Essays on Individual Savings Accounts in the Presence of Migration

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Dedicated to the uncle.

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Preface

Social insurance via individual savings accounts (ISA) strives to provide the same level of protection as a tax-financed benefit system, however with less accompanying downsides. From the very start, the idea of personal accounts attracted my interest because of its relatively simple mechanism which results in multifaceted consequences and advantages including a large variety of opportunities.

The general mechanism of the ISA system works as follows: Each individual holds a personal account which collects all contributions paid by this individual. The mandatory contribution rate replaces a part of the taxpayer's annual tax bill or of the current social security contributions. It is calculated as a share of the income. All benefits received by the individual in her life are debited from this account. This way, self-insurance is introduced to finance at least parts of the benefits by ISA. Redistribution ex post can then be viewed as insurance ex ante. The individual is able to internalize the total costs of her social insurance benefits due to the direct link between contributions, benefits and the resulting account balance. This internalization effect reduces moral hazard as well as adverse incentive effects. In consequence, durations and frequencies of unemployment spells or temporary layoffs are reduced (see e.g. Feldstein and Altman, 2007 and Chetty, 2005). The part of redistribution which transfers income across life cycle rather than across individuals is financed by the savings accounts. At the time of retirement, the balance is converted into a retirement bonus or annuity. This way it is integrated into the pension system to supplement old age payments. If the account balance is not sufficient to buy the minimum pension, the government bails out the individual and finances the gap of missing contribution payments out of general tax revenue.

The reduction in distortionary tax wedges for all taxpayers with a nonnegative account balance is the biggest improvement the ISA system provides for economic efficiency. As long as the individuals expect to end up with a positive account balance the mandatory contributions do not have the distortionary effect and behavior inducing character of a tax.

The second important type of efficiency gains results from the reduction of moral hazard and the decreased adverse incentive effects associated with the introduction of an ISA system. The individual who can expect a surplus on her account has the incentive to minimize the risk of depending on social benefits. In the case of unemployment insurance, individuals put more effort in the job search, refuse job offers less and increase the effort at work which in turn decreases job losses. These effects reduce the unemployment rate which in turn reduces public expenditures. In summary, the ISA system can improve the incentives of high-income earners without decreasing consumption possibilities of low-income earners (Sörensen, 2003).

Literature provides many arguments why ISA can redistribute life-cycle incomes at a lower efficiency cost than common tax systems. However, all existing models on ISA only show results in a closed economy scenario and do not consider the possibility of migration. Chapter 1 is a first approach to model ISA in the presence of migration by introducing unemployment benefit accounts combined with a pension system in two symmetric countries. While providing liquidity and lifetime income insurance, ISA can improve employment incentives. First, the theoretical model focuses on the individual perspective and the related decisions regarding labor supply as well as migration. It shows how some individuals have a higher incentive to emigrate due to the introduction of ISA. However, there are also contrary effects as some individuals may have lower incentives because of a reduced tax rate and a higher net wage in the country of residence. Subsequently, the government perspective shows how the implementation of a complementary ISA system can generate a higher tax income due to efficiency gains. By holding the governments' budget constraints balanced, the tax rate can be reduced in the presence of migration if the positive effects exceed the negative ones.

The second chapter presents a theoretical model of ISA in an asymmetric world with the possibility of migration. In an asymmetric world, individuals have more incentives to migrate than in a symmetric case as presented in chapter 1. This can be due to different gross wages or tax systems, which leads to a higher net wage for the individual. The model also shows how individual behavior like labor supply and migration decisions influences the governments' budget constraints. Comparing scenarios, the results reveal that ISA in combination with cooperation among governments can be a promising way to reduce tax distortions in a two-country model – especially for countries with high unemployment rates. Therefore, governments should cooperate by exchanging information about the employment history of emigrants and set the right incentives. In the presence of cooperation, there is no discrimination with respect to the origin of individuals. Further, this chapter shows that the tax rates of two asymmetric countries tend to indicate a convergence with the help of cooperation and compensation payments.

In contrast to the other chapters, chapter 3 changes the subject from unemployment accounts to medical savings accounts (MSA). It presents the first theoretical model on MSA in the presence of migration. In times where countries struggle with overwhelming public debts, there might be a potential for improvement via alternative financing options in the health care sector. While spending on health care has increased faster than the GDP in most of the OECD countries, Singapore found a solution leading to an only moderate increase of health care expenditures with the introduction of a MSA system in the middle of the 1980s (Pauly and Goodman, 1995a). Besides analyzing the individual decision making process regarding labor supply, demand of health care and migration, this paper also contributes insights regarding the mix between tax and contributions in different scenarios with the help of a numerical example. The results show that MSA can improve the situation of all individuals and governments, if the accompanying effects are considered diligently.

Chapter 1

Efficient Redistribution with Individual Savings Accounts in the Presence of Migration

1.1 Introduction

Taxation distorts labor supply and reduces the incentives of individuals to search for employment. In the extreme case of a tax rate of 100 percent, no single individual would have a monetary incentive to work. One possible objective of a government could be to reduce the tax rate and the accompanying distortions to its lowest extent, while still covering public expenditures. A higher net wage motivates individuals to choose a higher labor supply and brings more individuals into work ceteris paribus.

But how can the tax rate be reduced? Bovenberg et al. (2008) show with the help of Danish data that on average three quarters of the contributions and taxes, an individual pays over lifetime, are redistributed back to the same individual via benefits. Only one quarter is used for interpersonal redistribution. Different authors apply the same methodology of calculation and find that there are significant shares of intrapersonal redistribution in other countries as well

Country	**Approximate share of intrapersonal redistribution**	**Source**
Sweden	82 % 76 %	Pettersson and Pettersson (2003) Fölster (1999)
Italy	76 %	O'Donoghue (2001)
Denmark	75 %	Bovenberg et al. (2008)
Great Britain	71 %	Falkingham and Harding (1996)
Ireland	55 %	O'Donoghue (2001)
Australia	52 %	Falkingham and Harding (1996)

Table 1.1: Overview of Approximate Shares of Intrapersonal Redistribution in Different Countries.

If one provides a direct actuarial link between the contributions made and the benefits received, a significant amount of charges would lose the distortive character of a tax. Individual savings accounts (ISA) can provide such an actuarial link by implementing an account for every citizen. The goal of social insurance with ISA is to preserve the same level of protection without the distortions that appear in financing public expenditures via taxes. Efficiency gains and a higher motivation for individuals to supply labor would be the result. ISA work rather as a complement than a substitute to a fully tax-financed system. While ISA cover the intrapersonal part of redistribution, taxes are still needed to finance the interpersonal redistribution between individuals and provide a lifetime-income insurance. Thus, ISA only substitute part of the total tax financing.

The idea of ISA goes back to the end of the twentieth century (e.g. Fölster, 1997; Orszag and Snower, 1998; Orszag et al., 1999) and has been discussed by many authors. However, the presence of migration has not been taken into account in literature so far. Due to technological progress and political decisions, the mobility of labor is increasing. Consequently, a generous welfare state may face high inflows of immigrants who want to enjoy the same benefits of the local welfare system as the other citizens (Borjas, 1999; Sinn, 1997). However, the movement of individuals directly influences the public budget. From the perspective of an individual, migration brings more opportunities to maximize the individual lifetime utility. Naming two of them: Individuals can emigrate to a country where they earn a higher net wage due to a different taxation system or they profit from a high inflow of foreign tax payers which can lead to a reduction of the local tax rate and increase the net wage. On the other hand, the outflow of taxpayers and the inflow of individuals because of high welfare benefits can result in potential losses. However, the presence of migration has not been taken into account in literature so far. This paper contributes to close this research gap by providing a theoretical model of unemployment savings accounts in the presence of migration.

The following sections will show how the introduction of ISA influences the decisions of individuals and governments with a continuum of heterogeneous types of individuals regarding the migration costs. In the cooperative equilibrium presented in this chapter, one positive effect is the significant decrease of the tax rate due to ISA. This has an impact on the labor supply and the migration decision of individuals holding the budget equations of the two symmetric countries balanced.

To show the effects of the introduction of unemployment accounts in the presence of migration, this paper is organized in three parts: First, an overview of the existing literature is presented as well as related criticism and downsides of ISA. The second part introduces a theoretical model from an individual perspective followed by the view of the governments. Then, the theoretical model is calculated with exemplary numbers. The last section concludes the results and gives implications for further research in this field.

1.2 Literature Review on Individual Savings Accounts

Literature on Unemployment Accounts

The literature on ISA can be divided in two major categories: Unemployment accounts and comprehensive accounts. Orszag and Snower (2002) focus on the incentives of workers and unemployed individuals after the introduction of unemployment accounts. The authors are convinced that the unemployment account system is compatible with a Pay-As-You-Go (PAYG) as well as a fully funded

(FF) scheme. The funded system can then also be organized and maintained by private institutions (Boss et al., 2008). Bovenberg and Sörensen (2004) discover that a system change with the help of ISA can produce a welfare gain that is a Pareto improvement. They use a method inspired by Kaplow (1996) which focusses on generational accounts. However, there are authors in literature who have a different opinion (Breyer, 1989; Sinn, 2000).

Brown et al. (2006) analyze the incentive effect of replacing an unemployment benefit system by an unemployment account system, too. The authors maximize the workers' Cobb-Douglas utility function with respect to leisure and calibrate their model with reasonable assumptions for European countries with high unemployment rates in an unemployment benefit and unemployment account system. According to Brown et al. (2006), the rewards of keeping and seeking a job are higher in an unemployment account system and the calibration shows that unemployment levels in Europe's high-unemployment countries could decline by 30 to 50 percent due to the introduction of unemployment savings accounts. Boss et al. (2008) present a concrete proposal for replacing unemployment assistance in Germany through unemployment accounts. The authors refer to the results of Brown et al. (2006).

Literature on Comprehensive Welfare Accounts

Stiglitz and Yun (2005) as well as other authors (e.g. Orszag et al., 1999) argue for ISA that integrate more than just the unemployment insurance. The scope can be expanded to other insurances. This might be welfare enhancing as long as the respective risks are not perfectly positively correlated. There are exemplary expansion possibilities in literature like educational accounts (Poutvaara, 2004, Sörensen, 2003 and Fölster et al., 2003) and health accounts (Fölster et al., 2003 and Hsiao, 1995). In both cases, individuals often temporarily lack liquidity. To support the desired smoothing of consumption over time, the government could provide a liquidity insurance by introducing an account system which includes expenses for education or health care. The lack of liquidity is the primary problem of the uninsured individuals and the immediate access of liquidity, e.g. in the case of emergency, is crucial (Chetty, 2005; Card et al., 2007 and Shimer and Werning, 2008).

There are more arguments in literature in favor of more comprehensive accounts: Bovenberg et al. (2006) analyze a proposal of the Danish Economic Council (2005) and find that the introduction of ISA is Pareto improving. To ensure a Pareto improvement the system features a lifetime-income guarantee so that no individual can be worse off compared to the existing tax-financed transfer system. The proposed ISA system includes programs like benefits for short-term unemployment, short-term sickness, loans for higher education, and many more. The authors show that the revenue of the resulting efficiency gains dominates the static revenue loss. Therefore the introduction of ISA is Pareto improving.

Bovenberg and Sörensen (2006) search for the optimal disability transfer system and find that it should be based more strongly on previous earnings. This could motivate all workers to increase their labor supply, while the government can reduce distortionary effects of the tax and transfer system. Although the authors focus in this paper on optimal redistribution of lifetime incomes in general, the social insurance scheme is based on the same principles as ISA considered for instance in Bovenberg and Sörensen (2004). They argue that social policies developed from a life-cycle perspective better fit the changing life courses of individuals (see also Bovenberg et al., 2008, for a more detailed view on the lifecycle perspective and resulting social policies). This is because consumers smooth their consumption individually over their lifetime under the assumption of well-functioning capital markets.

Bovenberg et al. (2012) combine the findings from Bovenberg and Sörensen (2006) and develop a formula measuring the net government revenue changes due to the introduction of ISA. While no person is worse off compared to the current tax-financed transfer system, individuals with positive account balances are better off. The resulting welfare gains calculated by applying the formula on a Danish data set are significantly higher than the budgetary losses. The authors find several reasons for this result. One reason is the big share of intrapersonal redistribution in the current Danish welfare state and another one is the potential efficiency gain from a cut of the high effective tax and benefit rates. The same formula is again used to show the improvement of the tradeoff between equity and efficiency. The numerical analysis confirms that the introduction of ISA would be Pareto improving in Denmark.

Fölster (2001) puts the focus on the individuals who end up with a negative balance in an ISA system. This is important because one has to keep in mind that those people have the same labor incentives as in a common tax financed system. They do not have the effort enhancing incentives like individuals with positive account balances as described by Orszag et al. (1999). Fölster (2001) uses actual income panel data from Sweden to compare account balances per deciles according to the final account balance. He finds that 15 to 17 percent of people tend to end up with a negative account balance. In a later examination by Fölster et al. (2002), the result of Fölster (2001) is confirmed using a longitudinal Swedish data set. Comparing these outcomes with the results of Feldstein and Altman (2007) for the U.S., then the values are quite different. Feldstein and Altman (2007) calculate that only 5.2 to 7 percent would end up with negative balances in the U.S. However, they use a different sample of population by excluding individuals who are not able to work at all in their life due to congenital disabilities. Another reason is that the ISA system of Fölster (2001) has a wider scope and includes more types of benefits and public services.

One option giving individuals with bad realization of life risks a realistic chance to have a surplus on their account in the end of their working life, is to implement a debt ceiling. As soon as the debt ceiling is reached, benefits are financed out of general taxes with no consequences for the individual. This debt ceiling can also be observed as an insurance against sickness or long-time spells of unemployment (Poutvaara, 2002).

Criticism on Individual Savings Accounts

Despite the arguments in favor of ISA, Stiglitz and Yun (2005) find that the account system does not guarantee that every individual is better off after the introduction. Individuals with long or frequent spells of unemployment during their working lives can be better off with a system that finances benefits entirely via taxes.

Another criticism refers to the missing constraints of human nature like the possibility of myopia, lack of self-control or other non-rational behavior. As one of the first authors, Stiglitz and Yun (2005) mention the issue of myopic behavior in the context of ISA. Myopia and lack of self-control are reasons for a government to take on a more paternalistic role and force individuals to save for bad times and old age. However, they also argue that even myopic individuals may respond to changes in the near future. The best solution would be to impose a higher repayment burden earlier in the individual's life. Nevertheless, the authors are convinced that ISA are a more attractive alternative than simple cuts in taxes and benefits.

Van Huizen and Plantenga (2011) take on a much more critical position regarding the idea of ISA than all previous authors. The authors use insights from behavioral economic research (e.g. Dalton and Ghosal, 2011 and Dohmen et al., 2010) to evaluate the employment incentives resulting from implementing unemployment accounts. They question the improvement of the employment incentives by pointing out that the effectiveness of ISA depends on two crucial assumptions: expectation of the individuals ending up with a positive balance and how they value their supplement pension. After analyzing the model of Brown et al. (2006), van Huizen and Plantenga (2011) focus especially on the role of time preference. They also introduce a subjective parameter that indicates the expectations of the individual whether the account holder will end up with a positive or negative balance. The result compares the positive incentive effects with the negative effect of forced savings in an exponential discounting model. The result depends crucially on the individual's expectations about the final account balance, the subjective discount factor and the remaining time to retirement. The lower the subjective discount factor the more patient is the individual and the more the internalization effect of ISA increases. The authors also tackle the issues of time-consistent preferences and the lack of self-control. Both effects can increase the preference for immediate rewards instead of waiting for the supplement pension. The authors point out some true difficulties and challenges that accompany the introduction of an ISA system. However, the picture they present shows how individuals behave when crucial factors like discount rates and time preferences are assumed in a rather extreme way.

Another issue mentioned in Sörensen (2003) is the influence on the individuals' behavior. While there are many positive behavioral effects associated with the introduction of ISA, some changes may reduce social welfare by discouraging socially desirable behavior. Hsiao (1995) presents examples from Singapore where medical savings accounts are in place since 1984. While moral hazard problems could have been reduced via partial self-insurance, some important preventive examinations, e.g. necessary vaccinations to reduce the risk of epidemic or endemic diseases, were postponed in some cases to save money. This is where the internalization effect of self-insurance reduces social welfare and changes the individuals' behavior in an unintended way.

Further, there is only limited empirical evidence on ISA in literature because only a few countries, e.g. in Latin America, have introduced savings accounts. Nagler (2013) finds that the introduction of ISA increases the number of individuals exiting their current employment. The author interprets this result as an indicator for higher labor mobility and market flexibility because in the preexisting severance pay scheme, the opportunity costs of an employment change were significantly higher. Reyes Hartley et al. (2011) study the incentive effects to find or leave a job within an ISA system using administrative records of the Chilean agency of the unemployment benefit program. The authors estimate the job-finding rate and provide strong empirical support that ISA improve work incentives and individuals internalize the costs of their unemployment spell. However, they also find that this does not apply to all individuals: For those with an insufficient account balance who rely on a solidarity fund, the moral hazard behavior in seeking a job is the same as in a common fully tax-funded benefit system. Card et al. (2007) support this finding with their result that individuals who can rely on benefits reduce their job-searching effort compared to individuals who are not eligible for unemployment benefits or use their own resources, e.g. from an ISA, while unemployed.

One commonality of all existing publications is that they do not include the possibility of migration. From an individual's perspective, migration gives the possibility to increase the individual lifetime income by migrating to a country with a higher net wage. Further, the question arises what the impacts on the governmental level are. The consequence is that the number of individuals and the share of citizen groups within a country, i.e. employed or (formerly) unemployed, can vary from one period to another and therefore, directly influences the tax income and government's public budget constraint. Hence, the following model is the first one which analyzes the introduction of unemployment accounts in the presence of migration.

1.3 The Model Framework and Individual Perspective

General Framework

First, the assumptions regarding timing and general framework of the model are described. Individuals are born in one of two countries, namely Home or Foreign, and live for three periods. It is assumed that all individuals face a quasilinear utility function, where the utility form is linear in consumption. At the beginning of the first period, individuals in Home and Foreign are exogenously assigned to a job. In the second period, it is assumed that all individuals find a job. If an individual works, she faces labor supply disutility. The disutility from non-leisure time is of quadratic form to allow for an increasing marginal disutility of work and to simplify calculations. The disutility of labor monetarizes all opportunity costs. An employed individual earns the same wage in Home and in Foreign per period. The total gross income depends on the wage rate and the decision how much labor the individual wants to supply. This is an endogenous decision and is determined by the maximization of lifetime income with respect to labor supply and the costs of labor. An employed individual pays a proportional income tax on the gross income. Moreover, the gross income is further reduced by a mandatory contribution rate in both countries if an ISA system is introduced. The contributions are credited to the account. By setting the contribution rate mandatory for all individuals, the governments are paternalistic because they help individuals who lack self-control to smooth their consumption better over time (Bovenberg et al., 2008). The mandatory contributions credited to the account earn interests with the same rate as the discount rate. The rates are equal in both countries and there is no tax on interests. To cover the costs of living and to preserve a certain social minimum standard, the unemployed individual is granted unemployment benefits in both countries. The unemployment benefits received are debited from the account with interest as well. This way, self-insurance is introduced to finance at least a part of the benefits by ISA. It is assumed that the account system is run as a fully funded system. There is no intergenerational connection. Therefore, it is sufficient to observe only one representative generation.

During the first period, individuals live in the country of origin. Before the second period begins, individuals can independently decide where to live for the rest of their life. Individuals decide rationally under the given and anticipated circumstances whether to migrate or not. All individuals will find a job in the second period regardless of their migration decision. The choice of leisure resulting from the labor supply decision in the second period can also be interpreted as an early retirement decision. In the following, the term 'employed' or 'unemployed' refers to the employment situation the individual faces in period one because this is crucial for the account balance in the end of the working life.

In the beginning of every period, individuals learn about the level of their migration costs. Due to the assumption that migration is only possible in the second period, one can assume that migration costs are prohibitively high in period one and three. After finding out their migration costs of the period, individuals decide how much labor to supply in the respective period. The migration costs include all monetarized and discounted costs, factors and preferences that may influence the migration decision, e.g. transportation costs, language or cultural barriers. However, the migration costs can be negative as well. The assumption of different migration costs is realistic and enriches the model with a continuum of heterogeneous types of individuals. The migration costs are debited from the lifetime income in the second period where the migration decision takes place. It is assumed that the two governments do not cooperate, i.e. they neither exchange information about the employment history of immigrants nor compensate each other for the loss of tax income due to migration. Because of this assumption, individuals themselves decide whether to keep their account balances after migration independent of the governments.

After the two working periods individuals enjoy their retirement in period three in the country where they lived in period two. The following figure 1.1 illustrates the described schedule and timing of decisions in the model

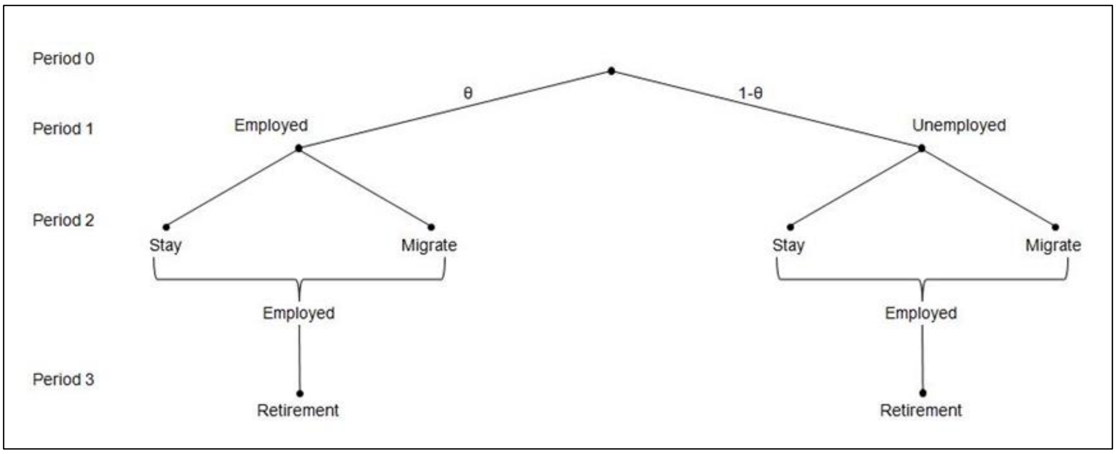

Figure 1.1: Structure of the Model and Timing of Decisions.
Source: Own Illustration.

Individuals who work in both periods naturally end up with a surplus on their account. They receive a refund of their contributions and buy an annuity that supplements their minimum pension payments. This holds also for the contributions made in a country where the individual does not live anymore. Hence, the positive balance on the account always belongs to the individual. In contrast, the individuals who received unemployment benefits in the first period end up with a negative balance on their account after their working life. The savings contributions will not be refunded. The remaining negative account balance is covered by the government which bails out the individuals. This bailout represents the lifetime income insurance and is financed out of general tax revenues. This is where the interpersonal redistribution takes place. If the individual does not manage to accumulate a surplus on her account, the mechanism ensures that the ISA system will work very similar to the current tax and benefit system.

Both types of individuals are fully aware of how their behavior influences their savings account balance and have corresponding expectations about their balance in the end. This is crucial for whether an individual internalizes the total costs of her unemployment spell or not. All individuals can save and borrow money at any time. It is assumed that the individuals keep their lifetime budget balanced, i.e. no Ponzi-scheme is allowed. The total discounted savings have to be equal to the total discounted debts over all three periods. The model neglects an explicit voluntary savings rate to reduce the danger of confusion between mandatory and voluntary savings.

The Labor Supply Decision of Employed Individuals in Home and Foreign

An employed individual born in Home who decides to stay after the first period will earn the following discounted lifetime income over all three periods

$$I_E^H = wl_1^H(1 - t^H - s) - {l_1^H}^2 + \frac{wl_{2E}^H(1-t^H-s)-{l_{2E}^H}^2}{1+r} + \left(\frac{1}{1+r}\right)^2 max\{0;\ s[(1+r)^2 wl_1^H + (1+r)wl_{2E}^H]\}. \quad (1)$$

The indication E stands for the fact that the individual is employed in the first period and H represents the individual who stays at Home, in her country of origin. The gross wage rate w is multiplied by l_1^H which reflects the labor supply decision for the first period. As all individuals provide labor in the second period l_{2E}^H represents the labor supply of formerly employed individuals in the second period. Because labor supply requires effort and the time spent working cannot be used for leisure, the terms ${l_1^H}^2$ and ${l_{2E}^H}^2$ are subtracted representing the costs of work. The gross wage is reduced by the tax rate t^H. If the mandatory savings contribution $s = 0$, no ISA system is implemented. The interest rates are labeled as r and the discount rate $\beta = \frac{1}{1+r}$. The last term of equation (1) represents the discounted ISA balance. All mandatory contributions are included and since the individual is employed in both periods, no benefits are subtracted. Thus, the account balance is definitely positive, if an ISA system is implemented. The contributions are therefore transferred back to the individual in the last period. Thus, equation (1) can be consolidated to

$$I_E^H = wl_1^H(1 - t^H) - {l_1^H}^2 + \frac{wl_{2E}^H(1-t^H)-{l_{2E}^H}^2}{1+r}. \quad (2)$$

The maximization problem

$$\max_{l_1^H;\, l_{2E}^H} I_E^H = wl_1^H(1 - t^H) - {l_1^H}^2 + \frac{wl_{2E}^H(1-t^H)-{l_{2E}^H}^2}{1+r}, \quad (3)$$

delivers the optimal amount of labor supply in period 1 and 2 namely

$$l_1^{H*} = \frac{w(1-t^H)}{2} \text{ and } l_{2E}^{H\ *} = \frac{w(1-t^H)}{2}. \tag{4}$$

Please see Appendix 1.1 for the second-order conditions. The labor supply decisions in the two periods depend solely on the wage and the tax rate in Home in the respective period. With a lower tax rate the labor supply increases. Due to the assumption that the tax rates and the wage rates do not change over time, the two optimal values of labor supply are identical, i.e. $l_1^{H*} = l_{2E}^{H\ *}$.

Now consider an employed individual who decides to emigrate from Home to Foreign after the first period. Emigration is related to discounted and monetarized costs within the interval $c \in \left[\underline{c}; \overline{c}\right]$ which are uniformly distributed with the density equal to one. Equation (5) shows the total lifetime income of an emigrant from Home to Foreign with past employment in period 1

$$I_E^F = wl_1^H(1-t^H-s) - l_1^{H^2} + \frac{wl_{2E}^F(1-t^F-s) - l_{2E}^{F\ 2} - c}{1+r}$$
$$+ \left(\frac{1}{1+r}\right)^2 max\{0;\ [s(1+r)^2 wl_1^H + s(1+r)wl_{2E}^F]\}. \tag{5}$$

In the second period, the individual finds a job in the other country and provides her labor supply l_{2E}^F there. Although, the individual leaves Home after the first period, she keeps her contributions paid in the first period on her account. The account balance is positive and hence, equation (5) can be rewritten as

$$I_E^F = wl_1^H(1-t^H) - l_1^{H^2} + \frac{wl_{2E}^F(1-t^F) - l_{2E}^{F\ 2} - c}{1+r}. \tag{6}$$

The maximization problem delivers the same solution for the optimal labor supply in period one. However, the solution for the optimal value in the second period changes due to the migration decision. The optimal values in the case of migration of an employed individual are

$$l_1^{H*} = \frac{w(1-t^H)}{2} \text{ and } l_{2E}^{F\ *} = \frac{w(1-t^F)}{2}. \tag{7}$$

Again, the second-order conditions can be found in Appendix 1.1. The labor supply decision in the second period depends solely on the wage rate and the corresponding tax rate. The migration costs are incorporated in the total lifetime income of an emigrant (see equation (5) and (6)). However, taking the first derivative of equation (6) with respect to labor supply, then the argument is independent of the migration costs. The two optimal values of the labor supply are only identical, if the tax rates are the same in both countries, i.e. $t^H = t^F$.

The Migration Decision of Employed Individuals in Home and Foreign

An individual decides to migrate if the total discounted lifetime income abroad is higher than the total discounted lifetime income in the country of origin, i.e. $I_E^F > I_E^H$.

Thus, the optimal values in (4) and (7) are inserted in the equation (2) and (6). This delivers a cutoff level of the migration costs $\tilde{c}_E^H$ for employed individuals born in Home

$$\tilde{c}_E^H < \frac{\left(w\left(1-t^F\right)\right)^2-\left(w\left(1-t^H\right)\right)^2}{4}. \qquad (8)$$

If the migration costs of an individual are equal to the cutoff level, she is indifferent between migration and staying. In this situation, it is assumed that the individual decides to stay in the country of origin. However, all individuals with migration costs below this threshold decide to migrate and all individuals with higher costs stay in the country of origin. If the two countries are symmetric and there are no differences with respect to the net wages, then the migration decision depends solely on the individual's migration costs. Hence, the right side of equation (8) is zero and all individuals with negative migration costs decide to emigrate.

An employed individual who is born in Foreign faces a similar problem. Hence, only the cutoff level is presented

$$\tilde{c}_E^F < \frac{\left(w\left(1-t^H\right)\right)^2-\left(w\left(1-t^F\right)\right)^2}{4}. \qquad (9)$$

The Labor Supply Decision of Unemployed Individuals in Home and Foreign

If there is no ISA system implemented, the labor supply and migration decision of unemployed individuals are equal to the employed individuals. This is because the system does not discriminate any individual concerning her employment history. However, if there is an ISA system, the discounted lifetime income of an unemployed individual, who lives in Home and decides to stay there is

$$I_U^H = b + \frac{wl_{2U}^H\left(1-t^H-s\right)-{l_{2U}^H}^2}{1+r}$$
$$+\left(\frac{1}{1+r}\right)^2 max\{0;\ [-(1+r)^2 b + s(1+r)wl_{2U}^H]\}. \qquad (10)$$

U in the subscript stands for the unemployment status in the first period. The unemployed individual receives unemployment benefits b in the first period. Those payments work like a liquidity insurance and are debited to the individual's account balance with interest.

The contributions paid in the second period are credited to the individual's account. This is shown in the last term of equation (10). In contrast to the employed individuals, the account balance of the unemployed individuals is assumed to be negative due to the received benefits in the first period. The afforded contributions do not suffice to cover these debts and therefore, the contributions on the account are not refunded by the government. The general tax revenue covers the remaining debts and bails out the individuals. The last term is then equal to zero. Equation (10) can then be rewritten as

$$I_U^H = b + \frac{wl_{2U}^H(1-t^H-s)-{l_{2U}^H}^2}{1+r}. \tag{11}$$

The maximization problem

$$\max_{l_{2U}^H} I_U^H = b + \frac{wl_{2U}^H(1-t^H-s)-{l_{2U}^H}^2}{1+r} \tag{12}$$

delivers the optimal amount of labor supply in period 2, namely

$${l_{2U}^H}^* = \frac{w(1-t^H-s)}{2}. \tag{13}$$

For the second-order conditions of the maximization problem please see Appendix 1.1. Comparing the labor supply decision in the second period to the employed case shows that the optimal value of labor supply now depends on the mandatory contribution rate s, too. If s increases, the labor supply of formerly unemployed individuals in the second period decreases ceteris paribus. This leads to an increase of distortions for this group of people because the mandatory contribution rate works like an additional tax. Those formerly unemployed individuals face an extra burden as soon as $s > 0$, and thus, their labor supply is always smaller than the labor supply of employed individuals whose labor supply is independent of s. Now consider an unemployed individual who decides to emigrate from Home to Foreign after the first period. Emigration is again related to migration costs c. Equation (14) shows the total lifetime income of an emigrant in this scenario under the assumption of no governmental cooperation

$$I_U^F = b + \frac{wl_{2U}^F(1-t^F-s)-{l_{2U}^F}^2-c}{1+r} + \left(\frac{1}{1+r}\right)^2 max\{0;\ [s(1+r)wl_{2U}^F]\}. \tag{14}$$

As the individual works in Foreign in the second period, the last term considers the contributions paid during this time. The government of Foreign does not care about the benefits received by the individual in another country. This means that individuals are discriminated with respect to their origin when it comes to the refund of contributions. In the situation above, the account balance of the individual is positive and her contributions are refunded, although she received unemployment benefits. Equation (14) can be consolidated to

$$I_U^F = b + \frac{wl_{2U}^F(1-t^F)-{l_{2U}^F}^2-c}{1+r} \tag{15}$$

and the maximization problem delivers the solution for the optimal labor supply in the second period for an unemployed emigrant without cooperation

$${l_{2U}^F}^* = \frac{w(1-t^F)}{2}. \tag{16}$$

See Appendix 1.1 for the second-order conditions. It shows that the labor supply of formerly employed and unemployed emigrants is the same and depends solely on the wage rate and the corresponding tax rate.

The Migration Decision of Unemployed Individuals in Home and Foreign

The unemployed individual decides to migrate if the total discounted lifetime income abroad is bigger than the one at Home. After inserting the optimal values (13) and (16) into the equations (11) and (15), the cutoff level of the migration costs $\tilde{c}_U^H$ for unemployed individuals born in Home is

$$\tilde{c}_U^H < \frac{\left(w\left(1-t^F\right)\right)^2-\left(w\left(1-t^H-s\right)\right)^2}{4} \, . \qquad (17)$$

If a country implements an ISA system, e.g. in Home with $s > 0$, then unemployed individuals have a higher incentive to emigrate. This is called the 'escape effect'. An unemployed individual who is born in Foreign faces again the same problem when it comes to the decision of labor supply and migration. The cutoff level is

$$\tilde{c}_U^F < \frac{\left(w\left(1-t^H\right)\right)^2-\left(w\left(1-t^F-s\right)\right)^2}{4} \, . \qquad (18)$$

As long as there are no ISA, $s = 0$, all individuals in one country face the same cutoff level. If ISA are introduced only in Home or in both countries, then $s > 0$ in the respective country and the new cutoff level is higher than before. Recall that the migration costs are uniformly distributed and all individuals with migration costs below the threshold of the cutoff level emigrate. This means that the introduction of ISA positively influences the emigration decision of formerly unemployed individuals. If a net recipient emigrates to escape from her negative account balance, the migration decision is distorted. Migration motivated by wrong incentives may have welfare reducing effects on the whole economy (Bodvarsson and Van den Berg, 2009). This may increase the incentives for governments to cooperate and support each other with information about the employment history or account balance of individuals.

1.4 The Governments' Tax Rate Decision

In all scenarios, there are governments that take the reaction function of individuals and set the tax rate in their country such that the public budget is balanced. While the savings contribution s is exogenously given, the governments take the lowest possible value for the tax rate. This can be assumed because the objective of the governments is to cover the public expenses and reduce the tax-related distortions under the constraints that all individuals in the country have a certain minimum income level and the public budget always has to be balanced. The punishment for deviation from the tax rate equilibrium or the balanced budget constraint is on a level which prevents governments from doing so. The tax rate of the other country is in each case taken as given.

It suffices to analyze only the budget constraint of the government in Home because the problem for the other government is symmetric if not explicitly pronounced or stated otherwise.

Closed Economy

Before individuals are allowed to migrate, the case of a closed economy is analyzed. If the government runs a fully tax-funded system, the budget equation in Home looks like

$$BC^H = \theta t^H w l_1^H - (1-\theta)b + \frac{\theta t^H w l_{2E}^H + (1-\theta) t^H w l_{2U}^H}{1+r} = 0. \quad (19)$$

The first part of the equation represents the tax payment of the share of individuals who find a job in the first period with probability $\theta \in [0;1]$. With the counter probability $1-\theta$ individuals do not get a job and are unemployed in the first period and receive unemployment benefits b. These are the only expenses of the government in this model and have to be financed out of the governments' tax revenue to keep the public budget balanced. The last fraction represents the public tax revenue in the second period where all individuals find a job and pay taxes. If we insert the optimal levels of labor supply, the budget constraint can be consolidated to

$$BC^H = \frac{w^2 t^H (1-t^H)}{2(1+r)} [\theta(1+r)+1] - (1-\theta)b = 0. \quad (20)$$

If Home now decides to introduce an ISA system, the government's budget constraint in Home looks like

$$BC^H = \theta t^H w l_1^H - (1-\theta)b^H + \frac{\theta t^H w l_{2E}^H + (1-\theta)(t^H + s) w l_{2U}^H}{1+r} = 0. \quad (21)$$

There is only one change now to the previous case without ISA: The savings contributions s are larger than zero and not refunded for formerly unemployed individuals because they face a negative account balance. Thus, the government collects additional tax revenue. If we insert the optimal values of labor supply, then the equation can be simplified to

$$BC^H = \frac{w^2 t^H (1-t^H)}{2(1+r)} [\theta(1+r)+1] + \frac{(1-\theta) w^2 s}{2(1+r)} (1 - 2t^H - s) - (1-\theta)b = 0. \quad (22)$$

The new term $\frac{(1-\theta) w^2 s}{2(1+r)} (1 - 2t^H - s)$ represents the effects of the introduction of ISA. On the one hand, the introduction of ISA brings an additional source of tax revenue due to the non-refunded contributions. This on the other hand reduces the willingness to work of former unemployed individuals. If the respective individuals decide to work less, the public revenue from the labor income tax rate t^H as well as the additional source s decline. The labor supply elasticity does not explicitly show up in this equation because I assumed the disutility from labor to be quadratic. Therefore, I receive a particular elasticity here, namely 1.

It is quite realistic that $1 > 2t^H + s$, if the government's choice of t^H and s are moderate. Thus, one can assume that the term is positive. The introduction of ISA then leads to a lower tax rate compared to the fully tax-funded system in a closed economy. Now, the analysis continues in an open economy with the possibility of migration.

Fully Tax-Funded Case in Open Economies (OEs)

First, the fully tax-funded scenario is presented as a starting point for comparison after the introduction of ISA. Assuming the two countries are open economies, the countries are price takers regarding interest and discount rates and take the tax rate of the other country as exogenously given. Further, full symmetry is assumed except for the respective tax rate of each country which is defined by the budget constraints.

If the government runs a fully tax-funded system in the presence of migration, then the budget constraint of Home is

$$BC^H = \theta t^H w l_1^H - (1-\theta)b + \frac{t^H w}{1+r}\left[\alpha_E^H \theta l_{2E}^{HH} + \alpha_U^H (1-\theta) l_{2U}^{HH} + (1-\alpha_E^F)\theta l_{2E}^{FH} + (1-\alpha_U^F)(1-\theta) l_{2U}^{FH}\right] = 0. \tag{23}$$

Since migration is only possible after the first period, nothing changes regarding the first two expressions of the equation. However, migration is possible and takes place before the second period. The resulting share of individuals who were employed in the first period and decide to stay in Home is α_E^H and the share of formerly unemployed individuals who stay is α_U^H. The last two terms in the big brackets are related to the share of formerly employed individuals $(1-\alpha_E^F)$ and a group of formerly unemployed individuals $(1-\alpha_U^F)$ who decide to emigrate from Foreign in the second period. In this case, the shares of employed and unemployed individuals are equal which simplifies the calculations. The shares result from the cutoff levels and Appendix 1.2 shows the definition of all the shares that are used. Inserting all values known and assuming that the wages in the first and second period are the same, the equation can be written as

$$BC^H = \frac{w^2 t^H (1-t^H)}{2(1+r)}\left[\theta(1+r) + 1 + \frac{w^2\left((1-t^H)^2 - (1-t^F)^2\right)}{2}\right] - (1-\theta)b = 0. \tag{24}$$

Compared to the closed economy case, the last term in brackets is new. It represents the difference between the net wage income of a worker in Home and in Foreign. It is positive, if the net wage in Home is higher than in Foreign. Then, the economy has additional tax revenue compared to the closed economy case for two reasons: First, with a higher net income more people have an incentive to move to Home. Second, a higher net income induces more citizens to stay in their country of origin. The taxpayers in Home profit from opening up the economy by a lower tax rate. However, if a symmetric case is assumed, with identical net wages in both countries, then the term is equal to zero. Again, Foreign faces a similar problem.

Although the economies are open now, the migration costs do not play any role in the governments' budget equation. This is because the optimal values of the labor supply decision are equal for all taxpayers. Further, also the share of employed and unemployed individuals who stay in Home is the same, i.e. $\alpha_E^H = \alpha_U^H$. Same holds for the share of employed and unemployed immigrants from Foreign $1 - \alpha_E^F = 1 - \alpha_U^F$. The symmetry of the problem is the reason why the migration costs cancel out.

For details on how this and other budget constraints are derived, see Appendix 1.3.

Introduction of Individual Savings Accounts only in Home in OEs

In this scenario, the government of Home decides to introduce an ISA system. However, Foreign still sticks to the fully tax-financed system.

The budget constraint of the government in Home then looks like the following

$$BC^H = \theta t^H w l_1^H - (1-\theta)b$$
$$+\frac{t^H w}{1+r}[\alpha_E^H \theta l_{2E}^{HH} + \alpha_U^H (1-\theta) l_{2U}^{HH} + (1-\alpha_E^F)\theta l_{2E}^{FH} + (1-\alpha_U^F)(1-\theta) l_{2U}^{FH}]$$
$$+\frac{sw}{1+r}[\alpha_U^H (1-\theta) l_{2U}^{HH}] = 0. \tag{25}$$

The mandatory savings contribution has the same implications as a tax for the formerly unemployed individuals of Home. The last term of the equation above, $\frac{sw}{1+r}[\alpha_U^H(1-\theta)l_{2U}^{HH}]$, is the additional revenue for the government by those individuals because their savings are not refunded in the end of their working life. Further, these individuals also take the savings rate s into account while making their decisions of labor supply and migration. Hence, also the parameters l_{2U}^{HH} and α_U^H are affected due to the introduction of ISA. The positive effect of a higher tax revenue for the government in Home due to an additional source of revenue, is lowered by the indirect effects like a lower labor supply and a higher emigration rate of formerly unemployed individuals. If one inserts the values known and assumes that the wage rates are the same in both periods, the equation above can be rewritten as

$$BC^H = \frac{w^2 t^H (1-t^H)}{2(1+r)}\left[\theta(1+r) + 1 + \frac{w^2\left((1-t^H)^2 - (1-t^F)^2\right)}{2}\right] - (1-\theta)b$$
$$+\frac{(1-\theta)w^2 s}{2(1+r)}\left[(1-2t^H - s)\left(\bar{c} + \frac{w^2\left((1-t^H-s)^2 - (1-t^F)^2\right)}{2}\right)\right]$$
$$-\frac{(1-\theta)w^2 s}{2(1+r)}\left[\frac{w^2 t^H(1-t^H)(2-2t^H-s)}{4}\right] = 0 \tag{26}$$

The impact of the introduction of ISA is visible in the second row in the positive effect of additional tax revenue of formerly unemployed individuals who stay in Home in the second period with the incorporated negative effect of a lower labor supply which reduces the general tax revenue. The last row represents the effect of emigration of formerly unemployed individuals who no longer pay their taxes t^H in Home because they want to escape from their negative balance. The so called 'escape effect' reduces the positive effects of the introduction of ISA in the presence of migration, if $2 > 2t^H + s$, i.e. this term is positive. Then, the whole term of the last row in equation (26) is subtracted from the government's budget.

Now, there is an asymmetric problem for the two governments. Therefore, the budget constraint of Foreign is presented separately

$$\begin{aligned} BC^F &= \theta t^F w l_1^F - (1-\theta)b \\ &\quad + \tfrac{t^F w}{1+r}\left[\alpha_E^F \theta l_{2E}^{FF} + \alpha_U^F (1-\theta) l_{2U}^{FF} + (1-\alpha_E^H)\theta l_{2E}^{HF} + (1-\alpha_U^H)(1-\theta) l_{2U}^{HF}\right] \\ &= 0 \end{aligned} \tag{27}$$

Inserting the optimal values and known shares, leads to a new situation because the two countries run different systems

$$\begin{aligned} BC^F &= \tfrac{w^2 t^F (1-t^F)}{2(1+r)}\left[\theta(1+r) + 1 + \tfrac{w^2\left((1-t^H)^2 - (1-t^H)^2\right)}{2}\right] - (1-\theta)b \\ &\quad + \tfrac{(1-\theta)w^2 s}{2(1+r)}\left[\tfrac{w^2 t^F (1-t^F)(2-2t^H-s)}{4}\right] = 0 \end{aligned} \tag{28}$$

At first sight, the equation resembles the fully tax-funded case in both countries without cooperation presented in the previous scenario. However, the budget equation of Foreign is affected by the introduction of an ISA system in Home. The expression in the second row of the equation above represents the higher incentive for formerly unemployed individuals born in Home to immigrate to Foreign. While the government in Home loses taxpayers, which is subtracted in the last row in equation (26), the government in Foreign gain further taxpayers through the implementation of an account system in Home ceteris paribus. Consequently, looking at this effect, it seems that the government of Foreign can profit from a system change in Home compared to the situation where both countries run a fully tax-funded system. However, this positive effect is relatively small compared to the attraction of taxpayers via a lower tax rate in Home resulting from ISA.

Introduction of Individual Savings Accounts in Both Countries in OEs

Let us now assume both countries have introduced an ISA system. The resulting budget constraint of the government in Home then looks like equation (25) from the previous case. However, the migration decision of formerly unemployed immigrants from Foreign is influenced by the introduction of ISA in their country of origin. If all values known are inserted, the difference becomes more obvious in the following budget equation for Home

$$BC^H = \frac{w^2t^H(1-t^H)}{2(1+r)}\left[\theta(1+r)+1+\frac{w^2\left(\left(1-t^H\right)^2-\left(1-t^F\right)^2\right)}{2}\right]-(1-\theta)b$$

$$+\frac{(1-\theta)w^2s}{2(1+r)}\left[(1-2t^H-s)\left(\bar{c}+\frac{w^2\left(\left(1-t^H-s\right)^2-\left(1-t^F\right)^2\right)}{2}\right)\right]$$

$$-\frac{(1-\theta)w^2s}{2(1+r)}\left[\frac{w^2t^H(1-t^H)(2-2t^H-s)}{4}\right]+\frac{(1-\theta)w^2s}{2(1+r)}\left[\frac{w^2t^H(1-t^H)(2-2t^F-s)}{4}\right]=0. \quad (29)$$

The first and second row are identical compared to the situation where only Home introduced an ISA system. The last term in the third line, $\frac{(1-\theta)w^2s}{2(1+r)}\left[\frac{w^2t^H(1-t^H)(2-2t^F-s)}{4}\right]$, represents the impact of the introduction of ISA on the migration decision of individuals from Foreign who did not work in the first period. It is again very probable that $2 > 2t^F + s$ holds and the expression is positive. This means that the introduction of ISA in Foreign brings higher revenue in Home. That is because the individuals with negative balances in Foreign try to escape from their anticipated additional tax burden in the second period, while the formerly unemployed individuals from Home have already done so in the previous case. The same implications apply for the government in Foreign. The budget constraint of Foreign looks very similar. Due to symmetry, one has to exchange only the tax rates to receive the equation. Please find further details regarding the derivation of the different budget constraints in Appendix 1.3.

1.5 Analysis and Numerical Example of the Resulting Tax Rates

This part analyzes the budget constraints of the governments by solving for the respective tax rate in a symmetric and cooperative case. The tax rate ensures that the public budget is balanced and fulfills the constraint of the minimum benefit. The examination of the equations is supported by replacing the variables with exemplary numbers. First, the cases with no migration are analyzed. Then, the open economy case is observed with no ISA and ISA implemented in both countries. The asymmetric case where ISA are only introduced in one country will be subject of the subsequent chapter. Hence, it suffices to analyze the budget equation of one country only because of symmetry.

Closed Economy

Now assume the following values

$w = 15 \qquad b = 20 \qquad \theta = 0.5 \qquad s = 0.15 \qquad r = 0$

Further, an exogenous revenue requirement with $e = 20$ is assumed, in order to receive reasonable tax rates. Given that the distortion in labor supply is increasing in the tax rate, the results would be different otherwise.

Initially, both countries finance their social insurance expenditures only with the help of the tax income. Recall equation (20), the budget constraint of Home can be rearranged to

$$BC^H = {t^H}^2 - t^H + \frac{2\left((1-\theta)b+e\right)(1+r)}{(\theta(1+r)+1)w^2} = 0. \tag{30}$$

From the resulting two solutions for the tax rate only one is plausible, namely the one where the tax rate is zero, if the public expenditures $(1-\theta)b$ are zero. This leads to the following result of the tax rate

$$t^H = 0.2313. \tag{31}$$

Now, Home introduces ISA while migration is still not possible. Remember the budget equation (22) and solve for the tax rate t_{ISA}^H yields

$$BC^H = {t_{ISA}^H}^2 - \left(1 - \frac{2s(1-\theta)}{\theta(1+r)+1}\right) t_{ISA}^H + \frac{2\left((1-\theta)b+e\right)(1+r) - w^2(1-\theta)s(1-s)}{(\theta(1+r)+1)w^2} = 0. \tag{32}$$

After inserting the assumed values, the resulting tax rate t_{ISA}^H is

$$t_{ISA}^H = 0.1907. \tag{33}$$

By introducing ISA, the tax rate can be reduced by 17.5 percent with the assumed numbers in the closed economy case. However, the more interesting question is whether the results can be confirmed when migration is possible. Therefore, I continue with the open economy case.

Open Economy

First, the migration cost interval has to be defined. It is assumed that the migration costs are equally distributed within the interval $c \in [-5; 30]$ with the density equal to one. Further, I assume that at first the mandatory contribution rate s is zero and both countries finance their public expenditures only with the help of taxes. By rearranging the budget constraint (24), one can solve the following equation for t^H

$$BC^H = \frac{{w^H}^2 t^H(1-t^H)}{2}\left[\theta + 1 + \frac{1}{\bar{c}-\underline{c}} \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{2}\right]$$
$$-(1-\theta)b^H - e = 0. \tag{34}$$

While equation (34) takes the tax rate t^F as given, now a symmetric cooperative equilibrium of tax rates is assumed. Hence, with the same tax and wage rates the last term in the big brackets, $\frac{1}{\bar{c}-\underline{c}} \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{2}$, is equal to zero. For further details regarding the derivation of the equation, please see Appendix 1.4.

The tax rates which solve the budget equation for the government in Home and Foreign are identical to the ones in the closed economy case, namely

$$t^H = t^F = 0.2313. \tag{35}$$

Due to the symmetric construction of the model, the same tax rates result as in the closed economy case. Only individuals with negative migration costs have an incentive to emigrate. However, the migration shares of immigrants and emigrants offset each other and this is why the result does not changed compared to the closed economy case before.

If both countries introduce ISA, there are effects on the individual labor supply as well as on the migration decision of all individuals as described in the previous parts. As a result of the migration cost and different migration decisions, the baseline budget equation in the open economy (25) has to be adjusted and looks as follows

$$BC^H = \frac{t_{ISA}^H w^2 (1-t_{ISA}^H)}{2}\left[\theta + \theta\frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w\left(1-t_{ISA}^F\right)\right)^2-\left(w\left(1-t_{ISA}^H\right)\right)^2}{4}\right) + \right.$$

$$\theta\left(1 - \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w\left(1-t_{ISA}^H\right)\right)^2-\left(w\left(1-t_{ISA}^F\right)\right)^2}{4}\right)\right) + (1-\theta)$$

$$\left.\left(1 - \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w\left(1-t_{ISA}^H\right)\right)^2-\left(w\left(1-t_{ISA}^F-s\right)\right)^2}{4}\right)\right)\right]$$

$$+\frac{(t_{ISA}^H+s)w^2}{2}\left[\frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w\left(1-t_{ISA}^F\right)\right)^2-\left(w\left(1-t_{ISA}^H-s\right)\right)^2}{4}\right)(1-\theta)(1-t_{ISA}^H-s)\right]$$

$$-(1-\theta)b - e = 0. \tag{36}$$

In this scenario, there are different incentives for formerly employed and unemployed citizens compared to the situation before. The latter group of individuals tries to escape from the negative account balance. However, their decision also depends on the migration costs. Hence, also the government's budget constraint includes terms of migration costs.

By inserting all known variables, the resulting cooperative equilibrium of symmetric tax rates which solve the budget equations for the governments in Home and Foreign are

$$t_{ISA}^H = t_{ISA}^F = 0.2116. \tag{37}$$

If the upper level of the migration costs decrease, i.e. $\bar{c} < 30$, more formerly unemployed individuals decide to migrate. Hence, the tax rates have to increase balancing the governments' budget in a symmetric cooperative equilibrium. If also the lower level of migration costs sinks, i.e. $\underline{c} < -5$, more formerly employed individuals have an incentive to migrate, too. However, this group of individuals does not affect the level of the tax rate as the model is symmetric and the formerly employed immigrants equal the emigrants of the same type of individuals. This is different with asymmetric incentives, e.g. the formerly unemployed individuals in this chapter and in more detail in the next chapter.

Another interesting fact is that the tax rate does not decrease in the same amount as in the closed economy case. While the reduction is about 17.6 percent in the closed economy, it is around 8.5 percent only in the open economy. This is due to the asymmetric incentives and the resulting 'escape effect' of individuals who want to get rid of their negative balance. Countries can solve this issue and provide the same incentives for all individuals with the same employment history by cooperating. This will be analyzed in the next chapter as well.

In summary, one can capture that the tax rate after the introduction of ISA is lower compared to the situation without an account system. This result also holds in the presence of migration depending on the migration costs.

1.6 Conclusion

As the first paper in literature presenting a theoretical model of ISA in the presence of migration, the results give an overview of the mechanisms and related decisions on the individual as well as the governmental level. First, the paper takes the perspective of individuals to analyze how ISA affect the behavior of people in the presence of migration. Due to the assumption of a symmetric world, the individuals' decision to migrate does not depend on the gross wage or the level of unemployment benefits. The net income is determined by the wage rate, tax rate and mandatory savings contributions as well as the labor supply. However, the migration decision depends on the related costs and the expected net wage in the two countries, which can vary, because of different systems. The introduction of ISA directly influences the individual migration decision because individuals with a negative account balance can escape from their debts. Thus, ISA have an important impact on the migration decision especially regarding people with negative accounts. On the other hand, ISA deliver incentives for a higher labor supply by increasing the net wage due to a decrease in tax rate. A lower tax rate and the resulting higher net wage under ISA again attract further immigrants, respectively taxpayers. This is shown by taking the governments' view: The governments aim at a balanced budget by covering social expenditures with tax income and the earnings from the ISA system if implemented. In the theoretical model, I face a symmetric problem regarding population size and unemployment rate. However, one has to keep in mind that the results of the numerical example arise from a cooperative equilibrium and governments do not maximize their budget constraints with respect to the tax rate.

The critics in literature regarding ISA bring up fair points though. Issues like lack of self-control or myopic behavior of individuals have to be controlled for as well as the effects of a forced savings rate. Another aspect to keep in mind is the assumption of the discount rate being equal to the interest rate. This assumption is crucial in order to guarantee the extra pension in the end of a worker's life. Individuals are motivated to have a positive balance on their account to receive this bonus. Therefore, they work and pay contributions. Without relying on this assumption, the entitlement of the government as tax collector and lifetime income insurer is weakened.

Summarizing the results of this paper, the introduction of ISA creates better incentives to supply labor and reduces distortions in the presence of migration for most of the individuals. The labor tax rate can be decreased and therefore it has a lower distortive effect on the individuals' supply of labor. Workers perceive the mandatory savings rate on labor income less as a punishment rather than insurance from a paternalistic government regarding liquidity and individual specific life risks. However, the unintended 'escape effect' of individuals with a negative account balance should be taken into account in more detail under different circumstances in order to find a way to avoid this effect. Hence, the next chapter enriches the research on this topic and expands the presented model by asymmetric countries regarding the level of gross wages, unemployment benefits and mandatory savings rates. Further, it allows the governments to cooperate regarding the tax policy and system choice.

Appendix 1.1 Second-Order Conditions of Individual's Perspective

First, the second-order condition for the optimal labor supply of an employed individual in the closed economy is presented. This belongs to the maximization problem of equation (3) and looks like

$$\frac{\partial I_E^{H^2}}{\partial l_1^{H^2}} = \frac{\partial I_E^{H^2}}{\partial\, {l_{2E}^H}^2} = -2 < 0.$$

Then, the optimal amount of labor supply in period 1 and 2 is a maximum. QED.

Same holds for the maximization problem of an emigrant in equation (6).

Next, the second-order derivative of the labor supply decision of an unemployed individual in the closed economy is checked. Due to unemployment in the first period, only the optimal value for the labor supply in the second period has to be checked. This is

$$\frac{\partial I_U^{H^2}}{\partial {l_{2U}^H}^2} = -2 < 0.$$

Again, the optimal labor supply of an unemployed individual in Home resulting from the maximization problem in equation (12) is a maximum. QED.

The same results hold also for the open economy cases without cooperation and therefore, they are left out.

Appendix 1.2 Results of the Migration Shares

CASE DESCRIPTION	INDIVIDUALS' MIGRATION SHARES
Individuals employed in both periods	Employed individuals in Home: $$\alpha_E^H = \bar{c} - \tilde{c}_E^H = \bar{c} - \frac{\left(w(1-t^F)\right)^2 - \left(w(1-t^H)\right)^2}{4}$$ Employed individuals in Foreign: $$\alpha_E^F = \bar{c} - \tilde{c}_E^F = \bar{c} - \frac{\left(w(1-t^H)\right)^2 - \left(w(1-t^F)\right)^2}{4}$$
Both countries with fully tax-financed budgets	Unemployed individuals in Home: $$\alpha_U^H = \bar{c} - \tilde{c}_U^H = \bar{c} - \frac{\left(w(1-t^F)\right)^2 - \left(w(1-t^H)\right)^2}{4}$$ Unemployed individuals in Foreign: $$\alpha_U^F = \bar{c} - \tilde{c}_U^F = \bar{c} - \frac{\left(w(1-t^H)\right)^2 - \left(w(1-t^F)\right)^2}{4}$$
Individual savings accounts implemented in Home only	Unemployed individuals in Home: $$\alpha_U^H = \bar{c} - \tilde{c}_U^H = \bar{c} - \frac{\left(w(1-t^F)\right)^2 - \left(w(1-t^H-s)\right)^2}{4}$$ Unemployed individuals in Foreign: $$\alpha_U^F = \bar{c} - \tilde{c}_U^F = \bar{c} - \frac{\left(w(1-t^H)\right)^2 - \left(w(1-t^F)\right)^2}{4}$$
Individual savings accounts implemented in Home and Foreign	Unemployed individuals in Home: $$\alpha_U^H = \bar{c} - \tilde{c}_U^H = \bar{c} - \frac{\left(w(1-t^F)\right)^2 - \left(w(1-t^H-s)\right)^2}{4}$$ Unemployed individuals in Foreign: $$\alpha_U^F = \bar{c} - \tilde{c}_U^F = \bar{c} - \frac{\left(w(1-t^H)\right)^2 - \left(w(1-t^F-s)\right)^2}{4}$$

Appendix 1.3 Derivation of the Budget Constraints

CASE DESCRIPTION	BUDGET CONSTRAINTS IN HOME
Closed Economy without ISA	$BC^H = \theta t^H w l_1^H - (1-\theta)b + \frac{\theta t^H w l_{2E}^H + (1-\theta) t^H w l_{2U}^H}{1+r}$ $= \theta \frac{w^2 t^H (1-t^H)}{2} + \frac{w^2 t^H (1-t^H)}{2(1+r)} - (1-\theta)b = 0$ $= \frac{w^2 t^H (1-t^H)}{2(1+r)} [\theta(1+r)+1] - (1-\theta)b = 0$
Closed Economy with ISA	Compared to the case without ISA above the labor supply l_{2U}^H changes and the mandatory contribution rate s is introduced. $BC^H = \theta t^H w l_1^H - (1-\theta)b^H + \frac{\theta t^H w l_{2E}^H + (1-\theta)(t^H+s) w l_{2U}^H}{1+r}$ $= \frac{w^2 t^H (1-t^H)}{2(1+r)} [\theta(1+r)+1] - \frac{(1-\theta) w^2 t^H s}{2(1+r)} + \frac{(1-\theta) w^2 s}{2(1+r)} (1 - t^H - s) - (1-\theta)b = 0$ $= \frac{w^2 t^H (1-t^H)}{2(1+r)} [\theta(1+r)+1] + \frac{(1-\theta) w^2 s}{2(1+r)} (1 - 2t^H - s) - (1-\theta)b = 0$
Open Economy and both countries without ISA	Using the results from the individuals' decisions, $l_{2E}^{HH} = l_{2U}^{HH} = l_{2E}^{FH} = l_{2U}^{FH}$ and $\alpha_E^H = \alpha_U^H$ as well as $(1-\alpha_E^F) = (1-\alpha_U^F)$, the budget constraint of Home can be calculated: $BC^H = \theta t^H w l_1^H - (1-\theta)b$ $+ \frac{t^H w}{1+r} [\alpha_E^H \theta l_{2E}^{HH} + \alpha_U^H (1-\theta) l_{2U}^{HH} + (1-\alpha_E^F)\theta l_{2E}^{FH} + (1-\alpha_U^F)(1-\theta) l_{2U}^{FH}]$ $= \frac{w^2 t^H (1-t^H)}{2(1+r)} \left[\theta(1+r) + 1 + \frac{w^2\left((1-t^H)^2 - (1-t^F)^2\right)}{2}\right] - (1-\theta)b = 0$
Open Economy and ISA implemented in Home only	Compared to the situation without ISA, the variables α_U^H and l_{2U}^{HH} change due to the introduction of ISA and α_U^H can be rewritten as $\alpha_U^H = \bar{c} - \frac{\left(w(1-t^F)\right)^2 - \left(w(1-t^H-s)\right)^2}{4} = \bar{c} - \frac{\left(w(1-t^F)\right)^2 - \left(w(1-t^H)\right)^2}{4} - \frac{w^2 s (2 - 2t^H - s)}{4}$. $BC^H = \theta t^H w l_1^H - (1-\theta)b + \frac{t^H w}{1+r} [\alpha_E^H \theta l_{2E}^{HH} + \alpha_U^H (1-\theta) l_{2U}^{HH} + (1-\alpha_E^F)\theta l_{2E}^{FH} +$ $(1-\alpha_U^F)(1-\theta) l_{2U}^{FH}] + \frac{sw}{1+r} [\alpha_U^H (1-\theta) l_{2U}^{HH}]$ $= \frac{w^2 t^H (1-t^H)}{2(1+r)} \left[\theta(1+r) + 1 + \frac{w^2\left((1-t^H)^2 - (1-t^F)^2\right)}{2}\right] - (1-\theta)b$ $- \frac{(1-\theta) w^2 s t^H}{2(1+r)} \left[\left(\bar{c} + \frac{w^2\left((1-t^H-s)^2 - (1-t^F)^2\right)}{2}\right)\right] + \frac{(1-\theta) w^2 s}{2(1+r)} \left[(1 - t^H - s)\left(\bar{c} + \right.\right.$ $\left.\left.\frac{w^2\left((1-t^H-s)^2 - (1-t^F)^2\right)}{2}\right)\right] - \frac{(1-\theta) w^2 s}{2(1+r)} \left[\frac{w^2 t^H (1-t^H)(2(1-t^H)-s)}{4}\right]$ $= \frac{w^2 t^H (1-t^H)}{2(1+r)} \left[\theta(1+r) + 1 + \frac{w^2\left((1-t^H)^2 - (1-t^F)^2\right)}{2}\right] - (1-\theta)b$ $+ \frac{(1-\theta) w^2 s}{2(1+r)} \left[(1 - 2t^H - s)\left(\bar{c} + \frac{w^2\left((1-t^H-s)^2 - (1-t^F)^2\right)}{2}\right)\right]$ $- \frac{(1-\theta) w^2 s}{2(1+r)} \left[\frac{w^2 t^H (1-t^H)(2-2t^H-s)}{4}\right] = 0$

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Compared to the situation without ISA, only the variables α_U^H changes in the budget constraint of the government in Foreign and can be rewritten similarly to the case above.

$$BC^F = \theta t^F w l_1^F - (1-\theta)b + \frac{t^F w}{1+r}[\alpha_E^F \theta l_{2E}^{FF} + \alpha_U^F (1-\theta) l_{2U}^{FF} + (1-\alpha_E^H)\theta l_{2E}^{HF} + (1-\alpha_U^H)(1-\theta) l_{2U}^{HF}]$$

$$= \frac{w^2 t^F(1-t^F)}{2(1+r)}\left[\theta(1+r) + 1 + \frac{w^2\left((1-t^H)^2-(1-t^H)^2\right)}{2}\right] - (1-\theta)b + \frac{(1-\theta)w^2 s}{2(1+r)}\left[\frac{w^2 t^F(1-t^F)(2-2t^H-s)}{4}\right] = 0$$

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The only variable that changes due to the introduction of ISA in Foreign is α_U^F. The term can be rewritten as $\alpha_U^F = \bar{c} - \frac{\left(w(1-t^H)\right)^2-\left(w(1-t^F-s)\right)^2}{4} = \bar{c} - \frac{\left(w(1-t^H)\right)^2-\left(w(1-t^F)\right)^2}{4} - \frac{w^2 s(2-2t^F-s)}{4}$.

$$BC^H = \theta t^H w l_1^H - (1-\theta)b + \frac{t^H w}{1+r}[\alpha_E^H \theta l_{2E}^{HH} + \alpha_U^H (1-\theta) l_{2U}^{HH} + (1-\alpha_E^F)\theta l_{2E}^{FH} + (1-\alpha_U^F)(1-\theta) l_{2U}^{FH}] + \frac{sw}{1+r}[\alpha_U^H (1-\theta) l_{2U}^{HH}]$$

$$= \frac{w^2 t^H(1-t^H)}{2(1+r)}\left[\theta(1+r) + 1 + \frac{w^2\left((1-t^H)^2-(1-t^F)^2\right)}{2}\right] - (1-\theta)b$$

$$+ \frac{(1-\theta)w^2 s}{2(1+r)}\left[(1-2t^H-s)\left(\bar{c} + \frac{w^2\left((1-t^H-s)^2-(1-t^F)^2\right)}{2}\right)\right]$$

$$- \frac{(1-\theta)w^2 s}{2(1+r)}\left[\frac{w^2 t^H(1-t^H)(2-2t^H-s)}{4}\right] + \frac{(1-\theta)w^2 s}{2(1+r)}\left[\frac{w^2 t^H(1-t^H)(2-2t^F-s)}{4}\right] = 0$$

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<td>Open Economy and ISA implemented in Home and Foreign</td>
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The only variable that changes due to the introduction of ISA in Foreign is α_U^F. The term can be rewritten as $\alpha_U^F = \bar{c} - \frac{\left(w(1-t^H)\right)^2-\left(w(1-t^F-s)\right)^2}{4} = \bar{c} - \frac{\left(w(1-t^H)\right)^2-\left(w(1-t^F)\right)^2}{4} - \frac{w^2 s(2-2t^F-s)}{4}$.

$$BC^H = \theta t^H w l_1^H - (1-\theta)b + \frac{t^H w}{1+r}[\alpha_E^H \theta l_{2E}^{HH} + \alpha_U^H (1-\theta) l_{2U}^{HH} + (1-\alpha_E^F)\theta l_{2E}^{FH} + (1-\alpha_U^F)(1-\theta) l_{2U}^{FH}] + \frac{sw}{1+r}[\alpha_U^H (1-\theta) l_{2U}^{HH}]$$

$$= \frac{w^2 t^H(1-t^H)}{2(1+r)}\left[\theta(1+r) + 1 + \frac{w^2\left((1-t^H)^2-(1-t^F)^2\right)}{2}\right] - (1-\theta)b$$

$$+ \frac{(1-\theta)w^2 s}{2(1+r)}\left[(1-2t^H-s)\left(\bar{c} + \frac{w^2\left((1-t^H-s)^2-(1-t^F)^2\right)}{2}\right)\right]$$

$$- \frac{(1-\theta)w^2 s}{2(1+r)}\left[\frac{w^2 t^H(1-t^H)(2-2t^H-s)}{4}\right] + \frac{(1-\theta)w^2 s}{2(1+r)}\left[\frac{w^2 t^H(1-t^H)(2-2t^F-s)}{4}\right] = 0$$

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Appendix 1.4 Derivation of the Equations in the Analysis and Numerical Example

The two equations of the closed economy cases are of quadratic forms and by inserting all known variables in equation (20) respectively (22) with ISA, the equations (30) respectively (32) result. They can be solved with common algebra.

However, more details may help to better understand the changes in the open economy part. As written in part 5, the definition of the migration costs is based on an assumption. The assumption ensures that the migration costs allow for migration flows between the two countries, i.e. they are not prohibitive and result in reasonable migration shares of the respective types of individuals. The resulting migration costs are $\underline{c} = -5$ and $\overline{c} = 30$. However, the equations have to be expanded by a term including the length of the interval $c \in [\underline{c}; \overline{c}]$ because it no longer holds that the length of the interval is equal to one as assumed in the theoretical model. For a better understanding, the migration cost interval is illustrated below

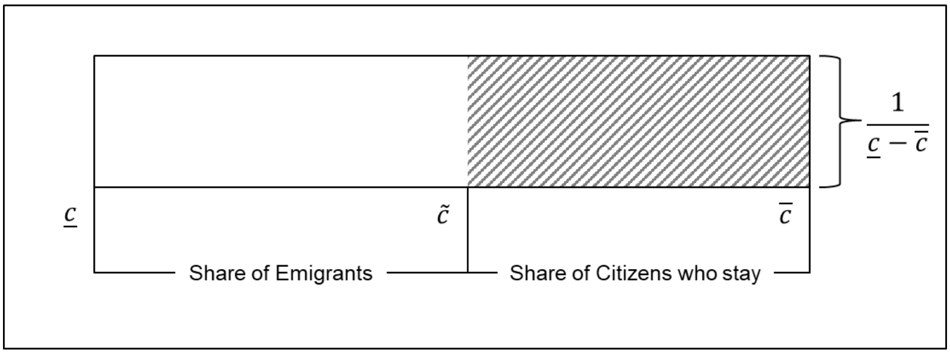

Figure 1.2: Migration Cost Interval with Cutoff Level.
Source: Own Illustration.

Figure 1.2 shows the upper and lower level of the interval and a cutoff level in the middle. It divides the share of emigrants and the individuals who stay in the country of origin. By multiplying the shares with $\frac{1}{\bar{c}-\underline{c}}$, the density of the interval is equal to one.

Hence, the new equation (23) used in the numerical example is

$$BC^H = \frac{w^{H^2} t^H (1-t^H)}{2} \left[\theta + \frac{1}{\bar{c}-\underline{c}} \left(\bar{c} - \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H)\right)^2}{4} \right) + \left(1 - \frac{1}{\bar{c}-\underline{c}} \left(\bar{c} - \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4} \right) \right) \right] - (1-\theta) b^H - e = 0, \qquad (23')$$

and for the government in Foreign it looks like this

$$BC^F = \frac{w^{F^2} t^F (1-t^F)}{2} \left[\theta + \frac{1}{\bar{c}-\underline{c}} \left(\bar{c} - \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4} \right) + \left(1 - \frac{1}{\bar{c}-\underline{c}} \left(\bar{c} - \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H)\right)^2}{4} \right) \right) \right] - (1-\theta) b^F - e = 0. \quad (23'')$$

In the last case of the numerical example, both countries introduce ISA in an open economy scenario. Therefore, equation (25) has to be adjusted. After inserting the migration shares from Appendix 1.2 and the known variables, the equation looks like

$$\begin{aligned} BC^H = {} & \frac{w^{H^2} t^H (1-t^H)}{2} \left[\theta + \theta \frac{1}{\bar{c}-\underline{c}} \left(\bar{c} - \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H)\right)^2}{4} \right) + \right. \\ & \left. \left(1 - \frac{1}{\bar{c}-\underline{c}} \left(\bar{c} - \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4} \right) \right) \right] + \\ & (1-\theta) \frac{w^{H^2} (t^H+s^H)(1-t^H-s^H)}{2} \frac{1}{\bar{c}-\underline{c}} \left(\bar{c} - \right. \\ & \left. \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H-s^H)\right)^2}{4} \right) \\ & - (1-\theta) b^H - e = 0, \end{aligned} \quad (27')$$

and similar for the government in Foreign

$$\begin{aligned} BC^F = {} & \frac{w^{F^2} t^F (1-t^F)}{2} \left[\theta + \theta \frac{1}{\bar{c}-\underline{c}} \left(\bar{c} - \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4} \right) + \right. \\ & \left. \left(1 - \frac{1}{\bar{c}-\underline{c}} \left(\bar{c} - \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H)\right)^2}{4} \right) \right) \right] + \\ & (1-\theta) \frac{w^{F^2} (t^F+s^F)(1-t^F-s^F)}{2} \frac{1}{\bar{c}-\underline{c}} \left(\bar{c} - \right. \\ & \left. \frac{\left(w^H(1-t^H-s^H)\right)^2 - \left(w^F(1-t^F-s^F)\right)^2}{4} \right) \\ & -(1-\theta) b^F - e = 0. \end{aligned} \quad (27'')$$

Again, the length of the migration cost interval, $\bar{c} - \underline{c}$, is used in order to keep the density equal to one.

Chapter 2

Individual Savings Accounts and Cooperation between Asymmetric Countries in the Presence of Migration

2.1 Introduction

The world has grown closer together. Due to globalization and digitalization, you can easily travel from one country to another. In an association of countries like the European Union (EU) the internal national frontiers have even disappeared completely. The absence of border controls in a single market further simplifies cross-country travelling. However, a free and uncontrolled migration policy brings along challenges for the social welfare states in the respective countries. Individual savings accounts (ISA) can be an approach to meet these challenges.

The literature on ISA, mainly based on the early works of Fölster (1997) and Orszag and Snower (1998), analyzes and describes the advantages of ISA especially in the context of unemployment benefits: The intrapersonal part of redistribution is organized in a more efficient way via unemployment accounts. The individuals' account balance shows the contributions, which the individuals add to their personal account, and the received benefits are subtracted. As a result, individuals internalize the total costs of the received unemployment benefits and increase their effort to find or keep a job. However, none of the existing ISA models in literature has ever taken the presence of migration into account, although one can observe increasing migration flows due to free mobility.

With the introduction of an unemployment account system in the presence of migration, questions arise how this will impact individuals' decisions regarding labor supply and migration. Further, also governments' budget constraints are affected by unemployment accounts and migration. How will they change? The previous chapter is an initial approach to find answers to these questions. In this chapter, the focus is on the consequences of the introduction of unemployment accounts in two asymmetric countries and how cooperation influences individuals' and governments' decisions.

One positive effect of ISA is the significant decrease of the tax rate. Especially countries with a high unemployment rate benefit from the introduction of savings accounts. I will show that cooperation in combination with the introduction of ISA can be a good strategy for both governments to deal with low migration costs and the unintended 'escape effect' of individuals with a negative account balance. I will show this with the help of both, a theoretical model and a numerical example.

This paper starts with a description of the general framework followed by an analysis of the individual situation with a continuum of heterogeneous types of individuals. It takes a deeper look into the decisions individuals' make regarding migration and labor supply after the introduction of ISA with cooperation. Further, the budget constraints of the two governments are presented and interpreted followed by a numerical example before concluding the results.

2.2 The General Framework of the Model

The general framework and timing of the model are very similar to the one introduced in the first chapter. However, the main difference from an individual perspective is the asymmetry in the level of wages, unemployment benefits and mandatory savings contributions. Further, the two governments can cooperate which is explained later in further detail.

For a better understanding, I will shortly summarize the main conditions and assumptions: Individuals live for three periods in one of two countries, Home or Foreign. It is assumed that all individuals face a quasilinear utility function, which is linear in income. The probability of finding a job in the first period is assigned exogenously and the population size is equal to one. In the second period, all individuals find a job by assumption. Both variables, population size and unemployment rate, will be asymmetric in the numerical example later on. If an individual is employed, she faces a disutility from working, which is of quadratic form to allow for an increasing marginal disutility of work and to simplify calculations. The disutility of labor monetarizes all possible opportunity costs. Individuals earn a wage for their supplied labor, which differs between the two countries. The individual decides endogenously how much labor she wants to supply. The gross wage is reduced by a proportional income tax depending on the current country of residence of the individual. It is assumed that individuals live in the same country where they find a job. Further, the mandatory contribution rate reduces the gross wage if an ISA system is introduced. However, the contribution rate is credited to the account of the individual. The account balance earns interests in the same amount as the discount rate and the rate is equal in both countries. There is no tax on interests.

Preserving a certain social minimum standard, the unemployed individual receives unemployment benefits that depend on the country of origin. The unemployment benefits are debited from the individual's account with interest. Hence, individuals finance at least part of their received benefits by themselves. There are no intergenerational dependencies because the account system runs as a fully funded system. Thus, only one representative generation has to be observed.

While living in the country of origin in the first period, individuals can independently decide where to live for the rest of their life before the second period begins. They decide rationally under the given conditions whether to migrate or not. In the second period, all individuals find employment. As in the first chapter, I use the term 'employed' or 'unemployed' referring to the employment situation of individuals in the first period.

In case of emigration, individuals face migration costs. The interval is uniformly distributed with the density equal to one. The migration costs consist of all monetarized and discounted costs influencing the migration decision. The interval of different migration costs enables the analysis of a continuum of heterogeneous types of individuals. The migration costs are subtracted from the lifetime income in the second period.

The assumption of cooperation between the governments further distinguishes this model from the one in the previous chapter. This means that the governments exchange information about the employment history of migrants and compensate each other for the loss of tax income of emigrated net recipients. Hence, individuals cannot escape from their negative balance by migration. As before, individuals with a positive balance keep their account after migration as well.

In the last period, individuals enjoy retirement in the country they recently lived in. In contrast to individuals who are employed in both periods, individuals who received unemployment benefits end up with a negative account balance. The government pays for the remaining sum that is not covered by the non-refunded contributions. This governmental bailout is an interpersonal redistribution and works like a lifetime income insurance. However, individuals with a positive balance receive a refund of their contributions in form of a supplement pension payment.

Further, individuals keep their lifetime budget balanced, i.e. no Ponzi-scheme allowed. Both types of individuals have rational expectations about their balance in the end. Thus, they internalize the total costs of their unemployment spell. All individuals are allowed to save and borrow money voluntarily. Therefore, it suffices to maximize the available discounted lifetime income for the individuals' optimal labor supply. However, the model does not include an explicit voluntary savings rate to avoid confusion between mandatory and voluntary savings rates.

2.3 The Individual Perspective

The Labor Supply Decision of Employed Individuals

First, I solve for the optimal labor supply of an employed individual in a closed economy in Home. The lifetime income of an individual is

$$I_E^H = w_1^H l_1^H (1 - t^H - s^H) - {l_1^H}^2 + \frac{w_2^H l_2^H (1 - t^H - s^H) - {l_2^H}^2}{1+r} + \left(\frac{1}{1+r}\right)^2 max\{0;\ s^H[(1+r)^2 w_1^H l_1^H + (1+r) w_2^H l_2^H]\}. \quad (1)$$

The label E indicates that the individual is employed in the first period and H stands for Home, her country of origin and residence in the second period. The gross wage in Home w^H is reduced by the local tax rate t^H and the mandatory contribution rate s^H. The term l_1^H is the labor supply decision for the first period respectively l_2^H for the second period. Of course, labor supply requires effort, therefore ${l_1^H}^2$ and ${l_2^H}^2$ are subtracted representing the costs of work. The discount and interest rate is labeled as r. Equation (1) also holds for an employed individual born in Home who decides to stay after the first period in an open economy. Hence, the following results hold as well in an open economy for employed individuals.

With $s^H = 0$, there is no ISA system implemented. However, if $s^H > 0$, the last term of equation (1) is positive and represents the discounted ISA balance. In the last period, the individual receives her contributions back. Hence, equation (1) is consolidated to

$$I_E^H = w_1^H l_1^H (1 - t^H) - {l_1^H}^2 + \frac{w_2^H l_2^H (1-t^H) - {l_2^H}^2}{1+r}. \tag{2}$$

The following maximization problem is

$$\max_{l_1^H;\, l_2^H} I_E^H = w_1^H l_1^H (1 - t^H) - {l_1^H}^2 + \frac{w_2^H l_2^H (1-t^H) - {l_2^H}^2}{1+r} \tag{3}$$

and delivers the optimal amount of labor supply in period 1 and 2 namely

$$l_1^{H^*} = \frac{w_1^H (1-t^H)}{2} \text{ and } l_2^{H^*} = \frac{w_2^H (1-t^H)}{2}. \tag{4}$$

Please check Appendix 2.1 for the second-order conditions. The optimal solutions show that the labor supply decision depends solely on the wage and the tax rate in Home in both periods. If the wage rates are constant over time, then the labor supply is identical, i.e. $l_1^{H^*} = l_2^{H^*}$. Further, labor supply increases with a higher wage and a lower tax rate.

Now, consider the case of an employed individual who emigrates from Home to Foreign before the second period. An employed emigrant from Home to Foreign has a total lifetime income of

$$I_E^F = w_1^H l_1^H (1 - t^H - s^H) - {l_1^H}^2 + \frac{w_2^F l_2^F (1-t^F-s^F) - {l_2^F}^2 - c}{1+r}$$
$$+ \left(\frac{1}{1+r}\right)^2 max\{0;\ [s^H (1+r)^2 w_1^H l_1^H + s^F (1+r) w_2^F l_2^F]\}. \tag{5}$$

As a result that the individual finds a job in the second period, she supplies the labor force l_2^F and earns the wage rate w_2^F in Foreign. Further, she pays taxes t^F and contributions s^F. The migration costs are uniformly distributed within the interval $c \in [\underline{c}; \overline{c}]$ and subtracted from the income. As already mentioned, the individual keeps the contributions she made on her account. Again, the account balance is positive and the individual lifetime income can be consolidated to

$$I_E^F = w_1^H l_1^H (1 - t^H) - {l_1^H}^2 + \frac{w_2^F l_2^F (1-t^F) - {l_2^F}^2 - c}{1+r}. \tag{6}$$

The labor supply for an employed emigrant results from the maximization of equation (6) with respect to l_1^H and l_2^F. It delivers the following optimal values

$$l_1^{H^*} = \frac{w_1^H (1-t^H)}{2} \text{ and } l_2^{F^*} = \frac{w_2^F (1-t^F)}{2}. \tag{7}$$

Again, the second-order conditions can be found in Appendix 2.1. Both optimal values depend only on the wage rate and the corresponding tax rate. The migration costs c reduce the lifetime income in the second period but do not play a role for the labor supply decision. The solutions in equation (7) are only equal, if the net income after tax is the same in both countries, i.e. $w_1^H(1-t^H) = w_2^F(1-t^F)$.

The Migration Decision of Employed Individuals

The level of migration costs where an individual decides to migrate arises from the fact that the total discounted lifetime income abroad is bigger than the total discounted lifetime income in the country of origin, i.e. $I_E^F > I_E^H$, in consideration of the individual's migration costs. This means if one inserts the optimal values of equations (4) and (7) in the equations (2) and (6), it delivers a cutoff level of the migration costs $\tilde{c}_E^H$ for an employed individual from Home which is

$$\tilde{c}_E^H < \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H)\right)^2}{4}. \tag{8}$$

The individual will stay in the country of origin if the migration costs are equal or higher than the cutoff level. Conversely, all individuals with migration costs below this level will emigrate. The problem is very similar for an employed individual who is born in Foreign. Hence, the resulting cutoff level is

$$\tilde{c}_E^F < \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4}. \tag{9}$$

The Labor Supply Decision of Former Unemployed Individuals

Let us now turn to the unemployed individuals: Equation (10) shows the discounted lifetime income of an unemployed individual, who lives in Home and decides to stay there

$$I_U^H = b^H + \frac{w_2^H l_2^H(1-t^H-s^H) - {l_2^H}^2}{1+r}$$
$$+ \left(\frac{1}{1+r}\right)^2 max\{0;\ [-(1+r)^2 b^H + s^H(1+r)w_2^H l_2^H]\}. \tag{10}$$

The label U indicates the unemployment spell in the first period. Preserving a social minimum standard for all citizens, the government grants unemployment benefits b^H in the first period. Those payments are recorded on the individual's account balance with interest and work like a temporary liquidity insurance.

Although the unemployed individual pays contributions in the second period, the account balance is negative due to the received benefits of the first period. The contributions can shoulder only part of the debts. Consequently, the contributions on the account are not refunded. The government covers the remaining debts financed by general tax revenue. The last term of equation (10) is then equal to zero and it can be consolidated to

$$I_U^H = b^H + \frac{w_2^H l_2^H (1-t^H-s^H) - {l_2^H}^2}{1+r}, \tag{11}$$

with the resulting maximization problem

$$\max_{l_2^H} I_U^H = b^H + \frac{w_2^H l_2^H (1-t^H-s^H) - {l_2^H}^2}{1+r}, \tag{12}$$

which provides the optimal level of labor supply in period 2

$${l_2^H}^* = \frac{w_2^H (1-t^H-s^H)}{2}. \tag{13}$$

Please see Appendix 2.1 for the second-order conditions. The optimal labor supply decision of formerly unemployed individuals looks similar to the solution for employed individuals. However, it depends also on the mandatory contribution rate s^H which distorts the decision. With larger s^H, the labor supply is reduced and the individuals are less willing to work ceteris paribus. If $s^H > 0$, the labor supply of unemployed individuals is lower than the one of employed individuals.

Considering cooperation between the two governments means inter alia that they exchange information about the employment history. Individuals who have a job in both periods are not affected by the status of cooperation. This is different for the former unemployed individuals because they face a negative account balance. Imagine now an ISA system is introduced in one country, namely Home, but not in the other one which holds on to the fully tax-funded system. Then, the lifetime income of a former unemployed emigrant from Home looks like

$$I_U^F = b^H + \frac{w_2^F l_2^F (1-t^F) - {l_2^F}^2 - c}{1+r} + \left(\frac{1}{1+r}\right)^2 max\{0;\ [-(1+r)^2 b_1^H]\}. \tag{14}$$

Due to cooperation, the individual ends up with a negative account balance because the governments exchange information about the employment status. However, there are no contributions in a fully tax-funded system and so there is no possibility of discrimination regarding the refund of contributions. Therefore, the government in Home pays for the social expenditures from the first period and the last term of equation (14) is zero. Then, equation (14) can be rewritten as

$$I_U^F = b^H + \frac{w_2^F l_2^F (1-t^F) - {l_2^F}^2 - c}{1+r} \tag{15}$$

and the optimal labor supply of the emigrant results from the corresponding maximization problem and is

$${l_2^F}^* = \frac{w_2^F (1-t^F)}{2}. \tag{16}$$

For the second-order conditions of the maximization problem please see Appendix 2.1.

The Migration Decision of Unemployed Individuals

Again, in a fully tax-funded system, the labor supply of formerly employed and unemployed emigrants is equal. If the lifetime income abroad is larger than at Home, then the individual decides to migrate. Putting the optimal values (13) and (16) into the consolidated equations (11) and (15), generates the cutoff level for unemployed individuals born in Home when the government in Foreign does not run an ISA system

$$\tilde{c}_U^H < \frac{\left(w^F(1-t^F)\right)^2-\left(w^H(1-t^H-s^H)\right)^2}{4}. \tag{17}$$

Hence, individuals can escape from their negative balances even under cooperation. However, the situation is different for unemployed individuals emigrating from Foreign to Home. Under cooperation, they are treated in Home like a formerly unemployed citizen and their contributions s^H are not refunded in the third period. Instead, the government of Home transfers them to Foreign as a compensation for the unemployment benefits paid in the first period. The lifetime income of a formerly unemployed individual born in Foreign who decides to migrate after the first period under cooperation looks as follows

$$I_U^H = b^F + \frac{w_2^H l_2^H(1-t^H-s^H)-{l_2^H}^2}{1+r} + \left(\frac{1}{1+r}\right)^2 max\{0;\ [-(1+r)^2 b^F + s^H(1+r)w_2^H l_2^H]\}. \tag{18}$$

The benefits b^F received in Foreign in the first period are debited to the individuals' account even though the individual emigrated. This leads to a negative balance and the maximization of the lifetime income yields the individual's optimal labor supply

$${l_2^H}^* = \frac{w_2^H(1-t^H-s^H)}{2}. \tag{19}$$

Consequently, formerly unemployed individuals from Foreign decide to emigrate in the presence of cooperation only if their migration costs are below the following cutoff level

$$\tilde{c}_U^F < \frac{\left(w_2^H(1-t^H-s^H)\right)^2-\left(w_2^F(1-t^F)\right)^2}{4}. \tag{20}$$

The cutoff level is different from the one in the absence of cooperation due to the non-refunded mandatory savings rate in Home, which directly influences the migration decision.

In the final case, ISA systems are implemented in both countries under cooperation. Thus, the mandatory savings contributions of both countries play a role in the respective labor supply decisions. They also influence the cutoff level of migration costs, which determines the share of individuals who migrate or stay in the country of origin. In this scenario, the cutoff level of the migration costs for a formerly unemployed individual from Home looks like

$$\tilde{c}_U^H < \frac{\left(w_2^F(1-t^F-s^F)\right)^2-\left(w_2^H(1-t^H-s^H)\right)^2}{4}. \quad (21)$$

Conversely, the cutoff level for unemployed individuals from Foreign is very similar

$$\tilde{c}_U^F = -\tilde{c}_U^H < \frac{\left(w_2^H(1-t^H-s^H)\right)^2-\left(w_2^F(1-t^F-s^F)\right)^2}{4}. \quad (22)$$

Due to the assumption that individuals can migrate after the first period only, differences in unemployment benefits do not directly influence the migration decision of the individual. However, differences in the rate of unemployment benefits between the two countries may influence the tax rate or the mandatory savings rate of the respective country. The transfers to unemployed individuals as well as their bailout have to be financed out of the general revenue of the government. The government earns revenue from the labor tax and the non-refunded mandatory savings contributions of the formerly unemployed. Thus, the amount of benefits or government expenses determine the total tax burden of individuals and therefore indirectly also the individual's labor supply and migration decision.

2.4 The Governments' Tax Rate Decision

In all scenarios, it is assumed that governments take the reaction function of individuals into account and set the tax rate in their country to balance the public budget. The mandatory savings contribution is exogenously given. Balancing the distortions for employed and unemployed individuals, the values of the mandatory contribution rate and the tax rate are both strictly positive. The governments' main objective is to preserve a certain minimum income level for all individuals and keep the public budget balanced. The lowest possible tax rate is chosen such that the public expenses are covered and the tax-related distortions are reduced to a minimum. Further, the tax rate of the other country is taken as given. There is no deviation from the balanced budget constraint or the cooperative equilibrium of tax rates due to high penalties. This means that I introduce a strong assumption regarding the behavior of the two countries. By assuming that they do not optimize when choosing their tax rates and both do not behave differently from what is expected, I assume no out-of-equilibrium responses and therefore, I constraint strategic interactions to a minimum, i.e. a cooperative solution only. However, the advantage is that I can show the mechanism and impact of an ISA system with a major focus.

Closed Economy

Before allowing for migration, the closed economy case is presented. Running a fully tax-funded system, the budget equation of the government in Home looks like

$$BC^H = \theta t^H w_1^H l_1^H - (1-\theta)b^H + \frac{\theta t^H w_2^H l_{2E}^H + (1-\theta)t^H w_2^H l_{2U}^H}{1+r} = 0. \quad (23)$$

The equation consists of three terms: The first one shows the tax payment of the employed individuals $\theta \in [0;1]$ in the first period. The other individuals are unemployed and receive unemployment benefits b^H represented in the second term. These social expenses have to be financed via tax revenue. The last term shows the tax revenue of the second period where all individuals receive a salary subject to labor income tax. Inserting the optimal values of labor supply and assuming constant wages over time, yields the budget constraint

$$BC^H = \frac{w^{H^2} t^H (1-t^H)}{2(1+r)} [\theta(1+r)+1] - (1-\theta) b^H = 0. \tag{24}$$

The budget constraint now consists only of two terms: First, tax revenue of the first two periods and second, public spending. However, the budget constraint in Home changes after the introduction of an ISA system to

$$BC^H = \theta t^H w_1^H l_1^H - (1-\theta) b^H + \frac{\theta t^H w_2^H l_{2E}^H + (1-\theta)(t^H + s^H) w_2^H l_{2U}^H}{1+r} = 0. \tag{25}$$

The change in the equation seems to be quite small, but has a crucial impact: Every worker has to pay the savings contribution rate s^H, which is larger than zero and not refunded for formerly unemployed individuals. This works like an additional tax and source of public income for the government. Assuming constant wage rates over time and using the optimal values to consolidate the equation, it follows

$$BC^H = \frac{w^{H^2} t^H (1-t^H)}{2(1+r)} [\theta(1+r)+1] + \frac{(1-\theta) w^{H^2} s^H}{2(1+r)} (1 - 2t^H - s^H)$$
$$-(1-\theta) b^H = 0. \tag{26}$$

Compared to the previous case, there is a new term $\frac{(1-\theta) w^{H^2} s^H}{2(1+r)} (1 - 2t^H - s^H)$, which represents the change resulting from the introduction of ISA. While ISA yields an additional source of tax revenue for the government, this in turn reduces the labor supply of former unemployed individuals because of the non-refunded contributions. A lower labor supply again decreases the public revenue from labor tax t^H and non-refunded contributions s^H. However, if $1 > 2t^H + s^H$, i.e. the term is positive, then the introduction of ISA results in a lower tax rate than in a fully tax-funded system ceteris paribus.

Fully Tax-Funded Case in Open Economies

Now, I assume that the two countries allow for migration. The two open economies take the tax rate of the other country as given. First, I present the fully tax-funded scenario as a starting point for comparison.

If the governments decide to cooperate, they exchange information about the employment history of emigrants and compensate their partner country for recipients of unemployment benefits who decide to leave their country of origin. For this group of formerly unemployed migrants, the country receives the full tax payments to simplify the calculations. The budget constraint of the government in Home running a fully tax-financed system in the presence of migration looks as follows

$$BC^H = \theta t^H w_1^H l_1^H - (1-\theta)b^H + \frac{t^H w_2^H}{1+r}[\alpha_E^H \theta l_{2E}^{HH} + \alpha_U^H(1-\theta)l_{2U}^{HH} + (1-\alpha_E^F)\theta l_{2E}^{FH}] + \frac{t^F w_2^F}{1+r}(1-\alpha_U^H)(1-\theta)l_{2U}^{HF} = 0. \quad (27)$$

We now have four shares of individuals which are each represented by α together with their respective labor supply l. There is the share of people α_E^H who were employed in the first period and decide to stay in Home and the share of formerly unemployed individuals who stay α_U^H. The last term in the big brackets is the share of formerly employed individuals who decide to emigrate in the second period, $(1-\alpha_E^F)$. The last term of the equation is the tax revenue from formerly unemployed emigrants from Home represented by the share $(1-\alpha_U^H)$ in the second period which is exchanged for the tax revenue of the formerly unemployed immigrants from Foreign. Those individuals work in Foreign and pay taxes, which are transferred to the country of origin due to the benefits received in the first period. The shares result from the cutoff levels and are presented in Appendix 2.2.

If one assumes that the wages in the first and second period are the same and inserts all the known values, the equation can be written as

$$BC^H = \frac{{w^H}^2 t^H(1-t^H)}{2(1+r)}\left[\theta(2+r) + (1-\theta)\bar{c} + (1+\theta)\frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4}\right] + \frac{{w^F}^2 t^F(1-t^F)}{2(1+r)}\left[(1-\theta)\left(1-\bar{c}+\frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H)\right)^2}{4}\right)\right] - (1-\theta)b^H = 0. \quad (28)$$

One can see that the migration costs cancel out if ${w^H}^2 t^H(1-t^H) = {w^F}^2 t^F(1-t^F)$. The compensation payment in the second row is multiplied by the factor $1-\theta$ because the governments are only compensated for former unemployed individuals under cooperation. Hence, with the help of cooperation the uncertainty for the governments' budget constraint resulting from migration due to differences in net wages can decline.

Foreign faces a similar problem with the same implications as for the government in Home because the two countries run the same system.

Introduction of Individual Savings Accounts only in Home in Open Economies

In the following scenario, the governments decide for different systems: The government of Home decides to introduce an ISA system, while Foreign holds on to the fully tax-financed system.

In the case where countries run different systems, it is very difficult to determine the right amount of compensation payments under cooperation. One option is that Foreign receives the sum of taxes and non-refunded contributions of the formerly unemployed immigrants from Home. In return, Foreign transfers all tax revenues of the emigrants from Home who did not work in the first period. The budget constraint of the government in Home under cooperation then looks like

$$BC^H = \theta t^H w_1^H l_1^H - (1-\theta) b^H + \frac{t^H w_2^H}{1+r} [\alpha_E^H \theta l_{2E}^{HH} + \alpha_U^H (1-\theta) l_{2U}^{HH} + (1 - \alpha_E^F) \theta l_{2E}^{FH}] + \frac{s^H w_2^H}{1+r} [\alpha_U^H (1-\theta) l_{2U}^{HH}] + \frac{t^F w_2^F}{1+r} [(1-\alpha_U^H)(1-\theta) l_{2U}^{HF}] = 0. \quad (29)$$

While nothing changes in the first period, there are additional revenues from formerly unemployed citizens in the second period. The last term shows the compensation payment from Foreign for the share of formerly unemployed emigrants from Home, $1-\alpha_U^H$. If one assumes that the wages are constant over time and inserts all values known, the equation can be written as

$$BC^H = \frac{w^{H^2} t^H (1-t^H)}{2(1+r)} \left[\theta(2+r) + (1-\theta)\bar{c} + (1+\theta) \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4} \right] + \frac{(1-\theta) w^{F^2} t^F (1-t^F)}{2(1+r)} \left[1 - \bar{c} - \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4} \right] - (1-\theta) b^H + \frac{(1-\theta) w^{H^2} s^H}{2(1+r)} \left[(1 - 2t^H - s^H) \left(\bar{c} + \frac{\left(w^H(1-t^H-s^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4} \right) \right] - \frac{(1-\theta) w^{H^2} t^H (1-t^H)}{2(1+r)} \left[\frac{w^{H^2} s^H}{4} (2 - 2t^H - s^H) \right] = 0 \quad (30)$$

The consolidated budget constraint of the government in Home is rather similar to the budget constraint before the introduction of ISA. The difference can be found in the third and fourth line of the equation. The effect of the introduction of ISA under cooperation is ambiguous and depends on the net wages of the two countries as well as the migration costs. The last line of the equation shows the migration effect of formerly unemployed individuals from Home. As described in the previous chapter, it is very probable that $2 - 2t^H - s^H > 0$. Then, the whole term is positive and subtracted.

This term is also visible in the consolidated budget constraint of Foreign's government running a fully tax-funded system in the presence of cooperation

$$BC^F = \frac{w^{F^2} t^F (1-t^F)}{2(1+r)} \left[\theta(2+r) + (1-\theta)\bar{c} + (1+\theta) \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H)\right)^2}{4} \right] + \frac{(1-\theta) w^{H^2} (t^H + s^H)(1-t^H)}{2(1+r)} \left[\left(1 - \bar{c} + \frac{\left(w^H(1-t^H-s^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4} \right) \right] + \frac{(1-\theta) w^{F^2} t^F (1-t^F)}{2(1+r)} \left[\frac{w^{H^2} s^H}{4} (2 - 2t^H - s^H) \right] - (1-\theta) b^F = 0. \quad (31)$$

While the first line is identical to the fully tax-funded system, the compensation term in the second line of the equation above is expanded by the non-refunded mandatory savings contribution s^H. The system change in Home also affects formerly unemployed individuals from Foreign and changes their decisions respectively. The change in migration incentives is shown in the brackets of the second row as well as in the third line. First, the governments receives a relatively high compensation for formerly unemployed emigrants of the amount $t^H + s^H$ presented in line two. The more formerly unemployed individuals decide to migrate from Foreign to Home, the higher the compensation payment in the second row. Second, as citizens who are formerly unemployed in Home have a higher incentive to emigrate than other individuals, the additional inflow is presented in the third line. It is a similar term which is subtracted from the budget equation (30) from the government in Home which is now added.

Introduction of Individual Savings Accounts in Both Countries in Open Economies

In the final case both countries introduce an ISA system. It is assumed that the governments exchange the non-refunded mandatory savings contributions s^H respectively s^F as compensation payments. The budget constraint of Home looks as follows

$$\begin{aligned}BC^H &= \theta t^H w_1^H l_1^H - (1-\theta) b^H + \\ &\frac{t^H w_2^H}{1+r}[\alpha_E^H \theta l_{2E}^{HH} + \alpha_U^H (1-\theta) l_{2U}^{HH} + (1-\alpha_E^F)\theta l_{2E}^{FH} + (1-\alpha_U^F)\theta l_{2U}^{FH}] + \\ &\frac{s^H w_2^H}{1+r}[\alpha_U^H (1-\theta) l_{2U}^{HH}] + \frac{s^F w_2^F}{1+r}[(1-\alpha_U^H)(1-\theta) l_{2U}^{HF}] = 0. \qquad (32)\end{aligned}$$

There are significant changes in this equation compared to the one in the previous scenario. First, the tax payments of former unemployed immigrants from Foreign are back again in the budget constraint. In contrast to the previous case, governments exchange only the non-refunded contribution payments. Hence, the government in Home receives only the non-refunded mandatory contribution s^F as compensation from Foreign. Beside these two obvious changes in the equation, there are also modifications and adjustments in the individuals' decisions which are presented previously in more detail. If all these values are inserted and the wages are assumed to stay constant over time, the budget constraint above can be rewritten as

$$\begin{aligned}BC^H &= \frac{{w^H}^2 t^H (1-t^H)}{2(1+r)}\left[\theta(2+r) + \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{2}\right] - (1-\theta) b^H + \\ &\frac{(1-\theta){w^H}^2 s^H (1-t^H-s^H)}{2(1+r)}\left[\bar{c} + \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4}\right] +\end{aligned}$$

$$\frac{(1-\theta){w^F}^2 s^F(1-t^F-s^F)}{2(1+r)}\left[1-\bar{c}-\frac{\left(w^H(1-t^H)\right)^2-\left(w^F(1-t^F)\right)^2}{4}\right]-$$
$$\frac{(1-\theta){w^H}^2 t^H(1-t^H)}{2(1+r)}\left[\frac{{w^H}^2 s^H(2-2t^H-s^H)}{2}-\frac{{w^F}^2 s^F(2-2t^F-s^F)}{2}\right]-$$
$$\frac{(1-\theta){w^H}^2 t^H s^H}{2(1+r)}\left[1+\frac{\left(w^H(1-t^H-s^H)\right)^2}{2}-\frac{\left(w^F(1-t^F-s^F)\right)^2}{2}\right]=0. \qquad (33)$$

The consolidated budget constraint of Home consists of five different parts. The first part in the first line represents the tax revenue from the income tax rate t^H which is paid by all four groups of workers in Home. The public expenses for the unemployed benefits in the first period are presented in the first row followed by the expression of the additional revenue for the government in Home via the non-refunded mandatory savings contributions of original citizens with negative balances on their accounts who decide to stay in their country of origin in the second row. The term in the third line is the compensation payment transferred by the government in Foreign to the government in Home for the share of individuals who did not work in the first period and then migrated from Home to Foreign. The fourth row presents the effect of the introduction of ISA on the migration decision. If one assumes that $2 > 2t^H + s^H$ and $2 > 2t^F + s^F$ which is very probable, then this term has a positive effect on the budget constraint if ${w^H}^2 s^H(2-2t^H-s^H) < {w^F}^2 s^F(2-2t^F-s^F)$. In contrast, if the two expressions are of the same size, then the migration decision of formerly unemployed individuals in Home and Foreign has no effect on the budget constraints. The fact that the formerly unemployed individuals are treated equally in both countries and cannot escape from their negative account balance weakens the incentive of migration for this specific type of individuals. The fifth row shows how the introduction of ISA in both countries reduces the incentive to work for formerly unemployed individuals. Consequently, their optimal labor supply is lower than under a fully tax-funded system ceteris paribus. As the labor supply of formerly employed individuals only depends on the tax rate, which is shown in part 2.3, their labor supply increases with a decreasing tax rate. This effect is already included in the budget equations. Further, the other country's budget constraint is again very similar. One has to exchange the labels for Home and Foreign to receive the equation.

An interesting fact about the two budget equations of Home and Foreign concerns the migration costs. If ${w^F}^2 s^F(1-t^F-s^F) = {w^H}^2 s^H(1-t^H-s^H)$ holds, then the migration costs in the second and third line of the budget equations cancel out. While the goal was to set better incentives for migration with the help of cooperation, the budget constraints can additionally be independent of the individuals' migration costs if their net wages and policy instruments are identical. This is an important result considering that one of the aims of the EU is to create one single internal market for commodities, services and labor supply. The single market within the EU allows all European citizens to work in a country of their choice with no visa requirements. This includes per se that the migration over borders of member countries is not different to the movement between two cities of the same country. Another goal is that all EU citizens are treated equally and independent of their origin within the EU. With the help of ISA under cooperation, both goals can be realized and guaranteed.

2.5 Numerical Example

The numerical example is used to illustrate the theoretical findings and give an exemplary result. This way the individuals' behavior and governments' budget equations can be observed in more depth. Moreover, the numerical example is necessary because there is only limited access to empirical data for introduced ISA systems, e.g. Singapore or China. Further, there is no ISA system in place within the EU. Thus, I chose this methodology to combine the fundamental framework of the theoretical model with current empirical figures using the approach of a steady state analysis. This example analyzes and confirms the following hypotheses:

Hypothesis 1: *After the introduction of ISA, the tax rate can be reduced in the closed and open economy compared to the fully tax-funded case.*

Hypothesis 2: *The country with the higher unemployment rate benefits more from the presence of ISA and cooperation.*

Hypothesis 3: *It is better for both countries to introduce ISA simultaneously.*

In order to start a numerical example analyzing the effects of the introduction of ISA in the presence of migration, I use data from Eurostat of Germany and France. Thus, I receive two asymmetric countries regarding the wage rate, population size and public expenditures. However, I would like to point out that the resulting tax rates are not comparable to real world and are only used as an exemplary illustration.

For the equations of Home in the theoretical model I use German data and French data for Foreign. Both budget constraints are set equal to zero. No country is allowed to make debts or exploit citizens by taxing more than it needs to cover social spending. The only variable the governments can determine is the tax rate. Each country sets the tax rate in order to receive a balanced budget. This means that the governments do not optimize. They just set budget-balancing tax rates in a cooperative equilibrium. It is assumed that both governments hold on to this equilibrium and do not deviate. In contrast to the theoretical framework, the population size and unemployment rate is no longer equal between the two countries which enriches the analysis. Beside this, nothing else changes concerning timing and setup of the model as presented in the theoretical part.

The data come from the homepage of the statistical office of the EU, 'Eurostat'. At the time, the data were retrieved, the latest complete data set available for all observed countries dated back to the year 2017. One may argue using values of one specific year is not representative. However, the main idea of this numerical example is to show the effect of introducing ISA in different scenarios ceteris paribus. Because all hypotheses assume that everything but the tax rate stays equal, the phrase "ceteris paribus" is valid for all the hypotheses but not mentioned separately in every case.

The amount of potential workers in each economy consists of employed workers (Eurostat, 2021a) and the registered unemployed workers (Eurostat, 2021b). Of course, the sum of the two parts is lower than the total population size. This is because children, retirees and disabled individuals are not counted into the number of potential workforce. Further, women or men can voluntarily decide not to participate in the working market.

The expenditure side includes unemployment benefits that are issued as share of the GDP (Eurostat 2021c). In order to find the absolute sum of expenditures on unemployment, the GDP level of 2017 is needed (Eurostat 2021d). However, there are other social security payments and additional public expenditures. Therefore, an exogenous revenue requirement e is added in both countries with the amount of 10 billion, generating realistic levels of tax rates in the closed economy scenario without individual accounts. The governments face these costs and have to cover them by implementing a labor income tax rate t^Hrespectively t^F. The tax rates are the only unknown variable and are determined endogenously by setting the governments' budget constraint equal to zero. In contrast, the mandatory savings rate s^H respectively s^F is chosen exogenously and set equal, $s^H = s^F = 0.15$.

Workers earn on average a certain gross wage, which can also be found on the homepage of 'Eurostat' (Eurostat, 2021e). This value includes the wage level as well as the working time or labor supply which individuals offer. Hence, the average gross wage of a worker combines them both, i.e. $w^{H/F}\ l^{H/F}$. By solving the tax rates in the baseline scenario of the closed economy case, the wage rate and labor supply can be divided and the wage rate is used separately and constantly over time in all other cases. For more details see Appendix 2.3.

Finally, the migration cost interval $\left[\underline{c};\overline{c}\right]$ is needed in an open economy. Due to a lack of empirical data this interval has to be assumed. The interval is chosen in order to ensure migration and receive reasonable results. Of course this does not allow for any comparison between the closed and open economy case. However, the focus is on the change resulting from the introduction of savings accounts in an open economy. Holding the interest and discount rate at the same level, simplifies the calculations and allows putting the focus on the remaining effects. This way the paper follows common literature and model designs concerning ISA. Please see Appendix 2.3 for more details and explanations on the underlying math of the numerical example.

Results and Analyses of the Numerical Example

The tax rates of the two countries which solve the public budget equations presented in part four are

Scenario		**Tax Rate in Home**	**Tax Rate in Foreign**
Closed Economy	(1a) Without ISA	$t^H = 0.17147$	$t^F = 0.31926$
	(1b) With ISA	$t^H = 0.16685$	$t^F = 0.30958$

Table 2.1: Results in the Closed Economy

Scenario		**Tax Rate in Home**	**Tax Rate in Foreign**
Open Economy with Cooperation	(2a) Without ISA	$t^H = 0.17160$	$t^F = 0.31964$
	(2b) With ISA only in Home	$t^H = 0.16720$	$t^F = 0.31777$
	(2c) ISA in both Countries	$t^H = 0.16678$	$t^F = 0.30955$

Table 2.2: Results in the Open Economy with Cooperation

Although the observed scenarios change, all other values stay the same except for the respective tax rates. This means that the tax rate works as an indicator of how the change of the situation affects the governments' budgets.

Analyzing the two tables above immediately reveals that the introduction of ISA goes along with a reduction of the tax rate in each country and for every scenario compared to the fully tax-funded situation. The tax rate is lower in a country, if the government decides to run an ISA system. This is the main advantage from a taxpayer view and holds in the presence of migration, too. Therefore, hypothesis 1 is true. The efficient redistribution and reduction of distortions is a fundamental and very important argument in favor of ISA.

Another interesting fact for countries with a relatively high unemployment rate is that with the help of ISA the tax rate decreases more than in other countries with less unemployment in absolute as well as in relative terms. This holds for all presented scenarios. For instance, if I take the closed economy case: The introduction of ISA in Home reduces the tax rate by 2.70 percent, while in Foreign the same step decreases the tax rate by 3.03 percent. Similar results appear by comparing the case in the open economy. Here, the tax rate drops in Home by 2.81 percent and in Foreign by 3.16 percent. The reason why the country with the higher unemployment level profits more is that there are relatively more people who shoulder at least part of their own social costs. Thus, hypothesis 2 is also confirmed. An interesting side effect is that it leads to a convergence of the tax rates of the two countries.

After revealing that the introduction of ISA can be a beneficial strategy, I analyze whether its introduction is the best reaction to the other country's system choice in the presented situations. In other words, if Home decides to introduce ISA, what is the best choice of Foreign when the reduction of tax rate related distortions is the goal. This can be found by comparing the scenarios (2b) and (2c): If one country chooses to run an account system, the tax rate of the other country can be reduced even more by opting for the introduction of ISA as well. Hence, hypothesis 3 holds in the exemplary case. It is more beneficial for both countries to introduce ISA simultaneously than sticking to a fully-tax funded system when the goal of the governments is to reduce the tax rate by keeping the budget balanced in a cooperative equilibrium of tax rates.

2.6 Conclusion

This paper presents the first theoretical model and a numerical example on ISA with asymmetric countries in the presence of migration. The introduction of ISA influences the behavior of individuals when it comes to their labor supply and migration decision. On the one hand, ISA can help to reduce the tax rate. This in turn has a positive effect on the time individuals spend on the job and increases the attractiveness for people to immigrate or continue to live in a country with the now lower taxes. However, the introduction of ISA can also lead to a negative effect regarding individuals with a negative account balance in the end of their working life. From the perspective of these individuals the mandatory savings contribution distorts the migration and labor supply decision because contributions are not refunded.

Cooperation between the two countries means that the governments exchange information on the employment history and transfer compensation payments to cover part of the social expenditures of emigrated benefit recipients. Comparing the results from an individual's and general point of view, cooperation leads to an equal treatment of individuals no matter where they are from. The equal treatment of citizens is an important pillar of the EU and its single market. The results of ISA under cooperation are in line with this claim. Moreover, cooperation in combination with the introduction of ISA in both countries decreases the possibility to escape from negative account balances. Thus, it provides a more efficient allocation and reduces distortions of the migration and labor supply incentives. However, even under cooperation there is a way how individuals can escape from their negative balance and avoid the additional tax: If the individual emigrates to a country which has not implemented an ISA system, there is no possibility to discriminate this individual with regards to the tax rate.

The two governments target a balanced budget and want to preserve a certain minimum income level for all individuals. Another objective of the governments is to reduce the tax rate respectively the related distortions. In the theoretical model, there is a symmetric problem regarding population size and unemployment rate. The budget equations also show that migration costs can cancel out even in the presence of cooperation. However, this depends on certain assumptions. After the introduction of ISA in both countries, the budget constraint under cooperation consists of five parts: First, there is the general tax revenue from all current residents in Home. Then, there is the additional public revenue from the non-refunded contributions from former unemployed citizens staying in Home. Another important element of cooperation is the compensation payment from Foreign for emigrated former unemployed individuals. The last two parts are indirect effects on the public budget resulting from behavioral changes regarding the migration and labor supply decision of individuals.

The numerical example confirms the results and is necessary due to the lack of empirical data. The calculations with concrete data from Germany and France show that ISA can significantly reduce the tax rate. Both countries gain the most from introducing an ISA system simultaneously. However, the unemployment abundant country profits more from an introduction of ISA. Moreover, this leads to a convergence of the tax rates of the two countries in this exemplary case.

Further, compensation payments are part of the cooperation between governments. They reduce the incentives and possibilities of governments to compete in a policy which targets the attraction of more taxpayers by underbidding the other country's tax rate. This is especially interesting in the context of a confederation like the EU. Hence, the introduction of ISA can avoid incentives for tax competition among member countries due to increased interdependencies. The question whether it can be beneficial in general, e.g. with governments optimizing their objective functions and interacting strategically, is left open for further research. Only the cooperative equilibrium is presented with budget-balancing tax rates.

Overall, this chapter shows that the introduction of ISA can be also beneficial in the context of asymmetric countries and under cooperation. From an economic point of view, cooperation provides better incentives for all individuals. However, cooperation itself cannot avoid the 'escape effect' of individuals with negative account balances; the introduction of ISA is needed as well. Thus, the policy advice for governments is to introduce ISA systems simultaneously and to cooperate as equal partners.

Appendix 2.1 Second-Order Conditions of Individual's Perspective

First, the second-order condition for the optimal labor supply of an employed individual in the closed economy is presented. This belongs to the maximization problem of equation (3) and looks like

$$\frac{\partial I_E^{H^2}}{\partial l_1^{H^2}} = \frac{\partial I_E^{H^2}}{\partial\, l_{2E}^{H^{\;2}}} = -2 < 0.$$

Then, the optimal amount of labor supply in period 1 and 2 is a maximum. QED.

Same holds for the maximization problem of an emigrant in equation (6).

Next, the second-order derivative of the labor supply decision of an unemployed individual in the closed economy is checked. Due to unemployment in the first period, only the optimal value for the labor supply in the second period has to be checked. This is

$$\frac{\partial I_U^{H^2}}{\partial\, l_{2U}^{H^{\;2}}} = -2 < 0.$$

Again, the optimal labor supply of an unemployed individual in Home resulting from the maximization problem in equation (12) is a maximum. QED.

The same results hold also for the open economy cases and therefore, they are omitted.

Appendix 2.2 Results of the Migration Shares

CASE DESCRIPTION	WITH COOPERATION
Individuals employed in both periods	Employed individuals in Home: $\alpha_E^H = \bar{c} - \tilde{c}_E^H = \bar{c} - \frac{\left(w_2^F(1-t^F)\right)^2 - \left(w_2^H(1-t^H)\right)^2}{4}$ Employed individuals in Foreign: $\alpha_E^F = \bar{c} - \tilde{c}_E^F = \bar{c} - \frac{\left(w_2^H(1-t^H)\right)^2 - \left(w_2^F(1-t^F)\right)^2}{4}$
Both countries with fully tax-financed budgets	Unemployed individuals in Home: $\alpha_U^H = \bar{c} - \tilde{c}_U^H = \bar{c} - \frac{\left(w_2^F(1-t^F)\right)^2 - \left(w_2^H(1-t^H)\right)^2}{4}$ Unemployed individuals in Foreign: $\alpha_U^F = \bar{c} - \tilde{c}_U^F = \bar{c} - \frac{\left(w_2^H(1-t^H)\right)^2 - \left(w_2^F(1-t^F)\right)^2}{4}$
Individual savings accounts implemented in Home only	Unemployed individuals in Home: $\alpha_U^H = \bar{c} - \tilde{c}_U^H = \bar{c} - \frac{\left(w_2^F(1-t^F)\right)^2 - \left(w_2^H(1-t^H-s^H)\right)^2}{4}$ Unemployed individuals in Foreign: $\alpha_U^F = \bar{c} - \tilde{c}_U^F = \bar{c} - \frac{\left(w_2^H(1-t^H-s^H)\right)^2 - \left(w_2^F(1-t^F)\right)^2}{4}$
Individual savings accounts implemented in Home and Foreign	Unemployed individuals in Home: $\alpha_U^H = \bar{c} - \tilde{c}_U^H = \bar{c} - \frac{\left(w_2^F(1-t^F-s^F)\right)^2 - \left(w_2^H(1-t^H-s^H)\right)^2}{4}$ Unemployed individuals in Foreign: $\alpha_U^F = \bar{c} - \tilde{c}_U^F = \bar{c} - \frac{\left(w_2^H(1-t^H-s^H)\right)^2 - \left(w_2^F(1-t^F-s^F)\right)^2}{4}$

Appendix 2.3 Derivation of the Equations in the Numerical Example

The source Eurostat (2021a) delivers the potential workforce aged between 20 and 64 years per country. I assume an equal distribution regarding the amount of individuals as well as the level of public spending per generation. As the theoretical model focuses on one representative generation only, I divide the number of potential workforce by n=44 years to receive the workforce per generation.

Further, I divide the interval from 20 to 64 years in two equal working periods of 22 years each and focus on one generation. In period 1, there is a risk of unemployment and in period 2 all individuals are employed as assumed in the theoretical model. As there is no unemployment in the second period, the unemployment rate in period 1 is double the size than the official report says and zero in period 2. On average, the unemployment rate then results in the official reported numbers again.

In the closed economy case, the amount of individuals in the economy stays constant over time and all individuals have the same labor supply, if there is no ISA system implemented. This allows dividing the expenditures equally over all taxpayers of the respective generation in each of the two working periods. The average income is the base for the labor tax and given by Eurostat (Eurostat, 2021e).

Separating the wage rate from labor supply requires some calculations

$$average\ income = \frac{w_1^H l_1^{H^*} + w_2^H l_2^{H^*} + w_2^H l_{2U}^{H\ *}}{3} = \frac{w^{H^2}(1-t^H)}{2}$$

$$\xrightarrow{yields} w^H = \sqrt{\frac{2}{(1-t^H)} average\ income}$$

This results in the wage rate of 300.48 Euro in Germany and 305.31 Euro in France. These values are used for all other cases allowing for an endogenous labor supply decision.

For the introduction of ISA in the closed economy, case (1b), equation (26) is adjusted and multiplied by the total amount of citizens in the respective country and generation.

When it comes to the open economy cases, the asymmetry of population size holds as well and the equations of the theoretical model are expanded by the size of each generation. Further, the migration costs are defined as in the previous chapter in order to solve for the tax rates. As written in part 2.5, the definition of the migration costs is based on an assumption. The assumption implies that the choice of migration costs allow for mobility between the two countries and ensure reasonable migration shares. The migration cost interval is $\underline{c} = -23{,}000$ and $\overline{c} = 250{,}000$. As before, the equations need to be adjusted by a term including the length of the interval $c \in [\underline{c}; \overline{c}]$ because it no longer holds that the length of the interval is equal to one as assumed in the theoretical model. For a better understanding, the migration cost interval is illustrated and explained in figure 1.2 of Appendix 1.4.

Hence, the new equation (27) used in the numerical example is

$$BC^H = \frac{{w^H}^2 t^H(1-t^H)}{2}\left[CIT_E^H + CIT_{E+U}^H \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^F(1-t^F)\right)^2-\left(w^H(1-t^H)\right)^2}{4}\right) + CIT_E^F\left(1-\frac{1}{\bar{c}-\underline{c}}\left(\bar{c}-\frac{\left(w^H(1-t^H)\right)^2-\left(w^F(1-t^F)\right)^2}{4}\right)\right)\right] + CIT_u^H \frac{{w^F}^2 t^F(1-t^F)}{2}\left[1 - \frac{1}{\bar{c}-\underline{c}}\left(\bar{c}-\frac{\left(w^F(1-t^F)\right)^2-\left(w^H(1-t^H)\right)^2}{4}\right)\right] - (1-\theta)b^H - e = 0, \quad (27')$$

and for the government in Foreign it looks like this

$$BC^F = \frac{{w^F}^2 t^F(1-t^F)}{2}\left[CIT_E^F + CIT_{E+U}^F \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^H(1-t^H)\right)^2-\left(w^F(1-t^F)\right)^2}{4}\right) + CIT_E^H\left(1-\frac{1}{\bar{c}-\underline{c}}\left(\bar{c}-\frac{\left(w^F(1-t^F)\right)^2-\left(w^H(1-t^H)\right)^2}{4}\right)\right)\right] + CIT_u^F \frac{{w^H}^2 t^H(1-t^H)}{2}\left[1 - \frac{1}{\bar{c}-\underline{c}}\left(\bar{c}-\frac{\left(w^H(1-t^H)\right)^2-\left(w^F(1-t^F)\right)^2}{4}\right)\right] - (1-\theta)b^F - e = 0. \quad (27'')$$

In both equations, the number of citizens per generation is represented by the term CIT with the subscript E for formerly employed and U for the formerly unemployed. The superscript H or F indicates again the country of origin.

The adjustments are also necessary in the other two scenarios in the open economy. Then, the equations (29) and (31) are adjusted to

$$BC^H = \frac{{w^H}^2 t^H(1-t^H)}{2}\left[CIT_E^H + CIT_E^H \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^F(1-t^F)\right)^2-\left(w^H(1-t^H)\right)^2}{4}\right) + CIT_E^F\left(1-\frac{1}{\bar{c}-\underline{c}}\left(\bar{c}-\frac{\left(w^H(1-t^H)\right)^2-\left(w^F(1-t^F)\right)^2}{4}\right)\right)\right] + CIT_u^H \frac{{w^H}^2 (t^H+s^H)(1-t^H-s^H)}{2}\frac{1}{\bar{c}-\underline{c}}\left(\bar{c}-\frac{\left(w^F(1-t^F)\right)^2-\left(w^H(1-t^H-s^H)\right)^2}{4}\right) + CIT_u^H \frac{{w^F}^2 t^F(1-t^F)}{2}\left[1-\frac{1}{\bar{c}-\underline{c}}\left(\bar{c}-\frac{\left(w^F(1-t^F)\right)^2-\left(w^H(1-t^H-s^H)\right)^2}{4}\right)\right] - (1-\theta)b^H - e = 0, \quad (29')$$

and

$$BC^F = \frac{w^{F^2} t^F(1-t^F)}{2}\left[CIT_E^F + CIT_E^F \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4}\right) + CIT_E^H \left(1 - \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H)\right)^2}{4}\right)\right) + CIT_u^F \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^H(1-t^H-s^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4}\right)\right] + CIT_u^F \frac{w^{H^2}(t^H+s^H)(1-t^H-s^H)}{2}\left[1 - \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^H(1-t^H-s^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4}\right)\right] - (1-\theta)b^F - e = 0. \qquad (31')$$

In the final case, both countries introduce ISA and equation (32) is adjusted for Home and symmetrically for Foreign. The two equations look like

$$BC^H = \frac{w^{H^2} t^H(1-t^H)}{2}\left[CIT_E^H + CIT_E^H \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H)\right)^2}{4}\right) + CIT_E^F \left(1 - \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4}\right)\right)\right] + CIT_u^H \frac{w^{H^2}(t^H+s^H)(1-t^H-s^H)}{2} \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^F(1-t^F-s^F)\right)^2 - \left(w^H(1-t^H-s^H)\right)^2}{4}\right) + CIT_u^H \frac{w^{F^2} s^F(1-t^F-s^F)}{2}\left[1 - \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^F(1-t^F-s^F)\right)^2 - \left(w^H(1-t^H-s^H)\right)^2}{4}\right)\right] + CIT_u^F \frac{w^{H^2} t^H(1-t^H-s^H)}{2}\left[1 - \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^H(1-t^H-s^H)\right)^2 - \left(w^F(1-t^F-s^F)\right)^2}{4}\right)\right] - (1-\theta)b^H - e = 0, \qquad (32')$$

and for the government in Foreign

$$BC^F = \frac{w^{F^2} t^F(1-t^F)}{2}\left[CIT_E^F + CIT_E^F \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4}\right) + CIT_E^H\left(1 - \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H)\right)^2}{4}\right)\right)\right] + CIT_u^F \frac{w^{F^2}(t^F+s^F)(1-t^F-s^F)}{2}\frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^H(1-t^H-s^H)\right)^2 - \left(w^F(1-t^F-s^F)\right)^2}{4}\right) + CIT_u^F \frac{w^{H^2} s^H(1-t^H-s^H)}{2}\left[1 - \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^H(1-t^H-s^H)\right)^2 - \left(w^F(1-t^F-s^F)\right)^2}{4}\right)\right] + CIT_u^H \frac{w^{F^2} t^F(1-t^F-s^F)}{2}\left[1 - \frac{1}{\bar{c}-\underline{c}}\left(\bar{c} - \frac{\left(w^F(1-t^F-s^F)\right)^2 - \left(w^H(1-t^H-s^H)\right)^2}{4}\right)\right] - (1-\theta)b^F - e = 0. \tag{32''}$$

Chapter 3

Medical Savings Accounts in the Presence of Migration

3.1 Introduction

Many countries struggle with high costs in the medical sector. In Germany, the spending in the health sector measured as share of the GDP increased by 1.5 percentage points from 2000 to 2018 (Gesundheitsberichtserstattung des Bundes, 2020). The trend that health expenditure increases faster than the GDP is common for most of the OECD countries (OECD, 2020). Common cost inflation and the invention of new, cost intensive treatments are among the cost drivers but also an overuse in the statutory health insurance. Some countries privatize parts or even the complete medical sector. Then, individuals are personally responsible for their health care and private companies offer medical supply and health insurance. If private companies have the power to decide who receives insurance protection and at which price, individuals with bad health conditions and low income suffer the most. Elderly and individuals with pre-existing illnesses may only receive health insurance at a prohibitive price if the insurance companies act in a risk minimizing way. A medical savings accounts (MSA) system can provide a statutory health insurance combined with less distortive effects than a fully tax-funded system. The idea of MSA is to reward individuals who pay more contributions than they consume in form of medical goods or treatments. The internalization of the health care costs reduces the incentive to consume more than necessary. Further, the intrapersonal redistribution is more visible for the net payer and transferred back to the individual at a different point of time. Hence, redistribution ex post can be viewed as insurance ex ante. However, there is still an interpersonal part of redistribution which can be financed out of general tax revenue for net recipients. Thus, the MSA system is rather a complement than a substitute for a tax-financed system.

On the other hand, MSA allow for a pooling equilibrium with the same contribution rates, i.e. equal insurance premiums for all insured individuals. This way, MSA ensure liquidity insurance for individuals with low income because they can receive medical treatments today in return for future contributions which smoothes their lifetime consumption. Further, MSA also provide lifetime insurance by bailing out individuals with negative account balances in the end of their working life. Negative balances can be due to bad health conditions or cost-intensive diseases.

This essay presents the first theoretical model on MSA in the presence of migration. The context of migration is important because mobility of labor continuously increases through globalization and more open immigration laws and policies. Consequently, individuals can not only travel but easily work in a country of their choice, for instance within the EU as a citizen of one of the member states. The model will show the effects of the introduction of a MSA system on the individual migration decision. Further, it will show from an individual perspective how the contribution rates influence the endogenous labor supply decision and the demand for health care.

With income-dependent contribution rates, the design and resulting costs of the health care system can be crucial for individuals when they make their residential decision. Of course also the standards and quality of a health care system are decisive reasons for migration. The endogenous migration decision of individuals influences on the other hand the budget equations of the governments. By keeping the public budgets balanced, there are different combinations of the tax rate and the medical contribution rate possible in a symmetric and cooperative case. The analysis will show that all individuals can benefit from the introduction of a MSA system.

This chapter is organized in five major parts: The first part gives an overview on the existing literature on MSA and presents empirical evidence from countries with an implemented MSA system. The second section describes the model on which the analysis is based. It is followed by the individuals' and the governments' perspective in the third respectively fourth part. Finally, different combinations between tax and contribution rates are presented and discussed followed by a conclusion of the results.

3.2 Literature Review on Medical Savings Accounts

One of the first known proposals of MSA in literature comes from Mark Pauly and John Goodman in 1995. They describe an account system, which leads to cost-effective consumer behavior regarding the demand for medical goods and services (Pauly and Goodman, 1995a). They also change the tax treatment of individuals in a way that there are tax credits for purchasing insurance. In combination with the proposal, the authors bring Singapore's empirical experience in focus where Medisave is a mandatory account scheme for medical treatments since 1984. The Singaporean Central Provident Fund was originally created to raise savings and secure the pensions for the elderly (Fölster et al., 2003). Since then, it has been expanded by several other schemes. Two examples are the introductions of the Medishield plan in 1990 for patients with expensive and major illnesses as well as the creation of the Medifund in 1993 for destitute people.

Several other health policy analysts comment the publication of the two authors. One of them is William Hsiao (1995) who presents empirical lessons from Singapore. In his view, the full coverage of benefits leads to a competition on quality and access rather than on prices and creates moral hazard because providers and consumers do not care about the costs of the medical goods. Further, individuals often rely blindly on the advice of their physician because they lack time or medical knowledge to reach a rational decision. This opens the door for providers to reach significant market power, control the demand and set the prices they want. In turn, this leads to higher cost inflation in health care, which Hsiao proves with Singapore's experience and cost development in the health sector. However, the decrease of expenditures is a central argument of MSA from a government's perspective due to a more efficient insurance system (Dixon, 2002).

On the other side, Pauly and Goodman (1995b) respond that the costs in the health sectors rise in every growing economy and the main argument for MSA is to enable Singaporeans to cover their own or at least parts of their medical spending when they are in need of health care. In fact, the Singaporean government spends less on medical services and health care than other developed countries (Barr, 2001). However, Hsiao (2001) is convinced that the Singaporean government can only fulfill the budget constraint of total health expenses by forcing a higher amount of out-of-pocket payments from patients than other countries do. Moon et al. (1996) confirm that out-of-pocket or payments via MSA are a strategy for cost control and create incentives to use less care. Keeler et al. (1988) showed that the annual expenses for health services are 75 percent higher if an individual is fully insured. Cretin et al. (1990) add with respect to examples from China that this result is also valid for other countries. However, out-of-pocket payments or MSA are only efficient and make a difference to full insurance in demand sectors with high or medium price elasticities. In the fields of chronical or cost intensive diseases, the price elasticity of consumers is low and the financial risk for individuals is high (Schreyögg, 2002).

Regarding the danger of moral hazard, Pauly and Goodman (1995b) state that the health system in Singapore is designed to give consumers the financial incentives to avoid wasteful spending and become diligent demanders of medical goods. Further, MSA are a viable way to support the demographic change. This requires a high participation rate as well as a high financial volume. Both is given in the Singaporean system at the moment. Other positive effects are the creation of a capital stock which may be used for (national) investments and thus induces growth of the (national) economy. MSA also increase the sovereignty of consumers and ensure a higher transparency regarding the costs of medical treatments (Schreyögg, 2003).

Nichols (1995) shifts the focus from the avoidance of tax distortions to the distortions in the insurance market due to adverse selection and risk segmentation. If all individuals shoulder their costs, then individuals with higher risks have to pay more and lose from a MSA system, e.g. the ones in old age or people with chronical illnesses. In contrast, Pauly and Goodman (1995b) argue that risk segmentation may even decrease because also low-risk people with no insurance are attracted to the insurance market due to tax subsidies. Further, no risk segmentation is possible in a group insurance where all workers pay the same premium and employers as well as employees share the contributions equally. Finally, risk segmentation is also not possible, if the MSA system is mandatory for everyone as it is in Singapore.

The design of the MSA systems is critical regarding the impact on consumers and governments (Deber and Lam, 2011). Singapore's MSA system often works as a role model. However, the analysis of the system in Singapore for instance is not fully conclusive because of lacking data. One important reason for the apparent success is the strong stewardship and accompanying reforms of the government

(Hanvoravongchai, 2002). One example for this is that Singaporean policymakers emphasize the importance of human resources and foster the development of skills or reskilling ensuring continuous high employment (Asher and Rajan, 2008). The idea behind this is to avoid insufficient balances at retirement and preserve economic security especially for the elderly. In contrast, Pauly and Goodman (1995b) argue more in favor of a neutral government so that individuals can make their own choices based on proper incentives. Wouters et al. (2016) conclude that MSA alone are not able to provide the necessary and adequate financial protection for each individual. There has to be some other safety net for low-income individuals, people with chronical illness or high medical expenses for other reasons.

Beside Singapore, there are other countries with experiences regarding MSA. Many authors compared the systems and pointed out differences. Schreyögg (2004) sees the development of two different directions: On the one side, there is Singapore with a compulsory enrolment and therefore a very high coverage of the population who all pay income-dependent contributions. On the other side, there are voluntary concepts like those of the United States or South Africa that cover only a small part of the populations. In these countries private insurance companies offer a supplement to public insurance and collect premiums based on risk calculations. In China, MSA is mandatory but only conducted as a pilot project for selected urban conurbations. There are other nations like Canada, Australia, UK as well as some European countries who have not introduced a MSA system yet but discuss the possibility across different political parties and interest groups (Deber and Lam, 2011; Richardson and McAulty, 2005; Thomson et al., 2010 and Goldsworthy, 2014).

By now, no literature exists about a concrete theoretical model of a MSA system. Neither is there an analysis about the impact of the presence of migration on individuals' decisions in this regard. With such migration possibilities as of today, e.g. within the Schengen area in Europe, the impact on all individual decisions including migration should be taken into account. Therefore, I developed the following model showing the theoretical mechanisms of MSA. The model shows the incentives of individuals regarding their expectations and gives policy recommendations for governments with respect to the optimal mix of tax and contribution rates.

3.3 Description and General Framework of the Model

The baseline model is identical to the theoretical models in the previous chapters expanded by MSA and without unemployment accounts. Now, imagine the world consists of two countries, Home and Foreign, and individuals are born in one of them. Individuals face a quasilinear utility function, where the utility form is linear in consumption by assumption. In the beginning of their working life, they have no possibility to migrate. Individuals find a job with an exogenous probability. In the second period, it is assumed that all individuals find a job. Employed individuals earn a gross wage per period which can differ between the two countries. The individual's gross income depends on the wage rate as well as the decision how much labor the individual wants to supply. All individuals face a quasilinear utility function, where the utility form is linear in income and quadratic in labor supply disutility or non-leisure time to allow for an increasing marginal disutility from working and for simplicity. The individuals' income is subject to a proportional income tax depending on the country of residence of the individual. Further, there are mandatory contributions for health insurance in the respective country, if a MSA system is introduced. The unemployed individuals receive unemployment benefits during the jobless spell preserving a social minimum income. The unemployment benefits are fully tax-financed in this model.

With the help of MSA, the individuals can buy medical services and medicine for a given price. The benefits from the consumption of medical goods result from a concave utility function with diminishing marginal returns. There is a satiation point in consumption of medical goods so that consumption is finite even with zero price. Due to the fact that I focus on the static mechanisms of a MSA system in this first theoretical model, there is no uncertainty about the individuals' need for medical goods. This is a major restriction assuming away e.g. the insurance component. Further, health spending is unrelated to productivity. In a richer model, there could be unpredictable health shocks that would also affect productivity. However, I stick to a steady state analysis where individuals have perfect foresight about the future and act accordingly rational. Another assumption regarding medical consumption is that medical expenses during retirement, i.e. in the third period, are financed out of general tax revenue. For simplicity reasons, medical consumption in period three is not explicitly mentioned in the model.

After the first period, there is a unique chance for migration. If individuals decide to emigrate, they stay in the new country for the following two periods, i.e. until the end of their life. In case of migration, individuals face related costs including all monetarized and discounted costs within a uniformly distributed interval with the density equal to one. In case an individual has strong preferences for another country, migration costs can be negative as well. The assumption of different migration costs enriches the model with a continuum of heterogeneous types of individuals. The migration costs reduce the lifetime utility in the second period where migration happens.

In the beginning of the third period, individuals enter the retirement phase of their life. Net payers to the account system naturally end up with a surplus on their account balance. They receive a refund of their contributions and buy an annuity that supplements their minimum pension payments. In contrast, individuals who are net recipients of medical services, end up with a negative balance on their account. The earlier paid contributions will not be refunded. The remaining negative account balance is covered by all taxpayers who bail out the individuals and ensure a lifetime income insurance. In fact, this is an interpersonal redistribution. There is no scenario where a person who is unemployed in period one would pay back the debts. Both individuals, the employed and unemployed, are fully aware of how their behavior influences their savings account balance and act accordingly rational. Their expectations correspond to their actual balance in the end. This assumption is important regarding the internalization effect of the total costs of the consumption of medical goods.

Another important assumption relates to the account balances of individuals in the end of their working life: I assume that the unemployed individuals cannot cover the full costs of their medical consumption because they do not pay contributions in the first period while they receive unemployment benefits. This results in a negative account balance for unemployed individuals. Conversely, individuals who are employed in the first two periods pay enough contributions to cover their own health spending and end up with a positive account balance.

Further, I assume no cooperation between the governments in this model. This means that the governments do not exchange information about the employment history of immigrants. It is assumed that individuals with a positive balance in the first period can keep their account surplus and individuals with a negative balance can get rid of it through migration.

Due to the individual preferences within the model, I refrain from modelling explicit voluntary savings rates. The individuals are indifferent at which point in time they consume. Hence, I abstract from explicit savings and borrowing decisions by assuming a quasi-linear utility function. The only restriction is that each individual's lifetime budget is balanced, i.e. no Ponzi-scheme is allowed. The discount and interest rates are equal to zero in both countries reducing notation and complexity.

3.4 The Individuals' Perspective

Employed Individuals in the Closed Economy

First, the individual's decisions regarding labor supply are defined and the demand of medical goods in a closed economy is analyzed. The individual lifetime utility U_E^H of an employed individual in Home looks like

$$U_E^H = w_1^H l_1^H (1 - t^H - m^H) - {l_1^H}^2 + w_2^H l_{2E}^H (1 - t^H - m^H) - {l_{2E}^H}^2 + \sum_{i=1}^{2} g(x_i) + max\{0;\ m^H (w_1^H l_1^H + w_2^H l_{2E}^H) - \sum_{i=1}^{2} p^H x_i\}. \quad (1)$$

The term $g(x_i)$ is a concave function of the consumption of the medical goods x_i in period i with diminishing marginal returns, i.e. $g'(\ \ ) > 0$ and $g''(\ \ ) < 0$. An employed individual earns a gross wage rate w_1^H and w_2^H in the first respectively the second period in Home per unit of labor supply, l_1^H and l_{2E}^H. The gross income of the individual is subject to the tax rate in Home, t^H, and mandatory contributions to the MSA, m^H. The corresponding costs of labor supply are represented in ${l_1^H}^2$ and ${l_{2E}^H}^2$. The price p^H values every unit of medical goods x_i per period i with $x \in [\underline{x}; \overline{x}]$, where $\overline{x}$ is the satiation point. It is assumed that $p^H \geq 0$. If $m^H = 0$, the result is the same as if there is no account system implemented, i.e. the fully tax-financed case.

It is assumed that the contributions made by this representative employed individual suffice to pay for the cost of the use of medical goods. Hence, the last term of equation (1) is larger than zero and the whole equation can be consolidated to

$$U_E^H = w_1^H l_1^H (1 - t^H) - {l_1^H}^2 + w_2^H l_{2E}^H (1 - t^H) - {l_{2E}^H}^2 + \sum_{i=1}^{2} [g(x_i) - p^H x_i]. \quad (2)$$

The following maximization problem delivers the optimal labor supply for the first and second period

$$\max_{l_1^H;\, l_2^H} U_E^H = w_1^H l_1^H (1 - t^H) - {l_1^H}^2 + w_2^H l_{2E}^H (1 - t^H) - {l_{2E}^H}^2 + \sum_{i=1}^{2} [g(x_i) - p^H x_i]. \quad (3)$$

Then, the optimal amount of labor supply in period 1 and 2 is

$$l_1^{H*} = \frac{w_1^H (1 - t^H)}{2} \text{ and } {l_{2E}^H}^* = \frac{w_2^H (1 - t^H)}{2}. \quad (4)$$

Please see Appendix 3.1 for the second-order conditions. The optimal solutions for labor supply depend only on the wage and the tax rate in Home in both periods. This means that a lower tax rate increases the labor supply, while a lower wage rate leads to a decrease. Further, if we assume a constant wage rate over time, then the labor supply is identical, i.e. $l_1^{H*} = {l_{2E}^H}^*$.

Next, the optimal demand or use of medical goods is calculated with the following maximization problem

$$\max_{x_i} U_E^H = w_1^H l_1^H (1 - t^H) - {l_1^H}^2 + w_2^H l_{2E}^H (1 - t^H) - {l_{2E}^H}^2 + \sum_{i=1}^{2} [g(x_i) - p^H x_i]. \quad (5)$$

The result of the first order condition is

$$\frac{\partial U_E^H}{\partial x_i} = g'(x_i) - p^H = 0. \quad (6)$$

The employed individual will consume the amount of medical goods until the marginal utility of consumption $g'(x_i)$ equals the marginal costs of another unit p^H. Due to the assumption about $g''(\quad) < 0$, the second-order condition confirms the optimal level. This also applies to all of the following optimizations of medical consumption in this chapter.

Unemployed Individuals in the Closed Economy

Now consider the case of an unemployed individual in a closed economy. The lifetime utility U_U^H of an unemployed individual in Home looks like

$$U_U^H = b^H + w_2^H l_{2U}^H (1 - t^H - m^H) - {l_{2U}^H}^2 + \sum_{i=1}^{2} g(x_i) + max\{0;\ m^H w_2^H l_{2U}^H - \sum_{i=1}^{2} p^H x_i\}. \quad (7)$$

The label U stands for the unemployment spell in the first period. The government pays unemployed benefits b^H in the first period as a temporary liquidity insurance and to preserve a social minimum standard for all citizens. The benefits are fully tax-financed.

It is assumed that the last term of equation (7), i.e. the individual's account balance, is negative, although the unemployed individual pays contributions in the second period. This is due to the costs of medical demand in the first two periods. The contributions cover only part of these debts. As a consequence, the contributions on the account are not refunded. The government assumes the liability to pay for the remaining sum financed by general tax revenue. The last term of equation (7) is then equal to zero and the equation can be rewritten as follows

$$U_U^H = b^H + w_2^H l_{2U}^H (1 - t^H - m^H) - {l_{2U}^H}^2 + \sum_{i=1}^{2} g(x_i), \quad (8)$$

The optimal labor supply of an unemployed individual in Home results from the maximization problem

$$\max_{l_{2U}^H} U_U^H = b^H + w_2^H l_{2U}^H (1 - t^H - m^H) - {l_{2U}^H}^2 + \sum_{i=1}^{2} g(x_i), \quad (9)$$

which provides the optimal level of labor supply in period 2

$${l_{2U}^H}^* = \frac{w_2^H (1 - t^H - m^H)}{2}. \quad (10)$$

Please see Appendix 3.1 for the second-order conditions. The optimal labor supply decision of former unemployed individuals now also depends on the mandatory contribution rate m^H which distorts the decision. With larger m^H, the labor supply is reduced and the individuals are less willing to work ceteris paribus. If $m^H = 0$, the labor supply of former unemployed is equal to the one of former employed individuals.

Analyzing the optimal demand of medical goods on the individual's lifetime utility brings up new results from the maximization problem

$$\max_{x_i} U_U^H = b^H + w_2^H l_{2U}^H (1 - t^H - m^H) - {l_{2U}^H}^2 + \sum_{i=1}^{2} g(x_i). \quad (11)$$

The result of the first order condition is

$$\frac{\partial U_U^H}{\partial x_i} = g'(x_i) = 0. \quad (12)$$

The individual with a negative account balance will consume the amount of medical goods until the marginal utility of consumption $g'(x_i)$ equals zero or the satiation point $\overline{x}$ is reached. The following figure will illustrate the results regarding the consumption of medical goods

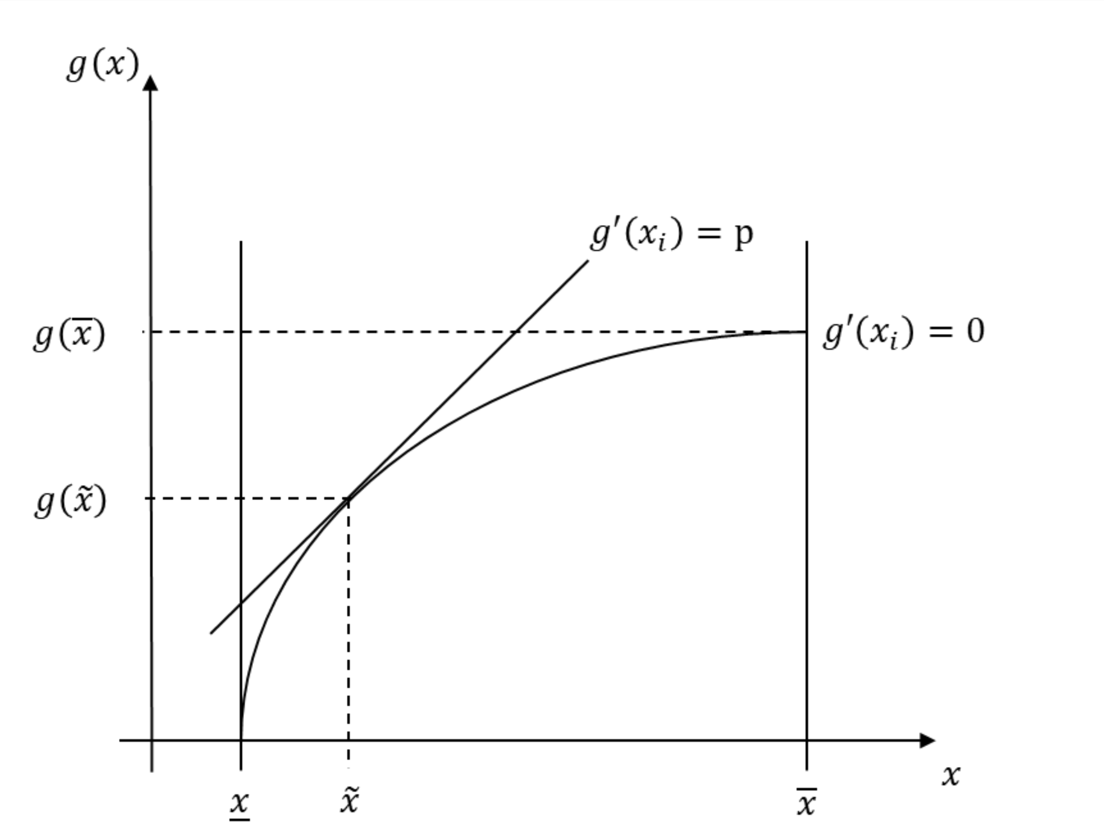

Figure 3.1: The Optimal Consumption of Medical Good x.
Source: Own Illustration.

Due to the negative account balance, the individual faces a moral hazard issue. If individuals do not have to take the full costs of their medical consumption into account, then there is a significant danger of overuse (Institute of Medicine, 2003). The respective individuals will consume until their marginal costs per unit of x is zero. However, employed individuals consume only as much as their marginal utility from consumption is equal to their marginal costs p^H. As long as it holds that $p^H > 0$, employed individuals will consume less, i.e. $\tilde{x} < \overline{x}$. Individuals with unemployment spell certainly have to bear a part of the costs via the tax rate t^H, but with a continuum of taxpayers the effect of own consumption of medical goods is equal to zero and does not change the implications. Hence, there has to be some restriction or constraint in the use of medical goods especially for individuals who do not internalize the full costs of their consumption.

Although unemployed individuals do not bear the full costs of their medical consumption, employed individuals still receive a higher utility as long as the following equation holds

$$U_E^H > U_U^H. \quad (13)$$

Evaluating equation (13) with the help of equations (2) and (8) and inserting the optimal values for labor supply from equations (4) and (10) as well as the respective consumption levels from (6) and (12) delivers

$$U_E^H - U_U^H = \frac{\left((1-t^H)w_1^H\right)^2}{4} - b^H + \frac{(2(1-t^H)-m^H)m^H {w_2^H}^2}{4}$$
$$+ \sum_{i=1}^{2}[g(\tilde{x}_i) - p^H x_i - g(\overline{x}_i)] > 0. \quad (14)$$

In the first period, it is assumed that the net wage of the employed individual is higher than the unemployment benefits b^H. In the second period, both individuals work and receive the same wage rate. However, the mandatory contributions of the former unemployed individual are not refunded and therefore work as an additional tax. Hence, the net wage of the individual who is employed in both periods is higher. Although the employed individual has to cover the costs of her own consumption per period $p^H x_i$ and the utility from medical consumption is higher for the unemployed individual, it is assumed that the unemployment benefits are sufficiently low and the net wage in the second period is higher to ensure that the total utility of the employed individual is still higher.

Migration Decision of Employed Individuals without Cooperation

Now consider the case of an employed individual who emigrates from Home to Foreign in the beginning of the second period. The total lifetime utility of an employed emigrant from Home to Foreign is

$$U_E^F = w_1^H l_1^H (1 - t^H - m^H) - {l_1^H}^2 + w_2^F l_{2E}^F (1 - t^F - m^F) - {l_{2E}^F}^2 - c +$$
$$g(\tilde{x}_1^H) + g(\tilde{x}_2^F) + max\{0;\ m^H w_1^H l_1^H + m^F w_2^F l_{2E}^F - p^H \tilde{x}_1^H - p^F \tilde{x}_2^F\}. \quad (15)$$

Due to the fact that the individual keeps her contributions from the first period on her account, the equation can be consolidated to

$$U_E^F = w_1^H l_1^H (1 - t^H) - {l_1^H}^2 + w_2^F l_{2E}^F (1 - t^F) - {l_{2E}^F}^2 - c +$$
$$g(\tilde{x}_1^H) - p^H \tilde{x}_1^H + g(\tilde{x}_2^F) - p^F \tilde{x}_2^F. \quad (16)$$

While the optimal value of labor supply in period 1 is already calculated in equation (4), the optimal value for the second period in Foreign, l_{2E}^F, is not. The following maximization problem solves for the labor supply in the second period

$$\max_{l_{2E}^F} U_E^F = w_1^H l_1^H (1 - t^H) - {l_1^H}^2 + w_2^F l_{2E}^F (1 - t^F) - {l_{2E}^F}^2 - c +$$
$$g(\tilde{x}_1^H) - p^H \tilde{x}_1^H + g(\tilde{x}_2^F) - p^F \tilde{x}_2^F. \quad (17)$$

Then, the optimal value of labor supply in period 2 is

$${l_{2E}^F}^* = \frac{w_2^F(1-t^F)}{2}. \quad (18)$$

Again, please see Appendix 3.1 for the second-order conditions. The optimal value depends only on the wage rate and the corresponding tax rate. The migration costs c within the interval $c \in [\underline{c}; \overline{c}]$ do not play a role for the labor supply decision neither does the consumption of health care. The decision regarding the optimal consumption level of medical goods is similar as in the case of an employed individual who stays in the country of origin. Hence, also emigrated individuals want to consume medical goods until their marginal utility equals marginal costs. However, the quasi-linear utility function, which is assumed in this model, does not include income effects. If the function includes income effects, then the individuals work more because the migration costs make them poorer.

The cutoff level of migration costs determines when an individual decides to migrate. It arises from the comparison of the lifetime utility abroad minus the total lifetime utility in the country of origin, i.e. $U_E^F - U_E^H > 0$. For simplicity reasons, I assume constant wages over the periods. This means if we insert the optimal values of (4) and (18) in the equations (2) and (16), it delivers a cutoff level of the migration costs $\tilde{c}_E^H$ for an employed individual from Home which is

$$\tilde{c}_E^H < \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H)\right)^2}{4} + g(\tilde{x}_2^F) - p^F \tilde{x}_2^F - g(\tilde{x}_2^H) + p^H \tilde{x}_2^H. \quad (19)$$

The individual migrates from Home to Foreign if the migration costs are below the cutoff level above. This happens e.g. if the difference between the two gross wages after taxes is high enough. Conversely, all individuals with migration costs equal or higher than this level will decide to stay in their country of origin. The last terms in equation (19) compare the different levels of medical consumption in period 2. However, if there are same prices for consumption, i.e. $p^H = p^F$, a symmetric case can be assumed and $\tilde{x}_2^F = \tilde{x}_2^H$. As a result the last terms would cancel out.

The problem is very similar for an employed individual who is born in Foreign and immigrated to Home. Hence, the resulting cutoff level is

$$\tilde{c}_E^F < \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4} + g(\tilde{x}_2^H) - p^H \tilde{x}_2^H - g(\tilde{x}_2^F) + p^F \tilde{x}_2^F. \quad (20)$$

Again, the last terms compare the utility level and costs of medical consumption. In the following part, I turn to the unemployed individuals again.

Migration Decision of Unemployed Individuals without Cooperation

The following equation shows the lifetime utility of an unemployed individual, who lives in Home and decides to migrate after the first period

$$U_U^F = b^H + w_2^F l_{2U}^F (1 - t^F - m^F) - {l_{2U}^F}^2 - c + g(x_1^H) + g(x_2^F) + max\{0;\ m^F w_2^F l_{2U}^F - p^F x_2^F\}. \quad (21)$$

The account balance of this individual is assumed to be positive. The medical consumption of the first period is not part of the account balance because of the status of no cooperation between the two governments. Due to the fact that the account balance of the unemployed individual is positive under these circumstances, the equation can be summarized to

$$U_U^F = b^H + w_2^F l_{2U}^F (1 - t^F) - {l_{2U}^F}^2 - c + g(x_1^H) + g(x_2^F) - p^F x_2^F. \qquad (22)$$

The optimal value for the labor supply in Foreign in period 2, l_{2U}^F, is equal to the one calculated in equation (18) with the same interpretation. The impact of the consumption of medical goods on the individuals' lifetime utility differs over the periods. The optimal consumption level of medical goods can be found by the derivative of equation (22) with respect to x_1^H and x_2^F. This yields two different solutions namely

$$\frac{\partial U_U^F}{\partial x_1^H} = g'(x_1^H) = 0 \text{ and } \frac{\partial U_U^F}{\partial x_2^F} = g'(x_2^F) - p^F = 0. \qquad (23)$$

The results show a case differentiation regarding the two periods: In period 1, the individual does not internalize the costs of her consumption of medical goods. Thus, a higher demand of medical goods increases the individual lifetime utility of an unemployed individual. Recall figure 3.1, the unemployed individual will end up with a consumption of $\overline{x}_1^H$ in period one. However, the individual decides to emigrate and escapes from her negative account balance because of no cooperation in the beginning of the second period. Now, the individual starts over again and internalizes the full costs of her health consumption. Hence, her consumption level decreases to the point where the marginal utility from another unit of x_2^F equals the marginal costs p^F. I define this level as $\tilde{x}_2^F$ according to figure 3.1. The individual will therefore reduce her consumption of medical goods in the second period to a lower value compared to the first period.

Regarding the migration decision of an unemployed individual, the cutoff level of migration costs is calculated again. An individual migrates from Home to Foreign if the migration costs are below this cutoff level

$$\tilde{c}_U^H < \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H-m^H)\right)^2}{4} + g(\tilde{x}_2^F) - p^F \tilde{x}_2^F - g(\overline{x}_2^H). \qquad (24)$$

Again, when it comes to the migration decision, the individual compares her net wages in the second period of the respective countries. The individual can escape from her negative account balance by migration and gets her mandatory contributions of the second period refunded in contrast to the case where she stays in Home. This 'escape effect' is the reason why the mandatory contributions of Foreign do not appear in the cutoff level compared to the contribution rate of Home. The equation also shows that the different consumption levels of medical goods have a direct influence on the migration decision. While the former unemployed individuals do not have to consider the costs of a unit of x, they fully internalize the costs after migrating to Foreign. The individual has to compare the potentially higher net wage in Foreign with the higher consumption possibilities of health care in Home and decide on this base whether to migrate or not. The problem is very similar for an unemployed individual who is born in Foreign. Hence, the resulting cutoff level is

$$\tilde{c}_U^F < \frac{\left(w^H(1-t^H)\right)^2-\left(w^F(1-t^F-m^F)\right)^2}{4} + g(\tilde{x}_2^H) - p^H\tilde{x}_2^H - g(\overline{x}_2^F). \quad (25)$$

In the following part, the perspective is switched and the role of the government is taken.

3.5 The Governments' Perspective

Now, the perspective of the government in Home is taken. For reasons of simplicity, I assume constant wages over all periods. Further, the amount of individuals per country is standardized equal to one. All other assumptions from the previous parts apply. Additionally, I assume same prices for medical goods in both countries, i.e. $p^H = p^F = p$. Another assumption is that the two governments do not cooperate with each other or exchange information regarding the employment history of migrants in the open economy cases. First, the budget equations are analyzed without migration.

3.5.1 Closed Economy

Fully Tax-Funded Scenario

In the absence of a MSA system, the tax rate is the only source of public income financing the expenditures like unemployment benefits and the costs of medical consumption. As a result of the absence of a direct link between tax rate and benefits, individuals do not internalize the costs of the use of medical goods. Therefore, all individuals consume until the marginal utility from consumption equals zero, i.e. $g'(x_i) = 0$, which is assumed to be the satiation point $\overline{x}$. The budget equation consists of tax income and expenditures and looks like

$$B^H(t^H) = T^H - E^H, \quad (26)$$

where

$$T^H = \theta t^H l_1^H w^H + t^H l_{2E}^H w^H$$
$$= (\theta+1)\left(\frac{t^H(1-t^H){w^H}^2}{2}\right), \text{ and} \quad (27)$$

$$E^H = (1-\theta)b^H + 2p\overline{x}. \quad (28)$$

The public income (27) consists of the tax paid by employed citizens in the first period and all individuals in the second period by assumption. Further, the expenditure side (28) sums up the spending on unemployment benefits in the first period and medical consumption of all citizens in the first and second period. All individuals consume the same because there is no internalization effect. Due to symmetry the results hold as well for the government in Foreign. By changing the superscript H to F, one receives the respective budget equation.

Now, the government decides to introduce a MSA system.

Introduction of a Medical Savings Account System

By introducing a MSA system, the budget equation is changed on both ends: the income and the expenditure side. The new equation is

$$B^H(t^H, m^H) = T^H - E^H, \tag{29}$$

where

$$\begin{aligned} T^H &= \theta t^H l_1^H w^H + \theta t^H l_{2E}^H w^H + (1-\theta)(t^H + m^H) l_{2U}^H w^H \\ &= \theta t^H (1-t^H) {w^H}^2 + (1-\theta)\left(\frac{(t^H + m^H)(1-t^H - m^H){w^H}^2}{2}\right), \text{ and} \end{aligned} \tag{30}$$

$$E^H = (1-\theta) b^H + 2(1-\theta) p\bar{x}. \tag{31}$$

On the one hand, the public income equation (30) includes additionally the mandatory contributions of the formerly unemployed individuals who find a job in the second period. The contributions are not refunded because of their negative account balance. Although this reduces the labor supply of these individuals, it delivers an additional source of public income. On the other hand, the expenditures represented in equation (31) are reduced compared to the fully tax-funded case because individuals who can obtain a positive account balance reduce their consumption of medical goods. This change of incentives is presented in more detail in the individual perspective before and directly impacts the government's budget. In the next part, the economies open up and migration is possible.

3.5.2 Open Economy

Fully Tax-Funded Scenario

Again, it starts with the case without an account system. First, the migration shares have to be defined before presenting the public budget constraint in the open economy case. After migration has taken place, the amount of taxpayers in the respective country is very important for the public budget. Considering the reaction function of individuals regarding their migration decision, I define the shares with the help of the upper level of the migration costs interval and the cutoff level calculated in the individuals' perspective part. All individuals within these two values stay in the country of origin because their individual migration costs are too high.

The migration shares already incorporate the optimal values of labor supply and medical consumption. First, the share of individuals who stay in Home over all three periods is presented. Due to the absence of a MSA system, all individuals are treated equally independent of their employment history or origin. The migration share for individuals in Home is defined as

$$\propto^H = \overline{c} - \tilde{c}^H$$

$$= \overline{c} - \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H)\right)^2}{4}, \tag{32}$$

with $\propto^H\ (t^H;\ t^F) \in [0;1]$. It is assumed that the level of medical consumption is equal in both countries and therefore cancels out.

The next term presents the share of individuals who stay in Foreign over all three periods. Again there is no difference between former employed and unemployed individuals

$$\propto^F = \overline{c} - \tilde{c}^F$$

$$= \overline{c} - \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4}, \tag{33}$$

with $\propto^F\ (t^F;\ t^H) \in [0;1]$. However, the government in Home is more interested in the share of individuals from Foreign who emigrate in the beginning of the second period. This share can be defined as $1 - \propto^F$. The resulting budget equation for the government in Home then looks as follows

$$B^H(t^H,\, t^F) = T^H - E^H, \tag{34}$$

where

$$T^H = \theta t^H l_1^H w^H + t^H l_{2E}^H w^H [\propto^H + 1 - \propto^F]$$

$$= \left(\theta + 1 - \frac{\left(w^F(1-t^F)\right)^2}{2} + \frac{\left(w^H(1-t^H)\right)^2}{2}\right)\left(\frac{t^H(1-t^H){w^H}^2}{2}\right), \text{ and} \tag{35}$$

$$E^H = (1-\theta)b^H + p\overline{x} + (\propto^H + 1 - \propto^F)p\overline{x}.$$

$$= (1-\theta)b^H + \left[2 - \frac{\left(w^F(1-t^F)\right)^2}{2} + \frac{\left(w^H(1-t^H)\right)^2}{2}\right]p\overline{x}. \tag{36}$$

The public earnings in equation (35) takes into account the tax income from individuals who work in period 1. In the second period, the tax payments from immigrants to Home are considered as well as the share of individuals who stay in Home.

The expenditure side (36) consists of unemployment benefits in the first period and medical consumption of all citizens in the first and second period. All individuals consume the same level $\overline{x}$ because they do not have to internalize the costs of consumption. The next part shows how migration shares and budget equations change due to the introduction of a MSA system in both countries.

Introduction of a Medical Savings Account System without Cooperation

Now, both governments introduce a MSA system. Again, the migration shares have to be defined first. They already incorporate the optimal values of labor supply and medical consumption resulting from the individuals' perspective. I will begin with the share of individuals who stay in Home over all three periods, if they are employed in the first period: $\propto_E^H$. It is defined as

$$\propto_E^H = \overline{c} - \tilde{c}_E^H$$
$$= \overline{c} - \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H)\right)^2}{4}, \quad (37)$$

with $\propto_E^H\ (t^H;\ t^F) \in [0; 1]$ and $\tilde{c}_E^H$ from equation (19). With equal prices and utility function $g(\quad)$, the level and costs of medical consumption offsets each other and does not appear in equation (37). The next share to be defined is the one of individuals who stay in Foreign over all three periods, if they are employed in the first period: $\propto_E^F$. The resulting value is

$$\propto_E^F = \overline{c} - \tilde{c}_E^F$$
$$= \overline{c} - \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F)\right)^2}{4}, \quad (38)$$

with $\propto_E^F\ (t^F;\ t^H) \in [0; 1]$ and hence the share of employed individuals from Foreign who immigrate to Home is $1 - \propto_E^F$. The cutoff level $\tilde{c}_E^F$ comes from equation (20). Again, the terms comparing the utility levels and costs of medical consumption cancel each other out because of the assumption regarding same prices as stated in the beginning of this part. Next, the shares of former unemployed individuals staying in the country of origin are presented starting with the share of individuals who stay in Home over all three periods. The share $\propto_U^H$ looks as follows

$$\propto_U^H = \overline{c} - \tilde{c}_U^H$$
$$= \overline{c} - \frac{\left(w^F(1-t^F)\right)^2 - \left(w^H(1-t^H-m^H)\right)^2}{4} - g(\tilde{x}) + p\tilde{x} + g(\overline{x}), \quad (39)$$

with $\propto_U^H\ (t^H;\ m^H;\ t^F) \in [0; 1]$ and the cutoff level $\tilde{c}_U^H$ from equation (24). Here, the levels of medical consumption are different. According to figure 3.1, it can be assumed that the level of consumption in Home will be higher than in Foreign,

$g(\overline{x}) > g(\tilde{x})$. It follows from the fact that individuals do not internalize the costs of medical consumption in Home due to the negative account balance. Further, individuals can escape from the negative balance by migrating because governments do not cooperate. The last share which has to be defined is the one of individuals who stay in Foreign over all three periods, if they are unemployed in the first period: $\propto_U^F$. Using the cutoff level $\tilde{c}_U^F$ from equation (25) yields

$$\begin{aligned}\propto_U^F &= \overline{c} - \tilde{c}_U^F \\ &= \overline{c} - \frac{\left(w^H(1-t^H)\right)^2 - \left(w^F(1-t^F-m^F)\right)^2}{4} - g(\tilde{x}) + p\tilde{x} + g(\overline{x}),\end{aligned} \tag{40}$$

with $\propto_U^F\ (t^F;\ m^F;\ t^H) \in [0;1]$. However, for the public budget equation of the government in Home the relevant share is the one of emigrated individuals from Foreign which is $1-\propto_U^F$.

The public budget equation for the government in Home in the case without cooperation is

$$B^H(t^H,\ m^H,\ t^F,\ m^F) = T^H - E^H, \tag{41}$$

where

$$\begin{aligned}T^H &= \theta t^H l_1^H w^H + \theta(\propto_E^H + 1 - \propto_E^F) t^H l_{2E}^H w^H + (1-\theta)(1 - \propto_U^F) t^H l_{2E}^H w^H \\ &\quad + (1-\theta)(\propto_U^H)(t^H + m^H) l_{2U}^H w^H \\ &= \left[\theta\left(2 - \frac{\left(w^F(1-t^F)\right)^2}{2} + \frac{\left(w^H(1-t^H)\right)^2}{2}\right) + (1-\theta)\left(1 - \overline{c} - \frac{\left(w^F(1-t^F-m^F)\right)^2}{4} + \right.\right. \\ &\quad \left.\left. \frac{\left(w^H(1-t^H)\right)^2}{4} + g(\tilde{x}) - p\tilde{x} - g(\overline{x})\right)\right]\left(\frac{t^H(1-t^H){w^H}^2}{2}\right) + \\ &\quad (1-\theta)\left(\overline{c} - \frac{\left(w^F(1-t^F)\right)^2}{4} + \frac{\left(w^H(1-t^H-m^H)\right)^2}{4} - g(\tilde{x}) + p\tilde{x} + \right. \\ &\quad \left. g(\overline{x})\right)\left(\frac{(t^H+m^H)(1-t^H-m^H){w^H}^2}{2}\right), \text{ and}\end{aligned} \tag{42}$$

$$\begin{aligned}E^H &= (1-\theta)(\propto_U^H + 1 - \propto_U^H)(b^H + p\overline{x}) + (1-\theta)(\propto_U^H)p\overline{x} \\ &= (1-\theta)(b^H + p\overline{x}) + (1-\theta)\left[\overline{c} - \frac{\left(w^F(1-t^F)\right)^2}{4} + \frac{\left(w^H(1-t^H-m^H)\right)^2}{4} - \left(g(\tilde{x}) - \right.\right. \\ &\quad \left.\left. p\tilde{x} - g(\overline{x})\right)\right] p\overline{x}.\end{aligned} \tag{43}$$

The public revenue equation (42) takes into account the tax earnings of the first and second period of employed individuals It also includes the non-refunded contributions of formerly unemployed individuals who stay in Home.

The expenditure side (43) consists of unemployment benefits in the first period and medical supply for native individuals who are unemployed in the first period and cannot afford to pay fully for their medical costs. In both countries, individuals are unemployed with the same exogenous probability $1-\theta$ with $\theta \in [0;1]$. However, the immigrated former unemployed individuals internalize the costs of medical consumption because they can escape from their negative account of the first period.

An important question is how the governments choose the tax and contribution rates. There are different ways to approach the question of how to mix these two rates: In the next part, I assume concrete numbers and present different possibilities of how the two governments can jointly set a symmetric mix of tax and contribution rates which balances their public budgets. Any deviation from this solution will be punished. There are many combinations of tax and contribution rates which keep the budget balanced in a symmetric case and some selected results are presented in the next part with the help of a numerical example.

3.6 Numerical Example on the Governments' Perspective

While the last part concentrates on the formulas to analyze the effects of the introduction of a MSA system, this part makes an additional step towards the question whether MSA can be favorable and for what groups of individuals. Further, it also gives a first indication of how to choose the tax and contribution rates and who profits from which combination. On the search for a possible policy mix, I analyze the fully tax-funded scenario followed by the case with an implemented MSA system without cooperation.

The primary objective of the two governments is to balance their budgets and provide a certain minimum level of income and medical supply. The tax and contribution rates are determined by assuming a cooperative solution. The two governments jointly and simultaneously decide which level of rates to choose as in a monopoly case. Both rates are chosen at the beginning of the first period and cannot be adjusted later on. There is a cooperative equilibrium in every case with a symmetric solution. It is assumed that the governments prefer the symmetric equilibrium which is derived. They do not maximize their budget equations. To better understand how the mix between the tax and contribution rate is determined, a numerical example is assumed with the following parameters

$w^H = w^F = 20 \qquad b^H = b^F = 10 \qquad p = 2 \qquad \theta = 0.5$

$c \in [-5;\ 95] \qquad g(x) = -\frac{1}{2}x^2 + 4x$ with $\tilde{x} = 2$, $g(\tilde{x}) = 6$ and $\overline{x} = 4$, $g(\overline{x}) = 8$

An additional expenditure requirement $e = 15$ is assumed in order to receive reasonable tax rates.

Closed Economy

As a result of the absence of a MSA system, it is assumed that no individual has an incentive to internalize the costs of medical consumption. Then, the numbers can be inserted in budget equation (26) and solved with the solution

$$t^H = t^F = 0.248. \tag{44}$$

Due to the symmetric setting of the model, the result is valid for both governments.

In the next case, a MSA system is introduced and the government keeps the contributions of the individuals with a negative account balance in exchange for their medical consumption. By inserting all known variables in equation (29), the following combinations result in a balanced budget

	$\boldsymbol{t^H = t^F}$	$\boldsymbol{m^H = m^F}$	$\boldsymbol{t^H + m^H = t^F + m^F}$
Case 1	0.192	0.025	0.217
Case 2	0.189	0.035	0.224
Case 3	0.185	0.049	0.234

Table 3.1: Symmetric Tax and Contribution Rates in a Balanced Budget without Migration.

All values are rounded to the third decimal. In case 1, the level of the contribution rate is at its minimum, ensuring a positive account balance for individuals who work for two periods. With the contribution rate in case 3, the assumption is fulfilled that individuals who work for only one period end up with a negative account balance. If the contribution rate is slightly higher, they will internalize the costs of their consumption as well and reduce their medical demand. In all cases, the tax rate is lower than in the scenario without an account system. The introduction of a MSA system even leads to the fact that the compound tax burden for individuals with a negative account is lower than the tax rate in the fully tax-funded case before. The compound tax burden consists of tax rate plus contribution rate.

Now, the individuals can freely decide where they want to live at the beginning of the second period because migration is possible.

Open Economy

First, the fully tax-funded case is analyzed. By inserting all variables and known numbers in equation (34), the following solution results in a symmetric and cooperative equilibrium

$$t^H = t^F = 0.248. \tag{45}$$

This is the same result as in the closed economy case because of the symmetric setting of the model and the assumption regarding the symmetry of tax rates without deviation. As the result is symmetric, individuals have an incentive for migration only in case of negative migration costs. However, the result is the same as before as the inflow of immigrants exactly offsets the outflow of emigrants.

After the introduction of a MSA system, the incentives change as analyzed in the individuals' perspective part. The public budget equation of the government in Home is presented in equations (41).

The following table 3.2 presents different symmetric combinations of tax and contribution rates which balance the public budget. All values are rounded to the third decimal. Please find more details on the derivation of the results in Appendix 3.2. The results are

	$\boldsymbol{t^H = t^F}$	$\boldsymbol{m^H = m^F}$	$\boldsymbol{t^H + m^H = t^F + m^F}$
Case 1	0.167	0.025	0.192
Case 2	0.166	0.035	0.201
Case 3	0.166	0.047	0.213

Table 3.2: Symmetric Tax and Contribution Rates in a Balanced Budget without Cooperation.

The presented contribution rates ensure the fulfillment regarding the assumptions made on the account balance of the respective individuals. The minimum contribution rate which ensures a positive account balance for individuals who work for two periods or former unemployed individuals who can escape from their negative account balance by migration is presented in case 1. However, there are symmetric solutions which balance the budget and improve the utility of certain groups of individuals.

If the governments care about individuals who internalize their costs of medical consumption, they would decide for the lowest tax rate possible in this scenario presented in case 3. These individuals only pay attention to a low tax rate and do not care about the level of contributions as they receive a refund.

However, there are also individuals who will not internalize their level of medical consumption. In this model, this group is characterized by suffering from unemployment in the first period and staying in their country of origin. As a result, these individuals end up with a negative account balance and do not receive a refund of their medical savings contribution. The resulting combination of tax and contribution rates in case 1 is the lowest possible sum of the two parameters. It ensures a higher utility level for these specific individuals than in the other cases because they care about the two rates equally compared to the individuals with a positive account.

An interesting fact is that with the introduction of a MSA system, the tax rate is in all cases lower than in the fully tax-funded scenario. Moreover, also the sum of tax and contribution rates is lower in all cases. This is especially important for individuals with a negative account balance because the contribution rate works like an additional tax as it is not refunded.

How is this possible? First, individuals with a positive account balance internalize the costs of their medical consumption and therefore reduce their level of consumption. Second, with a refund of contribution rates, those individuals have a higher incentive to supply labor because of a higher net wage. This increases the collected taxes and as a consequence also the public income. Finally, the additional tax revenue from non-refunded contributions increases the public income as well.

However, one has to keep in mind that the presented combinations of tax and contribution rates are derived in a symmetric and cooperative environment. This does not allow for strategic interactions between the two governments. A possible expansion of this model should consider and include game theoretic elements when it comes to the derivation of the tax and contribution rates. Parallel to a Cournot-Nash equilibrium, the two governments could maximize a certain social welfare function with respect to the choice of the other government. Further, a shadow price of public funds can give insights on the marginal benefits of a tax increase

3.7 Conclusion

This essay presents the first theoretical model of a MSA system from individuals' and governments' perspective in the presence of migration. Literature produce evidence that MSA significantly reduce medical costs in the health sector. By covering parts or the complete costs of medical demand, the account system gives consumers a financial incentive to take responsibility for their own behavior, e.g. by avoiding health problems through the lack of sports, unhealthy nutrition or obesity. It also reduces wasteful spending on unnecessary treatments. Individuals become diligent demanders of medical goods.

The individual perspective in this chapter models how the medical contribution rate influences the endogenous labor supply of individuals. While the refunded contributions in combination with a lower tax rate increase the labor supply of individuals with a positive account balance, the non-refunded contributions reduce the willingness to work due to the negative account balance. The demand for health care has to be observed very diligently because not all individuals may internalize the costs of medical treatments. They are tempted to consume more than necessary to increase their utility. The results are similar regarding the migration decision of individuals. While the contribution rates do not play a role for high-income individuals without an unemployment spell and only little spending on health care, the opposite is the case for the remaining individuals. The non-refunded contribution rates increase the cutoff level of migration costs at which the individual is indifferent between emigrating and staying. In the case without cooperation between the two countries, this leads to an ‘escape effect’ because individuals can free themselves of their negative account balance by emigrating. They receive a higher net wage abroad because the contribution rate of the second period is refunded. Remember that the model does not include uncertainty or unpredictable health shocks on productivity. This may influence and change the results. It should be considered in further research.

The section on the governments’ perspective presents the public budget constraints in the absence and presence of a MSA system without cooperation. It becomes obvious how the tax rate of the other government directly influences the share of migrants and therefore also the budget constraint of the opposite. Further, the governments’ budget function is used to calculate possible combinations of the tax and contribution rates in a symmetric and cooperative case in the last part. The two governments jointly decide for a symmetric policy mix of the tax and contribution rates. There are different combinations of the two parameter that keep the budget balanced. However, the results show that all individuals can benefit from a MSA system compared to a fully tax-financed system because it reduces the tax-related distortions, increases the individuals’ utility and provides the same liquidity and lifetime insurance as a fully tax-funded system.

However, a mix of tax and contribution rate is favorable as well. Hence, MSA contributions can rather be seen as a complement than a substitute of a tax rate. This ensures a combination of a more efficient insurance system with the help of an account system. At the same time it provides protection as well as interpersonal redistribution via a positive tax rate. This supports individuals with low income, long-term unemployment spells or cost intensive health care expenditures. By setting the contribution rate at a moderate level, the governments ensure a more efficient intrapersonal redistribution without losing potential for interpersonal redistribution protecting the poor, weak and chronical sick. Remember that the results are derived in a symmetric and cooperative case which does not consider deviation. This should be approached in further research.

On the other side, the account system is not per se beneficiary for every individual. There is a financial risk for people with chronical or cost intensive diseases. This has to be approached differently, e.g. according to Singapore where plans and funds were introduced to protect poor and weak individuals. In addition, there is also the risk of unintended behavior by avoiding necessary treatments like vaccinations due to financial incentives. This increases the risk of epidemic or pandemic diseases for all individuals and results in higher costs for everyone in the end. This also has to be considered and observed diligently by governments. Further, the MSA system does not solve the moral hazard problem for the group of low-income individuals regarding health consumption.

Beside the undisputed advantages of an account system, one has to diligently observe the accompanying effects and resulting incentives for all individuals that such a system change will bring along. A MSA system can improve the situation for individuals as well as governments. However, it needs continuous governmental stewardship and a focus on unintended behavior regarding health care consumption in order to succeed.

Appendix 3.1 Second-Order Conditions of Individual's Perspective

First the second-order condition for the optimal labor supply of an employed individual in the closed economy is presented. This belongs to the maximization problem of equation (3) and looks like

$$\frac{\partial {U_E^H}^2}{\partial {l_1^H}^2} = \frac{\partial {U_E^H}^2}{\partial\, {l_{2E}^H}^2} = -2 < 0.$$

Then, the optimal amount of labor supply in period 1 and 2 is a maximum. QED.

Next, the second-order derivative of the labor supply decision of an unemployed individual in the closed economy is checked. Due to unemployment in the first period, only the optimal value for the labor supply in the second period has to be checked. This is

$$\frac{\partial {U_E^H}^2}{\partial\, {l_{2U}^H}^2} = -2 < 0.$$

Again, the optimal labor supply of an unemployed individual in Home resulting from the maximization problem in equation (9) is a maximum. QED.

The same results hold also for the open economy cases without cooperation and therefore, they are skipped.

Appendix 3.2 Derivation of the Equations in the Numerical Example

As in the previous chapters, the cases in the closed economy are of quadratic form and thus, can be solved by using basic algebra.

In the open economy cases, the same adjustments have to be made as in chapter 1 regarding the migration costs. Saving notation and reducing complexity in the theoretical model, the length of the interval was assumed to be one. This does not hold in the numerical example because the migration costs interval is assumed to be $c \in [-5; 95]$. The chosen interval ensures migration flows and reasonable shares of the respective types of migrants. For a better understanding, the migration cost interval is illustrated in figure 1.2 in Appendix 1.4.

In order to keep the density of the migration cost interval equal to one, the equations have to be adjusted.

Hence, the new equation (34) used in the numerical example is

$$B^H(t^H,\, t^F) = \left(\theta + 1 - \frac{1}{\bar{c}-\underline{c}}\left(\frac{\left(w^F(1-t^F)\right)^2}{2} - \frac{\left(w^H(1-t^H)\right)^2}{2}\right)\right)\left(\frac{t^H(1-t^H)w^{H^2}}{2}\right)$$
$$-(1-\theta)b^H - \left[2 - \frac{1}{\bar{c}-\underline{c}}\left(\frac{\left(w^F(1-t^F)\right)^2}{2} - \frac{\left(w^H(1-t^H)\right)^2}{2}\right)\right]p\overline{x}, \qquad (34)$$

and for the government in Foreign it looks like this

$$B^F(t^F,\, t^H) = \left(\theta + 1 - \frac{1}{\bar{c}-\underline{c}}\left(\frac{\left(w^H(1-t^H)\right)^2}{2} - \frac{\left(w^F(1-t^F)\right)^2}{2}\right)\right)\left(\frac{t^F(1-t^F)w^{F^2}}{2}\right)$$
$$-(1-\theta)b^F - \left[2 - \frac{1}{\bar{c}-\underline{c}}\left(\frac{\left(w^H(1-t^H)\right)^2}{2} - \frac{\left(w^F(1-t^F)\right)^2}{2}\right)\right]p\overline{x}. \qquad (34'')$$

The last case of the numerical example shows the case where both countries introduce a MSA system in the presence of migration. Thus, equation (41) has to be modified and looks like this solving the numerical example

$$B^H(t^H,\ m^H,\ t^F,\ m^F) = \left[\theta\left(2-\frac{1}{\bar{c}-\underline{c}}\left(\frac{\left(w^F(1-t^F)\right)^2}{2}-\frac{\left(w^H(1-t^H)\right)^2}{2}\right)\right)+\right.$$

$$(1-\theta)\left(1-\frac{1}{\bar{c}-\underline{c}}\left(\overline{c}+\frac{\left(w^F(1-t^F-m^F)\right)^2}{4}-\frac{\left(w^H(1-t^H)\right)^2}{4}+\right.\right.$$

$$\left.\left.\left.g(\tilde{x})-p\tilde{x}-g(\overline{x})\right)\right)\right]\left(\frac{t^H(1-t^H){w^H}^2}{2}\right)+$$

$$(1-\theta)\frac{1}{\bar{c}-\underline{c}}\left(\overline{c}-\frac{\left(w^F(1-t^F)\right)^2}{4}+\frac{\left(w^H(1-t^H-m^H)\right)^2}{4}-g(\tilde{x})+\right.$$

$$\left.p\tilde{x}+g(\overline{x})\right)\left(\frac{(t^H+m^H)(1-t^H-m^H){w^H}^2}{2}\right)$$

$$-(1-\theta)(b^H+p\overline{x})-(1-\theta)\frac{1}{\bar{c}-\underline{c}}\left[\overline{c}-\frac{\left(w^F(1-t^F)\right)^2}{4}+\right.$$

$$\left.\frac{\left(w^H(1-t^H-m^H)\right)^2}{4}-\left(g(\tilde{x})-p\tilde{x}-g(\overline{x})\right)\right]p\overline{x}, \qquad (41')$$

and for the government in Foreign it looks as follows

$$B^F(t^F, m^F, t^H, m^H) = \left[\theta\left(2 - \frac{1}{\bar{c}-\underline{c}}\left(\frac{\left(w^H(1-t^H)\right)^2}{2} - \frac{\left(w^F(1-t^F)\right)^2}{2}\right)\right) + \right.$$

$$(1-\theta)\left(1 - \frac{1}{\bar{c}-\underline{c}}\left(\overline{c} + \frac{\left(w^H(1-t^H-m^H)\right)^2}{4} - \frac{\left(w^F(1-t^F)\right)^2}{4} + \right.\right.$$

$$\left.\left.\left. g(\tilde{x}) - p\tilde{x} - g(\overline{x})\right)\right)\right]\left(\frac{t^F(1-t^F){w^F}^2}{2}\right) +$$

$$(1-\theta)\frac{1}{\bar{c}-\underline{c}}\left(\overline{c} - \frac{\left(w^H(1-t^H)\right)^2}{4} + \frac{\left(w^F(1-t^F-m^F)\right)^2}{4} - g(\tilde{x}) + \right.$$

$$\left. p\tilde{x} + g(\overline{x})\right)\left(\frac{(t^F+m^F)(1-t^F-m^F){w^F}^2}{2}\right)$$

$$-(1-\theta)(b^F + p\overline{x}) - (1-\theta)\frac{1}{\bar{c}-\underline{c}}\left[\overline{c} - \frac{\left(w^H(1-t^H)\right)^2}{4} + \right.$$

$$\left. \frac{\left(w^F(1-t^F-m^F)\right)^2}{4} - \left(g(\tilde{x}) - p\tilde{x} - g(\overline{x})\right)\right]p\overline{x}. \qquad (41'')$$

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Eidesstattliche Versicherung

Ich versichere hiermit eidesstattlich, dass ich die vorliegende Arbeit selbständig und ohne fremde Hilfe verfasst habe. Die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sowie mir gegebene Anregungen sind als solche kenntlich gemacht.

Die Arbeit wurde bisher keiner anderen Prüfungsbehörde vorgelegt und auch noch nicht veröffentlicht. Sofern ein Teil der Arbeit aus bereits veröffentlichten Papers besteht, habe ich dies ausdrücklich angegeben.

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