

Social Insurance and the Completion of the Internal Market

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Abstract

With the completion of the internal market in the EU pressures may arise to diminish social insurance budgets. In a two-country model with an (imperfectly) integrated consumer goods market it is shown that competitive member states use the social insurance tax rate as an instrument to tax consumers abroad which buy imported goods or to improve employment and competitiveness of home-based firms. As a result, there is tax competition. If the number of firms is fixed, social insurance levels will be inefficiently high. If there is free entry and exit social insurance levels could be inefficiently low. This could be prevented by coordination of social insurance policies. In addition, it is shown that reductions of trade barriers have a downward effect on the size of social insurance budgets in the long run.

Keywords: economic integration, trade, imperfect competition and increasing returns, social insurance, tax competition.

1. Introduction

In 1985 the member states of the EU decided to reduce and eliminate nearly all trade barriers for the completion of the internal market. Although at that time most import tariffs and quantity restrictions were officially abolished, there still existed a lot of non-tariff barriers, like physical frontiers (custom regulations), technical frontiers including the discrimination of foreign bids for public purchases, and fiscal frontiers. Once, these barriers were introduced to protect and stimulate industries and employment at home. With the acceptance of the Internal Market Programme a lot of these instruments are indeed eliminated, but the incentive of policymakers to protect their home industries has not necessarily diminished, however. Policymakers can even be under more pressure to take protective or stimulative measures, because competition is intensified by the internal market programme.

This could imply that EU member states will use or intensify the use of other policy instruments to improve employment and competitiveness of their industries. Except for changes in tax and investment policies countries could adapt their social insurance policies.¹ These policies are an important instrument in that respect given the size of the social insurance system,² and the fact that member states are still autonomous in that policy area. Because the huge social insurance contributions are an important labour cost factor, the labour market is highly distorted, especially in the northern member states, producers plea for lower social insurance taxes. For that reason the use of social insurance taxes as a competitive policy instrument can have a downward effect on the level of social insurance in the member states.

However, the completion of the internal market induces also some effects that (partly) offset the downward pressure on the size of the social insurance budgets. Although the increasing competition on consumer goods market have some threats, especially for the import sector, the opportunities for the export sector will improve. Besides, lower trade barriers, and a better exploitation of economies of scale could have a downward effect on prices, which stimulates production and employment. This broadens the tax base for social insurance contributions, and could have a positive effect on the benefit levels. In addition, lower prices enlarge the scope to

¹The notion social insurance covers the broad area of sickness, unemployment, disability, and old-age insurance and the like in this paper. The social benefits are most often paid by earnings-related contributions by workers and payroll taxes by employers, see Atkinson (1987) and Barr (1992) for an overview.

²In 1989 the total size of the social insurance budget equals 24.7% of GDP in the EU. (Eurostat (1991)).

increase taxes in order to tax (implicitly) foreign consumers that buy import goods more heavily. This causes an upward effect on the tax rate.

This paper analyzes these opposing effects of the internal market programme on social insurance policies. We develop a two-country model that is based on three strands in the literature: firstly, the literature on imperfect competition, increasing returns and trade (see Smith and Venables (1988) among others), secondly, the literature on labour market rigidities and the like (see Layard et al. (1991)), and thirdly, the fiscal federalism literature on interregional externalities and trade (see Arnott & Grieson (1981), Mintz & Tulkens (1986), Wilson (1987), and Wildasin (1993)).

Imperfect competition is introduced to cover the effects of the changes in trade barriers and social insurance policies on competitiveness of firms and adjustments in the industries. By the assumptions that firms set their own prices, and that there are fixed costs in production firms will obtain profits if the number of firms is fixed in the short run, and by entry and exit of firms adjustments in the industries will take place in the long term. The results will show that the distinction between the short and long term can be crucial for the results.

Labour market rigidities are introduced to represent the fact that social insurance contributions whether they are paid by workers or producers have an upward effect on labour costs and thereby on consumer prices. As a result competitiveness and trade are affected by social insurance policies. For simplicity the upward effect of worker-based social insurance contributions on wages is assumed. It can be the consequence wage bargaining between labour unions and firms.

In addition, this paper is one in the field of the literature on fiscal federalism and trade. In that literature there is in general a tax on capital or production. Fiscal policy causes externalities, because it has an upward effect on consumer prices, and thereby creating terms-of-trade effects. These effects are clearly discussed in Arnott & Grieson (1981). In some of these papers fiscal policy also affects the tax base in the other countries. Both externalities will also appear here. This paper deviates from the others, because here the role of labour taxes is examined in an economic union with integrated consumer goods markets. Moreover, we consider the effects of lower trade barriers. Until now economists did not pay much attention to these consequences of economic

integration.³ It is even argued by Wildasin (1990) and Bureau and Champsaur (1992) among others that the pressures on the social insurance systems of the EU member states are negligible, because of the low degree of labour mobility. In this paper we provide a theoretical model with a high degree of consumer goods mobility in which these pressures do exist, however.

Using this two-country model we analyze whether member states can use the social insurance tax rates as a competitive policy instrument, and its effect on the tax rates compared to the case that social insurance policies are coordinated. The paper will show that tax competition will lead to an overprovision of the level of social insurance in the short run. This is due to the dominance of the terms-of-trade effect over the comparative-advantage effect. The latter effect represents the incentive of countries to set low tax rates in order to stimulate production, employment, real wages and real profits. We also show that this result does not necessarily hold if there is free entry and exit. Entry and exit has a downward pressure on the average price level and thereby reducing the terms-of-trade effect relative to the comparative-advantage effect. In particular, if the degree of consumer substitutability between home-produced and foreign-produced goods is high, and wages are sensitive for changes in employment the comparative-advantage effect tends to dominate the positive terms-of-trade effect. Then there is underprovision of social insurance.

In the second part of the paper the effects of the internal market programme on social insurance are analyzed by a decrease in the exogenous trade barriers. It shows that the effect of further integration has a downward effect on social insurance levels in the long run whether taxes are determined coordinately or not. However, the paper does not conclude whether this leads to an increase in tax competition between the countries.

Section 2 presents the analytical framework to examine the relationship between consumer good mobility and decision making on social insurance. The social insurance model is based on Lejour & Verbon (1995), in which producers and workers both have a say in the policy decisions on social insurance. For the modelling of production and trade we use the imperfect competition model of Dixit and Stiglitz (1977), which is extended for integrated economies by Smith & Venables (1988). In the next section we analyze social insurance policy in a member state, and the Nash equilibrium is analyzed in section 4. The results of coordinated and noncoordinated social

³One of the exceptions is Persson and Tabellini (1992), who analyze the effect of imperfect capital mobility. In general only the effects of labour mobility on income redistribution (Brown and Oates (1987) and Wildasin (1991)), and on social insurance systems (Lejour and Verbon (1994)) are considered.

insurance policies are compared in section 5 to answer the question whether tax competition emerges. Section 6 examines the effects of a reduction of the trade barriers on the level social insurance. In the last section we summarize the main results and qualify the model.

2. The social insurance model and trade

This section presents, firstly, the modelling of the social insurance system and decision-making. This model is based on Verbon (1990) and Lejour & Verbon (1995). Secondly, we present, the model of imperfect competition with economies of scale and trade, based on Smith & Venables (1988).

decision making on social insurance

Social insurance contributions are an important labour cost factor for employers, because of the employer-based social insurance taxes, and the fact that workers try to shift their social insurance contributions to employers in wage negotiations. In the model we assume that the workers pay all social insurance contributions, but that a part of these contributions is passed on to employers by wage bargaining. These contributions are τw for every employed worker, where τ represents the social insurance tax rate and w the nominal gross wage. Every worker who becomes jobless, as a consequence of illness, disability or unemployment, receives a benefit, ηw , where η represents the benefit rate. The budget equation of the social insurance system in a country reads⁴

$$\tau w N = \eta w (H - N) \quad \Rightarrow \quad \eta = \tau \gamma \quad \gamma \equiv \frac{N}{H - N}$$

where N represents the number of employed workers and $H - N$ the number of beneficiaries. It is assumed that the size of the labour force, H , is exogenous, and that the employment level is endogenously determined by profit maximisation. It follows that the risk of being non-employed is endogenous on a macroeconomic level.⁵ Note that the reverse of the workers-beneficiaries ratio, $\frac{1}{\gamma}$, can be interpreted as the price of the social insurance system.

⁴As long as it is not confusing, we do not indicate that variables are country-specific. Later on, we use superscripts to refer to countries. Then only equations for country A are presented as those for country B are similar.

⁵Although the risk of being ill or disabled is partly determined by medical causes, so from an economic point of view this risk is exogenous, economic circumstances determine the risk of being non-employed, the effort of employers to attract partially disabled, and the like. For simplicity we abstract from the exogenous risk.

Workers have a chance, $\frac{N}{H}$, of being employed and a chance, $\frac{H-N}{H}$, of being non-employed. Dependent on their state of employment they receive labour or benefit income. The expected (indirect) utility of a representative worker in a country is equal to

$$E(U_l) = \frac{N}{H} U((1-\tau)\omega) + \frac{H-N}{H} U(\eta\omega) \quad \omega = w/p \quad (2)$$

It is assumed that workers fully consume their real income. ω and p represent the real wage, and the average price level, respectively. The latter variable will be defined in equation (5). $U(\cdot)$ represents the utility of real income whether one is employed or non-employed. The utility function is twice continuously differentiable, increasing, strictly concave and it satisfies the Inada conditions. These assumptions imply that workers are risk averse. If there is a positive chance to be non-employed, workers are prepared to pay social insurance taxes in order to obtain a benefit if one is non-employed. For the analysis of the second-order conditions it will be assumed that the utility function is of the CRRA type.

The income source of producers is nominal profit. Increases in production costs, like an increase in gross wages will have a negative effect on profits. They derive utility from real profits, so $U_c = U(\pi/p)$. Because the utility of workers and producers are affected by the system, both groups try to influence social insurance policy. The interests of both groups are represented in the following decision-making function

$$D = \xi H E(U_l) + n U_c \quad (3)$$

The decision-making function is a representation of the politically weighted utilities of workers and producers. The parameter ξ represents the relative political power of workers. Note, that if ξ equals 1, equation (3) represents a standard social welfare function. n indicates the number of producers.⁶

2.2 imperfect competition, increasing returns, and trade

Workers, employed or non-employed, and producers spend their whole income on consumer goods. These goods are differentiated goods, whether produced in their own or the foreign country. All

⁶Note that if the number of firms is variable due to free entry and exit, profits tend to become negligible. Then producers have no political influence. If the number of producers is fixed, profits are assumed to be positive. Then governments take into account the interests of producers.

individuals try to maximise their direct utility, $U(x)$, given their budget, $I = px$. x represents the index of differentiated consumer goods, which is equal to

$$x^A = (n^T)^{\frac{\theta-1}{\theta}} \left(\sum_{i=1}^{n^A} x_i^{A\theta} + \sum_{j=n^A+1}^{n^T} x_j^{A\theta} \right)^{\frac{1}{\theta}} \quad 0 < \theta \leq 1 \quad (4)$$

n^T denotes the total number of firms in both countries together. It is used in equation (4) for normalization. The parameter θ represents the degree of substitutability between the differentiated goods. x_j^A is the amount of consumer good j that consumed in country A with the associated producer price p_j^A .⁷ The price index reads

$$p^A = n^{T \frac{1}{b-1}} \left(\sum_{i=1}^{n^A} p_i^{A(1-b)} + \sum_{j=n^A+1}^{n^T} p_j^{A(1+t)(1-b)} \right)^{\frac{1}{1-b}} \quad b \equiv \frac{1}{1-\theta} \quad (5)$$

t denotes the trade costs to export goods, which are included in the consumer prices. We assume that the trade costs are identical for all imported consumer goods whether they are produced in country A or B. These costs consist mainly of trade-barrier costs, and transportation costs. The multiplicative term including the number of firms normalizes the price index. We obtain the demand for the home- and foreign-produced goods by solving the consumer maximisation problem. As individual income is linear in the demand functions, it is easy to aggregate them

$$x_i^A = \frac{I^A}{p^A n^T} \left(\frac{p_i^A}{p^A} \right)^{-b} \quad i = 1, \dots, n^A \quad x_j^A = \frac{I^A}{p^A n^T} \left(\frac{p_j^A(1+t)}{p^A} \right)^{-b} \quad j = n^A+1, \dots, n^T \quad (6)$$

As in most models on imperfect competition, total nominal income in a country, I , is assumed to be given. This can be motivated by using an imperfect competition model as in Blanchard and Fischer (1989), in which consumers also derive utility from holding money balances. Then, total nominal income is proportional to exogenous money supply. This relation underlies the short-cut used here.⁸

Producers of differentiated goods set prices taking into account consumer demand. It is assumed that each firm produces one variety that is sold at home and abroad. Due to market segmentation

⁷The index used in the subscripts refers to the country of origin of the consumer good.

⁸By using this short-cut instead of money in the utility function in a two-country model, we neglect the effects of changes in tax rates on aggregate nominal income within a country. These effects do exist, although the effects on nominal income in both countries together is zero. By taking into account these effects the conclusion that there is underprovision of social insurance would be strengthened.

and market power producer prices can differ in these markets. Labour is the only production factor, so all production costs are labour costs. Real profits of firm i in country A equal

$$\frac{\pi_i^A}{p^A} = \frac{p_i^A x_i^A}{p^A} + \frac{p_i^B x_i^B}{p^A} - \omega^A L_i^A \quad i = 1, \dots, n^A \quad (7)$$

In the long term profits vanishes because of entry and exit of firms. The condition, $\pi_i = 0$ determines the (endogenous) number of firms in a country. L_i^A represents the size of employment in firm i in country A. Total employment in country A is equal to

$$N^A = \sum_{i=1}^{n^A} L_i^A = n^A c_0 + c \sum_{i=1}^{n^A} (x_i^A + x_i^B) \quad (8)$$

c_0 and c represent fixed and constant marginal costs, respectively. This specification of the cost function is introduced by Krugman (1979) to allow for decreasing average costs. It is the most simple way to represent economies of scale in the model.

Producers maximise their profits by setting the optimal prices. Because there are many producers it is assumed that producers do not take the effect of their price decisions on the aggregate price level into account. Of course, producers do take the change in the demand for their goods into account. As a result it follows that

$$p_i^A = p_i^B = \frac{b}{b-1} c w \quad i = 1, \dots, n^A \quad (9)$$

Because there are many producers they have no market power. This implies that their prices do not depend on their market shares, but only on marginal costs and the mark up. So, producer prices at home and abroad are identical. The ratio $\frac{b}{b-1}$ determines monopoly profits. A higher degree of substitutability increases competition, and therefore reduces monopoly profits.

In most EU countries wages are determined by bargaining between firms and labour unions at decentralized levels (industry or firm level), see Layard et al. (1991). Wage bargaining is, however, not modelled here. Although it would give a nice underpinning of the determination of wages, the complexity of the model would increase substantially, without adding much to its main point: the

analysis of tax competition in (imperfectly) integrated consumer goods markets.⁹ For that reason we assume that the real wage is a function of employment and the tax rate as in most wage bargaining models. This assumption implies that nominal wages are fully indexed to the price level, and permits no nominal wage rigidity. Because high tax rates reduce the net wage and increase the benefits and thereby increasing the bargaining power of labour unions, it will be assumed that the relation between the real wage and the tax rate is positive. High employment levels do also improve the bargaining position of labour unions, because, firstly, labour is more scarce for firms, and it lowers the price of the social insurance system, and thereby also improving the opportunities for the workers outside the firm. Summarizing

$$\omega = \omega(\tau, N), \quad \omega_{\tau} \equiv \frac{\partial \omega}{\partial \tau} > 0, \quad \omega_N \equiv \frac{\partial \omega}{\partial N} > 0 \quad (10)$$

⁹As can be seen in Lejour and Verbon (1995), an explicit wage-bargaining structure also affects also the choice for the social insurance system. Due to the distortionary effects of taxation induced by trade, the reasons for social insurance could disappear in a simple set up. As a consequence the model has to be extended by introducing more elements that sustain a social insurance system, like a group of beneficiaries who do not participate in the labour force. The model is not extended in this way, because the increasing complexity of the model can not be justified by the additional benefits to our view.

3. The optimal social insurance tax rate in one country

In studying fiscal equilibria in case policymakers do not behave cooperatively, it is quite natural to assume that policymakers take fiscal decisions of other countries as given. Then the fiscal equilibrium is characterised as a Nash equilibrium. Secondly, it is assumed that policymakers are well informed about the economic decisions of the private sector in both countries, and take this information into account in optimising the decision-making function. In this section we analyze the optimal social insurance tax rate for one country in the short and long term, respectively. The succeeding section analyzes the Nash equilibrium. Note, that the only decision variable for policymakers is the tax rate. The benefit level follows from substitution of the tax rate and employment level in the budget restriction, equation (1).

Taking all information about the private sector into account the policymakers maximise the decision-making function, equation (3), in which the budget constraint is substituted, given the economic sub-model, $D = D(\tau, N, \omega, \pi/p)$.¹⁰ We differentiate this function with respect to the tax rate, taking into account the effects on employment, wages, and real profits.¹¹ In the long term profits vanish, and are therefore not relevant for the long-term analysis.

The effects of a change in the tax rate on the economic variables are derived by differentiating the economic sub-model with respect to all endogenous variables, see appendix 1. In the short term, an increase in country A's tax rate has an upward pressure on real wages in country A. Producers will raise their nominal prices which has an upward effect on the average price levels in country A and B. Due to the indexation of nominal wages this causes upward effects on nominal wages and prices. The increase in the general price level reduces real income, so consumer demand will be lower, and production and employment will be contracted in the union as a whole. Due to the increase in country A's tax rate the increase in producer prices of firms located in country A is relatively larger than those of the producers located in country B. As a result employment and production in country A is contracted. The decline in employment weakens the bargaining position of unions. However, the initial rise in the real wage is dominant, so real wage increases in spite of less employment. The increase in competitiveness of firms in country B causes an upward effect

¹⁰The economic sub-model consists of 16 equations in which producer prices, general price levels, demand for home and foreign goods, employment, real wages and profits or the number of firms are determined, see equation (5) to (10).

¹¹From now on, it is assumed that producers i and j are the representative producers of country A and B, respectively.

on production and employment. However, due to the loss of consumer purchase power induced by higher prices, production and employment in country B also fall, and the real wage is reduced. Profits shrink in country B as is also the case in country A.

In the long term, if there is free entry and exit, the loss in competitiveness due to higher taxes, causes a reduction in the number of firms in country A, and increases the number of firms abroad. This contracts employment at home even more. In addition, the upward effect of higher prices on the price level is very modest, because firms that produced more expensively have left the industry (country A), while firms that produce more cheaply, due to lower labour costs, enter the industry (country B). Opposed to the results in the short term it is possible that the real wage will be pushed down in country A. This depends on the size of the loss in production and employment which in its turn depends on the degree of substitution of home and foreign goods, θ , and the effect of a change in employment on the real wage, ω_N . Appendix 1 proves that if $\frac{\theta \omega_N N}{(1-\theta)\omega} > 1$ the loss in employment and its effect on the real wage is such large that the real wage will indeed be pushed down. Due to the substitution from more expensive goods produced in country A to cheaper goods produced in country B, production and employment in country B will increase. Because the upward effect of the increase in country A's tax rate on prices is modest now, opposite to the short term, the increase in production, employment, and profits is not completely offset by less consumers purchase power if the inequality above is met.

Differentiating the welfare function to the tax rate, the first-order condition reads¹²

¹²In appendix 2 the second-order condition of the maximisation problem is derived. Note, that the interests of those who profit from tariff revenues are not represented in this analysis.

$$\begin{aligned}
Z \equiv \frac{dD}{d\tau} &= \xi(U((1-\tau)\omega) - U(\eta\omega))N_\tau + \xi N \frac{d((1-\tau)\omega)}{d\tau} U'((1-\tau)\omega) \\
&+ \xi(H-N) \frac{d\eta\omega}{d\tau} U'(\eta\omega) + n \frac{d(\pi/p)}{d\tau} U'(\pi/p) = 0
\end{aligned} \tag{11}$$

$$\begin{aligned}
\frac{d((1-\tau)\omega)}{d\tau} &\equiv -\omega + (1-\tau)(\omega_\tau + \omega_N N_\tau) < 0 & N_\tau &\equiv \frac{\partial N}{\partial \tau} < 0 \\
\frac{d\eta\omega}{d\tau} &\equiv \gamma\omega + \tau\gamma_N N_\tau \omega + \eta(\omega_\tau + \omega_N N_\tau) > 0 & \gamma_N &= \frac{H}{(H-N)^2}
\end{aligned} \tag{12}$$

$$\frac{d(\pi/p)}{d\tau} \equiv \frac{\pi}{p\omega} (\omega_\tau + \omega_N N_\tau) + \frac{c\omega}{b-1} N_\tau < 0$$

The discussion of the first-order condition is split into the cases that the number of firms is fixed and that there is free entry and exit. In the first case the first-order condition is the one in equation (11). The first three effects represents the effects of a change in the tax rate on workers' expected utility. The first term represents the negative effect of an increase in the tax rate, on employment, and thereby on the probability to find a job. Because it is assumed that the net wage exceeds the benefit, this reduces expected utility. The second term represents the effect on the net wage. An increase in the tax rate, reduces the net wages, although there can be an upward effect on the gross wage. The third term represents the marginal benefits of a tax increase. It has a positive effect on the benefit, in spite of the higher price of the system due to a less favourable ratio of employed to non-employed. The last term represents the effect on profits. The increase in the tax rate affects employment and production negatively, and thereby profits although that can be a partially offsetting effect of higher real wages, and therefore higher producer prices. Appendix 1 shows that this offsetting effect is dominated by the effect of less employment, so real profits are reduced by an increase in the tax rate.

It follows that there is a trade-off between the positive effect of a change in the tax rate on the benefit level and gross wages, and the negative effects through lower net wages, and the induced change in employment for workers. Producers do face only negative effects. Given that a positive social insurance tax rate exists, this tax rate is lower than the one preferred by the workers in equilibrium. As a result, an increase in the relative political influence of workers will have an

upward effect on the tax rate, while an increase in the relative influence of producers will have the opposite effect. Because it follows from the first-order condition that in equilibrium the workers' marginal benefit of a change in the tax rate is larger than their marginal cost, an increase in the tax rate has a positive effect on the benefit level, although there is a negative employment effect. The positive relation between the tax rate and benefit level, $\frac{\partial \eta \omega}{\partial \tau} > 0$, implies that whether tax rates are lowered or raised (due to tax competition), the benefit levels are also lowered or raised, respectively. For that reason we analyze only effects on the tax rate. The qualitative effects on benefit levels are similar in spite of the opposite changes in the ratio of employed to non-employed.

In the long-term producers earn no profits, so their income is not affected by changes in the social insurance tax rate. For that reason it is assumed that only workers decide on social insurance policy in the long-term analysis, so $D = HE(U)$. Compared to the first-order condition presented in equation (11) for the short-term analysis, the effects on profits disappear. The workers' marginal benefits and costs equalize in that case. Workers' preferred tax rate is also the optimal tax rate now. The positive effects of an increase in the tax rate on the benefit and gross wages is exactly offset by the negative effects on the net wage and employment.

4. The Nash equilibrium

After having analyzed the optimal tax rate of one country given the foreign tax rate we examine the Nash equilibrium. At first, we derive the reaction of the policymakers to a change in the foreign tax rate. In the first-order condition we substitute equation (7) to eliminate real profits, and the elasticities, $e_{\tau}^N = -\frac{\partial N}{\partial \tau} \frac{\tau}{N} > 0$, and $e_{\tau}^{\omega} = \left(\frac{\partial \omega}{\partial \tau} + \frac{\partial \omega}{\partial N} \frac{\partial N}{\partial \tau} \right) \frac{\tau}{\omega} > 0$. This is shown in appendix 2. Hereby it is assumed that all firms within a country are identical. In addition, it is assumed that the elasticities are constant, and that the utility function is of the CRRA type. Real wages are eliminated by multiplying the modified first-order condition by $\omega^{\sigma-1}$. Total differentiation of equation (11) to the home and foreign tax rate, taking into account the effects on employment, profits and prices gives

$$\frac{dZ^I}{d\tau^I} d\tau^I + \frac{dZ^I}{d\tau^J} d\tau^J = 0 \quad I \neq J \quad I, J = A, B \quad (13)$$

Equation (13) describes the reaction of the policymakers in the home country to a change in the foreign tax rate. The coefficients are given by

$$\frac{dZ^I}{d\tau^H} = \frac{\partial Z^I}{\partial \tau^H} + \frac{\partial Z^I}{\partial N^I} \frac{\partial N^I}{\partial \tau^H} \quad H, I = A, B \quad (14)$$

$\frac{dZ^I}{d\tau^I}$ represents the second-order condition of maximisation of the policy function that is negative. $\frac{dZ^I}{d\tau^J}$ indicates the effect of a change of the foreign tax rate on marginal utility with respect to the home tax rate. This effect on the home country is induced by the change in trade flows, which affects employment and thereby profits (Note that $\frac{\partial Z^I}{\partial \tau^J} = 0$). These effects will be discussed in more detail.

The term $\frac{\partial Z}{\partial N}$ indicates the effect of employment on the marginal value of the policy function with respect to the tax rate. For the long-term case this effect consists of two elements. At first, an increase in employment decreases the probability of being non-employed. This implies that the negative effect of an increase in the tax rate on the net wage becomes relatively more important. As a consequence, the demand for social insurance expressed by workers will decrease. Secondly, an increase in employment decreases the price of the social insurance system. For any value of the tax rate the benefit rate will be higher. The substitution effect gives an incentive to raise the tax rate, but there is an opposed income effect. In the long-term case the substitution effect is undoubtedly dominated (see appendix 2), so $\frac{\partial Z}{\partial N} < 0$. This implies that if employment is stimulated by an increase in the foreign tax rate, workers demand less insurance.

For the short-term case the derivative also contains a third effect, the positive effects of a change in employment on real profits. Given that $1 - \sigma < 0$, this effect is positive. This last inequality is imposed, because the second-order condition of the maximisation problem has to be satisfied. A increase in real profits raises the marginal costs of the tax rate. Because an increase in the foreign tax rate lowers production, employment and real profits due to the overall loss in consumer purchase power, producers are more interested in lowering the home tax rate. Workers demand more insurance, because the increase in the foreign tax rate has a negative effect on employment in the short run. This effect can be explained in a similar way as in the case of free entry and exit.

The opposing interests of workers and producers imply that the sign of $\frac{\partial Z}{\partial N}$ is ambiguous in the short term.

From this analysis it follows that the slope of the reaction functions is not unambiguously clear in the short term. The distribution of the political power seems to be a relevant element. If the political influence of the workers is relatively large the sign of $\frac{\partial Z}{\partial N}$ will be negative, while it will be positive if the influence of the producers is relatively large. In the long term, however, $\frac{\partial Z}{\partial N}$ has undoubtedly a negative sign. The slopes of the reaction curves are negative if $\frac{\partial N^A}{\partial \tau^B} > 0$, that is to say if the condition $\frac{\theta \omega_N N}{(1-\theta) \omega} > 1$ is met. For this reason we will assume as a benchmark case that $\frac{dz^I}{d\tau^J} < 0$. Given that the reaction curves are defined for every positive value of the foreign tax rate, and assuming that both countries are identical there exists at least one Nash equilibrium. If the additional assumption is introduced that $|\frac{dz^I}{d\tau^I}| > |\frac{dz^I}{d\tau^J}|$,¹³ the Nash equilibrium is unique. In the remainder of the paper we will assume that these assumptions are satisfied.

5. The coordinated equilibrium

This section derives the coordinated equilibrium, and compares it with the Nash equilibrium to consider the question whether the member states use the social insurance tax rates strategically in the Nash equilibrium to improve employment and competitiveness of their firms. Such strategic behaviour of member states could lead to an inefficient high or low provision of social insurance.

In general noncoordinated behaviour under the Nash-equilibrium is not efficient due to the external effects of decision making. These effects are present, because member states do not take into account the beneficial or harmful effects of an improvement in their competitiveness due to a decrease of their own tax rate on the other member states. The fiscal externalities could be corrected if the countries would coordinate decision making on social insurance policy. With the term ‘coordination’ we characterise the situation that countries decide autonomously on the level of social insurance, but in a mutual action with the other countries they set tax rates such that the reciprocal external effects are effectively taking into account. Because there is no central authority in the EU, the externalities can only be internalized if countries voluntarily coordinate their

¹³In a dynamic set up this condition implies that the Nash-equilibrium is stable.

decisions. So, coordination must be ‘welfare’ improving for all countries involved. This is guaranteed if

$$dD^I = \frac{\partial D^I}{\partial \tau^I} d\tau^I + \frac{\partial D^I}{\partial \tau^J} d\tau^J > 0 \quad I \neq J \quad I, J = A, B \quad (15)$$

If this expression is evaluated at the Nash equilibrium, it follows that policymakers in country A wants to coordinate decision making in case

$$dD^A = \left[\xi (U((1-\tau)\omega) - U(\eta\omega)) \frac{\partial N^A}{\partial \tau^B} + \xi N(1-\tau^A) \frac{d\omega^A}{d\tau^B} U'((1-\tau)\omega) \right] \\ \left[+ \xi (H-N) \frac{d\eta\omega^A}{d\tau^B} U'(\eta\omega) + n \frac{d(\pi_i/p)^A}{d\tau^B} U'(\pi_i/p) \right] d\tau^B > 0 \quad (16)$$

This inequality implies that policymakers want to coordinate decision making in case the other country decreases its tax rate, if the expression in brackets has a negative sign, or, increases the tax rate, if the expression in brackets has a positive sign. For the signs of the derivatives we refer to section 3 and appendix 1.

In the short term workers and producers only want to coordinate decision-making with the other country if the foreign social insurance tax rate is lowered, because lower foreign tax rates improve employment, wages and profits. If there is no entry and exit a lower foreign tax rate has such large effect on consumer purchase power that production, employment, and real profits will increase in country A. Of course, the home country (A) gets a comparative disadvantage by lower foreign labour costs. However, the purchase-power effect dominates, such that on net, employment, real wages, production and real profits in country A increase. So, workers and producers benefit from lower foreign tax rates in the short term.

In the long term profits disappear caused by entry and exit of firms. More importantly, due to the increase in labour costs that foreign firms face, some of these firms will go out of business, while new home firms enter the market. The increase in the number of home firms improves competition on the home market substantially, and more than offsets the loss of competitiveness due to the elimination of foreign firms. As a result the upward effect of an increase in the foreign tax rate on

the average price level is very modest. Therefore it is not necessarily the case that this effect dominates. Assuming that the sufficient condition $\frac{\theta \omega_N N}{(1-\theta)\omega} > 1$ is met, the effect on the price level is dominated by the comparative-advantage effect for the home country. Then an increase in the foreign tax rate has an upward effect on employment and real wages, and consequently raises welfare.

Suppose that countries agree to coordinate their decisions by acting ‘as if’ they maximise the following policy function

$$D^I = D^I + D^J \quad I, J = A, B \quad (17)$$

It is of interest to consider in the direction of the change in the tax rates compared to the Nash equilibrium. Taking the derivative of this modified policy function for country A, and evaluating it in the Nash-equilibrium, see equation (11), it follows that

$$\begin{aligned} Z^{A'} \equiv \frac{dD^B}{d\tau^A} &= \xi(U((1-\tau)\omega) - U(\eta\omega)) \frac{\partial N^B}{\partial \tau^A} + \xi N(1-\tau^B) \frac{d\omega^B}{d\tau^A} U'((1-\tau)\omega) \\ &+ \xi(H-N) \frac{d\eta\omega^B}{d\tau^A} U'(\eta\omega) + n \frac{d(\pi_i/p)^B}{d\tau^A} U(\pi_i/p) \end{aligned} \quad (18)$$

$Z^{A'}$ represents the net externality of the tax rate that is faced by the foreign country (B). This externality has some similarities with the one in Mintz and Tulkens (1986). In their model, which deals with commodity tax competition between member states, there are two opposite external effects: one on the tax base of the other country (the benefit rate in this model), and the other one on consumer good prices (terms-of-trade externality). They prove that in an economy in which both member states produce and trade with each other the externality on the consumer goods prices is dominated.

Here these opposing external effects are hidden in the expression $\frac{\partial N^B}{\partial \tau^A}$, and consequently also in the derivatives of real wages and profits with respect to the foreign tax rate. This is due to the fact that wages are fully indexed to prices in this model. If the terms-of-trade externality dominates $\frac{\partial N^B}{\partial \tau^A} < 0$, and if this externality is dominated the inequality sign reverses. In addition, there are external effect on foreign real wages and foreign profits (in the short run) in this model. These external effects depend fully on the change in employment. Given that the effect of change on foreign employment is determined, all external effects work in the same direction.

Due to the large effect of an increase in the tax rate on the average price levels in the short run, the terms-of-trade externality dominates. This has a negative effect on production, employment, and real wages in the foreign country. Because of less demand, real profits shrink. Then equation (18) has clearly a negative sign. So, the tax rates are inefficiently high in the Nash equilibrium compared to the situation that countries coordinate social insurance policies.

In the long term the effects of the terms-of-trade externality are reduced, due to adjustments in the number of firms. More expensive firms, located in country A, leave the industry, while cheaper producing firms enter the industry in country B. As a result the upward effect of an increase in the tax rate on the average price levels is reduced substantially. Given that the degree of substitution between home-produced and foreign-produced goods is large enough, and that wages are relatively sensitive to changes in employment, the externality on the tax base tends to dominate. Countries set the tax rate strategically low to obtain a comparative advantage of their firms in order to stimulate production, and employment in their own country, if $(b-1)\omega_N N > \omega$. An increase in employment has also a positive effect on the real wage. It follows that the sign of equation (18) is positive. Then the levels of social insurance are inefficiently low in the Nash equilibrium compared to the coordinated equilibrium.

Normally, tax competition is defined as the case where countries compete to attract the mobile good with the use of the tax rate on that good, see Wildasin (1988). Interestingly, in this case the competitive instrument is the social insurance tax rate, a tax rate on an immobile good. The relation between the tax rate and the mobile good is indirect. The result is based on the two-sided link between consumer good markets and distorted labour markets. In the first place the size of the trade flows determines partly production and employment, and consequently the tax base of the social insurance system. In the second place, the tax rate affects consumer good prices induced by changes in the labour costs, and therefore trade flows. Consequently, also in this case a change in the tax rate distorts the tax base, although the effect is indirect through the change in trade flows.¹⁴

This result sheds also some other light on the well-known conclusion in the literature that countries have to tax their immobile factors in an integrated market. This analysis suggest that there are may be upper limits on labour income tax rates in the long run, because of the linkage between the

¹⁴In Bucovetsky and Wilson (1991) and Lejour and Verbon (1995) the same sort of result is derived. In both papers a tax on labour income is used by the jurisdictions as an instrument to attract mobile capital.

distorted labour market and the consumer goods market. Of course, direct taxes on profits or capital have also strong negative effects on the tax base. The last decade these tax rates, especially corporate tax rates, are indeed substantially reduced in Europe. However, given the size of the social insurance budget, and distortions on the labour market, a decrease in capital income and profit taxes can be less effective in stimulating the own industries and employment than a decrease in labour income taxes, like the social insurance tax if the comparative-advantage effect of lower social insurance contributions dominates the purchase-power effect. Glancing at policy plans and economic advices in most EU member states it seems that this is indeed the case. So, a downward adaption of taxes on the immobile factor labour could be an important competitive policy instrument for the member states in the next decades. The analysis also suggests that the effectiveness of this measure critically depends on the flexibility (no barriers to enter the market) and the degree of competition of the consumer goods market.

6. A reduction of trade barriers

In 1985 the member states of the European Union agreed to take about 300 measures to complete the internal market in 1993. These measures consist of the abolition of border control and administrative barriers, convergence of technical standards, and nondiscrimination of foreign bids for public purchases in the Union.¹⁵ It is expected that the benefits of these measures will spread out over all member states, although Neven (1990) argues that the effects for the northern member states may be modest. Besides, in Bliss & Braga de Macedo (1990) it is argued that the new southern member states can obtain the benefits only after an adjustment period.

This section analyzes the effects of the completion of the internal market on social insurance by reducing the trade barrier costs, t . It is assumed that both countries are identical, so the reduction in trade barrier costs has similar effects in both countries. For simplicity the analysis is carried out for only one country. The assumption that $|\frac{dz^i}{d\tau^i}| > |\frac{dz^j}{d\tau^j}|$ guarantees that the results for the one-country analysis carry over to the Nash equilibrium. In this section it is also assumed that the elasticities are constant and that the utility function is of the CRRA type. Given these assumptions The first-order condition is differentiated with respect to the tax rate and trade barrier costs in both countries taking into account the effects on employment, real wages and real profits.

¹⁵More detailed information on these measures and the costs of not removing these barriers is given in Emerson et al. (1988).

$$\frac{dZ}{d\tau} d\tau + \frac{dZ}{dt} dt = 0 \quad (19)$$

$$\frac{dZ}{dt} = \frac{\partial Z}{\partial N} \frac{\partial N}{\partial t} \quad (20)$$

$\frac{dZ}{dt}$ represents the total effect of a change in trade barriers on the marginal utility with respect to the tax rate. As in the previous section this effect is induced by the change in the trade flows, which affects employment and thereby real wages and profits.¹⁶ Lower trade barriers have a downward effect on prices, and stimulate trade and production in both countries. As a consequence employment levels and real wages are pushed up. In the short term real profits do also increase, while in the long term new firms enter the market. As explained in section 4 risk-averse workers prefer less insurance due to the increase in employment, and consequently a lower tax rate in the long term. In that case lower trade barriers will have a downward effect on the social insurance tax rates. From the first-order condition it follows that not only the tax rates, but that also the benefit levels are reduced.

The effects in the short term are not unambiguously clear. Lower trade barriers stimulate production, and thereby also profits in our model. As a result the marginal costs of taxes for producers decrease, so there is less opposition against social insurance. However, workers do demand less insurance at the margin. So, workers and producers have different preferences about the direction of the change of the tax rate, as can be seen in the ambiguity of $\frac{\partial Z}{\partial N}$ in the short run. Note that this ambiguity also follows from the assumption that producers have no market power, see equation (9). This assumption is made for the sake of simplicity. If firms would have market power, their mark up would depend on their market shares at home and abroad. Then it could follow that a reduction in tariffs on both markets would have a negative effect on profits because the marginal loss at the home market could dominate the marginal benefits at the foreign markets. The simulation results of Smith and Venables (1988) do suggest that profits are reduced by the internal market programme. In that case it is in the interest of both workers and producers to reduce the social insurance tax rate. Given this stage of integration in the EU it is expected that the process of integration will have a downward pressure on the social insurance system. However, in this model producers have no market power, so workers and producers react differently to the

¹⁶The first-order derivatives of the economic variables with respect to the trade barriers can be derived in a similar way as is done in appendix 1 with respect to the tax rate. The second-order derivatives are written out in appendix 2.

completion of the internal market. In that case the political power of both groups becomes a determining factor in the decision-making process.

It can also be shown that a liberalization of consumer goods market has a downward effect on social insurance if these policies are coordinated. If the first-order condition, equation (11), is combined with the effect on foreign welfare, equation (18), and constant elasticities are assumed, it is easy to show that an increase in employment due to lower trade barriers reduces the marginal welfare of social insurance taxes for both countries in the long term. Then lower trade barriers stimulate employment, and affect the level of social insurance negatively. In the short term, the increase in production and employment has a positive effect on profits, and reduce therefore the marginal costs of taxation. The workers want to reduce the social insurance tax rate, so the net effect is not clear in the short run.

Whether social insurance policies are coordinated or not, the qualitative effects of lower trade barriers are similar. However, these results does not say anything about a change in the degree of policy competition in the area of social insurance due to more integrated consumer markets. This effect could be analyzed by differentiating the marginal welfare externality with respect to the trade barriers. An increase in the marginal welfare externality due to lower trade barriers would suggest that tax competition increases (decreases) if the marginal externality has a positive (negative) sign. However, the effect on the marginal welfare externality is ambiguous. So, it is not clear whether policy competition is increased or not. Therefore the model has to be simplified, as is done in Lejour (1995).

7. Conclusions

This paper analyzes the effects of the completion of the internal market on the social insurance policies in the EU member states. The analysis is carried out by combining three strands in the literature; the imperfect competition models with increasing returns and trade, the two-country fiscal federalism models, and the literature on labour market distortions. It is assumed that social insurance benefits are financed by workers-based taxes, which have an upward pressure on labour costs due to tax shifting from workers to employers. The existence of social insurance systems then affects employment and competitiveness, because labour costs are reflected in consumer good prices that are set by producers. The decisions on the social insurance tax rate levels are a

compromise between the preferences of workers which benefit from the system on average and producers which are net contributors.

Our two-country model shows that member states can use their social insurance tax rate as an instrument to tax consumers abroad that buy imported goods or to improve employment and competitiveness of their firms in an integrated consumer goods market. This leads to over- or underprovision of social insurance compared to the case that social insurance policies are coordinated in the Union. The model shows that the terms-of-trade effect dominates in the short run. Then countries set inefficiently high tax rates in order to tax foreign consumers. In the long run the terms-of-trade effect is reduced by entry and exit of firms. If the degree of substitutability between home- and foreign produced goods is large enough, and real wages are sensitive for changes in employment, the terms-of-trade effect is dominated. Then countries set inefficiently low tax rates in order to obtain comparative advantages. If the two mentioned conditions are met, the effects in the short run and in the long run can differ substantially.

Because the completion of the internal market reduces the number of instruments of the member states to favour their own industries and the size of the distortions on the labour markets, it can be expected that the use of social insurance taxes as an instrument to obtain comparative advantages will be increased. On the other hand, the opportunities to tax consumers abroad are also increased. From both perspectives the prevailing opinion that social insurance policies are purely a national issue has to be corrected. Although harmonisation is not necessary, coordination of decision making seems to be fruitful in spite of the fact that labour is hardly mobile in the EU if the incentives to obtain comparative advantages and to tax consumers abroad do not offset each other.

In the second part of the paper the effects of the reduction and elimination of trade barriers are analyzed. The implementation of the internal market programme has a negative effect on the social insurance budget in the long term. Due to the reduction in trade barriers employment, real wages, and production will increase. These effects reduce the need for social insurance, and have therefore a negative effect on the social insurance tax rates and benefit levels in the EU.

The conclusions of this paper suggest that social insurance policies are used as a competitive instrument in the EU. It is not clear whether these policies are more frequently used as an instrument for policy competition. The choice for the social insurance tax rate as an instrument for policy competition due to a restriction of other policy instruments as consequence of the internal

market programme is not modelled here. Therefore models are needed that endogenise the choice for policy instruments. These models could analyze the shift between policy instruments into more depth, see also Lejour (1995).

In this model attention was paid to real rigidities on the labour market. According to Layard. et al. (1991) these are substantial in the EU member states. Nominal rigidities on the labour market are ignored in this analysis. With fixed nominal wages there are no price effects on nominal wages as is the case in this model. This issue is worked out in Lejour (1994). The qualitative results suggest that overprovision result is weakened. However, it was the main aim of this paper to see whether there is tax competition in the field of social insurance policy even if labour is hardly mobile. The answer to that question is positive. This paper does not give a full answer to the question whether there is under- or overprovision. We need quantitative results of the real and nominal rigidities on the labour market, and the importance of the terms-of-trade effect relative to the comparative-advantage effect in order to determine the net effect of tax competition on the level of social insurance. Although this effect is not clear, the qualitative results of our model suggest that potentially these effects could be important.

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Appendix 1: The derivatives with respect to the social insurance tax rate

This appendix derives the derivatives of economic variables, like employment, profits (or the number of firms), and real wages with respect to the tax rate in country A. It presents the necessary steps to derive the signs of these derivatives. The derivatives with respect to country B's tax rate can be derived in a similar way, but are not presented here. It is assumed throughout the whole appendix that countries are identical. In the derivations we often use the derivatives of the market shares for convenience. The market shares of firm i in country A and B, s_i^A and s_i^B , are defined as

$$s_i^A = \frac{p_i^A x_i^A}{\sum_i p_i^A x_i^A + \sum_j p_j^A (1+t_j^A) x_j^A} = \frac{1}{n^T} \left(\frac{p_i^A}{p^A} \right)^{1-b} \quad s_{n^{B,i}}^B = \frac{1}{n^T} \left(\frac{(1+t) p_{n^{B,i}}^B}{p^B} \right)^{1-b} \quad i = 1, \dots, n^A \quad (A1.1)$$

The expression after the last equality sign is derived by substituting the demand functions. By definition $\sum_i s_i^A + \sum_j s_j^A = 1$, from which market shares of foreign producers can be derived.

At first, the derivatives of the price index, the market shares, and the consumer good prices are derived, see equation (5), (A1.1), and (9). Superscripts are omitted if the derivatives with respect to τ^A are similar for both countries. It is assumed that producers a and b are representative in country A and B, respectively.

$$\frac{\partial p_a^A}{\partial \tau^A} = \frac{\partial p_a^B}{\partial \tau^A} = p_a^A \left(\frac{1}{\omega^A} \frac{\partial \omega^A}{\partial \tau^A} + \frac{1}{p^A} \frac{\partial p^A}{\partial \tau^A} \right) \quad (A1.2)$$

$$\frac{\partial p_b^A}{\partial \tau^A} = \frac{\partial p_b^B}{\partial \tau^A} = p_b^B \left(\frac{1}{\omega^B} \frac{\partial \omega^B}{\partial \tau^A} + \frac{1}{p^B} \frac{\partial p^B}{\partial \tau^B} \right) \quad (A1.3)$$

$$\frac{\partial p}{\partial \tau^A} = p \left(\frac{1}{(b-1)n^T} \frac{\partial n^T}{\partial \tau^A} + \frac{s_a}{1-b} \frac{\partial n^A}{\partial \tau^A} + \frac{s_b}{1-b} \frac{\partial n^B}{\partial \tau^A} + \frac{n^A s_a}{p_a} \frac{\partial p_a}{\partial \tau^A} + \frac{n^B s_b}{p_b} \frac{\partial p_b}{\partial \tau^A} \right) \quad (A1.4)$$

$$\frac{\partial s_a}{\partial \tau^A} = -\frac{s_a}{n^T} \frac{\partial n^T}{\partial \tau^A} + (b-1) s_a \left(\frac{\partial p}{p \partial \tau^A} - \frac{\partial p_a}{p_a \partial \tau^A} \right) \quad (A1.5)$$

$$\frac{\partial n^A}{\partial \tau^A} s_a + n^A \frac{\partial s_a}{\partial \tau^A} + \frac{\partial n^B}{\partial \tau^A} s_b + n^B \frac{\partial s_b}{\partial \tau^A} = 0 \quad (A1.6)$$

With the help of these equations we derive a relation between the derivatives of the home and foreign real wage with respect to the tax rate. The following substitutions are carried out: firstly, substitute (A1.2) in (A1.5) and do the same for the derivative $\frac{\partial p}{\partial \tau^A}$, secondly, substitute the derivatives of the market shares in (A1.6) for country A and B, and, thirdly, add up equation (A1.6) for both countries. As a result it follows that

$$\omega_\tau + \omega_N \left(\frac{\partial N^A}{\partial \tau^A} + \frac{\partial N^B}{\partial \tau^A} \right) = 0 \quad (A1.7)$$

This relation holds whether the number of firms is endogenous or not. Now, we discuss, firstly, the case that the number of firms is fixed, so $\frac{\partial n^A}{\partial \tau^A} = \frac{\partial n^B}{\partial \tau^A} = 0$. Then the derivatives of employment within a firm with respect to the tax rate becomes, see equation (8)

$$\frac{\partial L_a^A}{\partial \tau^A} = c \frac{\partial x_a^A}{\partial \tau^A} + c \frac{\partial x_a^B}{\partial \tau^A} = c x_a^A \left(\frac{1}{s_a^A} \frac{\partial s_a^A}{\partial \tau^A} - \frac{1}{p_a^A} \frac{\partial p_a^A}{\partial \tau^A} \right) + c x_a^B \left(\frac{1}{s_a^B} \frac{\partial s_a^B}{\partial \tau^A} - \frac{1}{p_a^B} \frac{\partial p_a^B}{\partial \tau^A} \right) < 0 \quad (\text{A1.8})$$

The derivative of foreign employment with respect to the tax rate has a similar structure. Combining both derivatives and multiplying with n we get

$$\frac{\partial N^A}{\partial \tau^A} + \frac{\partial N^B}{\partial \tau^A} = -(N^A - n^A c_0) \left(\frac{1}{p^A} \frac{\partial p^A}{\partial \tau} + \frac{1}{p^B} \frac{\partial p^B}{\partial \tau} \right) = -\frac{\omega_\tau}{\omega_N} < 0 \quad (\text{A1.9})$$

The last equality in equation (A1.9) follows from (A1.7). So, it follows that the average price level in both countries together will increase due to higher tax rates. Combining equation (A1.9) with equation (A1.4) in which equation (A1.2) and (A1.3) are substituted, we can express both derivatives of the average price levels as a function of the derivative of the foreign real wage. These derivatives are substituted in the derivative of foreign employment, $\frac{\partial N^B}{\partial \tau^A}$. Then this derivative is expressed in derivatives of foreign real wage with respect to the tax rate. Using this it follows that

$$\frac{\partial \omega^B}{\partial \tau^A} \left(1 + \frac{\omega_N N}{\omega} \left(b + \frac{(s_a^A - s_b^A)}{2s_b^A} \right) + \frac{\omega_N}{\omega} \frac{(b-1) c I (s_a^A - s_b^A)}{(1+t) p_b^B 2} \right) = -\frac{\omega_\tau}{2} < 0 \quad (\text{A1.10})$$

So, $\frac{\partial \omega^B}{\partial \tau^A}, \frac{\partial N^B}{\partial \tau^A} < 0$. Using equation (A1.7) it follows that $\frac{\partial \omega^A}{\partial \tau^A} > 0$. The derivative of home employment with respect to the tax rate can be derived in a similar way as foreign employment. As a result we get $\frac{\partial N^A}{\partial \tau^A} < 0$. From the derivatives of real wages with respect to the tax rate it follows quite easily that $\frac{\partial s_a}{\partial \tau^A} > 0$, and $\frac{\partial s_b}{\partial \tau^A} < 0$. Before the derivatives of the profits are determined, the profit function is rewritten using the expressions for prices and employment, to express real profits as a function of real wages and employment, see equation (7).

$$\frac{\pi_a}{p^A} = \frac{\omega}{(b-1)n^A} (N^A - n^A b c_0) > 0 \quad (\text{A1.11})$$

Because an increase in the tax rate raises the real wage, but lowers employment in country A, the effect on profits is not immediately clear. However, using the relation between the derivatives of real wages and employment (not showed here) it follows that the derivative of employment dominates such that $\frac{\partial(\pi_a/p^A)}{\partial \tau^A} < 0$. The increase in the tax rate has a negative effect on foreign real wages and foreign employment, so the effect on foreign real profits is also negative.

Now, we consider the case that there is free entry and exit. Then profits are zero, and production and employment per firm are fixed. So, it follows that the sign of equation (A1.8) is zero. This is valid for both countries. After substitution of the derivatives for market shares and prices, equation (A1.2), and (A1.5) in (A1.8) for both countries, and adding up the resulting two expressions it follows that the derivatives of the average prices can be expressed as a function of the change in the total number of firms.

$$\frac{1}{p^A} \frac{\partial p^A}{\partial \tau} + \frac{1}{p^B} \frac{\partial p^B}{\partial \tau} = - \frac{2}{n^T} \frac{\partial n^T}{\partial \tau} \quad (\text{A1.12})$$

In addition we know from equation (A1.7) that the change in the real wages of both countries together is zero. Moreover, the change in employment of both countries together depends solely on entry and exit of firms. Using this in equation (A1.7) it follows that

$$\frac{\partial n^T}{\partial \tau^A} = - \frac{n^A \omega_\tau}{\omega_N N} < 0 \quad (\text{A1.13})$$

Substituting this result in equation (A1.12), it shows that the average price level in both countries together increases due to higher tax rates.

The derivative of the number of home firms can be simply determined by using equation (A1.6) and substituting, $\frac{\partial n^T}{\partial \tau^A} = \frac{\partial n^A}{\partial \tau^A} + \frac{\partial n^B}{\partial \tau^A}$, and the derivatives of the market shares. As a result

$$\frac{\partial n^A}{\partial \tau^A} = \frac{n^A}{n^T} \frac{\partial n^T}{\partial \tau^A} + (b-1) \frac{n^A}{\omega^A} \frac{\partial \omega^A}{\partial \tau^A} + \frac{(b-1)n^A s_b^A}{s_a^A - s_b^A} \left(\frac{1}{p^B} \frac{\partial p^B}{\partial \tau^A} - \frac{1}{p^A} \frac{\partial p^A}{\partial \tau^A} \right) \quad (\text{A1.14})$$

This derivative depends on the derivatives of the average price levels which are eliminated in the following way. Substitute equation (A1.12) for $\frac{1}{p^B} \frac{\partial p^B}{\partial \tau^A}$ in equation (A1.8) that is zero in the long run. Then both derivatives of the average prices can be expressed as derivatives of wages and the total number of firms. By substituting these expressions for the derivatives of the prices in equation (A1.14), the derivative of the number of firms in country A only depends on the derivatives of the real wages in the own country, and the total number of firms. The latter derivative is already determined in equation (A1.13). Knowing that $\frac{\partial \omega^A}{\partial \tau^A} = \omega_\tau + \omega_N L_a^A \frac{\partial n^A}{\partial \tau^A}$ and substituting the modified equation (A1.14) in this equation it follows that

$$\frac{\partial \omega^A}{\partial \tau^A} \left(1 - \frac{\omega_N N (b-1)}{\omega} \left(1 + \frac{2 b s_b^A \left(s_a^A + \frac{s_b^A}{1+t} \right)}{(s_a^A - s_b^A) \left(s_a^A + \frac{b s_b^A}{1+t} \right)} \right) \right) = \frac{\omega_\tau}{2} > 0 \quad (\text{A1.15})$$

Equation (A1.15) shows that the sign of $\frac{\partial \omega^A}{\partial \tau^A}$ is not clear due to the ambiguity in the sign of the term in brackets. Assuming that $\omega_N N (b-1) \geq \omega$ is a sufficient condition to guarantee that $\frac{\partial \omega^A}{\partial \tau^A}$ has a negative sign

as long as $s_a^A - s_a^B > 0$. The latter inequality is always satisfied if $t > 0$. Consequently, $\frac{\partial \omega^B}{\partial \tau^A}, \frac{\partial N^B}{\partial \tau^A}, \frac{\partial n^B}{\partial \tau^A} > 0$, and $\frac{\partial N^A}{\partial \tau^A}, \frac{\partial n^A}{\partial \tau^A} < 0$.

Appendix 2: The second-order derivatives

This appendix presents the second-order derivatives of the decision-making function. The analysis is simplified by introducing the elasticities, $e_\tau^N = -\frac{\partial N}{\partial \tau} \frac{\tau}{N} > 0$, and $e_\tau^\omega = \frac{d\omega}{d\tau} \frac{\tau}{\omega} = \left(\frac{\partial \omega}{\partial \tau} + \frac{\partial \omega}{\partial N} \frac{\partial N}{\partial \tau} \right) \frac{\tau}{\omega} > 0$ in the first-order condition, equation (11). It follows that

$$\begin{aligned} \tau Z = & -\xi [U((1-\tau)\omega) - U(\eta\omega)] N e_\tau^N + \xi N \left(\frac{-\tau}{1-\tau} + e_\tau^\omega \right) (1-\tau)\omega U'((1-\tau)\omega) + \\ & \xi (H-N) \left(1 - \frac{H}{H-N} e_\tau^N + e_\tau^\omega \right) \eta \omega U'(\eta\omega) + n \frac{\pi}{\omega p} \left(e_\tau^\omega - e_\tau^N \frac{N}{N - bn c_0} \right) U'(\pi/p) = 0 \end{aligned} \quad (\text{A2.1})$$

Moreover, it is assumed that the elasticities are constant, and that the utility function is of the CRRA type. $\sigma_x = -\frac{x U''(x)}{U'(x)}$ is defined as the elasticity of marginal utility to income. Firstly, it is assumed that entry and exit is endogenous. This implies that the second term on the second row of equation (A2.1) is not relevant. Real wages are eliminated from equation (A2.1) by multiplying with $\omega^{\sigma-1}$. Differentiation with respect to the tax rate gives

$$\begin{aligned} \tau \frac{dZ}{d\tau} = & \frac{\gamma N e_\tau^N}{1-\tau} \eta^{-\sigma} - N(1-\tau)^{-(\sigma+1)} - \frac{\partial N}{\partial \tau} \frac{H}{N} \left(1 - \frac{H}{H-N} e_\tau^N + e_\tau^\omega \right) \eta^{1-\sigma} + \\ & (1-\sigma) \frac{(H-N)}{1-\tau} \left(\gamma + \tau \frac{H}{(H-N)^2} \frac{\partial N}{\partial \tau} \right) \left(1 - \frac{H}{H-N} e_\tau^N + e_\tau^\omega \right) \eta^{-\sigma} \end{aligned} \quad (\text{A2.2})$$

The expression in equation (A2.2) is derived by substituting the first-order condition times $\frac{N_\tau}{N} - \frac{1-\sigma}{1-\tau}$ in the second-order derivative. Note that the sign of equation (A2.2) has to be negative to satisfy the second-order condition of the maximisation problem. This is more likely the larger is the degree of risk aversion. Probably it has to be larger than one. In addition we want to know the effects of a change in employment on the first-order condition. Differentiating equation (A2.1) with respect to employment gives

$$\tau \frac{\partial Z}{\partial N} = -\frac{H}{N} \left(1 - \frac{H}{H-N} e_\tau^N + e_\tau^\omega \right) \eta^{1-\sigma} < 0 \quad (\text{A2.3})$$

This expression follows after substituting the first-order condition times $\frac{1}{N}$ in the second-order derivative. The sign of equation (A2.3) is always negative.

If profits do exist (the short term analysis) substitution of the first-order condition times $\frac{1}{N}$ in equation (A2.3) gives the expression in equation (A2.3) added by the positive term $-\frac{H_c}{N} \frac{\pi}{p} (e_\tau^\pi - e_\tau^p) U'(\pi/p)$. In addition, $\frac{\partial Z}{\partial N}$ is extended with two other positive terms that pertains the derivatives of the real profits. Due to

these three positive terms the sign of equation (A2.3) is ambiguous. In the short run it cannot be excluded that $\frac{\partial Z}{\partial N} > 0$.

The second-order condition of the maximisation problem consists now (if the number of firms is fixed) of equation (A2.2) added with the mentioned positive terms times the derivative of employment with respect to the tax rate which is negative. As a result, if the second-order condition of the maximisation problem in the long-term is satisfied, it is also satisfied in the short-term case. So, equation (A2.2) has a negative sign.