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Economic Integration, Imperfect Competition, and International Policy Coordination*

by

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Abstract

The paper examines policy externalities between imperfectly competitive open economies where unemployment prevails in general equilibrium. We develop a two-country and two-sector model with monopolistic competition in the goods market and wage bargaining in the labor market. Policy externalities operate through the real exchange rate and economic integration is modeled as a reduction in trade costs. We explore how market integration influences policy spillovers, employment and real wages. We also examine how national and supranational commodity tax policies affect sectoral and total employment. Finally, we characterize optimal commodity taxes with non-cooperative and cooperative policies and offer some rough estimates of the welfare gains from policy coordination, using a calibrated version of the model.

JEL-Classification: D43, E61, F15, J23, J64.

Keywords: Economic integration, imperfect competition, wage determination, policy cooperation.

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1. Introduction

The European economic integration has brought issues regarding policy coordination to the fore in recent policy debates and research efforts. The discussion has been concerned with economic policies in general, including monetary and fiscal policies, as well as "structural" policies dealing with taxes and regulations. The case for policy coordination relies on the idea that non-cooperative outcomes fail to internalize various policy externalities. One channel for international policy spillovers operates through the real exchange rate.

This paper contributes to the discussion about policy coordination regarding commodity taxation. To that end we develop a two-country and two-sector general equilibrium model of international trade where the real exchange rate is endogenously determined. The model features imperfect competition in product and labor markets and unemployment prevails in general equilibrium. The framework allows a positive analysis of the effects of market integration and the nature of policy spillovers as well as a normative analysis of the gains from policy coordination.

The paper is related to and unifies two strands of recent contributions. One strand of literature has primarily addressed positive issues and examined how product market integration affects wage bargaining and employment in unionized economies.¹ Papers by Andersen and Sørensen (1992), Driffill and van der Ploeg (1993, 1995), Danthine and Hunt (1994), Huizinga (1993), Sørensen (1994) and Naylor (1998) belong to this category. The modeling strategies differ across the papers, and so do the results. Some of the studies model increased product market integration as a reduction in trade costs; cf. Driffill and van der Ploeg (1993) and Naylor (1998). Other studies assume that integration increases the elasticity of substitution between domestic and foreign goods; see Andersen and Sørensen (1992) and Danthine and Hunt (1994). A third category, represented by Huizinga (1994) and Sørensen (1994), compare two polar cases, autarky vs perfectly integrated product markets. The fact that the different modeling approaches produce different results comes as no surprise. In general, the effect of integration on bargained wages depends on how integration affects the perceived wage elasticity of labor demand. Wage moderation is the outcome if this elasticity increases, as in Andersen and Sørensen (1992) and

¹ An earlier literature investigated the effects of integration on product markets by making use of the new trade theories with monopolistic competition and increasing returns to scale; cf. Venables (1987), Smith and Venables (1986) and Venables and Smith (1988). These contributions did not address questions pertaining to imperfect labor markets and wage bargaining.

Danthine and Hunt (1994). Increased wage pressure is the result if the labor demand elasticity is reduced, as in the model of oligopolistic rivalry in Naylor (1998).

The other strand of related literature has explored the case for policy coordination among economies with integrated product markets. Andersen and Sørensen (1995) as well as Andersen, Rasmusen and Sørensen (1996) analyze optimal fiscal policies with and without international cooperation. The main result is that uncoordinated fiscal policy is too expansionary. Similar results were obtained – in models without labor market distortions – in earlier contributions by van der Ploeg (1987), Turnovsky (1988) and Devereux (1991). The reason for the overexpansion result is that a government that acts non-cooperatively has an incentive to use fiscal policy as a means to improve the country's terms of trade.

Our study differs from and extends the previous contributions in several respects. We include a non-tradable sector in the analysis, which makes it possible to examine *sector-specific* policies. In particular, the two-sector framework allows an analysis of how employment and welfare at home and abroad is affected by, for example, sectorally differentiated value added taxes (or payroll taxes). This is of obvious relevance for the ongoing discussions within the European Union regarding harmonization of value added taxes; one issue in this discussion is whether there should be supranational rules concerning the member countries' policies regarding sectoral tax differentiation. In general, a case can be made for some sectoral differentiation of value added taxes, but whether there is any rationale for policy *coordination* in this area is an open question. Our analysis sheds light on this issue.

The two-sector framework is important in the analysis also for another reason. Our model of equilibrium unemployment features complete real wage flexibility with respect to general changes in labor or commodity taxes, a wellknown feature of many models of equilibrium unemployment.² The main reason for this property of the model is that we assume that the real unemployment compensation is indexed to the real after-tax consumer wage through a fixed replacement ratio. Absent a non-tradable sector, this assumption implies that unemployment in an open economy would be invariant to changes in the real exchange rate. Unemployment would then be determined by an aggregate wage setting schedule that could be drawn as a vertical line in the real wage and (un)employment space and domestic employment policies would have no effect on foreign employment. However, the presence of a non-tradable sector implies that policies concerning

² See, for example, Johnson and Layard (1986), Layard et al (1991) and Pissarides (1991, 1998).

domestic employment may have repercussions on foreign employment through sectoral *reallocation effects*, as induced changes in the real exchange rate affect the sectoral allocation of labor. These reallocation effects may in turn affect *total* employment, a possibility that follows from our model of an imperfect labor market where sectoral wages are not necessarily equalized.

Economic integration would seem to make issues concerning international policy linkages more relevant than they otherwise would have been. One might conjecture that policy externalities among countries would increase in importance as barriers to trade are removed; of course, no international policy spillovers would exist under complete autarky. However, our analysis shows that there is no simple association between the removal of trade barriers and the magnitude of policy spillovers. Although domestic policies in general affect foreign employment through adjustments of the real exchange rate, we show that these spillover effects vanish as trade costs approach zero and product markets thus become completely integrated.

We proceed by presenting the model in the next section of the paper. In section 3 we take a look at some implications of increased market integration. Section 4 is devoted to a positive analysis of international repercussions of tax policies; we focus on how national and supranational policies concerning commodity taxes affect sectoral and total employment in the two countries. Section 5 includes an analysis of optimal commodity taxation and Section 6 concludes.

2. The Model

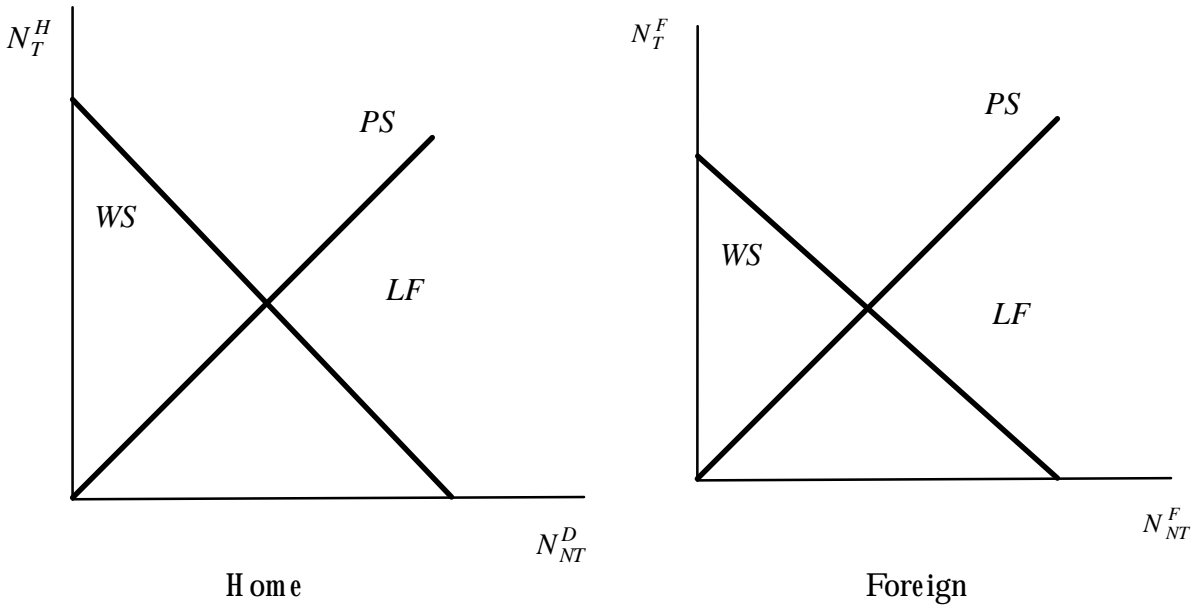
2.1 Brief Outline

We begin with a brief overview of the main ingredients of the model by means of Figure 1. There are two countries, Home (H) and Foreign (F). In each country there are two sectors, a tradable (T) and a non-tradable (NT) sector. Tradables and non-tradables are produced in many varieties. Total employment in the tradable sector is denoted N_T^j whereas total employment in the non-tradable sector is denoted N_{NT}^j , $j=H, F$. Labor is the only factor of production. In Figure 1, the dashed and negatively sloped 45-degree lines denoted LF represent the labor force constraints in the countries. In an economy with full employment, the feasible employment combinations would coincide with the labor force constraint. With imperfect labor markets, the feasible employment combinations are located to the left of the labor force constraint, as illustrated in Figure 1 by the WS -lines. These lines are derived from wage setting behavior; hence the label WS . The position of a WS -line is determined by labor and product market characteristics within a country. An increase in wage pressure, caused by, say, higher unemployment benefits or more powerful unions, produces a

downward shift of the *WS*-line. The slope of a *WS*-line is determined by parameters of the model that capture sectoral differences in the market power of firms and unions. A reallocation of employment across sectors has no effect on total employment if the slope is equal to minus unity; otherwise a reallocation does affect total employment.

The positively sloped lines, denoted *PS*, capture relative demand for tradables and non-tradables. The *PS*-lines incorporate the firms' price setting decisions – hence the label *PS* – but *not* wage-setting decisions. They are derived from two relationships, namely the demand for tradables and non-tradables as increasing functions of aggregate real income. By substituting out real income from these relationships we obtain a *PS*-equation for each of the countries. An important feature of the model is that *PS* in general depends on the real exchange rate, i.e., the relative price of foreign goods in terms of domestic goods. For a given real exchange rate, equilibrium obtains when the *PS*-line intersects with the *WS*-line. In general "world" equilibrium with balanced trade, the real exchange rate is determined simultaneously with the other variables in the two economies.

Figure 1. Wage Setting and Price Setting in Open Economies.



Policy spillovers operate through the real exchange rate. Domestic policies affect the real exchange rate through the effects on wage setting (*WS*) and/or relative demand (*PS*) at home. For example, an increase in wage pressure in Home has a "direct" effect on *WS* – involving a shift towards the origin in Home – and "indirect" effects on the *PS*-lines in both countries through the

real exchange rate. A reduction in the tax on domestic tradables has a direct effect on PS in Home, raising the demand for tradables and inducing a reallocation of employment towards the tradable sector. The increased supply of tradables in Home relative to the supply of tradables in Foreign causes an adjustment of the real exchange rate, i.e., an increase in the price of foreign tradables relative to the price of domestic tradables. This relative price adjustment affects the sectoral allocation of employment in Foreign, and possibly total employment as well.

This completes the brief overview of the model. We proceed to the details.

2.2 Consumers

We normalize the number of individuals in each country to unity. There is no labor mobility between countries. The following characterization pertains to Home; analogous descriptions hold for Foreign. Individual i consumes traded (C_{iT}^H) and non-traded (C_{iNT}^H) goods and has a utility function given as:

$$(1) \quad \Lambda_i = \left(\frac{C_{iT}^H}{\alpha} \right)^\alpha \left(\frac{C_{iNT}^H}{1-\alpha} \right)^{1-\alpha}, \quad 0 < \alpha < 1.$$

Labor is supplied inelastically without loss of utility. Both tradables and non-tradables appear in many varieties and the sub-utility functions for the different varieties are given as:

$$(2) \quad \begin{aligned} C_{iT}^H &= \left(\sum_{j=1}^{K_T} C_{ij}^{\frac{\mu-1}{\mu}} \right)^{\frac{\mu}{\mu-1}}, \\ C_{iNT}^H &= \left(\sum_{\ell=1}^{K_{NT}^H} C_{i\ell}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \end{aligned} \quad \mu, \sigma > 1.$$

There are K_T varieties of tradables; K_T^H of these are produced in Home and $K_T - K_T^H$ in Foreign. The number of varieties of non-tradables in Home is given by K_{NT}^H . The number of varieties produced in each of the countries is exogenous. The parameter μ (σ) is the elasticity of substitution between any two tradable (non-tradable) goods.

The individual receives unemployment benefits, B , if he is unemployed and labor income, W_i , if he is employed in one of the sectors. Profits are distributed equally to all individuals as

dividends, π . The individual's income is thus given as $I_i = W_i + \pi$ if he is employed and as $I_i = B + \pi$ if he is unemployed. The budget constraint takes the form:

$$(3) \quad I_i = \sum_{h=1}^{K_T^H} \tilde{P}_h^H C_{ih}^H + \sum_{f=K_T^H}^{K_T} \tilde{P}_f^H C_{if}^H + \sum_{\ell=1}^{K_{NT}^H} \tilde{P}_\ell^H C_{i\ell}^H.$$

The consumer (producer) price of tradables produced in Home is denoted \tilde{P}_h^H (P_h^H), whereas \tilde{P}_f^H (P_f^H) is the domestic consumer (producer) price of tradables produced in Foreign. \tilde{P}_ℓ^H (P_ℓ^H) is the consumer (producer) price of non-tradables in Home. C_{ih}^H , C_{if}^H , and $C_{i\ell}^H$ are the domestic consumer's demand for domestically produced tradables, foreign produced tradables, and non-tradables. Destination-based value added taxes, denoted t_T^j and t_{NT}^j for $j=H, F$, create a wedge between consumer and producer prices, i.e., $\tilde{P}_h^H = P_h^H(1 + t_T^H)$, $\tilde{P}_f^H = P_f^H(1 + t_T^H)$, and $\tilde{P}_\ell^H = P_\ell^H(1 + t_{NT}^H)$ for consumer prices in Home. Our results are independent of whether value added taxes are destination-based or origin-based.³ Moreover, value added taxes and payroll taxes are equivalent in our model so all results can be obtained by sectoral differentiation of payroll taxes.

The individual demand for the specific goods is derived by maximizing the utility function given by (1) and (2), subject to the budget constraint in (3). From this maximization we derive the aggregate *domestic* demand function pertaining to a specific firm. This takes the form

$$(4) \quad C_h^H = \alpha \left(\frac{\tilde{P}_h^H}{\tilde{P}_T^H} \right)^{\frac{1}{1-\mu}} \frac{I^H}{\tilde{P}_T^H}, \quad h=1, \dots, K_T^H,$$

for a firm that produces tradables in Home. I^H is the aggregate domestic income whereas \tilde{P}_T^H is the general price index for tradables relevant for domestic consumers:

$$(5) \quad \tilde{P}_T^H = \left[\sum_{j=1}^{K_T} (\tilde{P}_j^H)^{1-\mu} \right]^{\frac{1}{1-\mu}} = \left[K_T^H (\tilde{P}_h^H)^{1-\mu} + (K_T - K_T^H) (\tilde{P}_f^H)^{1-\mu} \right]^{\frac{1}{1-\mu}}.$$

Some of the prices in the price index are set by foreign firms. The expression in the rightmost bracket is derived by assuming symmetric conditions for firms within each country.

³ This is in contrast to the analysis in Lockwood (1993) of commodity tax competition under perfect competition, where a switch from the destination principle to the origin principle does affect the equilibrium outcome.

A firm in Home producing tradables faces also *foreign* demand for its product. With equal preferences in the two countries, the *aggregate* demand relevant for such firm is given by:

$$(6) \quad C_h = C_h^H + C_h^F = \alpha \left[\left(\frac{\tilde{P}_h^H}{\tilde{P}_T^H} \right)^{-\mu} \frac{I^H}{\tilde{P}_T^H} + \left(\frac{\tilde{P}_h^F}{\tilde{P}_T^F} \right)^{-\mu} \frac{I^F}{\tilde{P}_T^F} \right], \quad h=1, \dots, K_T^H.$$

\tilde{P}_h^F is the price of tradable h produced in Home facing consumers in Foreign, and \tilde{P}_T^F is the general price index for tradables relevant for foreign consumers. I^F is the aggregate income level in Foreign. Analogous derivations yield the demand relevant for a firm that produces non-tradables.⁴ The general consumer price index in Home, denoted \tilde{P}^H , is obtained as a weighted geometric average of the price of tradables, \tilde{P}_T^H , and the price of non-tradables, \tilde{P}_{NT}^H , i.e., $\tilde{P}^H = (\tilde{P}_T^H)^\alpha (\tilde{P}_{NT}^H)^{1-\alpha}$. The general consumer price index in Foreign is given in an analogous way.

2.3 Firms

In each country there are a large number of firms that produce tradables and non-tradables. A particular variety is produced by only one firm. Labor is the only factor of production, the production technology is linear and all productivity parameters are normalized to unity. Exports involve ("iceberg") transport costs proportional to the export value. Markets are segmented because of transport costs and prices for identical products can differ across countries. Firms set prices to maximize profits, taking wages as given. The objective function for a representative domestic firm in the tradable sector can be written as:

$$(7) \quad \Pi_h = P_h^H C_h^H + P_h^F C_h^F - W_h (C_h^F + C_h^H) - F^H P_h^F C_h^F = P_h^H C_h^H + P_h^F C_h^F / \tau^H - W_h (C_h^F + C_h^H).$$

W_h is the nominal wage and F^H the transport cost, where $F^H \in [0,1)$ and $\tau^H \equiv 1/(1-F^H)$. $F^H = 0$ implies $\tau^H = 1$. The product markets are completely integrated when $\tau^j = 1, j=H, F$.

The following price setting rules are obtained for domestic and foreign markets:

⁴ The demand function is for a specific firm in the non-tradable sector is: $C_\ell^H = (1-\alpha) \left(\frac{\tilde{P}_\ell^H}{\tilde{P}_{NT}^H} \right)^{-\sigma} \frac{I^H}{\tilde{P}_{NT}^H}$, $\ell = 1, \dots, K_{NT}^H$.

$$(8) \quad P_h^H = \kappa_T W_h,$$

$$(9) \quad P_h^F = \tau^H P_h^H = \tau^H \kappa_T W_h.$$

$\kappa_T \equiv \mu / (\mu - 1)$ is the usual markup factor. The optimal price in the foreign market is, in general, higher than the domestic price due to transport costs. Once prices are set we obtain output and employment from the relevant demand functions. By aggregating over the domestic firms and using the relationships between consumer and producer prices we obtain the following aggregate labor demand schedule for the domestic tradable sector:

$$(10) \quad N_T^H = \frac{\alpha K_T^H I^H}{P_h^H (1 + t_T^H)} \left[\left(\frac{P_h^H}{P_T^H} \right)^{1-\mu} + \frac{I^F (1 + t_T^H)}{I^H (1 + t_T^F)} \left(\frac{P_h^H}{P_T^F} \right)^{1-\mu} (\tau^H)^{-\mu} \right],$$

where $P_T^H = \tilde{P}_T^H / (1 + t_T^H)$ and $P_T^F = \tilde{P}_T^F / (1 + t_T^F)$ are producer price indexes. Aggregate demand for labor in the tradable sector depends on the relative price of domestic goods in the home market, P_h^H / P_T^H , as well as the relative price of domestic goods in the foreign market, P_h^H / P_T^F . It also depends on the aggregate real income in Home and Foreign.

It will be convenient to define the *real exchange rate* as $p \equiv P_f^F / P_h^H$. By using the expressions for the price indexes for tradables in Home and Foreign we can rewrite (10) and obtain

$$(10') \quad N_T^H = \frac{\alpha I^H}{P_h^H (1 + t_T^H)} \left[\left[1 + k_T^{-1} (\tau^F)^{1-\mu} p^{1-\mu} \right]^{-1} + \frac{I^F (1 + t_T^H)}{I^H (1 + t_T^F)} \left[(\tau^H)^{1-\mu} + k_T^{-1} p^{1-\mu} \right]^{-1} (\tau^H)^{-\mu} \right],$$

where $k_T \equiv K_T^H / (K_T - K_T^H)$. A rise in p , i.e., a real depreciation, increases labor demand in the domestic tradable sector. In general equilibrium we also need to consider adjustments in real incomes, something that we do in the subsequent analysis.

Analogous reasoning can be used to derive pricing rules for firms in the non-tradable sector; we get $P_\ell^H = \kappa_{NT} W_\ell$, where $\kappa_{NT} \equiv \sigma / (\sigma - 1)$. In a symmetric equilibrium, the demand for labor in the non-tradable sector is given by $N_{NT}^H = (1 - \alpha) I^H / \tilde{P}_\ell^H$.

2.4 Wage Determination and the Labor Market

There is one union in each firm and each union cares about the utility of its members. The indirect utility function for the worker is given as $\Lambda_i^* = I_i / \tilde{P}^H$, where I_i is the state-dependent income. The time horizon is infinite and workers are concerned with their expected lifetime utility, recognizing the possibility of transitions across sectors and labour force states. (See Appendix A for details on the labor market structure.) Let V_h denote the expected lifetime utility of a worker employed in a particular firm h in the tradable sector, V_ℓ the expected lifetime utility of a worker employed in a firm ℓ in the non-tradable sector, and V_u the expected lifetime utility of an unemployed worker. The nominal wage is set in decentralized union-firm negotiations, taking the general price and wage levels as given. Wages are chosen according to Nash bargains where the objectives are of the form:

$$\begin{aligned} m a x_{W_h} \Omega_h &= [n_h(W_h)(V_h(W_h) - V_u)]^{\lambda_T^H} [\Pi_h(W_h) / \tilde{P}^H]^{1-\lambda_T^H}, \\ m a x_{W_\ell} \Omega_\ell &= [n_\ell(W_\ell)(V_\ell(W_\ell) - V_u)]^{\lambda_{NT}^H} [\Pi_\ell(W_\ell) / \tilde{P}^H]^{1-\lambda_{NT}^H}. \end{aligned}$$

The union's contribution to the Nash bargain is given by its "rent", i.e., $n_h(V_h - V_u)$ for the tradable sector, and $n_\ell(V_\ell - V_u)$ for the non-tradable sector, with employment at the firm level denoted n_h and n_ℓ . The parameters λ_T^H and λ_{NT}^H measure the relative bargaining power of the unions relative to the firms, with $\lambda_i^H \in (0,1]$, for $i=T, NT$. The wage bargains recognize that the firms unilaterally determine employment once wages are set. The real wages in Home implied by the bargains are:

$$(11) \quad \frac{W_h}{\tilde{P}^H} = \left(\frac{\lambda_T^H + \mu - 1}{\mu - 1} \right) \bar{V}^H, \quad h=1, \dots, K_T^H,$$

$$(12) \quad \frac{W_\ell}{\tilde{P}^H} = \left(\frac{\lambda_{NT}^H + \sigma - 1}{\sigma - 1} \right) \bar{V}^H, \quad \ell=1, \dots, K_{NT}^H.$$

The wage is set as a constant markup on \bar{V}^H , which is the per period value of unemployment adjusted for dividends.⁵ The markups capture the market power of the unions relative to the firms and are increasing in λ_T^H and λ_{NT}^H and decreasing in σ and μ . Note that a rise in σ or μ increases the elasticity of labor demand and profits with respect to wage changes. By symmetry,

⁵ $\bar{V}^H \equiv rV_u - \pi / \tilde{P}^H$, where r is the discount rate (see Appendix A for details).

wages are set equal across bargaining units within each sector in equilibrium, i.e., $W_h = W_T^H$ and $W_\ell = W_{NT}^H$. From eqs. (11) and (12) we obtain the relative wage as $Z^H \equiv W_{NT}^H / W_T^H$. Since all workers face the same opportunities the relative wage takes the form:

$$(13) \quad Z^H = \frac{(\mu - 1)(\lambda_{NT}^H + \sigma - 1)}{(\sigma - 1)(\lambda_T^H + \mu - 1)}.$$

The relative wage is thus fixed by preference parameters and the measure of union bargaining power. The value of unemployment net of dividends is, under our assumption of no discounting, obtained as a weighted average of the utilities in the different states; the weights are given by the employment rates, N_T^H and N_{NT}^H , and the unemployment rate, U^H :

$$(14) \quad \bar{V}^H = N_T^H \frac{W_T^H}{\tilde{P}^H} + N_{NT}^H \frac{W_{NT}^H}{\tilde{P}^H} + U^H \frac{B^H}{\tilde{P}^H}.$$

The wage equations in (11) and (12) can be expressed as an equilibrium relationship between employment in the two sectors by eliminating \bar{V}^H by means of (14) and by using the labour force identity, i.e., $1 = N_T^H + N_{NT}^H + U^H$. The resulting employment relationship takes the form:

$$(15) \quad N_T^H = \psi^H - \left(\frac{Z^H - b^H}{1 - b^H} \right) N_{NT}^H,$$

where $\psi^H < 1$ is a constant.⁶ The parameter b^H is the fixed replacement rate with unemployment benefits indexed to the average wage in the tradable sector, i.e., $B^H = b^H W_T^H$; no results would change if benefits instead were indexed to the wage in the non-tradable sector. The inequalities $b^H < Z^H$ and $b^H < 1$ must hold as participation constraints. As (15) reveals, there is a tradeoff between employment in the two sectors; indeed, this is the *WS*-line for Home as illustrated in Figure 1. The relative wage, Z^H , plays a crucial role for this tradeoff. An increase in employment in the non-tradable sector is exactly offset by a decrease in employment in the tradable sector if the relative wage is unity, i.e., $Z^H = 1$. However, an expansion of non-tradable employment is not completely offset by a decline in employment in the tradable sector if $Z^H < 1$, and it is more than

⁶ $\psi^H \equiv 1 - [\lambda_T^H / (\lambda_T^H + \mu - 1)](1 - b^H)^{-1}$.

offset if $Z^H > 1$. A rise in the market power of unions or firms, or a higher replacement rate, produces a shift to the left of the *WS*-line by reducing ψ^H .

To understand the employment tradeoff, consider an exogenous increase in the demand for labor in the non-tradable sector and assume $Z^H < 1$. This raises wage pressure and thereby crowds out employment in the tradable sector. A wage premium for workers in the tradable sector, $Z^H < 1$, moderates the increase in wage pressure since the relative probability of finding a job in the high-wage sector has decreased. The rise in employment in the non-tradable sector is in this case not completely offset by lower employment in the tradable sector.

2.5 General Equilibrium

General equilibrium with a balanced government budget implies balanced trade. We can write the trade balance expression as:

$$(16) \quad TB = K_T^H \tau^H P_h^H C_h^F - (K_T - K_T^H) \tau^F P_f^F C_f^H,$$

where the first term represents the value of exports and the second term the value of imports. Recall that $\tau^H P_h^H = P_h^F$ is the price foreigners pay for tradables produced in Home (net of value added taxes in Foreign); analogously, $\tau^F P_f^F = P_f^H$ is the price domestic consumers pay for tradables produced in Foreign (net of domestic value added taxes). From the individuals' utility maximization we obtain the aggregate domestic demand for tradables produced in Foreign as well as foreigners' aggregate demand for tradables produced in Home. By making use of the price indexes for tradables relevant for domestic and foreign consumers, we obtain the trade balance condition ($TB=0$) as:

$$(17) \quad \frac{I^F}{I^H} = \left(\frac{1+t_T^F}{1+t_T^H} \right) \frac{1+k_T^{-1}(\tau^H)^{\mu-1} p^{1-\mu}}{1+k_T(\tau^F)^{\mu-1} p^{\mu-1}} \equiv \left(\frac{1+t_T^F}{1+t_T^H} \right) f(p; \tau^H, \tau^F).$$

Straightforward calculations yield the following partial derivatives: $f_p(\cdot) < 0$, $f_{\tau^H}(\cdot) > 0$ and $f_{\tau^F}(\cdot) < 0$. A rise in p – a real depreciation – improves the trade balance, which has to be offset by a decline in foreign income relative to domestic income so as to maintain external balance. A rise in transport costs in Home, τ^H , worsens the trade balance, which requires an offsetting rise in foreign relative income. Analogous arguments hold for changes in transport costs in Foreign.

We have now derived the relationships needed to characterize the general equilibrium. It will be convenient to make use of the equations for the *WS*- and *PS*-lines. To that end we first represent the equilibrium in each country by the following equations:

$$(18) \quad N_T^j = \Psi^j - \left(\frac{Z^j - b^j}{1 - b^j} \right) N_{NT}^j \quad j=H, F$$

$$(19) \quad N_T^j = \frac{\alpha I^j}{\kappa_T W_T^j (1 + t_T^j)} \Gamma^j(p; \tau^H, \tau^F) \quad j=H, F$$

$$(20) \quad N_{NT}^j = \frac{(1 - \alpha) I^j}{\kappa_{NT} W_{NT}^j (1 + t_{NT}^j)} \quad j=H, F$$

$$(21) \quad Z^D = \frac{(\mu - 1)(\lambda_{NT}^j + \sigma - 1)}{(\sigma - 1)(\lambda_T^j + \mu - 1)} \quad j=H, F$$

where

$$(22) \quad \Gamma^H(.) \equiv \frac{k_T + (\tau^F)^{1-\mu} (\tau^H)^{-1} p^{1-\mu}}{k_T + (\tau^F)^{1-\mu} p^{1-\mu}},$$

and

$$(23) \quad \Gamma^F(.) \equiv \frac{k_T^{-1} + (\tau^H)^{1-\mu} (\tau^F)^{-1} p^{\mu-1}}{k_T^{-1} + (\tau^H)^{1-\mu} p^{\mu-1}}.$$

Eq. (18) reproduces (15) and represents the tradeoff between employment in the two sectors, i.e., the *WS*-line. Eqs. (19) and (20) represent the aggregate demand for labor in the two sectors for each country. To derive (19) for Home we use eq. (10) and the trade balance condition (17); the derivation is analogous for Foreign. The aggregate demand relationships for the tradable sectors thus incorporate the trade balance condition through $\Gamma^H(.)$ and $\Gamma^F(.)$ with the following partial derivatives: $\Gamma_p^H(.) \geq 0$, $\Gamma_{\tau^H}^H(.) < 0$, $\Gamma_{\tau^F}^H(.) > 0$, $\Gamma_p^F(.) \leq 0$, $\Gamma_{\tau^H}^F(.) > 0$, and $\Gamma_{\tau^F}^F(.) < 0$.

Eqs. (18) - (21) for Home (Foreign) yield domestic (foreign) sectoral employment and real domestic income, conditional on p . To derive the equations for relative labor demand we use (19) and (20) to obtain:

$$(24) \quad N_T^j / N_{NT}^j = A \theta^j Z^j \Gamma^j(p; \tau^H, \tau^F), \quad j=H, F.$$

$A \equiv \alpha \kappa_{NT} / (1 - \alpha) \kappa_T$ is a constant and $\theta^j \equiv (1 + t_{NT}^j) / (1 + t_T^j)$ captures *relative* tax pressure, i.e., the tax pressure in the non-tradable sector relative to the tradable sector. Eq. (24) is the positively sloped *PS*-schedule, as illustrated in Figure 1 above. The employment levels in the two domestic and the two foreign sectors, conditional on p , are thus obtained from eqs. (18) and (24). We note that taxes only affect sectoral and total employment through the *relative* tax pressure. The fact that *total* tax pressure does not matter for employment outcomes is essentially driven by two features of the model, namely the iso-elastic utility functions and the fixed replacement rates.⁷

It remains to determine the real exchange rate, i.e., the relative price between foreign and domestic tradables. This is obtained by making use of two relationships: (i) the demand for foreign tradables relative to the demand for domestic tradables, and (ii) the supply of foreign tradables relative to the supply of domestic tradables. To obtain the relative demand schedule we use the two equations in (19) together with the trade balance condition (17), recognizing that prices are set as markups on wages. The resulting relationship gives the demand for foreign tradables relative to domestic tradables as a function of the real exchange rate and trade costs, i.e.,

$$(25) \quad \frac{N_T^F}{N_T^H} = \frac{\Gamma^F(p; \tau^H, \tau^F)}{\Gamma^H(p; \tau^H, \tau^F)} f(p; \tau^H, \tau^F) p^{-1},$$

where the right-hand side is decreasing in p . A rise in p , i.e., a fall in domestic relative prices, increases the demand for domestic tradables relative to foreign tradables.

To obtain the relative supply schedule we use eqs. (18) and (24) to solve for N_T^H and N_T^F as functions of p . The outcome is the following relationship

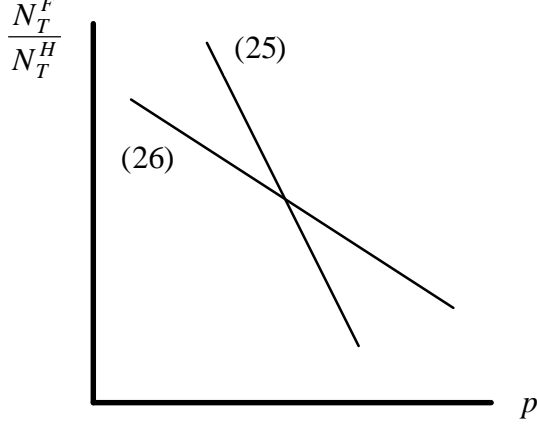
$$(26) \quad \frac{N_T^F}{N_T^H} = \frac{\psi^F}{\psi^H} \cdot \frac{1 + (Z^H - b^H)[A\theta^H Z^H \Gamma^H(p)]^{-1}(1 - b^H)^{-1}}{1 + (Z^F - b^F)[A\theta^F Z^F \Gamma^F(p)]^{-1}(1 - b^F)^{-1}},$$

where the right-hand side is non-increasing in p . Eqs. (25) and (26) are illustrated in Figure 2. It is easily verified that the slope of (25) is steeper than the slope of (26), the reason being that (26)

⁷ Many models of equilibrium unemployment have the property that labor and commodity taxes are completely borne by labor if unemployment benefits are indexed to after-tax real wages; see, for example, Pissarides (1998).

incorporates wage adjustments to changes in the real exchange rate whereas eq. (25) is a demand-side relationship that holds conditional on wages.⁸

Figure 2. The Determination of the Real Exchange Rate.



We use eqs. (25) and (26) to equate relative demand and relative supply and obtain:

$$(27) \quad Q \equiv f(p; \tau^H, \tau^F) p^{-1} - \frac{\psi^F}{\psi^H} \cdot \frac{\Gamma^H(p; \tau^H, \tau^F) + (Z^H - b^H)[A\theta^H Z^H]^{-1}(1 - b^H)^{-1}}{\Gamma^F(p; \tau^H, \tau^F) + (Z^F - b^F)[A\theta^F Z^F]^{-1}(1 - b^F)^{-1}} = 0,$$

Eq. (27) implicitly determines p ; note that $Q_p < 0$ holds. Eq. (27) together with eqs. (18) and (24) determine sectoral employment in each of the two countries along with the real exchange rate.

This completes the description of the model. We now turn to an investigation of the effects of market integration and the nature of policy spillovers.

3. The Effects of Market Integration

3.1 Market Integration and Spillover Effects on Employment

We note from eqs. (18), (24) and (27) that international policy spillovers on employment work through $\Gamma^H(\cdot)$ and $\Gamma^F(\cdot)$, which involve the trade balance condition. Changes in the real exchange rate will in general affect employment in both countries, so policies in one country that affect p will thereby also influence employment in the other country.

How does increased market integration, i.e., a reduction in trade costs, affect these spillover effects? From (22) and (23) we can conclude that there will be *no* spillover effects on employment if (i) transport costs are infinitely high or if (ii) transport costs are zero. More specifically we have:

⁸ The relative supply schedule is horizontal if product markets are completely integrated, i.e., if $\tau^j = 1, j=H, F$.

Proposition 1. (i) Infinitely high transport costs: $\tau^H \rightarrow \infty$ implies $\Gamma^H \rightarrow 1$; analogously, $\tau^F \rightarrow \infty$ implies $\Gamma^F \rightarrow 1$. (ii) Zero transport costs: $\tau^H = 1$ implies $\Gamma^H = 1$; analogously, $\tau^F = 1$ implies $\Gamma^F = 1$.

The fact that spillover effects on employment are absent when transport costs are infinitely high is obvious since there will be no trade in this case. To understand the second and less obvious part of the proposition, note that balanced trade implies that any decline in imports has to be matched by a corresponding decline in exports. An increase in p causes an increase in the domestic consumers' demand for domestic tradables and a reduction in the imports of tradables. External balance requires an offsetting fall in the foreign demand for domestic goods through a decline in foreign income relative to domestic income, as revealed by eq. (17). The resulting substitution of domestic demand for foreign demand has no effect on domestic labor demand when $\tau^H = 1$, since this implies that the prices of domestic tradables are the same at home and abroad. The purchasing power of foreign income in terms of domestically produced goods is thus the same as the purchasing power of domestic income and the reallocation of spending patterns have no real effects. With positive transport costs, however, a reallocation of spending induced by a rise in p does matter for domestic labor demand. The purchasing power of foreign income in terms of domestic tradables is lower than that of domestic income, which implies that the demand for domestic labor increases when domestic demand is substituted for foreign demand.⁹

The result that spillover effects on employment vanish as markets become completely integrated does not imply absence of policy externalities with respect to social welfare. Changes in the real exchange rate affect welfare directly, through relative prices, even if there is no effect on employment. This implies, as discussed in section 5, that policy externalities prevail even if markets are completely integrated.

From here on we will, unless stated otherwise, present results that hold for strictly positive transport costs. Results for the case with zero transport costs are easily obtained as special cases with $\Gamma^H = \Gamma^F = 1$.

⁹ Holmlund and Kolm (1997) examine the effects of environmental tax reforms in a model of a small open economy with the same labor market structure as the one adopted here. Since they assume zero trade costs, there will be no employment effects arising from changes in the real exchange rate.

3.2 Market Integration, Employment and Real Wages

We have noted that several recent papers have analyzed how economic integration would affect wage bargaining and ultimately employment. Closer integration, i.e., a reduction in trade costs, have both direct and indirect effects as domestic employment is a function of $\Gamma^H(p; \tau^H, \tau^F)$, whereas foreign employment is a function of $\Gamma^F(p; \tau^H, \tau^F)$. We first consider the effect of domestic transport costs, τ^H , on the real exchange rate.

A rise in τ^H implies that foreign consumers have to pay higher prices for tradables produced in Home relative to tradables produced in Foreign. This shifts demand towards tradables produced in Foreign. A rise in τ^H also worsens the trade balance, which requires an offsetting rise in foreign income relative to domestic income; cf. eq. (17). This effect reinforces the rise in the relative demand for foreign tradables and p tends to *increase*.

Eq. (26) incorporates wage adjustments to higher domestic transport costs and the sectoral reallocation of workers. There will be a reallocation of workers from the tradable towards the non-tradable sector in Home, whereas the opposite movements take place in Foreign. This implies that the supply of tradables produced in Home falls relative to tradables produced in Foreign. Referring to Figure 2, there will be an upward shift of the relative supply schedule, which tends to *reduce* p . However, this negative supply effect on p never dominates the positive demand effect. From inspection of (27) we can conclude:

Proposition 2. An increase in domestic trade costs (τ^H) increases p .

The effects of trade costs on employment are, however, ambiguous. We can decompose the total effect on domestic employment as follows

$$(28) \quad \frac{dN_i^H}{d\tau^j} = \frac{\partial N_i^H}{\partial \Gamma^H} \left[\frac{\partial \Gamma^H}{\partial \tau^j} + \frac{\partial \Gamma^H}{\partial p} \frac{\partial p}{\partial \tau^j} \right], \quad \begin{array}{l} i = T, NT \\ j = H, F \end{array}$$

where $\partial N_T^H / \partial \Gamma^H > 0$ and $\partial N_{NT}^H / \partial \Gamma^H < 0$. The first term in the bracket captures the direct (p -constant) effect, whereas the second term reflects the indirect effect operating through the real exchange rate. To sign (28) we need to sign the bracketed expression.

Consider the effect on N_T^H of a rise in *domestic* transport costs. The first term within brackets in (28) is negative, reflecting the fall in foreign demand for domestically produced tradables. This effect is counteracted by an induced increase in p , which raises the demand for domestic tradables. The net effect on N_T^H is ambiguous, which implies that the effect on N_{NT}^H is ambiguous as well. Hence, the effect on total employment is also ambiguous.

A *global* reduction in transport costs ($\tau^H = \tau^F = \tau$) has no effect on the real exchange rate if there is complete symmetry between the countries.¹⁰ The second term in the brackets of (28) then drops out. A symmetric reduction in τ has, however, an ambiguous effect on $\Gamma^H(\cdot)$, so it is in general impossible to sign the employment effects even in a wholly symmetric world.

We next ask how a global reduction in trade costs affects real consumer wages. There is no wage response in partial equilibrium, as is revealed by eqs. (11) and (12); this is an implication of the fact that technologies and union objective functions are iso-elastic. In general equilibrium, however, there will be real wage adjustments to economic integration. These arise for a number of reasons. The direct effect involves a fall in consumer prices due to lower import prices, and hence a rise in real wages. In addition there may be indirect effects working through the real exchange rate and the tax rate (via the government's budget restriction).¹¹ The net effect cannot be determined in general, but there is a presumption that real wages will rise as trade costs fall. This is certainly the case when countries as well as sectors are symmetric.¹² The real wage is then given as

$$(29) \quad \frac{W^j}{\tilde{P}^j} = K^* \kappa^{-1} (1 + t^j)^{-1} [1 + \tau^{1-\mu}]^{\alpha/(\mu-1)}, \quad j=H, F$$

where K^* is a constant.¹³ The tax rate is fixed by the government budget restriction once total employment is determined. The effect on the real wage of a symmetric increase in trade costs is obtained as:

¹⁰ By symmetric countries (a symmetric world) we mean that the parameters of the economies do not differ across the two countries. However, the number of firms in the non-tradable sectors are irrelevant for the aggregate outcomes and need not be restricted.

¹¹ The government's budget restriction is given as: $t_{NT}^H P_\ell^H C_{NT}^H + t_T^H (P_h^H C_h^H + P_f^H C_f^H) = (1 - N_{NT} - N_T) b W_T$. A balanced budget can always be achieved through adjustment of t_T^H or t_{NT}^H while keeping θ^H fixed.

¹² By symmetric sectors we mean $\mu = \sigma$ and $\lambda_T^j = \lambda_{NT}^j$, and thus $Z^j = 1$ for $j=H, F$.

¹³ $K^* \equiv (K_T)^{\alpha/(\mu-1)} (K_{NT})^{(1-\alpha)/(\sigma-1)}$.

$$\frac{d \ln(W^j / \tilde{P}^j)}{d\tau} = - \frac{\alpha \tau^{-\mu}}{1 + \tau^{1-\mu}} < 0, \quad j=H, F.$$

The real exchange rate remains fixed at unity and the tax rate does not change since total employment is not affected if the sectors are symmetric. The equilibrium real wage thus increases when trade costs fall.

In conclusion, we have seen that there can be no presumption that market integration would strengthen policy spillover effects concerning employment; in fact, those spillover effects vanish as markets become completely integrated. The effects of market integration on sectoral and total employment are in general ambiguous whereas the effect on real wages is likely to be positive.

3. The Effects of National and Supranational Tax Policies

We now turn to the employment effects of commodity taxation. The national policy is represented by the *relative* tax pressure in Home, i.e., $\theta^H \equiv (1 + t_{NT}^H) / (1 + t_T^H)$; recall that the *total* tax pressure has no effects on sectoral or total employment. The analysis of foreign policies is analogous and therefore omitted. We also examine the consequences of supranational (global) policies, i.e., simultaneous changes of domestic and foreign policies. The government's budget is always balanced.

Consider first a *domestic* policy that increases the relative tax pressure in Home, i.e., a policy that raises the tax on non-tradables relative to the tax on tradables. By making use of eqs. (18), (24) and (27), we can conclude:

Proposition 3. An increase in domestic relative tax pressure (θ^H) increases p and N_T^H / N_{NT}^H , but reduces N_T^F / N_{NT}^F . The effect on N_{TOT}^H is positive (negative) if $Z^H > 1$ ($Z^H < 1$); analogously, the effect on N_{TOT}^F is negative (positive) if $Z^F > 1$ ($Z^F < 1$).

To understand the effects on employment, consider first the direct effect in Home. A rise in θ^H due to a reduction in t_T^H implies lower prices of tradables, which result in expanding employment.¹⁴ The resulting decline in unemployment increases domestic wage demands, which leads to higher wages and prices and falling employment in the non-tradable sector; the economy

¹⁴ To keep the budget balanced, this reduction has to be offset by a rise in the tax on non-tradables.

thus moves along its *WS*-schedule as employment is reallocated towards the tradable sector. This process also implies that the supply of domestic tradables increases relative to the supply of foreign tradables, which has to be accompanied by a real depreciation, i.e., a rise in p . This rise in p reduces the relative demand for tradables in Foreign; there is a further upward shift of the domestic *PS*-schedule whereas the foreign *PS*-schedule shifts downwards. The resulting increase in foreign unemployment leads to wage moderation and thereby to rising employment in the foreign non-tradable sector.

The effects on *total* employment of the shifts of relative demand in both countries depend on sectoral relative wages. Total employment is not affected so long as wages are equal across sectors, i.e., $Z^H = Z^F = 1$. Total employment increases if employment is allocated towards a sector with less wage pressure, and vice versa.

The effects of a *global* tax policy ($\theta^H = \theta^F = \theta$) is more difficult to characterize. The effect on p is ambiguous, as it is generally unclear how the relative supply of domestic vs foreign tradables is affected, i.e., we cannot determine whether (26) in Figure 2 shifts up or down. The effect on p is zero in a symmetric world, in which case the relative supply of domestic vs foreign tradables is unaffected by the policy. In the symmetric case we can conclude that there will be a reallocation of employment towards the tradable sector in both countries; absent effects on p , we are left with only the *direct* effects of the policy. Summarizing the results for the symmetric case we have:

Proposition 4. A global increase in relative tax pressure ($\theta^H = \theta^F = \theta$) has no effect on p in a symmetric world. The policy increases N_T^H / N_{NT}^H and N_T^F / N_{NT}^F . The effects on N_{TOT}^H and N_{TOT}^F are positive (negative) if $Z^H = Z^F > 1$ ($Z^H = Z^F < 1$).

5. Welfare Analysis: Tax Competition vs Tax Coordination

Our normative analysis of tax policies focuses on a comparison between non-cooperative and cooperative policy behavior. The social welfare function is taken to be utilitarian and is obtained through summation of the individual indirect utility functions. Welfare for Home is then given as:

$$(30) \quad SW^H = N_T^H \frac{W_T^H}{\tilde{p}^H} + N_{NT}^H \frac{W_{NT}^H}{\tilde{p}^H} + (1 - N_T^H - N_{NT}^H) \frac{B^H}{\tilde{p}^H} + \frac{\Pi_T^H}{\tilde{p}^H} + \frac{\Pi_{NT}^H}{\tilde{p}^H}.$$

Π_T^H and Π_{NT}^H are aggregate nominal profits in the two sectors, distributed to individuals as dividends. By using the expression for profits and the government budget restriction, we can write social welfare as $SW^H = (P_h^H C_T^H + P_h^H C_T^F + P_\ell^H C_{NT}^H) / P^H$, which corresponds to the real value of the domestic aggregate production. Moreover, by using the trade balance condition we obtain:

$$(30') \quad SW^H = \frac{I^H}{\tilde{P}^H} - \frac{P_h^F C_T^F F^H}{\tilde{P}^H}.$$

The first term is the real income that captures the real value of aggregate domestic consumption, whereas the second term represents the waste due to transport costs. For obvious reasons there will be no waste when $F^H = 0$ and hence $\tau^H = 1$.

We first consider *uncoordinated* optimal tax policies in the special case with $\tau^H = 1$. With zero transport costs, the term representing waste in (30') disappears. Only the relative tax pressure influences social welfare and the relevant policy instrument is therefore θ^H .¹⁵ The specific tax rates follow residually from the optimal relative tax pressure and the government budget constraint. The optimal relative tax pressure in Home, taking policy in Foreign as given, is

$$(31) \quad \theta^H = \left(\frac{\kappa_T}{\kappa_{NT} Z^H} \left(\frac{Z^H - b^H}{1 - b^H} \right) \right) \Phi^H(.),$$

where $\Phi^H(.) \equiv [1 - (\partial p / \partial \theta^H)(\theta^H / p) \rho^H] / [1 + (\partial p / \partial \theta^H)(\theta^H / p) \rho^H \alpha (1 - \alpha)^{-1}] < 1$ and ρ^H is a constant: $\rho^H \equiv 1 / (1 + k_T p^{\mu-1})$ when transport costs in both countries are zero.¹⁶ Recall that $\theta^H > 1$ means that the non-tradable sector should be taxed heavier than the tradable sector.

Consider the three main factors on the right-hand-side of (31). The factor in the *first* parenthesis captures the incentive to restore efficiency in the output mix. If, for example, the tradable sector is relatively less competitive, i.e., $\mu < \sigma$ and thus $\kappa_T > \kappa_{NT}$, the price of tradables tends to be too high (and consumption too low) compared to the price (and consumption) of non-tradables. Higher taxes on the non-tradable sector can correct this distortion. The factor in the

¹⁵ See Appendix B for details on the maximization of social welfare.

¹⁶ Eq. (31) holds even if there are positive transport costs in Foreign, i.e., $\tau^F > 1$. We will, however, impose zero transport costs in both countries when we subsequently analyze the symmetric Nash equilibrium.

second parenthesis suggests, by contrast, that the non-tradable sector should be taxed relatively less if $Z^H < 1$, which in general is the case when $\mu < \sigma$. The reason is that aggregate employment, and hence aggregate consumption, can be increased by lowering taxes on the non-tradable sector when $Z^H < 1$. The *third* factor, given by $\Phi^H(\cdot)$, captures that an increase in θ^H increases p which in turn reduces social welfare. This effect induces the government to set lower taxes on the non-tradable sector than would have been chosen if p had been unaffected.

Eq. (31) gives the optimal relative tax pressure chosen by the domestic government, taking the foreign government's tax policy as given. We can thus view (31) as a reaction function, where θ^H is implicitly defined as a function of θ^F . Note, however, that θ^F only affects θ^H through $\Phi^H(\cdot)$, since social welfare is only affected by θ^F through p . The reaction function for the foreign government can be derived in a similar fashion, yielding θ^F as a function of θ^H .¹⁷ The solution of the two reaction functions gives the tax structure that prevails in a Nash equilibrium.

Consider now the case where two symmetric countries *coordinate* their tax policies in order to maximize total welfare. With policy coordination it is recognized that there is no scope for welfare improvements by reducing taxes to influence the real exchange rate. The optimal θ^j is hence given by (31) with $\Phi^j = 1, j=H, F$, and we can conclude:

Proposition 5. The non-tradable sector is taxed too little relative to the tradable sector in a Nash equilibrium, provided that there are no transport costs and the countries are symmetric.

It is possible to solve explicitly for the optimal tax structure. The solution is particularly simple when the sectors are symmetric in the "strong" sense that $\mu = \sigma$, $\lambda_T = \lambda_{NT}$ and $\alpha = 0.5$. Uniform taxation would be optimal under policy cooperation as long as $\mu = \sigma$ and $\lambda_T = \lambda_{NT}$. The relative tax pressure in the symmetric Nash equilibrium, θ_N , is obtained as:

$$(32) \quad \theta_N = -\frac{1}{4\mu} [1 - (16\mu^2 - 8\mu + 1)^{1/2}].$$

¹⁷ The corresponding reaction function for the foreign country is given by

$\theta^F = (\kappa_T / \kappa_{NT} Z^F)(Z^F - b^F)(1 - b^H)^{-1} \Phi^F(\cdot)$, where

$\Phi^F(\cdot) \equiv [1 + \rho^F (\partial p / \partial \theta^F) (\theta^F / p)] / [1 - (\alpha / (1 - \alpha)) \rho^F (\partial p / \partial \theta^F) (\theta^F / p)]$ and $\rho^F \equiv 1 / (1 + k_T p^{1-\mu})$ when

transport costs in both countries are zero.

It is straightforward to verify that θ_N is increasing in μ . Moreover, we have $\theta_N \in (0.5, 1)$ since $\mu \in (1, \infty)$. The lower μ is, the higher the elasticity $(\partial p / \partial \theta^H)(\theta^H / p)$. A low value of m means that the relative demand for tradables produced in Home is not very sensitive to changes in p ; sizeable changes in p are therefore required so as to maintain equilibrium in the market for tradables.

If transport costs are positive, we have to consider how the tax structure affects the amount of waste, i.e., the second term in (30'). A look at this term reveals that the direct effect of a higher θ^H , given p , is to reduce the real value of the waste. The induced increase in p will, however, also affect the real value of the waste. The net effect on the waste of a higher p is *positive* because the export of tradables increases.

The fact that the waste increases with a higher p gives an additional incentive for the domestic government to reduce θ^H ; recall that the real value of income, i.e., the first term in the welfare measure, also falls with a higher p . It is hence tempting to believe that governments in a Nash equilibrium will chose too low levels of θ^j also when there are positive transport costs. This may, however, not be the case because there will be a direct cross-country effect from the relative tax pressure when policies are coordinated. In fact, a higher θ^F tends to increase the waste in Home by increasing the volume of exports. This relationship is ignored in a Nash equilibrium but internalized with coordinated policies. In the latter case it is recognized that a lower θ^F also reduces the waste in Home, which implies incentives to lower the relative tax pressure relative to the uncoordinated equilibrium. It is not possible to analytically determine whether or not the relative tax pressure is set too low or too high in a Nash equilibrium.

We have undertaken numerical experiments in order to shed some light on the magnitude of the spillover and welfare effects (see Table 2). The model is calibrated so as to produce an unemployment rate of 10 percent for the case with zero transport costs and symmetric sectors as

Table 2. Welfare Effects of Coordinated Tax Policies.

	SW_N	SW_C	θ_N	θ_C	U_N	U_C	Z
$\tau^D = \tau^F = 1^1)$	100.00	100.03	0.952	1.000	10.00	10.00	1
$\tau^D = \tau^F = 1.5^1)$	100.00	100.00	1.006	1.007	10.00	10.00	1
$\tau^D = \tau^F = 1^2)$	100.00	100.12	0.970	1.076	9.89	10.28	0.91
$\tau^D = \tau^F = 1.5^2)$	100.00	100.00	1.124	1.137	10.24	10.28	0.91

Notes: SW_N and θ_N represent social welfare and the relative tax pressure in the Nash equilibria. SW_C and θ_C represent the cooperative cases. The superscripts refer to the set of parameter values used: 1) $\alpha = 1/3$, $s = m = 10.5$, $\lambda_T^H = \lambda_{NT}^H = \lambda_T^F = \lambda_{NT}^F = b^H = b^F = 0.5$, $k_T = 1$; 2) $\alpha = 1/3$, $\sigma = 25$, $\mu = 5.09$,

$\lambda_T^H = \lambda_{NT}^H = \lambda_T^F = \lambda_{NT}^F = b^H = b^F = 0.5$, $k_T = 1$. Social welfare is normalized to 100 in the Nash cases for the two parameter sets and the two trade cost regimes. The two parameter sets generate unemployment rates of 10 percent when there are no transportation costs and the two sectors are equally taxed. well as symmetric countries.¹⁸ It turns out that the impact on the real exchange rate of changes in θ^j is small in general, which implies that sectoral employment is not substantially affected by the changes working through the real exchange rate. With very low values of μ it is possible to obtain some sizeable action in p , but the induced effects on relative employment is quite small even in this case. As indicated by Table 2, the welfare gains from coordinated tax policies appear to be very small. These basic results are quite robust for alternative plausible parameter values.

6. Concluding Remarks

We have examined policy externalities between imperfectly competitive open economies. To that end we have developed a two-country and two-sector general equilibrium model with monopolistic competition in product markets and wage bargaining in labor markets. The equilibrium is characterized by structural unemployment and involves persistent sectoral wage differentials. We have focused on policy externalities operating through the real exchange rate. Domestic tax policies affect the real exchange rate and therefore, in general, output, employment and welfare in the foreign country.

We have derived a number of results concerning the nature of these policy spillovers, their dependence on trade costs, and the implications for optimal commodity taxation. In particular, we have shown that uncoordinated tax policies imply that the non-tradable sector is taxed too little relative to the tradable sector, the reason being that governments attempt to use commodity tax differentiation to influence the terms of trade. All of our results concerning commodity taxes translate into equivalent results regarding payroll taxes.

Although the presence of policy externalities provides a case for policy coordination, our numerical exercises suggest that the gains from coordinated tax policies are small. Of course, these simulations are merely illustrative, and the model is fairly specific, but they do give pause to proposals to impose supranational restrictions on sectoral differentiation of value added taxes.

Our analysis has taken the number of firms in each country as exogenously fixed. An interesting but nontrivial extension would be to allow for free entry and an endogenous determination of the number of product varieties. We also believe that our framework can be used

¹⁸ The parameters for the benchmark case with $\tau^j = 1$ are: $\alpha = 1/3$, $\sigma = \mu = 10.5$, $k_T = 1$ and

$\lambda_T^H = \lambda_{NT}^H = \lambda_T^F = \lambda_{NT}^F = b^H = b^F = 0.5$.

to shed light on issues in trade policy. Indeed, our measure of waste due to trade can be reinterpreted as export taxes and it is possible to derive optimal export taxes (or subsidies) with and without policy cooperation. These and other extensions are left for future work.

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Appendix A

The Labour Market¹⁹

The indirect utility function for the worker is given as $\Lambda_i^* = I_i / \tilde{P}^H$. Define V_h , V_h^* as the expected lifetime utility of a worker employed in a particular firm h , and an arbitrary firm, in the tradable sector; V_ℓ , V_ℓ^* as the expected lifetime utility of a worker employed in a particular firm, and an arbitrary firm, in the non-tradable sector; and V_u as the expected lifetime utility of an unemployed individual. Assuming an infinite time horizon we can write the value functions as:

$$\begin{aligned}
 (A1) \quad rV_h &= \frac{W_h + \pi}{\tilde{P}} + q_T(V_u - V_h), \\
 rV_\ell &= \frac{W_\ell + \pi}{\tilde{P}} + q_{NT}(V_u - V_\ell), \\
 rV_u &= \frac{B + \pi}{\tilde{P}} + a_T(V_h^* - V_u) + a_{NT}(V_\ell^* - V_u).
 \end{aligned}$$

¹⁹ The model of the labour market draws on Holmlund (1997) and Kolm (1998).

The discount rate is denoted r and q_i is the exogenous probability that a worker is separated from his job in sector i , $i=T, NT$. The probability of leaving unemployment for employment in sector i is denoted a_i .²⁰ The workers have no sector-specific skills and move between firms through a spell of unemployment. On-the-job search and job-to-job mobility are ruled out by assumption.

From (A1) we can derive expressions for the utility differences between employment and unemployment:

$$(A2) \quad \begin{aligned} V_h - V_u &= \frac{1}{q_T + r} \left(\frac{W_h + \pi}{\tilde{P}^H} - rV_u \right) \\ V_\ell - V_u &= \frac{1}{q_{NT} + r} \left(\frac{W_\ell + \pi}{\tilde{P}^H} - rV_u \right) \end{aligned}$$

rV_u is common for all workers since their labour market histories are irrelevant for the job-finding probabilities. Flow equilibrium requires equality between the inflow and outflow of workers to and from a sector. This implies $q_T N_T^H = a_T U^H$ for the tradable sector and $q_{NT} N_{NT}^H = a_{NT} U^H$ for the non-tradable sector. Wages are set equal across bargaining units in each sector in a symmetric equilibrium, i.e., $W_h = W_T^H$ and $W_\ell = W_{NT}^H$. In a symmetric equilibrium, outside opportunities are given by a probability-weighted average of the utilities in the different states. For simplicity, we focus on the case when the discount rate approaches zero. Using the flow equilibrium constraints as well as the labour force identity, $1 = N_T^H + N_{NT}^H + U^H$, we can write the flow value of unemployment, net of dividends, as:

$$(A3) \quad \bar{V}^H \equiv rV_u - \pi / \tilde{P}^H = N_T^H \frac{W_T^H}{\tilde{P}^H} + N_{NT}^H \frac{W_{NT}^H}{\tilde{P}^H} + U^H \frac{B^H}{\tilde{P}^H}.$$

Note that non-labor income, π / \tilde{P}^H , does not affect the utility difference between employment and unemployment since it is state independent.

²⁰ The value functions in (A1) are consistent with a continuous time formulation where q_i and a_i are interpreted as transition rates.

Appendix B

Maximization of Social Welfare

Social welfare is given as

$$(B1) \quad SW^H = \frac{I^H}{\tilde{P}^H} - \frac{P_h^F C_T^F F^H}{\tilde{P}^H},$$

where the general consumer price index is: $\tilde{P}^H = (\tilde{P}_T^H)^\alpha (\tilde{P}_{NT}^H)^{1-\alpha}$. By substituting the sectoral consumer prices, \tilde{P}_T^H and \tilde{P}_{NT}^H , into this index and making use of the price-setting rules as well as eqs. (20) and (21), we can write the consumer price index as

$$(B2) \quad \tilde{P}^H = I^H \cdot \left(\delta^H (\theta^H)^\alpha N_{NT}^H (\theta^H) \left[1 + k_T^{-1} (p(\theta^H, \theta^F))^{1-\mu} (\tau^F)^{1-\mu} \right]^{\alpha/(\mu-1)} \right)^{-1},$$

where $\delta^H \equiv (Z^H)^\alpha (K_T^H)^{\frac{\alpha}{\mu-1}} (K_{NT}^H)^{\frac{\alpha}{\mu-1}} \kappa_T^{-\alpha} \kappa_{NT}^\alpha (1-\alpha)^{-1}$. With zero domestic transport costs ($F^H = 0$), the social welfare function thus takes the form:

$$(B3) \quad SW^H = \delta^H (\theta^H)^\alpha N_{NT}^H (\theta^H) \left[1 + k_T^{-1} (p(\theta^H, \theta^F))^{1-\mu} (\tau^F)^{1-\mu} \right]^{\alpha/(\mu-1)}.$$

$N_{NT}^H(\theta^H)$ can be derived from (18)-(23) and is given as

$$(B4) \quad N_{NT}^H(\theta^H) = \frac{\Psi^H}{A \theta^H Z^H + (Z^H - b^H)(1 - b^H)^{-1}},$$

where $\Psi^H \equiv 1 - [\lambda_T^H / (\lambda_T^H + \mu - 1)](1 - b^H)^{-1}$. The real exchange rate is obtained as a function of relative tax pressure, $p = p(\theta^H, \theta^F)$, by means of eq. (27). Domestic social welfare is hence affected by θ^H directly as well as through p . However, recall that p does not appear as an argument in N_{NT}^H when $\tau^H = 1$. However, when $\tau^H > 1$, we have $N_{NT}^H = N_{NT}^H(\theta^H, p(\theta^H, \theta^F))$.