WORKING PAPERS
4/2002

An Equilibrium Analysis of International Fiscal Transfers as Insurance against Asymmetric Shocks

Liliane Karlinger

Vienna, February 2002

FEDERAL MINISTRY
OF FINANCE

An Equilibrium Analysis of International Fiscal Transfers as Insurance against Asymmetric Shocks

Liliane Karlinger

Vienna, February 2002

Impressum:

Published, edited and printed by:
Federal Ministry of Finance
Himmelpfortgasse 4-8
A-1015 Vienna
Internet: www.bmf.gv.at

Comments and suggestions should be directed to:
Abt. III/13, Dr. Kurt Bayer
Tel.: +43-1-514 33/1560
email: kurt.bayer@bmf.gv.at

CONTENTS

VORWORT

FORUM FINANZ, die Informationsplattform des Bundesministeriums für Finanzen, hat im Jahr 2001 bereits zum dritten Male einen Aufsatzwettbewerb für junge ÖkonomInnen ausgeschrieben. StudentInnen und JungökonomInnen sollen dadurch mit BMF-spezifischen Themen vertraut gemacht und an anwendungs- und politik-orientierte Analysen gewöhnt werden. Das Bundesministerium für Finanzen erwartet sich durch diese Arbeiten auch Inputs in die eigene Arbeit.

Die besten Arbeiten werden jedes Jahr von einer hochrangigen Jury bewertet und mit Geldpreisen prämiert. Im Jahr 2001 hat die Jury neben anderen die Arbeit von Frau Liliane Karlinger zum Thema „An Equilibrium Analysis of International Fiscal Transfers as Insurance against Asymmetric Shocks“ ausgewählt. Der Preis wurde vom Herrn Bundesminister für Finanzen persönlich an Frau Liliane Karlinger überreicht.

Abstract

A static two-country general equilibrium model with uncertainty about labor productivity is developed to analyze potential welfare gains from fiscal cooperation under ex-ante heterogeneity of agents. The fiscal transfer scheme under consideration is a flat uniform labor income tax redistributed as equal lump-sum transfers. Simulations of the bargaining solution show that fiscal cooperation generally reduces output and employment, but can be desingned to provide Pareto improvements on the competitive market equilibrium through interpersonal risk-pooling.
JEL classification numbers: H21, H87, E61

1 Introduction

It has often been pointed out that the European Monetary Union (EMU) limits national policymakers in their ability to actively stabilize output fluctuations in their economies induced by macroeconomic shocks. In particular, EMU implies the centralization of monetary policy and the loss of the exchange rate instrument as a shock absorber. Loss of the latter is potentially harmful if the countries that joined the EMU do not constitute an „Optimal Currency Area“. Countries are less likely to form an optimal currency area if macroeconomic shocks are predominantly asymmetric, nominal rigidities prevail in the short run, labor mobility is low and automatic stabilization from federal taxes and government spending is low.

Empirical analyses suggest that most of these characteristics do apply to the Euro countries (cf. *Bayoumi/Eichengreen* [3], *Caporale* [4], C*hristodoulakis et al.* [5], *Obstfeld/Peri* [14], *Gros* [11]). EMU, therefore, is likely to shoulder the national fiscal authorities with a higher adjustment burden. However, the scope for national fiscal policies to stabilize business cycle fluctuations will be limited in the EMU due to the provisions of the Maastricht Treaty and the Growth and Stability Pact.

As a result, several authors discussed the implementation of some kind of European Fiscal Transfer System (EFTS) designed to act as a substitute for the shock-absorbing capacity of exchange rate realignments and to insure the countries concerned against asymmetric shocks (e.g. *Italianer/Vanheukelen* [13], *van Aarle* [1], *Fatás* [10], *von Hagen/Hammond* [12], *Bajo-Rubio/Díaz-Roldán* [2]).

The present paper intends to analyze the desirability of such an insurance scheme in a general equilibrium framework. More precisely, we ask the question whether a simple tax-and-transfer scheme providing insurance to production economies that face the risk of stochastic productivity shocks would be welfare improving. The structural characteristics of this question are related to some of the literature on income inequality and redistributive taxation under uncertainty, like *Diamond/Helms/Mirrlees* [6], *Eaton/Rosen* [9], *Varian* [15], *or Easley et al.* [7]. The most important reference here is *Easley/Kiefer/Possen* [8], who show that in a two-period, *n*-agent production economy in which productivity is subject to idiosyncratic shocks and there do not exist contingent markets in all states, the competitive equilibrium will not be Pareto optimal and there might be a potential for Pareto-improving government intervention based on income-dependent taxes and lump-sum transfers which provide insurance through interpersonal risk-pooling.

Our analysis basically transfers this interpersonal risk-sharing principle mutatis mutandis from the individual-agent to the country level. We will follow *Easley/Kiefer/Possen* [8] in ruling out purely redistributive policies and in adopting the Pareto criterion as the welfare measure; this choice seems natural in a situation where (two or more) independent and autonomous countries have to agree on the voluntary implementation of a policy measure such as the one in question. The decision making process we have in mind implies that unanimity will be required and, hence, that the welfare gains from our policy changes have to be noncontroversial.

Note, however, that *Easley/Kiefer/Possen* [8] impose complete ex-ante symmetry (i.e. homogeneity) of agents. In particular, their results crucially depend on the assumption that all individuals face the same distribution of the productivity parameters. This assumption excludes distributional differences between agents (i.e. „structural" heterogeneity of countries) and the occurrence of positive correlation among agents (i.e. „international" aggregate shocks), two features that we will frequently find in practice, as the European experience shows (cf. *Christodoulakis et al*. [5]).

As *Easley et al*. [7] demonstrate, however, policy intervention will be welfare improving even in the presence of aggregate shocks provided that asymmetric shocks still occur with positive probability, an argument that can be easily verified in the context of our model. Therefore, our analysis will concentrate on the implications of relaxing the second assumption, i.e. the symmetry assumption, by allowing the individuals in our model to be even ex-ante different.

We will proceed as follows: Section 2 presents the economy and its autarchy equilibrium; section 3 introduces fiscal cooperation under distributional asymmetry and investigates its desirability. Section 4 investigates the limits of welfare gains from fiscal cooperation under distributional asymmetry; section 5 presents numerical simulations of the model that will illustrate and amend the theoretical solutions obtained before. Finally, section 6 summarizes the main results and points out to open questions left for further research.

2 The Economy

We consider a one-period economy with two countries indexed by i • {1, 2}; in each country, there is a representative agent who has a strictly increasing, strictly concave, di.erentiable utility function $\bar{U}^i(c^i, l^i)$ defined on consumption, $c^i \geq 0$, and leisure, $l^i \geq 0$. We assume that $\bar{U}^1 = \bar{U}^2$ and

$$\lim_{c^i \to 0} \frac{\partial \bar{U}^i(c^i, l^i)}{\partial c^i} = \infty \text{ for all } l^i, \text{ and } \lim_{l^i \to 0} \frac{\partial \bar{U}^i(c^i, l^i)}{\partial l^i} = \infty \text{ for all } c^i.$$

These agents produce a single, homogenous consumption good using labor as the only input. The underlying production technology is linear, where agent *i's* labor input is $\bar{l} - l^i$ ($\bar{l} > 0$ is the total available hours) and agent *i's* labor productivity is denoted θ^i. Individual output is, therefore,

$$y^i = \theta^i \left(\bar{l} - l^i \right), \tag{1}$$

and aggregate output in the economy is

$$y = y^1 + y^2 = \theta^1 \left(\bar{l} - l^1 \right) + \theta^2 \left(\bar{l} - l^2 \right). \tag{2}$$

In this model, uncertainty arises from labor productivity θ^i, which is a random variable defined on two states of the world, ω • {1, 2}, that occur with known probability $p(\omega) > 0$ where $p(1) + p(2) = 1$. The state of the world is realized after the countries agreed on the tax policies (if they choose to do so at all), but before the individuals make their decisions on leisure and consumption and an equilibrium is reached. The productivity for individual *i* in state *w* is denoted $\theta^i(\omega)$, agent *i's* consumption is denoted $c^i(\omega)$, her leisure is $l^i(\omega)$, and the same convention is followed for the other variables. Without loss of generality, we can assume that $\theta^1(1) > \theta^1(2)$ and $\theta^2(2) > \theta^2(1)$, i.e. state 1 is more favorable to country 1, while state 2 is more favorable to country 2.

With consumption being the numéraire, the individuals face the following budget constraint:

$$c^i(\omega) + w^i(\omega)\, l^i(\omega) \leq I^i(\omega) \equiv w^i(\omega)\, \bar{l} \tag{3}$$

where $I^i(\omega)$ is agent *i's* income in state ω and $w^i(\omega)$ is agent *i's* real wage rate in state ω. The competitive equilibrium without any fiscal activity (denoted „autarchy solution“) will be characterized by the demand functions for consumption and leisure resulting from maximizing utility $\bar{U}^i(c^i, l^i)$ subject to the budget constraint (3):

$$c^i = c^i \left(I^i(\omega), w^i(\omega)\right) \text{ and } l^i = l^i \left(I^i(\omega), w^i(\omega)\right) \tag{4}$$

where $w^i(\omega) = \theta i(\omega)$. This means that each agent will adjust her consumption and leisure according to her realized labor productivity, and equilibrium prices of leisure and consumption are exogenous.

Note that, in this framework, the agents can neither self-insure through saving (i.e. intertemporal risk-pooling) nor buy insurance on a private competitive insurance market, as any insurance company would have to include both agents under a single contract, which would make competition between insurance companies incompatible with the provision of the Pareto optimal insurance contract. However, since our agents are assumed to be risk-averse, this competitive equilibrium will not necessarily be Pareto optimal for want of private insurance options. Therefore, we want to find out if the two countries can engage in a mutually beneficial form of fiscal cooperation that (at least partly) replaces the private insurance strategies that are not available in our case.

3 Fiscal Cooperation under Asymmetry

The fiscal cooperation we have in mind here is similar to a negative income tax scheme and works as follows: Before the productivity parameters are realized, the two countries agree irrevocably to tax their citizens. labor income at a previously announced, uniform and linear tax rate; then uncertainty is resolved, the individuals make their decisions on labor supply and consumption, and the two countries pool the proceeds from taxation and redistribute them equally among their citizens. This way, unlucky low-income agents will benefit from the system as they pay less taxes than they receive as transfers, while lucky individuals will be the net-payers of the system; hence, there is an ex-post-redistribution of resources from the lucky ones to the unlucky ones which corresponds to a situation of interpersonal risk-pooling.[1]

The economy under consideration here is thus a hybrid system of autonomy with respect to production and consumption on the one hand (note that there is no foreign trade in our model) and binding cooperation with respect to tax rates and revenue redistribution on the other hand.[2]

Since, in the following, we restrict ourselves to linear labor income taxation, the concept of Pareto optimality we refer to is, of course, always a conditional one. Note further that since labor supply is endogenous in our model, full insurance is not feasible; hence, the lucky individual.s income will always be higher than the unlucky one.s, even in the presence of insurance.

In terms of our model as outlined in Section 2, the relevant (after-tax) wage rate is now: $w^i(\omega) = (1 - \tau)\,\theta^i(\omega)$, where $-1 < \tau < 1$ is the flat labor income tax rate (or wage subsidy if $\tau < 0$). Total tax revenue (or subsidy expenditure) is

$$\begin{aligned} T(\omega) &= \tau\left(\theta^1(\omega)\left(\bar{l} - l^1(\omega)\right) + \theta^2(\omega)\left(\bar{l} - l^2(\omega)\right)\right) \\ &= \tau\left(y^1(\omega) + y^2(\omega)\right) \end{aligned} \tag{5}$$

[1] Note that the international .budget. will always be balanced as tax revenue exactly equals transfer payments, i.e. the resource constraint is satisÞed at each point in time (which, in our case, is necessary as we only consider a one-period economy).

[2] Throughout the rest of the paper, we will impose uniformity of the underlying tax rate. Of course, one might want to ask the question why we do not let the two countries decide individually on the rate at which they wish to tax their citizens rather than assuming a uniform tax rate. The intuitive answer to this question would be as follows: If both countries agree to pool their revenue after raising the taxes individually, each country can make itself better o. at any given .foreign. tax rate by setting the domestic tax rate to zero; that way, it can fully beneÞt from the insurance scheme without contributing to it. As a result, however, both countries will choose zero tax rates and the insurance system will not come into being.

and each individual receives a lump-sum transfer (or pays a lump-sum tax) of ½*T (ω)* such that the „federal budget" will always be balanced. We assume that the individuals act competitively, i.e. they consider the tax rate as exogenous and are not aware of their inßuence on the transfer payments through their decision on labor input. The new budget constraint is now

$$c^i(\omega) + (1-\tau)\theta^i(\omega)l^i(\omega) \leq I^i(\omega) \equiv (1-\tau)\theta^i(\omega)\bar{l} + \frac{1}{2}T(\omega) \qquad (6)$$

Again, maximizing utility subject to the budget constraint (6) will yield demand functions for consumption and leisure, $c^i = c^i(I^i(\omega), w^i(\omega))$ and $l^i = l^i(I^i(\omega), w^i(\omega))$.

The simplest form of introducing distributional asymmetry here is to let

$$p(1) \neq p(2) \text{ while having } \theta^1(1) = \theta^2(2) > \theta^1(2) = \theta^2(1), \qquad (7)$$

i.e. perfect negative correlation of $\theta^i(\omega)$ of the two countries' (ex-post) performance.[3]

A Pareto improving tax rate will be any tax rate that increases one individual's indirect expected utility without reducing the other individual's expected utility; as a first step, let us therefore analyze under which conditions each of our two countries would agree to a small (almost zero) tax rate independently of the other one.

Agent *i's* indirect expected utility is defined by

$$EU^i(\tau) = p(1)U^i(1) + (1-p(1))U^i(2) \qquad (8)$$

where agent *i's* indirect utility of state ω is a function of her optimal consumption and leisure,

$$U^i(\omega) = U^i\left(c^i\left(I^i(\omega), (1-\tau)\theta^i(\omega)\right), l^i\left(I^i(\omega), (1-\tau)\theta^i(\omega)\right)\right). \qquad (9)$$

Note that $p(1) \neq ½$ implies that $EU^1(\tau) \neq EU^2(\tau)$, i.e. the two countries are now ex-ante different.

Obviously, we have

$$\frac{\partial EU^i(\tau)}{\partial \tau} = p(1)\frac{\partial U^i(1)}{\partial \tau} + (1-p(1))\frac{\partial U^i(2)}{\partial \tau}. \qquad (10)$$

---

[3] Note that this implies that aggregate output will be constant across states.

The Lagrangian of the individual's maximization problem is

$$\mathcal{L}^i = U^i\left(c^i, l^i\right) + \lambda^i\left[(1-\tau)\,\theta^i(\omega)\left(\bar{l} - l^i(\omega)\right) + \frac{1}{2}T(\omega) - c^i(\omega)\right], \quad (11)$$

and applying the Envelope Theorem to this expression yields

$$\frac{\partial U^i\left(c^i, l^i\right)}{\partial \tau} = \frac{\partial \mathcal{L}^i}{\partial \tau} \quad (12a)$$

$$= \lambda^i\left(-\theta^i(\omega)\left(\bar{l} - l^i(\omega)\right) + \frac{1}{2}\frac{\partial T(\omega)}{\partial \tau}\right) \quad (12b)$$

$$= \frac{\partial U^i(\omega)}{\partial c}\left(-\theta^i(\omega)\left(\bar{l} - l^i(\omega)\right) + \frac{1}{2}\frac{\partial T(\omega)}{\partial \tau}\right). \quad (12c)$$

Proposition 1 *Under the above assumptions, there will always be a range of strictly positive probability values, p (1)* • *[*$\underline{p}$*,*$\bar{p}$*], for which a small tax-and-transfer scheme would be beneficial to both countries,* $\frac{\partial EU^i(\tau)}{\partial \tau}|_{\tau=0} > 0$ *for i* = 1, 2. *The values of* $\underline{p}$ *and* $\bar{p}$ *depend entirely on the marginal utilities of consumption in states* 1 *and* 2, *which in turn depend on the degree of similarity between the two states.*

Proof: After inserting from equ. (5)[4] and simplifying the appropriate terms in equ. (10), we obtain for country 1

$$\frac{\partial EU^1(\tau)}{\partial \tau}|_{\tau=0} = \frac{1}{2}\left(y^1(2) - y^1(1)\right)\left(p(1)\left(\frac{\partial U^1(1)}{\partial c} + \frac{\partial U^1(2)}{\partial c}\right) - \frac{\partial U^1(2)}{\partial c}\right) \quad (13)$$

Let us assume that $\theta^1(1) > \theta^1(2) \Rightarrow l^1(1) < l^1(2)$, i.e. the labor supply curve is positively sloped; then $y^1(1) > y^1(2)$ and $\frac{\partial U^1(2)}{\partial c} > \frac{\partial U^1(1)}{\partial c}$, which means that the sign of $\frac{\partial EU^1(\tau)}{\partial \tau}|_{\tau=0}$ depends entirely on $p(1)$. In particular, $\frac{\partial EU^1(\tau)}{\partial \tau}|_{\tau=0}$ is *dec*reasing in $p(1)$ (i.e. it will be the lower, the more probable the favorable state for country 1 is) and it will be positive if $p(1)$ is *below* a critical value $\bar{p}$, i.e. if the state that is favorable to country 1 is not „too probable". It can be easily shown that

$$\bar{p} = \frac{\frac{\partial U^1(2)}{\partial c}}{\frac{\partial U^1(1)}{\partial c} + \frac{\partial U^1(2)}{\partial c}} \in \left(\frac{1}{2}, 1\right) \quad (14)$$

Analogous results can be obtained for country 2:

$$\frac{\partial EU^2(\tau)}{\partial \tau}|_{\tau=0} = \frac{1}{2}\left(y^1(2) - y^1(1)\right)\left(\frac{\partial U^1(1)}{\partial c} - p(1)\left(\frac{\partial U^1(1)}{\partial c} + \frac{\partial U^1(2)}{\partial c}\right)\right) \quad (15)$$

---

[4] Note that $\frac{\partial T(\omega)}{\partial \tau}|_{\tau=0}$ = y^1 (ù) + $y^2(\omega)$ and that equ. (7) implies $y^1(1) = y^2(2) > y^1(2) = y^2(1)$.

Now, $\frac{\partial EU^2(\tau)}{\partial \tau}|_{\tau=0}$ is *in*creasing in *p* (1) and will be positive if *p* (1) is above a critical value $\underline{p}$ where

$$\underline{p} = \frac{\frac{\partial U^1(1)}{\partial c}}{\frac{\partial U^1(1)}{\partial c} + \frac{\partial U^1(2)}{\partial c}} \in \left(0, \frac{1}{2}\right) \tag{16}$$

□

Proposition 2 *There is no value of p* (1) • *(0,1) for which both* $\frac{\partial EU^1(\tau)}{\partial \tau}|_{\tau=0}$ *and* $\frac{\partial EU^2(\tau)}{\partial \tau}|_{\tau=0}$ *are negative.*

Proof: Just note that $\frac{\partial EU^1(\tau)}{\partial \tau}|_{\tau=0}$ < 0 for any *p* (1) > $\bar{p}$ • (½, 1), while $\frac{\partial EU^2(\tau)}{\partial \tau}|_{\tau=0}$ < 0 for any *p* (1) < $\underline{p}$ • (0,½). Obviously, *p* (1) can never be larger than $\bar{p}$ and smaller than $\bar{p}$ at the same time. □

The last result says that a system of small wage subsidies (which corresponds to a strictly negative labor income tax rate) Þnanced by lump-sum taxes will never be desirable for both countries, and hence, will never be Pareto improving. The intuition behind this result is clear: Negative tax rates combined with lump-sum taxes would „reward“ the lucky one (realizing the high productivity parameter) and „punish“ the unlucky one, a mechanism which is the opposite of insurance; such a system would therefore aggravate the uncertainty in the economy and make the risk-averse individuals worse off.

4 Limits to ex-ante Heterogeneity

Easley/Kiefer/Possen [8] mention that „our symmetry assumption should be regarded as a simplifying approximation. The assumption is by no means a necessary condition for Pareto-improving policies to exist, however, (...) too much heterogeneity will eliminate the potential for Pareto improvement“. (p. 949)

While section 3 was devoted to exploring the potential for Pareto improvement in the presence of asymmetry, we will now turn to the second half of the quoted sentence: where are the limits of welfare gains from a fiscal intervention under ex-ante heterogeneity?

First of all, note that as long as the particular type of asymmetry as introduced in section 3 holds, i.e. $\theta^1(1) = \theta^2(2) > \theta^1(2) = \theta^2(1)$ and $0 < p(1) < 1$, we have perfect negative correlation between the two countries, and there will be some potential for welfare improvement even away from $p(1) = ½$. Therefore, let us turn to two limiting cases where we would intuitively expect the potential for Pareto improvement to be eliminated, namely

- if one country is more productive than the other in both states of the world (Case A);
- if one country does not face any uncertainty at all, i.e. it realizes the same productivity parameter in both states, while the other country does either better of worse than that (Case B).

Case A can be characterized as follows: $\theta^1(1) > \theta^1(2) = \theta^2(2) > \theta^2(1)$;
this is a razor-edge case where we assume that country 1 is weakly more productive than country 2 in both states.

Proposition 3 *If one country is weakly more productive than the other in both states of the world, then there is no potential for Pareto improvement through fiscal cooperation under the above assumptions.*

Proof: Let us evaluate the derivatives of the indirect expected utility at a point of no policy:

$$\begin{aligned}\frac{\partial EU^1(\tau)}{\partial \tau}\Big|_{\tau=0} &= p(1)\frac{1}{2}\frac{\partial U^1(1)}{\partial c}\left(y^2(1)-y^1(1)\right)+\\ &+(1-p(1))\frac{1}{2}\frac{\partial U^1(2)}{\partial c}\left(y^2(2)-y^1(2)\right) \qquad (17)\end{aligned}$$

while

$$\frac{\partial EU^{2}(\tau)}{\partial\tau}|_{\tau=0} = p(1)\frac{1}{2}\frac{\partial U^{2}(1)}{\partial c}\left(y^{1}(1)-y^{2}(1)\right)+ + (1-p(1))\frac{1}{2}\frac{\partial U^{2}(2)}{\partial c}\left(y^{1}(2)-y^{2}(2)\right) \quad (18)$$

Our assumptions on the distributional properties of $\theta^{i}(\omega)$ imply that $y^{1}(2) = y^{2}(2)$ which in turn implies that

$$\frac{\partial EU^{1}(\tau)}{\partial\tau}|_{\tau=0} < 0 \text{ and } \frac{\partial EU^{2}(\tau)}{\partial\tau}|_{\tau=0} > 0 \quad (19)$$

Hence, country 1, which is superior in terms of productivity, will not benefit from fiscal cooperation. □

Case B can be characterized by $\theta^{1}(1) > \theta^{2}(2) = \theta^{2}(1) > \theta^{1}(2)$. Here, country 2 faces no uncertainty at all, while country 1 does either better (state 1) or worse (state 2) than country 2.

Proposition 4 *If one country does not face any uncertainty at all, while the other country does either better or worse than that, then there will not necessarily be a potential for Pareto improvement through fiscal cooperation under the above assumptions.*

Proof: Let's again analyze equations 17 and 18; after rearranging terms, we see that

$$\frac{\partial EU^{1}(\tau)}{\partial\tau}|_{\tau=0} > 0 \text{ if } \frac{y^{1}(1)-y^{2}(1)}{y^{2}(2)-y^{1}(2)}\frac{p(1)}{1-p(1)} < \frac{\frac{\partial U^{1}(2)}{\partial c}}{\frac{\partial U^{1}(1)}{\partial c}} \quad (20)$$

and

$$\frac{\partial EU^{2}(\tau)}{\partial\tau}|_{\tau=0} > 0 \text{ if } \frac{y^{2}(2)-y^{1}(2)}{y^{1}(1)-y^{2}(1)}\frac{1-p(1)}{p(1)} < \frac{\frac{\partial U^{2}(1)}{\partial c}}{\frac{\partial U^{2}(2)}{\partial c}} \quad (21)$$

Note that our assumptions on the distributional properties of $\theta^{i}(\omega)$ imply that $y^{2}(1) = y^{2}(2)$. Since country 2 faces no uncertainty, $\frac{\partial U^{2}(1)/\partial c}{\partial U^{2}(2)/\partial c}|_{\tau=0} = 1$; hence, we must have $p(1)(y^{1}(1) - y^{2}(1)) > (1 - p(1))(y^{2}(2) - y^{1}(2))$ for $\frac{\partial EU^{2}(\tau)}{\partial\tau}|_{\tau=0}$ to be positive. The smaller $p(1)$ and the smaller country 1's productive „advantage" in state 1, the less likely is this condition to be satisfied. For country 1, in turn, taxes will be the more desirable the more dissimilar the two states of the world are to it. Hence, we can conclude that neither country 1 nor country 2 will be necessarily interested in fiscal cooperation under the present ircumstances, and very specific conditions have to be met for a tax scheme to be mutually beneficial.□

5 Simulations

The following simulations will illustrate the theoretical results we obtained in the previous section for a simple economy composed of two individuals; the functional form of the utility function is a log-version of the standard Cobb-Douglas utility function,

$$U(c,l) = \alpha \ln c + (1-\alpha)\ln l \text{ ,where } 0 < \alpha < 1 \tag{22}$$

The demand functions for consumption and leisure are therefore

$$c^i(\omega) = \alpha I^i(\omega) \text{ and } l^i(\omega) = \frac{1-\alpha}{(1-\tau)\theta^i(\omega)} I^i(\omega) \tag{23}$$

where $I^i(\omega) = (1-\tau)\,\theta^i(\omega)\,\bar{l} + ½T(\omega)$ is agent i's income in state ω and $T(\omega) = \tau\,(\theta^1(\omega)\,(\bar{l} - l^1(\omega)) + \theta^2(\omega)\,(\bar{l} - l^2(\omega)))$ is total tax revenue. Again, indirect expected utility is $EU^i(\tau) = p(1)U^i(1) + (1 - p(1))\,U^i(2)$.

5.1 Individually Optimal Tax Rates

Every tax rate that solves the following Pareto optimization problem can be considered Pareto optimal:

$$\max_{\tau} EU^i(\tau) = EU^i\left(c^i\left(I^i(\omega), w^i(\omega)\right), l^i\left(I^i(\omega), w^i(\omega)\right)\right)$$

$$\text{such that } EU^j(\tau) = C \tag{24}$$

where C is some constant s.t. $C \geq EU^j(\tau = 0)$, and $-1 < \tau < 1$. However, as soon as we allow for $p(1)$ to be di.erent from $p(2)$ (which implies that also $EU^1(\tau) \neq EU^2(\tau)$), we should expect to find more than one such tax rate at each level of $p(1)$. Therefore, let us first turn to the unconstrained optimization problem for country 1.

The standard parameter values to be used in the following (unless specified otherwise) are: $\alpha = 0.5$, $\theta^1(1) = 2$, $\theta^1(2) = 1$, $\theta^2(2) = 2$, $\theta^2(1) = 1$, $\bar{l} = 10$, which corresponds to the distributional asymmetry as introduced in section 3 where $\theta^1(1) = \theta^2(2) > \theta^1(2) = \theta^2(1)$.

Figure 1 shows the graph of $EU^1(\tau)$ for different values of $p(1)$, namely for $p(1) = 0.1$ (dashed line), $p(1) = 0.5$ (solid line) and $p(1) = 0.9$ (dotted line); we see that expected utility is not monotone in the tax rate and that it shifts upward and flattens as $p(1)$ increases. The small circles represent the loci where expected utility is maximized; we can observe that the individually optimal tax rate for country 1 seems to decrease as $p(1)$ increases.

Figure 2 shows the individually optimal tax rates for country 1 and 2 as functions of $p(1)$. We find that while the optimal tax rate for country 1, τ^*_1, decreases and even turns negative as $p(1)$ increases, i.e. as the state more favorable to country 1 becomes more probable, the optimal tax rate for country 2, τ^*_2, is negative for low values of $p(1)$ and increases as the state unfavorable to country 2 becomes more probable.; the two curves intersect at $p(1) = 0.5$ where the two countries are ex-ante fully identical. Away from $p(1) = 0.5$, however, a certain conflict of interest arises. As we should expect from our findings of section 3, there is a common (symmetric) range of $p(1)$-values where *both* τ^*_1 and $\boldsymbol{\tau}^*_2$ are *positive* (namely the interval $(\frac{1}{3}, \frac{2}{3})$), but there is no value of $p(1)$ for which both tax rates will be *negative*.

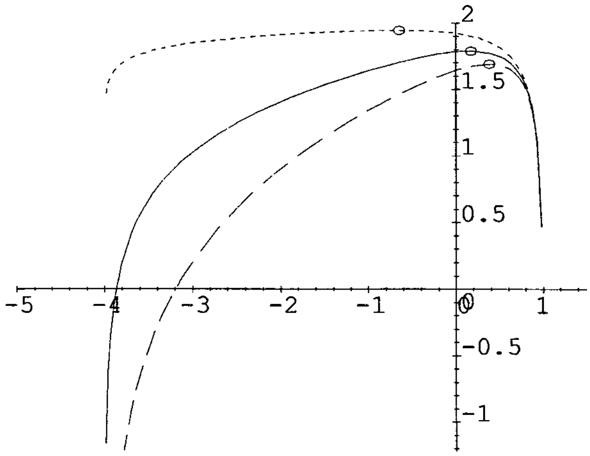

Figure 1: $EU^1(\tau)$ for $p(1) = 0.5$ (solid), $p(1) = 0.9$ (dotted), and $p(1) = 0.1$ (dashed)

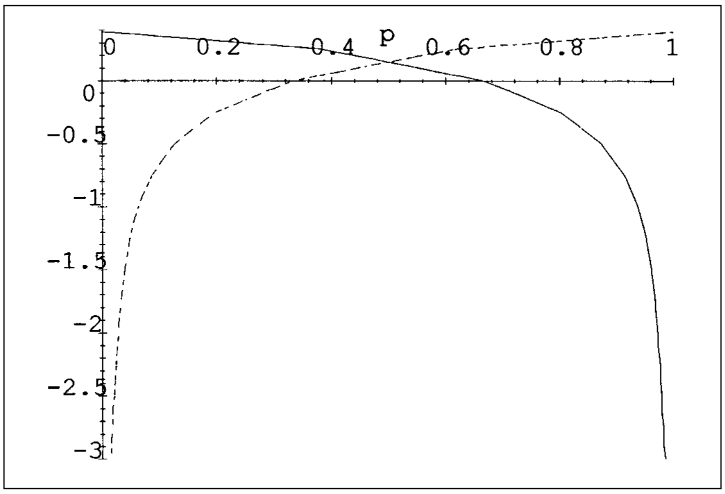

Figure 2: Optimal Tax Rates for Country 1 (solid) and Country 2 (dotted)

5.2 The Social Solution

Figure 2 showed that the fully symmetric case (at *p* (1) = ½) is the only case where the individual optimum will correspond to the social optimum, i.e. the individually optimal tax rate is also the unique Pareto optimal tax rate. In all other cases, determining the social optimum is not so straightforward. We will usually find a variety of tax rates that have a Pareto improving e.ect, but none of them will simultaneously maximize both individuals' expected utility. Hence, we could either introduce some sort of policy maker or social planner who maximizes a social welfare function, or we could let the two countries enter a bargaining process where they divide the gains from their fiscal cooperation among each other. The latter approach, which seems more natural in our specific framework, will be followed below.

The bargaining procedure underlying the following analysis is a Nash bargaining process as represented by the following maximization problem:

$$\max_{0\leq\tau\leq1} \left(EU^1(\tau) - EU^1(0)\right)^{\beta} \left(EU^2(\tau) - EU^2(0)\right)^{1-\beta} \qquad (25)$$

In our framework, expected utility at $\tau = 0$ is the natural threatpoint as every country is free to refuse cooperation in which case the autarchy solution is the best feasible outcome. The parameter β in the Nash product represents relative bargaining power of the two countries.

To get the flavor of the possible results, let us analyze the case of *p* (1) = 0.45. Figure 3 depicts the peak of the utility possibility set above the threatpoint for country 1 (x-axis) and country 2 (y-axis) for different values of τ , namely $0 \leq \tau \leq 0.24$. The way to read this graph is as follows: the small cross at the lower left-hand corner of the graph represents the autarchy solution; as we increase the tax rate, we increase both countries' expected utility up to a point at $\tau = 0.128$ (represented by the left-hand circle) where country 2's *EU* is maximized; if we further increase τ , we keep on improving country 1's outcome while country 2's *EU* now falls below its maximum value. At a tax rate of 0.207, country 1's expected utility is maximized (represented by the right-hand circle); if we continue to increase τ, both countries will fall below their respective optimal outcomes. During the bargaining process, the two countries have to agree on some point on the utility possibility set between their most preferred positions, for instance on the point represented by the small box in Figure 3 where $\tau = 0.15229$.

Figure 4 shows the individually optimal tax rates for country 1 and 2 as well as the Nash bargaining outcomes (the argmax of the Nash product)

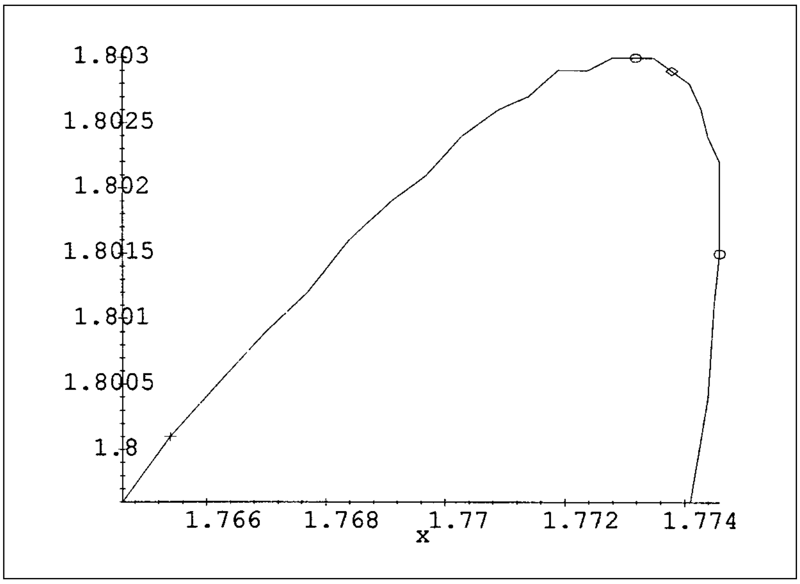

Figure 3: Utility Possibility Set (EU^1 on the x-axis, EU^2 on the y-axis) for $0 < \tau < 0.2$

for various values of *p* (1) under standard parametrization. We see that the Nash bargaining tax rates are all positive, symmetric around *p* (1) = 0.5 (which is due to the fact that we assumed symmetric bargaining power, $\beta = 0.5$) and slightly above the smaller desired tax rate (reflecting the necessary compromise between the two countries that was determined in the Nash bargaining procedure); at *p* (1) = 0.5, the Nash bargaining tax rate coincides with the individually optimal tax rates which, in turn, coincide with the social optimum.

Let us now compare the outcome under different regimes; Figure 5 showes expected utility for country 1 under autarchy (solid), fiscal cooperation (dotted), and the benchmark case of full insurance[5] (dashed) as functions of *p* (1). We see that under fiscal cooperation, expected utility is no longer a linear function of *p* (1). The largest utility gains from insurance are realized between *p* (1) = 0.4 and *p* (1) = 0.5, where we can also observe the highest Nash bargaining tax rates. Above *p* (1) = 0.5, the utility gains for country 1 decrease as country 1 is less and less likely to benefit from the system. Compared to the (unfeasible) full insurance scenario, the utility gains from insurance appear to be rather modest.

[5] which was calculated using the same (completely inelastic) labor supply under autarchy (i.e. $(1 - \alpha)\bar{l}$), but now assuming that it is exogenous

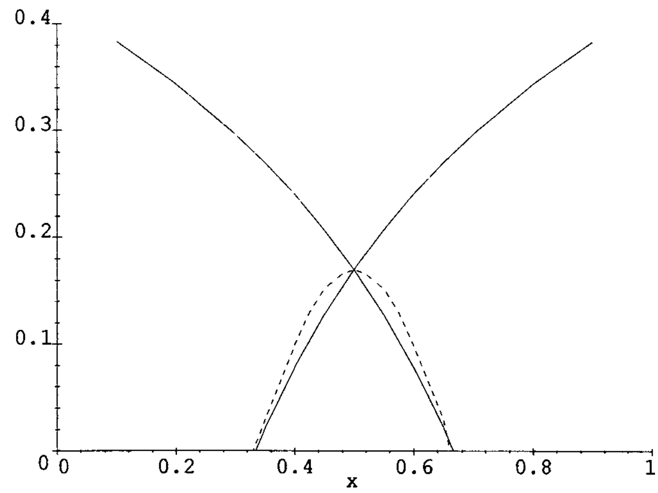

Figure 4: Individually desired tax rates (solid) and Nash bargaining outcomes (dotted) for $\beta = 0.5$

Morover, note that under fiscal cooperation, output and leisure will vary with the probability of the two states (because of varying tax rates), which is not the case under autarchy or full insurance. Fiscal cooperation leads to a drop in output and „employment“ (i.e. leisure will be higher) compared to both autarchy and full insurance. These losses in terms of output and employment can be interpreted as the distortions induced by the tax scheme. We see, however, that the individuals would be better off under fiscal cooperation than under autarchy; in particular, the utility gains from insurance are greatest where output is lowest, namely around $p(1) = 0.5$. Obviously, neither consumption nor employment are appropriate measures of social welfare.

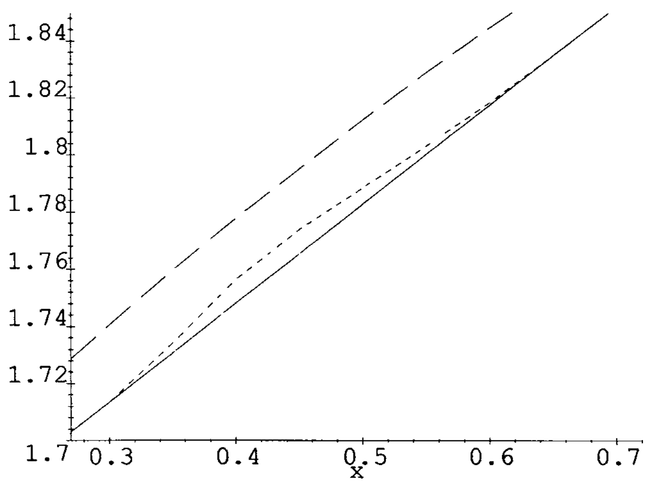

Figure 5: Country 1’s expected utility under autarchy (solid), fiscal cooperation (dotted) and full insurance (dashed) for different values of $p(1)$

6 Conclusion

The present paper intends to analyze the desirability of a system of international fiscal transfers as insurance against asymmetric shocks in a general equilibrium framework. More precisely, a static two-country general equilibrium model with uncertainty about labor productivity was developed to analyze potential welfare gains from fiscal cooperation under ex-ante heterogeneity of agents.

We found that a simple tax scheme with uniform flat labor income tax rates and lump-sum transfers can be welfare improving even in the presence of (limited) structural heterogeneity of agents, while a system of wage *subsidies* financed by lump-sum *taxes* will never be desired by both countries, and hence, will never be Pareto optimal.

Since, in the so-called fully symmetric case, the agents are ex-ante identical, the individual and social optimum will coincide and there will be a unique Pareto-optimal tax rate. In all other cases, a certain conflict of interest arises between the two countries and determining the social optimum is not so straightforward. Hence, we decided to let the two countries enter a bargaining process to determine the common tax rate. We found that the largest utility gains from insurance were realized in the neighborhood of the symmetric case, where we could also observe the highest Nash bargaining tax rates.

We also found that fiscal cooperation leads to distortions in terms of output and „employment“ (i.e. leisure will be higher) compared to both autarchy and full insurance. We could observe, however, that the individuals would be better off under fiscal cooperation than under autarchy; in particular, the utility gains from insurance are greatest where output is lowest.

Further research will be required to consider the e.ects of other forms of taxation, like a consumption tax, a combination of both consumption and labor income taxation, previously determined unilateral tax rates, or non-linear tax rates. Another interesting extension would be to allow for intertemporal transfers, e.g. by including capital as a second factor of production.

References

[1] *van Aarle, Bas* (1996): Essays on Monetary and Fiscal Policy Interaction: Applications to EMU and Eastern Europe, dissertation, TilburgUniversity.

[2] *Bajo-Rubio, Oscar/Díaz-Roldán, Carmen* (1999): Insurance mechanisms against asymmetric shocks in a Monetary Union: An application to the European Monetary Union, FEDEA Working Paper No. EEE 62

[3] *Bayoumi, Tamim/Eichengreen, Barry* (1992): Shocking Aspects of European Monetary UniÞcation, NBER Working Paper No. 3949, Cambridge, MA.

[4] *Caporale, Guglielmo Maria* (1993): Is Europe an optimum currency area? Symmetric versus asymmetric shocks in the EC, National Institute Economic Review, May 1993, pp. 95-103.

[5] *Christodoulakis, Nicos/Dimelis, Sophia P./Kollintzas, Tryphon* (1995): Comparisons of Business Cycles in the EC: Idiosyncracies and Regularities, Economica, February 1995, 62, pp. 1-27.

[6] *Diamond, P. A./Helms, L. J./Mirrlees, J. A.* (1980): Optimal Taxation in a Stochastic Economy: A Cobb-Douglas Example, Journal of Public Economics, 1980, 14, pp. 1-29.

[7] *Easley, David/Kiefer, Nicholas M./Possen, Uri* (1985): An Equilibrium Analysis of Optimal Unemployment Insurance and Taxation, The Quarterly Journal of Economics, 1985, 100, Supplement, pp. 989-1010.

[8] *Easley, David/Kiefer, Nicholas M./Possen, Uri* (1993): An Equilibrium Analysis of Fiscal Policy with Uncertainty and Incomplete Markets, International Economic Review, November 1993, 34 (4), pp. 935-952.

[9] *Eaton, Jonathan/Rosen, Harvey S.* (1980): Optimal Redistributive Taxation and Uncertainty, The Quarterly Journal of Economics, September 1980, pp. 357-364.

[10] *Fatás, Antonio* (1998): Redistribution vs. Insurance: Does Europe need a fiscal federation?, Economic Policy, April 1998, 26, pp. 165-203.

[11] *Gros, Daniel* (1996): A Reconsideration of the Optimum Currency Area Approach: The Role of External Shocks and Labour Mobility, in: National Institute Economic Review, October 1996, 158, pp. 108-117.

[12] *von Hagen, Jürgen/Hammond, George W.* (1998): Regional Insurance against Asymmetric Shocks: An Empirical Study for the European Community, The Manchester School, June 1998, 66 (3), pp. 331-353.

[13] *Italianer, Alexander/Vanheukelen, Marc* (1993): Proposals for Community stabilization mechanisms: Some historical applications, European Economy: reports and studies, 1993, 5, pp. 493-510.

[14] *Obstfeld, Maurice/Peri, Giovanni* (1998): Asymmetric Shocks: Regional non-adjustment and Þscal policy, Economic Policy, April 1998, 26, pp. 207-259.

[15] *Varian, Hal R.* (1980): Redistributive Taxation as Social Insurance, Journal of Public Economics, 1980, 14, pp. 49-68.

BILANZEN UND BERICHTE

⇒ **Die Euro-Umstellung im öffentlichen Sektor.**
Wien, November 2000. *(d/e Download)*

⇒ **Österreichische Wirtschafts- und Budgetzahlen 2000/2001.**
Wien, Jänner 2001. *(d/e)*

⇒ **Budget 2002.**
Budgetrede des Bundesministers für Finanzen vor dem Nationalrat.
Wien, 1. März 2001.

⇒ **Forum Finanz.**
Jahresbericht 2000.
Wien, April 2001.

⇒ **Countdown zum Nulldefizit.**
Leistungsbericht 2000-2002.
Wien, April 2001. *(d/e)*

⇒ **Versicherungsaufsicht.**
Jahresbericht 2000.
Wien, September 2001. *(d/e)*

BROSCHÜREN UND RATGEBER

⇒ **Steuerlicher Wegweiser für neugegründete Unternehmen.**
(Beiblatt mit Änderungen) Wien 1997.

⇒ **Die Umsatzsteuer-Identifikationsnummer.**
Anwendung und Wirkung.
(Beiblatt mit Änderungen für 1999)
Wien, Oktober 1997.

⇒ **Zoll-Info 2002.**
Zoll-Tipps für die Einreise nach Österreich.
Wien, Jänner 2002. *(d/e)*

⇒ **Das Steuerbuch 2001.**
Tipps für Lohnsteuerzahlerinnen und Lohnsteuerzahler.
Wien, März 2001. *(d/e/türkisch/serbisch/kroatisch/slowenisch)*

⇒ **Der Euro kommt!**
Folder. Wien 2001.

⇒ **Der Euro kommt! - Umrechnungstabelle.**
Wien, September 2001.

SCHRIFTENREIHE

⇒ **Der Beamte als Aufsichtsrat.** Und: **Keine Einflußmöglichkeiten der öffentlichen Verwaltung auf ausgegliederte Rechtsträger?**
Wien, Mai 1999.

⇒ **Das Mehrwertsteuerrecht der EU.**
Wien, August 1999. *(vergriffen)*

⇒ **Die Verbrauchsteuern der EG.**
Wien, September 1999.

⇒ **Internationale Geschäftsfälle in der Betriebsprüfung.**
Wien, Oktober 1999.

⇒ **Berufungssenate in der Finanzverwaltung.**
Wien, Oktober 2000.

⇒ **Grenzen des Wachstums – Wachstum ohne Grenzen.**
Wien, März 2001.

⇒ **Österreichs Doppelbesteuerungsabkommen. Standortpolitische Bedeutung, Verhandlungsablauf, Abkommensziele.**
Wien, September 2001.

⇒ **Gesundheitsförderung in der Finanz- und Zollverwaltung**
Leitfaden zum Fehlzeitenmanagement
Wien, Februar 2002.

PUBLIKATIONEN DES BMF

Stand: Februar 2002

WORKING PAPERS

⇒ **Der OECD-Wirtschaftsbericht über Österreich 1999.**
Working Paper 1/1999. Wien, Juni 1999.

⇒ **Kostennutzenanalyse in der EU.**
Working Paper 2/1999. Wien, Juli 1999. *(vergriffen)*

⇒ **Kosovo-Krise und Wiederaufbau**
Working Paper 3/1999. Wien, August 1999.

⇒ **Transmissionsmechanismen der Geldpolitik.**
Working Paper 4/1999. Wien, September 1999. *(vergriffen)*

⇒ **Die neue Bedeutung der Einkommenspolitik als inationales Politikfeld im Rahmen der Europäischen Wirtschafts- und Währungsunion.**
Working Paper 5/1999. Wien, Dezember 1999.

⇒ **The Political Economy of Financial Crises.**
Working Paper 6/1999. Wien, Dezember 1999.

⇒ **Koordination der Wirtschaftspolitik in der EU.**
Working Paper 1/2000. Wien, Januar 2000. *(vergriffen)*

⇒ **Regulatoren in Netzwerkindustrien - Eine polit-ökonomische Synthese.**
Working Paper 2/2000. Wien, Januar 2000. *(vergriffen)*

⇒ **Indexprobleme der realen Volkswirtschaftlichen Gesamtrechnung und Verzerrungen bei Prognosen und Analysen.**
Working Paper 3/2000. Wien, März 2000. *(vergriffen)*

⇒ **Aktuelle Herausforderungen für die österreichische Wirtschaftspolitik in der WWU.**
Working Paper 4/2000. Wien, August 2000.

⇒ **Österreichische Budgetpolitik in der WWU.**
Working Paper 5/2000. Wien, August 2000.

⇒ **Österreichische Strukturpolitik in der WWU.**
Working Paper 6/2000. Wien, August 2000.

⇒ **Österreichischer Finanz- und Kapitalmarkt in der WWU.**
Working Paper 7/2000. Wien, September 2000.

⇒ **Entwicklung der Definition für das mittelfristige Budgetziel in den Stabilitäts- und Konvergenzprogrammen.**
Working Paper 8/2000. Wien, September 2000.

⇒ **Der Vertrag von Nizza: Ein Wegweiser für die Europäische Integration.**
Working Paper 1/2001. Wien, April 2001.

⇒ **Österreich im neuen Europa. Überblick über die Argumente zur EU-Erweiterung.**
Working Paper 2/2001. Wien, Mai 2001.

⇒ **EU-Erweiterung: Budgetäre Auswirkungen wirtschaftlicher Anpassungsszenarien.**
Working Paper 3/2001. Wien, Juni 2001.

⇒ **Das Europäische Wirtschafts- und Sozialmodell – Stand der Umsetzung ein Jahr nach Lissabon.**
Working Paper 4/2001. Wien, August 2001.

⇒ **Strukturindikatoren.**
Working Paper 5/2001. Wien, Oktober 2001.

⇒ **Renditen der Universitätsausbildung.**
Working Paper 6/2001. Wien, Oktober 2001.

⇒ **Austria: Public Pension Projections 2000 – 2050.**
Working Paper 7/2001. Vienna, October 2001.

⇒ **Euro exchange rate policy: Institutions and procedures.**
Working Paper 8/2001. Vienna, October 2001.

⇒ **Verteilungspolitische Aspekte von Kapitalsteuerwettbewerb.**
Working Paper 1/2002. Wien, Februar 2002.

⇒ **The Euro, the Dollar, and the International Monetary System**
Working Paper 2/2002. Vienna, February 2002.

⇒ **Reale Konvergenz im Euroraum mit besonderer Berücksichtigung der EU-Osterweiterung**
Working Paper 3/2002. Wien, Februar 2002.

Kostenlose Bestellungen der Publikationen:

Bundesministerium für Finanzen
Öffentlichkeitsarbeit
Himmelpfortgasse 8, 1015 Wien
Tel.: +43-1-514 33/1346 (Mo bis Fr von 08.00 Uhr bis 15.30 Uhr)
Internet: www.bmf.gv.at (Rubrik Publikationen)