A2.6), (A2.13) implies that a rise in L/L^* will result in a lower Y/Y^*.

While (A2.12) is not affected by capital mobility, allowing for the latter implies – see (12′) – that (A2.13) ought to be modified as

$$\frac{Y}{Y^*} = \frac{(r/w)K - \frac{1-\alpha}{\alpha}L}{(r/w)K^* - \frac{1-\alpha}{\alpha}L^*}. \tag{A2.13′}$$

Hence, when capital flows from F to H, $K > K^*$ and a sufficient condition for $Y/Y^* > 1$ is $L/L^* = 1$. But $Y/Y^* > 1$ can also result even if $L/L^* > 1$, provided that $r(K-K^*) > \frac{1-\alpha}{\alpha} w(L-L^*)$ holds. On the other hand, when capital flows from H to F, $K < K^*$ and $Y/Y^* < 1$ will follow if $L/L^* \geq 1$.

(IV) The impact of a firm's price change on unions' monopoly power:

To see how a change in *p* affects ε, first note that from equation (5),

$$\left(\frac{p}{P_x}\right)^{1-\sigma} = \left(N + N^*\left(\frac{p^*}{p}\right)^{1-\sigma}\right)^{-1}. \tag{A2.14}$$

Thus, a ceteris paribus rise in *p* reduces $\left(\frac{p}{P_x}\right)^{1-\sigma}$. Given (A1.5) and (A1.11), unions' mark-up factor is

$$\varepsilon = \frac{1-\varepsilon_P}{\varepsilon_L} = \frac{\frac{\alpha\mu N}{J}\left(\frac{p}{P_x}\right)^{1-\sigma}}{1+\alpha(\sigma-2)-\frac{\alpha(\sigma-1)^2 N}{\sigma J}\left(\frac{p}{P_x}\right)^{1-\sigma}}. \tag{A2.15}$$

It is easy to verify that ε will fall as a result of a ceteris paribus reduction in $\left(\frac{p}{P_x}\right)^{1-\sigma}$ if $\sigma^2-\left(2+\frac{\mu}{1-\alpha\mu}\right)\sigma+\frac{1}{1-\alpha\mu}>0$ holds. The sufficient condition for the latter is $\sigma>2+\frac{\mu}{1-\alpha\mu}$. Since $0<\frac{\mu}{1-\alpha\mu}<1$, $\sigma>3$ ensure that the sufficient condition holds. The same procedure can be used to show that ε^* rises as a result of a ceteris paribus reduction in $\left(\frac{p}{P_x}\right)^{1-\sigma}$.

(V) Employment ratio and its impact on the monopoly power of the unions:

Equations (21) and (A2.4)-(A2.6) imply that employment at the firm level remain the same in the two countries, i.e. $L/N=L^*/N^*$, hence

$$\frac{N^*}{N}=\frac{L^*}{L}. \tag{A2.16}$$

Next, (A2.14) and (A2.5) imply

$$\left(\frac{p}{P_x}\right)^{1-\sigma}=\frac{1}{N+N^*}, \tag{A2.17}$$

which can be used together with (A2.16) to rewrite (A2.15) as

$$\varepsilon=\frac{1-\dfrac{\alpha\mu}{J}}{1+\dfrac{L^*/L}{1+\alpha(\sigma-1)^2-\dfrac{J\sigma}{1+L^*/L}}}. \tag{A2.18}$$

Hence, it follows that, for all plausible values of (α, μ, σ, J), ε is a monotonically increasing function of L/L^*. Similar calculations show that ε^* is a monotonically decreasing function of L/L^*. Note that this result is not affected by capital mobility.

A3. The initial symmetric equilibrium

We calculate the policy multipliers by shocking the model at an initial symmetric equilibrium where the two countries are identical in all respects (see A5 below for the multipliers). Clearly, given the symmetry in endowments and parameters, in such an initial equilibrium there will be no capital mobility, no trade in *Y*, and no net trade in *X*. First note that in the symmetric equilibrium, equations (A2.8)-(A2.11) imply:

$$E_x=\beta M, \tag{A3.1}$$

$$N\,px=\beta M, \tag{A3.2}$$

$$wL=\alpha\beta M, \tag{A3.3}$$

and

$$r\overline{K} = (1-\alpha\beta)M \ . \qquad \text{(A3.4)}$$

The rest of the equations are given in Table A3.1 below, which are obtained from those in Table 1 (for each equation, the number after the description corresponds to that in Table 1) and: (i) in the fully symmetric case there is no distinction between Home and Foreign variables and each variable for F is set equal to its corresponding variable in H; (ii) tax rates on income from labour and capital are equal, i.e. $q = t$; and (iii) the unemployment benefit rate is fixed as a proportion of the tax rate, i.e. $b = \gamma t$ where $\gamma > 1$.

Table A3.1 Equations of the model in the initial symmetric equilibrium

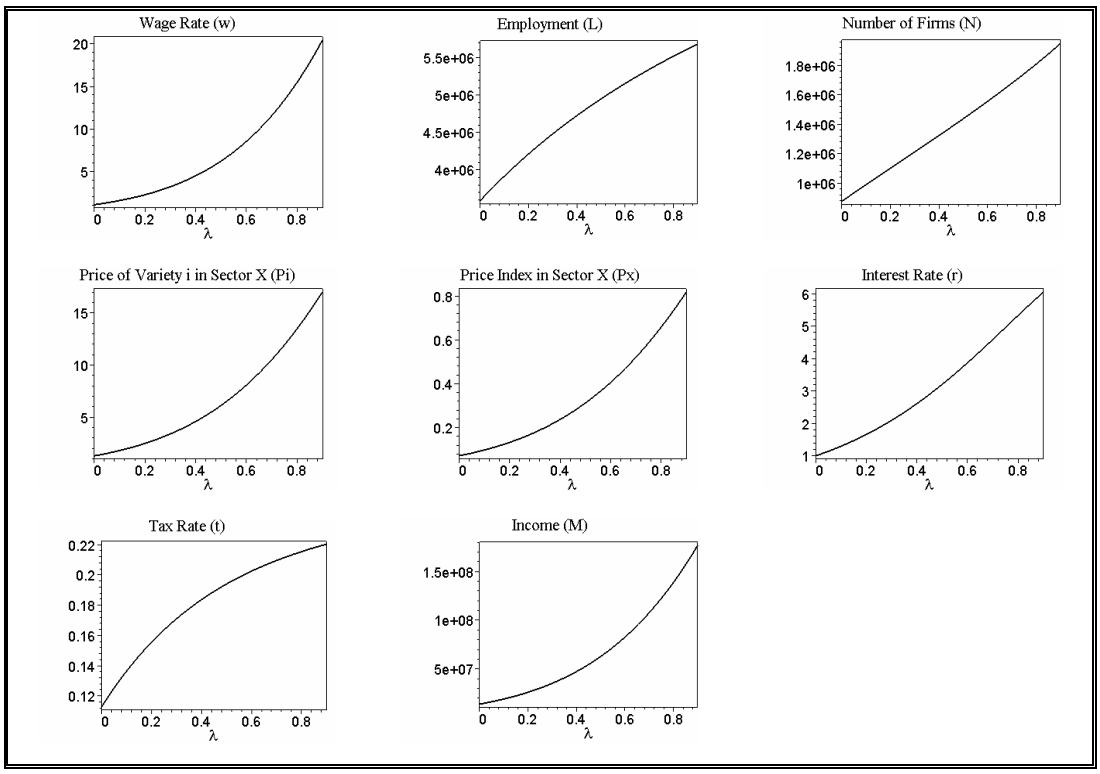
(A3.6)	price index in sector *y* (5):	$P_x = (2N)^{\frac{1}{1-\sigma}} p$
(A3.7)	zero profit condition in sector *y* (9):	$r^{1-\lambda} P_x^{\lambda} = 1$
(A3.8)	consumer price index (14):	$P = P_x^{\mu}$
(A3.9)	government budget constraint (15):	$\gamma w(\overline{L} - L) = wL + r\overline{K}$
(A3.10)	firms price mark-up rule in sector *x* (19):	$p = \frac{\sigma}{\sigma - 1} w^{\alpha} r^{1-\alpha}$
(A3.11)	zero profit condition in sector *x* (20):	$x = (\sigma - 1)\phi$
(A3.12)	unions' wage setting rule (22):	$\frac{w}{P} = \frac{\tilde{V}}{1-\varepsilon - t\left((1-\varepsilon)(1+\gamma) + \varepsilon\gamma\frac{\overline{L}}{L}\right)}$
(A3.13)	market clearing in sector *y* (24):	$Y = (1-\mu)M$

The 12 equations – consisting of (A3.1)-(A3.4) and those in Table A3.1 – determine the values of *N*, *L*, *Y*, *x*, *p*, P_x, *P*, *w*, *r*, *M*, E_x, and *t*. The solution is calibrated at $\overline{K} = \overline{L} = 10^6\phi$; J=100; μ=0.4; σ =6; α=0.7; γ =2; and Figure A3.1 below shows plots of the main variables against λ. Finally, note that, from equations (A2.17) above, in the symmetric equilibrium, the union mark-up factor is

$$\varepsilon = \frac{1 - \frac{\alpha\mu}{2J}}{1 + \alpha(\sigma - 2) - \frac{\alpha(\sigma-1)^2}{2J\sigma}}, \qquad \text{(A3.5)}$$

which implies $\varepsilon = 0.78915$ when evaluated at the above parameter values.

Figure A3.1 Initial Symmetric Equilibrium



A4. The initial impact of a rise in *w* on demand for good *X*

To find the immediate impact (or first round effect) of a rise in *w*, and hence *p* as firms mark-up their price using the rule in (19) (but when *N*, N^*, *L*, L^*, p^* and E_x^* have not yet adjusted) on demand for *X*, we examine $d(x+x^*)/dw$. From equation (18) in Table 1,

$$x + x^* = \left(E_x + E_x^*\right)P_x^{\sigma-1}\left(p^{-\sigma} + p^{*-\sigma}\right).$$

Totally differentiating the above keeping p^* and E_x^* constant yields

$$d(x+x^*) = \left(\frac{x+x^*}{E_x+E_x^*}\right)dE_x + (\sigma-1)\left(\frac{x+x^*}{P_x}\right)dP_x - \sigma\left(\frac{x}{p}\right)dp\,. \tag{A4.1}$$

From (A2.8) and (A2.10) we have $E_x + E_x^* = \left(wL + w^*L^*\right)/\alpha$ and hence

$$dE_x = \left(\frac{L}{\alpha}\right)dw\,, \tag{A4.2}$$

when *L*, L^*, w^* and E_x^* are kept constant. From equation (5) in Table 1 we obtain

$$dP_x = N\left(\frac{P_x}{p}\right)^{\sigma} dp\,, \tag{A4.3}$$

when N, N^* and p^* are kept constant. Finally, From (19) in Table 1 we obtain

$$dp = \alpha\left(\frac{p}{w}\right)dw, \qquad \text{(A4.4)}$$

when N, N^* and p^* are kept constant. Substituting (A4.2)-(A4.4) into the right-hand-side of (A4.1) and evaluating the resulting expression in the initial symmetric equilibrium, described in Section A3 above, we obtain

$$\frac{d(x+x^*)}{dw} = \frac{(1-\alpha)x}{w} > 0.$$

A5. The policy multipliers and numerical simulations

The multipliers are derived by totally differentiating the relevant equations and solving the system to determine dz/db where b is the unemployment benefit rate in H and z is one of the endogenous variables of interest, i.e. N, L, Y, x, p, P_x, P, w, r, M, K, their counterparts for country F, and the two instruments used. These multiplies have very large algebraic expressions and are not provided here, but are available on request from the authors. In general, each multiplier – when governments use t and one of t^*, q^*, b^* as policy instruments – is a complex non-linear function of parameters (μ, σ, α, ϕ, λ), endowments $(\bar{K}, \bar{L})$, 'reservation wage' $\tilde{V}$, number of unions J, and the initial equilibrium values of the tax and benefit rates, $(t_o, q_o, b_o, t_o^*, q_o^*, b_o^*)$. For each scenario we have calculated and plotted the multipliers against λ for the calibration:

$$\mu = 0.4; \qquad \sigma = 6; \qquad \alpha = 0.7;$$

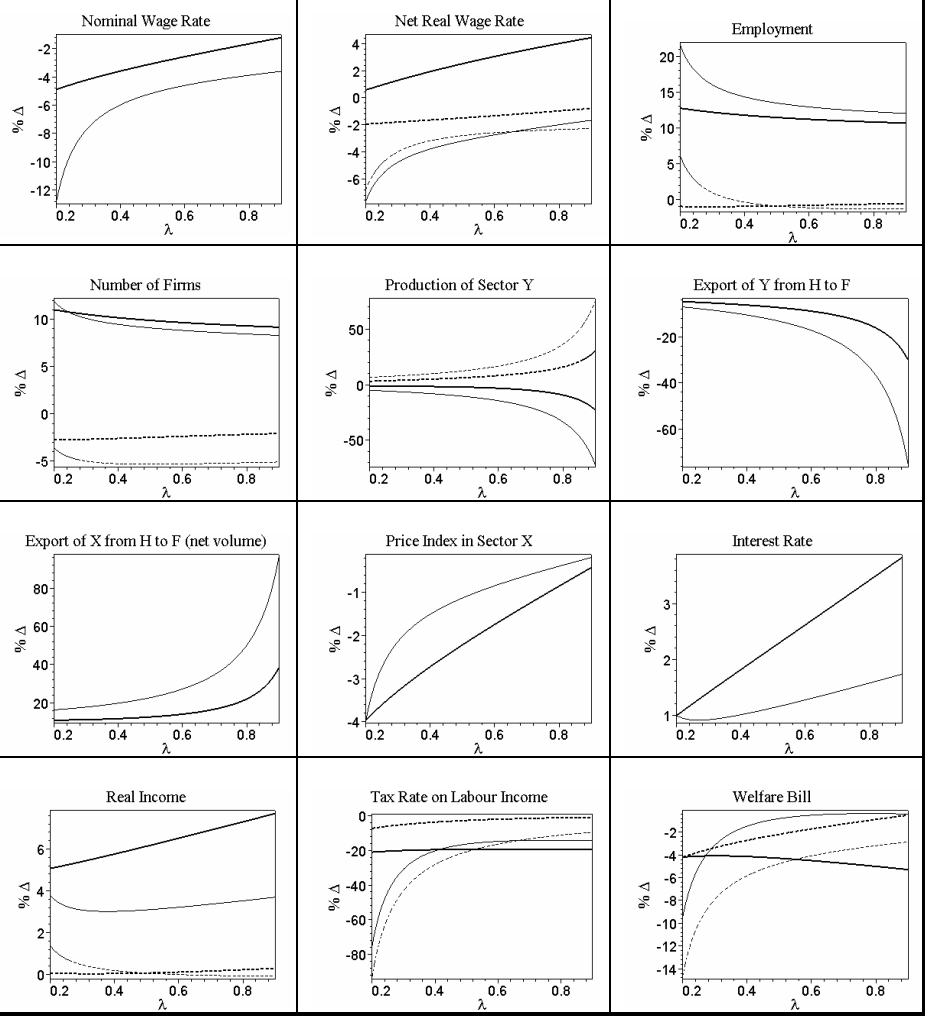
$$\bar{K} = \bar{L} = 10^6\phi; \qquad J = 100;$$

$$b_o = b_o^*; \qquad t_o = t_o^*; \quad q_o = q_o^*; \qquad \text{and} \qquad t_o = q_o = 0.5b_o$$

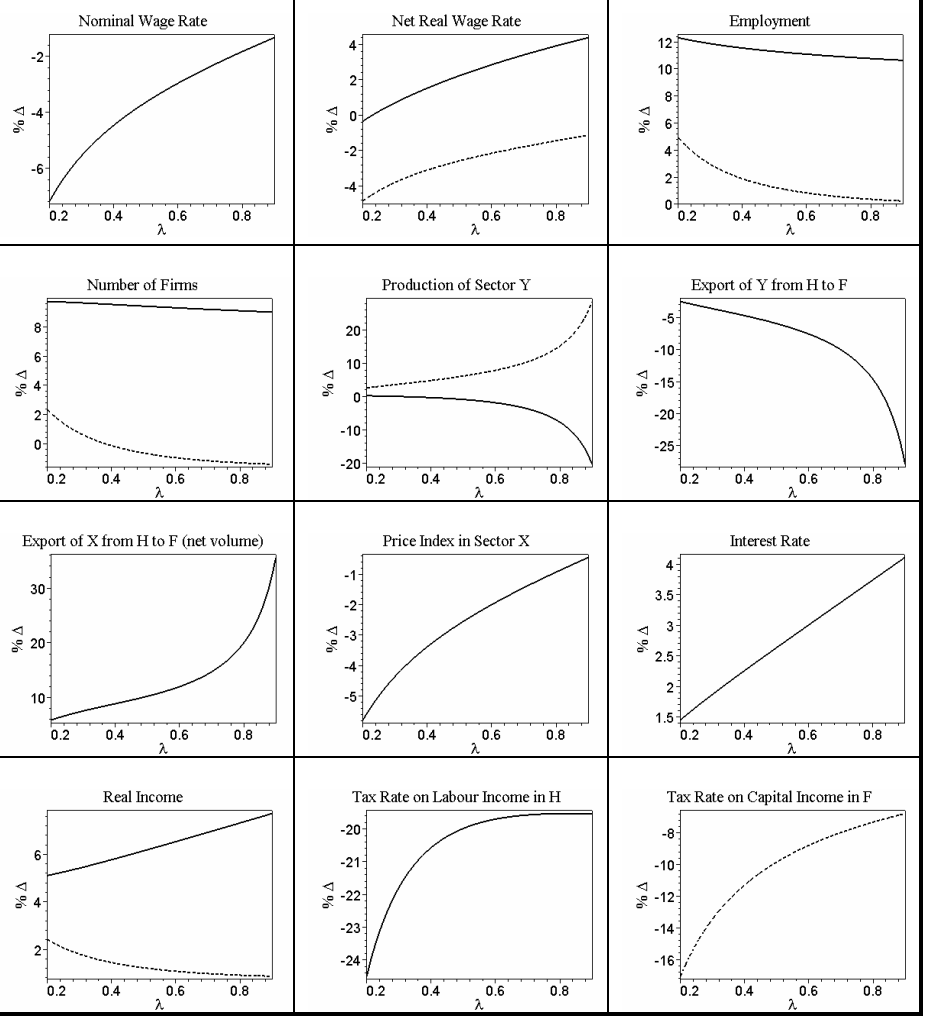
Figures A5.1 to A5.4 below give these plots. For the benchmark case – i.e. no capital mobility and t and t^* used as instrument – we have plotted the multipliers for two different values of α in order to examine the effect of a change in the intensity of utilisation of labour in sector x. To ensure the robustness of the numerical results presented below, we have used extensive numerical simulations, covering the plausible parameter values, to verify that the results do not change qualitatively.

Figure A5.1. Welfare Policy Shock Multipliers with no Capital Mobility[1]

policy: $\%\Delta b = \%10$; $\Delta q = \Delta q^* = \Delta b^* = 0$; t and t^* allowed to adjust endogenously[2]



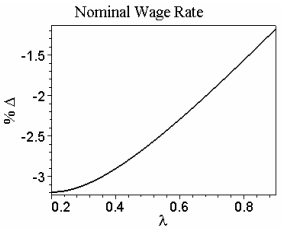
policy: $\%\Delta b = \%10$; $\Delta q = \Delta t^* = \Delta b^* = 0$; t and q^* allowed to adjust endogenously

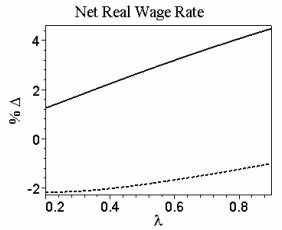


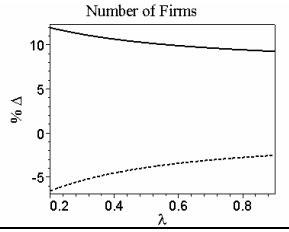
1. When multipliers for H and F are different the graph for F is depicted by a broken curve; 2. The thinner curves show the policy effect when $\alpha = 0.3$.

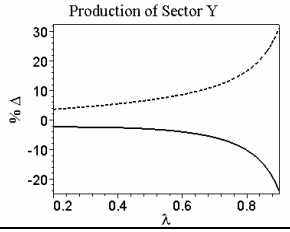
Figure A5.2. Welfare Policy Shock Multipliers with no Capital Mobility[1]

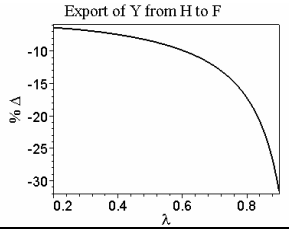
policy: $\%\Delta b = \%10$; $\Delta q = \Delta q^* = \Delta t^* = 0$; t and b^* allowed to adjust endogenously

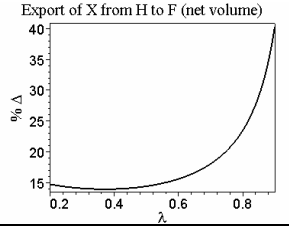


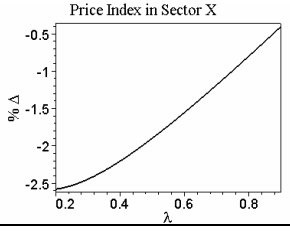


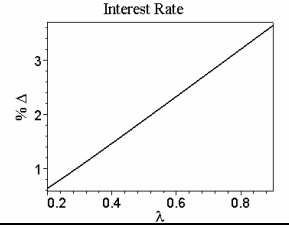


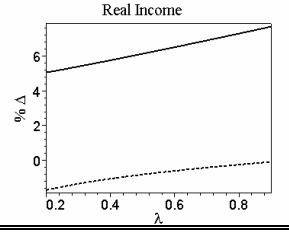


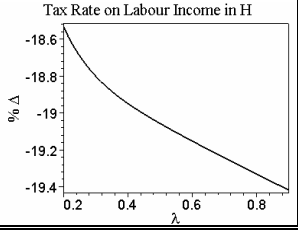


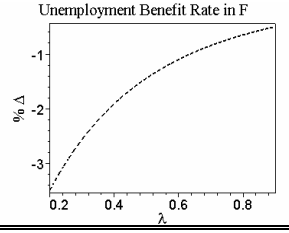




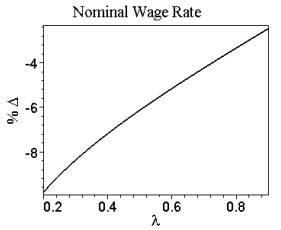


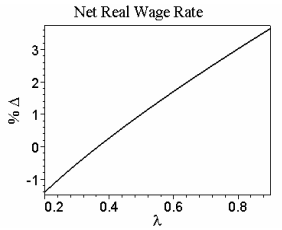


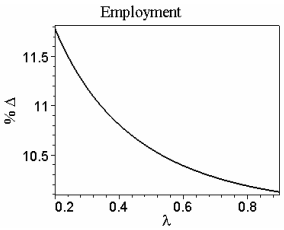


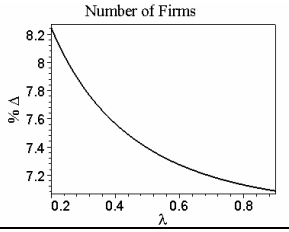


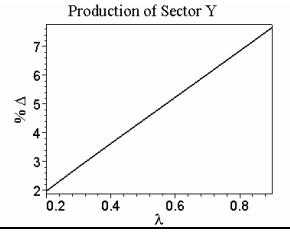
policy: $\%\Delta b = \Delta b^* = \%10$; $\Delta q = \Delta q^* = 0$; t and t^* allowed to adjust endogenously



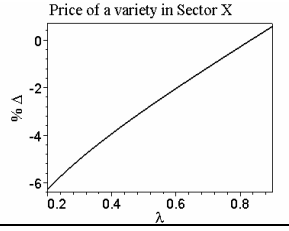


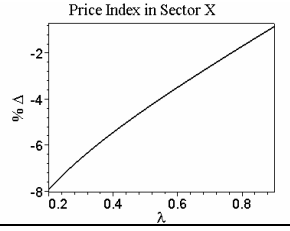


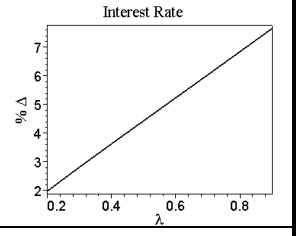


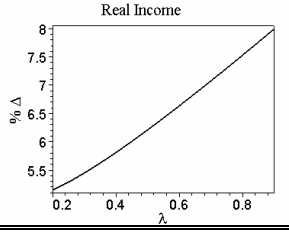


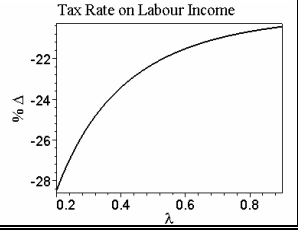
In this case there is no capital flow and the net volume of export of X is zero.

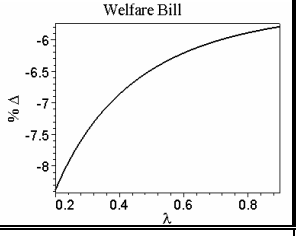








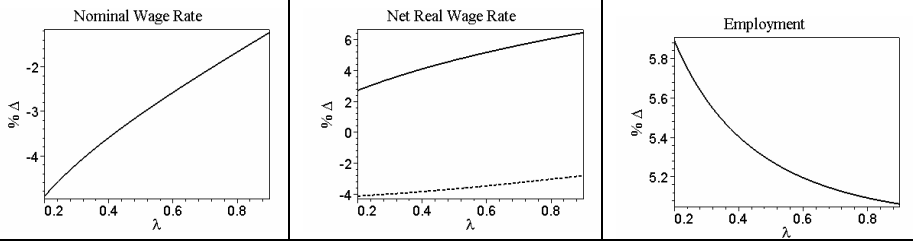


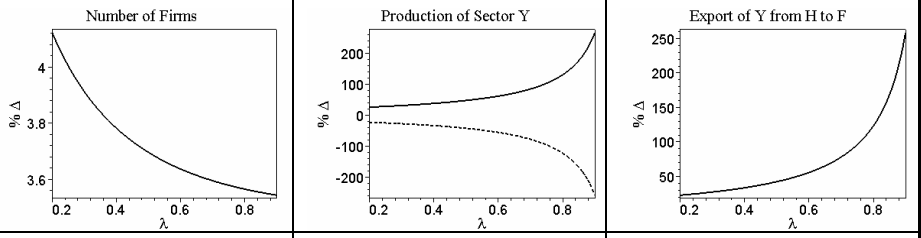


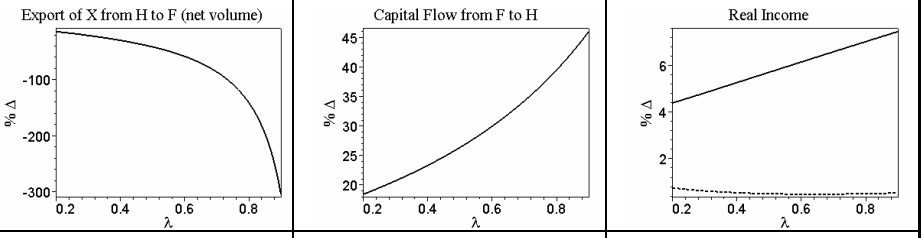
1. When multipliers for H and F are different the graph for F is depicted by a dotted curve.

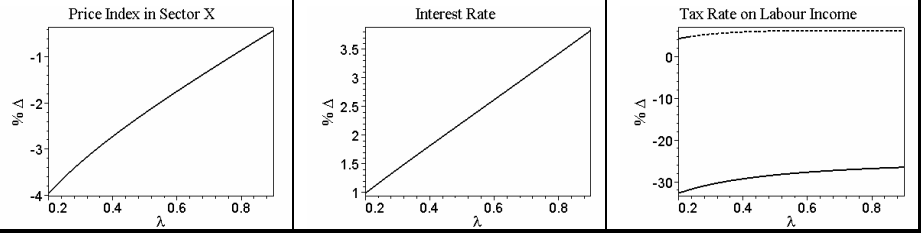
Figure A5.3. Welfare Policy Shock Multipliers with Capital Mobility[1]

policy: $\%\Delta b = \%10$; $\Delta q = \Delta q^* = \Delta b^* = 0$; t and t^* allowed to adjust endogenously

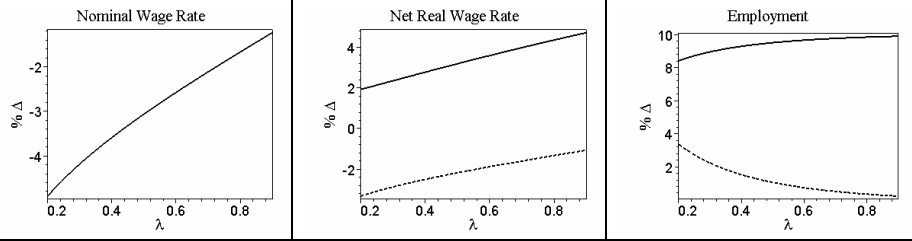


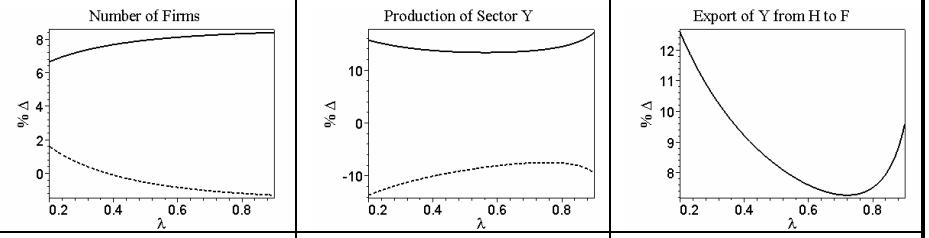


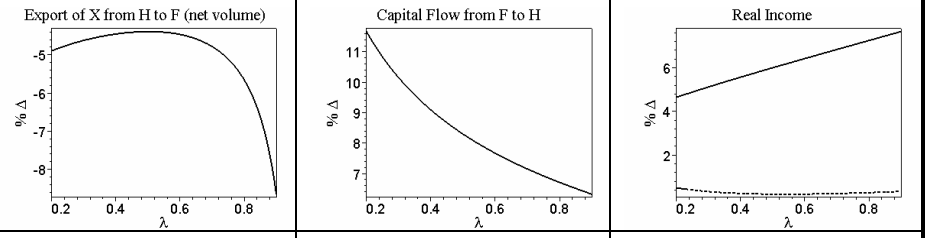


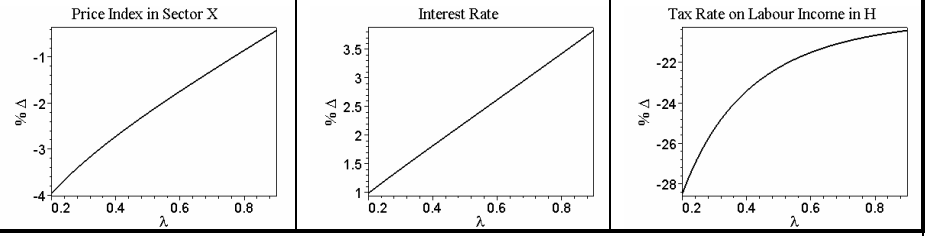


policy: $\%\Delta b = \%10$; $\Delta q = \Delta t^* = \Delta b^* = 0$; t and q^* allowed to adjust endogenously[2]





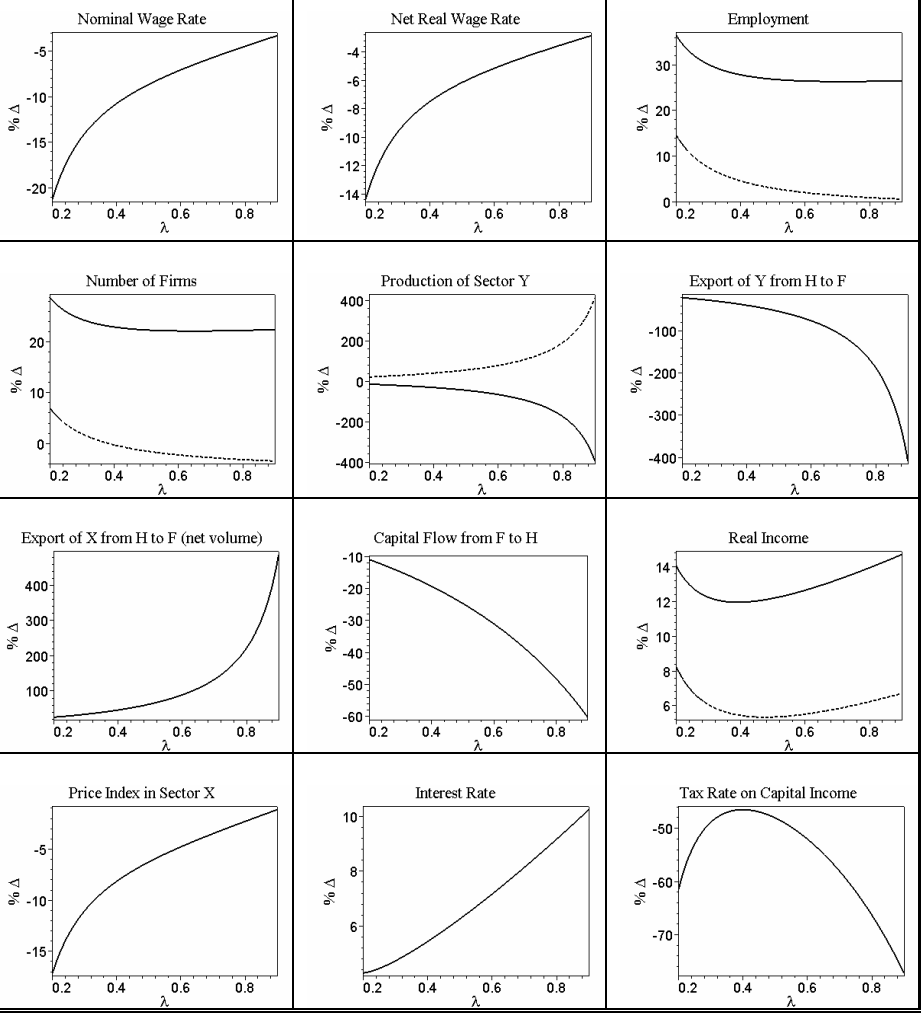




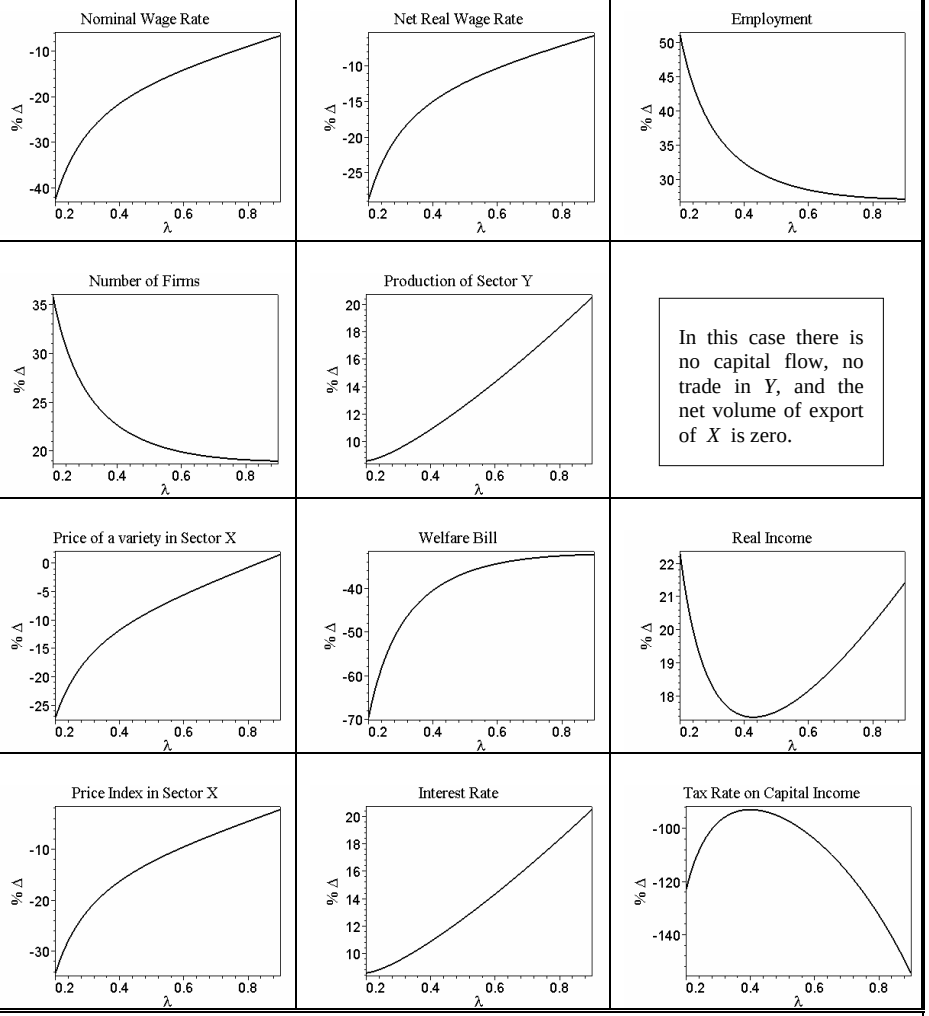
1. When multipliers for H and F are different the graph for F is depicted by a dotted curve. 2. q^* has to return to its initial value, hence $dq^*/db=0$.

Figure A5.4. Welfare Policy Shock Multipliers with Capital Mobility[1]

policy: $\%\Delta b = \%10$; $\Delta t = \Delta t^* = \Delta b^* = 0$; q and q^* allowed to adjust endogenously[2]



policy: $\%\Delta b = \Delta b^* = \%10$; $\Delta t = \Delta t^* = 0$; q and q^* allowed to adjust endogenously



In this case there is no capital flow, no trade in *Y*, and the net volume of export of *X* is zero.

1. When multipliers for H and F are different the graph for F is depicted by a dotted curve. 2. At lower levels of *a* the direction of capital flow is reversed.