Three Essays in the Economics of Migration and Security

Inaugural-Dissertation

zur Erlangung des Grades

Doctor oeconomiae publicae (Dr. oec. publ.)

an der Ludwig-Maximilians-Universität München

2012

vorgelegt von

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Promotionsabschlussberatung:	15. Mai 2013

Datum der mündlichen Prüfung: 07.05.2013

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Acknowledgments

First and foremost, I want to thank my thesis supervisors, Andreas Haufler and Panu Poutvaara, for their extremely helpful comments, encouragement and constructive criticism. Andreas Haufler always took the time to discuss the direction of my research and ensuing issues, and guided me masterly through the process of writing this dissertation. He also permitted me to stray out of the field of theoretical public economics and sympathetically accompanied my forays into econometrics and security economics. Panu Poutvaara was always at hand to comment on the progress of my research and gave valuable advice on the topics covered in this dissertation. This thesis benefited a great deal from their comments and ideas. I am very grateful to Christian Holzner as well for agreeing to act as the third member of my thesis committee. Furthermore, I gratefully acknowledge financial support from the Deutsche Forschungsgemeinschaft through GRK 801.

I am also indebted to Matz Dahlberg, Neil Ferguson, Jana Jarecki, Sebastian Jauch, Tim Krieger, Sergey Kuniavsky, Assaf Razin, Klaus Schmidt, Sebastian Stoll, Christian Traxler, Silke Übelmesser and Stanley Winer for advice and comments on individual chapters of this thesis. I am grateful to Salmai Qari for co-authoring the econometric part of this dissertation, and to my fellow Ph.D. students at the Munich Graduate School of Economics and the participants of the Public Economics seminar at the LMU Munich for the fruitful discussions.

I particularly want to thank my brother, Peterhans Hendel, for his advice on programming issues and mathematical proofs, and for his leniency towards the abuse of mathematical notation economists are prone to. Finally, I want to thank my parents for their sponsorship throughout all the years of my education, for encouraging me to seize the chance of doing a Ph.D. in Economics at the LMU Munich, and for their ongoing moral support during my studies.

Ulrich Hendel
Munich, December 2012

"What is it that confers the noblest delight? What is that which swells a man's breast with pride above that which any other experience can bring to him? Discovery! [...] To give birth to an idea - to discover a great thought - an intellectual nugget, right under the dust of a field that many a brain-plow had gone over before."

Mark Twain (2012)

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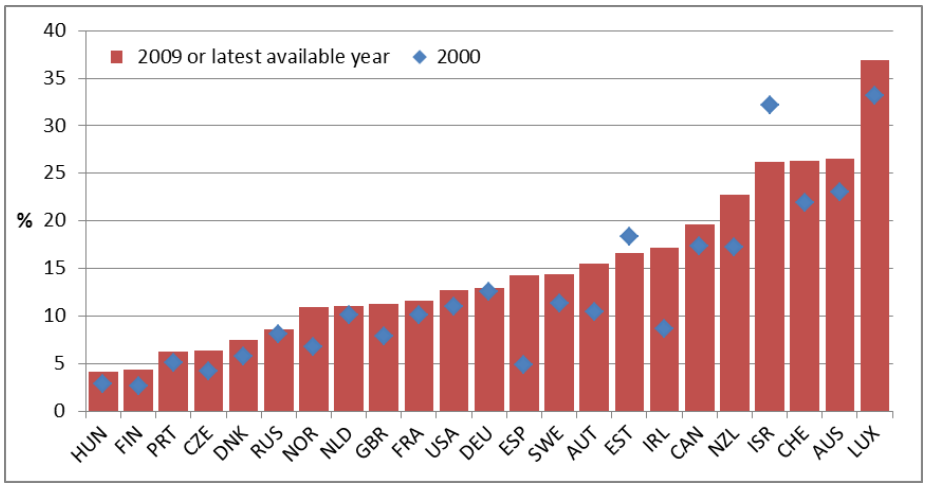
Introduction

This thesis sets out to provide new insights into three particular aspects of modern-day migration and national security. In the course of this dissertation I will deal with tax competition with mobile altruistic taxpayers, with the influence of immigration on attitudes towards a particular aspect of the welfare state, namely day care for school children, and finally with the antagonistic behaviour of terrorist organizations and governments. The analysis of these issues is motivated by the economic importance and the wide-ranging implications of the vast current migratory flows, and by the persistent threat domestic and international terrorist groups pose to the security of Western societies.

Cheap international transport, European integration and the move towards a globalized economy have led to a massive increase in cross-border movements and ethnic heterogeneity in the last decades. Particularly the recent economic turmoil in Europe has led to a surge in migration within the European Union (EU), from struggling countries such as Greece and Spain towards "pillars of stability" such as Germany. In the first half of 2012, immigration into Germany increased by 15% in comparison with the first half of 2011, in which in turn immigration was already 20% higher than in the first half of 2010 (Statistisches Bundesamt, 2012).

Even in normal times, mobility between open countries is high. In 2008, more than 6 million people either permanently left or entered a country of the EU, which amounts to roughly one percent of the total population of about 500 million of the EU at the time. In the same year, the EU's country average of non-native citizens was about six percent (Eurostat, 2012b). Differences between European countries are vast, of course. While Germany's share of foreign-born citizens was about 13% in 2008, less than one percent of the Polish population consisted of non-natives (OECD, 2011b). Figure 1 shows the development of the foreign-born population in selected countries in the decade following 2000. It becomes visible that in this period, the foreign-born population share, and thus ethnic heterogeneity, increased in most countries,

Figure 1 – Share of foreign-born population in selected countries, 2000 and 2009



Adapted from OECD (2011b)

including many of the big developed economies.

The phenomena of increasing mobility, more heterogeneous populations and associated issues have long been the topic of economic research. These issues range from the relationship of migration with the provision of particular kinds of education (Poutvaara, 2008), to the viability of welfare states in the face of migrating net-recipients and net-contributors (Weichenrieder and Busch, 2007), to the economic impact of border security measures put in place to tackle transnational terrorism (Mirza and Verdier, 2008).

As early as 1885 E. G. Ravenstein formulated his "laws of migration" which, amongst other claims, propose that migrants are attracted by "great centres of commerce or industry" (a summary and discussion of Ravenstein's "laws" is given in Grigg (1977)). One of the first economic treatments of the private and social costs and benefits connected with migration has been attempted by Sjaastad (1962), who pointed out taxation issues and externalities arising from the migration decision of individuals. About three decades later, Borjas (1989) has identified three main topics of economic interest with regard to immigration: The drivers of the "direction, size and composition of the immigrant flow", the "impact of immigration on the economies of the sending and receiving countries", and the adaption of immigrants to their host country.

The first two chapters of this thesis, which deal with tax competition and support for the welfare state, aim

to provide new insights into particular aspects of the drivers and the "impact" of immigration. The first chapter is also related to Sjaastad's (1962) idea that tax differentials between jurisdictions may give rise to inefficiencies, while the second chapter is connected with his notion that publicly funded services might be affected by migration. Implicitly related to the adaption of immigrants to their host country is the topic of the third chapter which ventures into the field of security economics by modeling a competitive game between a terrorist organization and a government. The threat to security depicted in this chapter might stem from the free movement and settlement decision of potentially dangerous groups and individuals, as for instance the 9/11 attacks in the US by predominantly Saudi-Arab terrorists and the creation of terrorist cells in Germany and the UK by citizens with a migration background show.

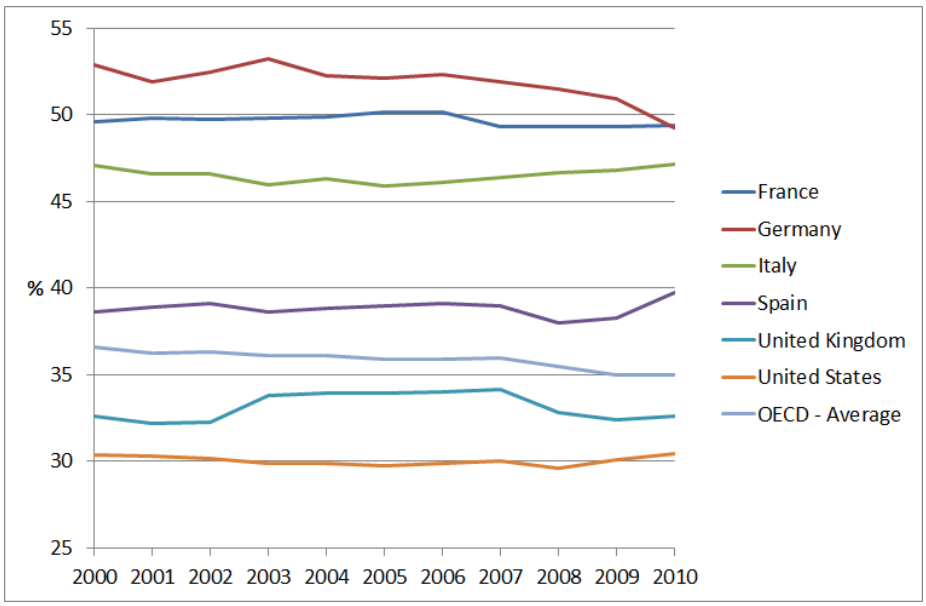
The role of the government is also of particular interest in the treatment of the three topics of this dissertation. In the first chapter, the government chooses its tax rate so as to maximize the transfer towards poor citizens. In the third chapter, the government's problem is to find the optimal combination between own consumption and counter-terrorism spending which reduces the threat from terrorism. Chapter two takes a more indirect approach to the role of the government by illuminating individual attitudes which may constitute a political constraint for governments and which might be shaped by immigration. After this general introduction, I will now briefly motivate the individual chapters of this thesis.

In the first chapter of this dissertation, I will apply different concepts of altruism to a model of tax competition between states with mobile taxpayers. Tax competition in the absence of any barrier to migration and any incentive to pay taxes should drastically reduce the tax levied on mobile populations. Common tax competition models even suggest that, in the case of perfectly mobile populations, welfare states will undercut each other's tax rate to attract taxpayers and keep welfare recipients at bay to the point where tax rates are zero. However, as Figure 2 shows, the tax burden for the average worker in many OECD countries stayed roughly the same over the last decade, and there still remains a huge scope for taxation given that Germany and France taxed about 14% above the OECD average in 2010.[1]

Motivated by these findings, the first chapter develops a two-country framework with mobile altruistic

[1] The tax burden is calculated as the sum of personal income tax, payroll tax and employees' and employers' social security contributions, divided by the sum of gross wage, employers' social security contributions and payroll tax (i.e. the labour cost) times 100. The average worker is single and earns the average income of full-time workers in the respective countries.

Figure 2 – Tax burden in percent for the average worker in selected OECD countries, 2000-2010

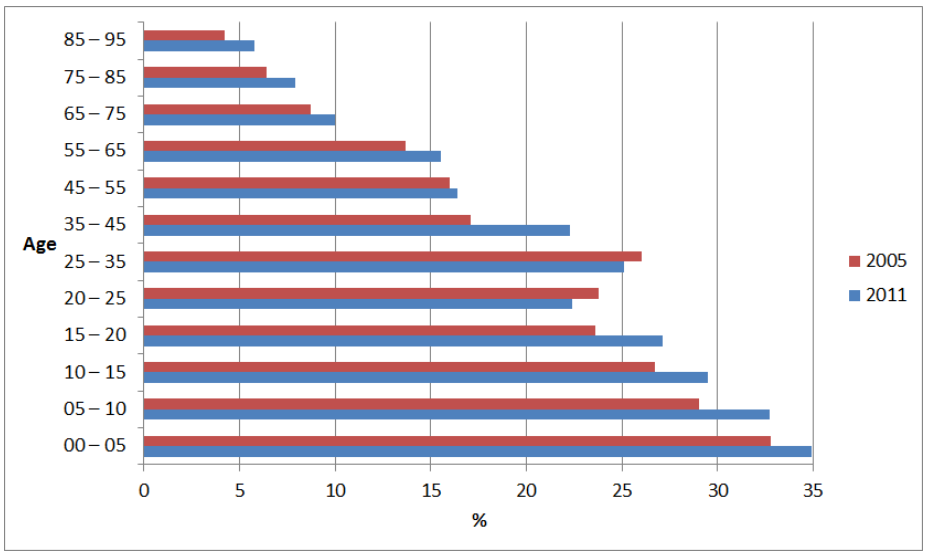


Source: OECD (2012)

taxpayers and immobile welfare recipients. It is shown that unique pure strategy Nash equilibria (NE) in taxation exist which are different from zero given sufficiently strong altruistic preferences. In the related literature, this amelioration of the "Race to the Bottom" of tax rates is usually achieved by introducing barriers to migration such as migration costs, home country attachment (cf. Konrad, 2008) or even patriotism (cf. Qari et al., 2012).

Without doubt, it is well-nigh impossible to explain many actions such as giving to charities or volunteering by taking recourse to the original strict notion of the "homo oeconomicus", a coldly calculating human being who is only concerned about his own welfare, even if one is willing to acknowledge that, as H. L. Mencken (1982, p. 17) put it, "a large part of altruism, even when it is perfectly honest, is grounded upon the fact that it is uncomfortable to have unhappy people about one". Concepts of altruism can be used to account for these deviations from what seems to be the proper economic rationale, and chapter one applies concepts which have been examined and confirmed in laboratory experiments to motivate redistributive taxation.

Figure 3 – Share of people with migration background in the total population of Germany by age cohort, 2005 and 2011



Source: Statistisches Bundesamt (2005, 2011)

The model in chapter 1 also shows that, if countries are asymmetric with respect to the number of welfare recipients, specific kinds of altruistic motivations may support pure strategy NE in which the country with the fewer poor attracts more taxpayers and sets higher taxes. This implies that rich countries with a small number of welfare recipients may actually benefit from tax competition.

The second chapter, which is based on joint work with Dr. Salmai Qari (MPI, Munich and WZB, Berlin), sallies forth into the field of econometrics and contributes to the long-standing debate whether immigration poses a threat to the welfare state. As pointed out above, immigration and thus ethnic heterogeneity in developed countries have been increasing over the last decades, which has been argued to reduce the generosity of the welfare state and the support for redistributive taxation (for an overview see Stichnoth and Straeten, 2011). Immigration also poses a challenge to the educational system as immigrant pupils tend to perform worse than their native peers (OECD, 2006). As Figure 3 shows, the share of pupils in Germany with a migration background, that is, with at least one non-native parent, has been increasing between 2005 and 2011. The age structure indicates that the share of pupils with a migration background will rise further as the $0-5$ age cohort is larger than the $5-20$ age cohorts.

For the case of Germany, we examine how the support for the public provision of day care, a particular aspect of the educational system, is associated with higher levels of ethnic heterogeneity. To this end, we employ mixed effects models to analyse individual-level data from the 1997 and 2002 waves of the German Socio-Economic Panel and data from official sources. Public day care, just as a publicly funded educational system, is clearly redistributive from families with high incomes and without children towards families with low incomes and offspring, and thus a part of the welfare state. In contrast to the typical result that support for the welfare state is eroded if ethnic heterogeneity increases (cf. Dahlberg et al., 2012), we find no evidence that the preferences for public provision of day care are negatively connected with the share of foreign pupils. We find weak evidence that a larger share of non-German pupils may actually be associated with an increase in the support for the public provision of day care.

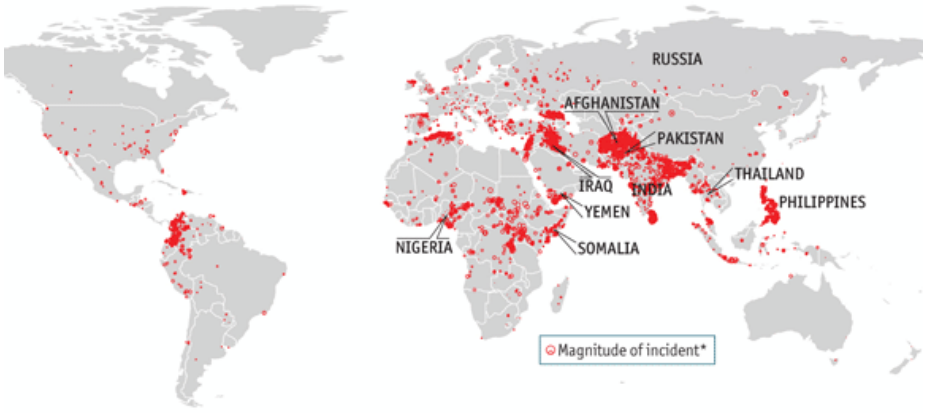
Chapter three deals with terrorism, one of the prominent threats to security many countries face today. A recent daily chart by the Economist, shown in Figure 4, illustrates that the number of terrorist attacks has strongly risen since 2004, and that terrorism is truly a global phenomenon.[2] The US Department of State (2010) reported that almost 58,000 people were injured or killed by terrorist attacks in 2009 worldwide. In the same year, about 300 terrorist attacks (according to the definition of Europol) were perpetrated in the EU (Europol, 2010).

Terrorism is of interest to economists because most aspects of terrorism can be subjected to economic analysis. Furthermore, the economic impact of terrorist activities can be severe. The US spent almost $US 1.3 trillion on the "War on Terror" between 2001 and 2011 (Belasco, 2010), while the direct economic costs of the 9/11 attacks are estimated to be $US 31 billion (Krugman, 2004). In addition to the direct destruction of physical capital and human lives, the threat of terrorism can alter voting behaviour (cf. Gould and Klor, 2010), reduce individual happiness (cf. Frey et al., 2007), distort trade flows (cf. Mirza and Verdier, 2008) and hamper growth and investment (cf. Abadie and Gardeazabal, 2008).

The third chapter proposes a simple game theoretic model in which a government tries to infer the size, and therefore the threat from, a terrorist organization by its actions. It turns out that large terrorist groups, if they are interested in increasing their manpower, have an incentive to appear weaker than they

[2] The military endeavours of the US and its allies in Iraq and Afghanistan and subsequent inter-ethnic conflict and attacks against the occupying forces in these countries are primarily to blame for the increase in terrorist attacks, of course.

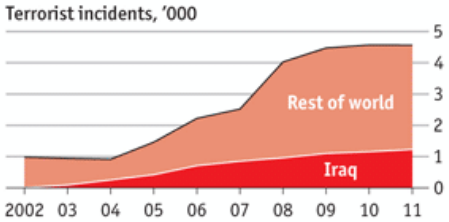
Figure 4 – Global terrorism index, 2002-2011



Score, maximum=10

Rank	Country	Score	Rank	Country	Score
1	Iraq	9.56	6	Somalia	7.24
2	Pakistan	9.05	7	Nigeria	7.24
3	Afghanistan	8.67	8	Thailand	7.09
4	India	8.15	9	Russia	7.07
5	Yemen	7.31	10	Philippines	6.80

Source: Institute for Economics and Peace



Source: Economist (2012)

are. Furthermore, the government may want to invest more into counter-terrorism measures if it observes no terrorist activities. These results indicate that it matters for the optimal government strategy whether the government is facing a terrorist group of the commonly assumed "political" or "military" type (cf. Arce and Sandler, 2007), or whether it is confronted by a terrorist organization that wants to achieve growth (cf. Feinstein and Kaplan, 2010). The behaviour of contemporary terrorist groups gives some evidence for the existence of such a growth motive and the resulting terrorist and government strategies.

The main part of this dissertation is structured as follows: chapter one will create a framework in which the effect of altruistic preferences on the outcome of tax competition between two welfare states is examined. This chapter is based on Hendel (2012a). The second chapter consists of an empirical study of the relationship between immigration and the attitudes towards the public provision of school children day care. The third chapter develops a game theoretic model of interaction between a terrorist organization and a government and characterizes their optimal strategies and the outcome of the game. This chapter is

based on Hendel (2012b). The thesis is concluded by an outlook which briefly illustrates why the economic treatment of migration and national security will be of enduring importance in the foreseeable future.

Chapter 1

The Influence of Altruistic Preferences on the Race to the Bottom of Welfare States

1.1 Introduction

Most taxation, be it income tax, property tax, compulsory health or unemployment insurance, constitutes a form of wealth transfer from taxpayers in the higher income brackets to those with low or no income. Therefore, the tax competition literature argues that regions and countries compete for a mobile tax base consisting of redistribution-averse taxpayers which leads to a destructive Race to the Bottom in taxes. This in turn makes the provision of tax-financed public goods and welfare transfers all but impossible in the worst case.[1] However, the empirical evidence for this phenomenon is rather mixed.[2]

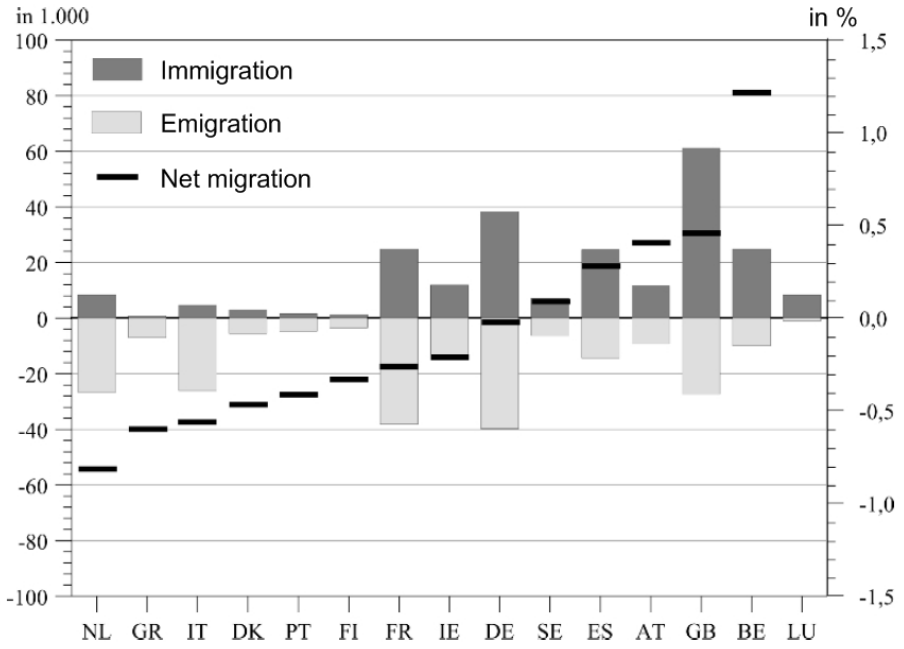
In contrast to what the Race to the Bottom theory suggests, some countries with high tax rates seem to have a high appeal for taxpaying migrants, as can be seen from European migration patterns of highly qualified personnel (see Figure 1.1). For example, Norway with a tax wedge of 43%, Sweden with 50.9% and Belgium with 60.5% (OECD, 2010) for high-earning singles are able to sustain tax rates above the OECD average of 41.1% and are still attractive for European migrants.[3] One could argue that in the case of Norway low unemployment rates and high net incomes are the dominant reasons for the net influx of 40,000 migrants in 2009 (Statistics Norway, 2009). But Sweden and particularly Belgium did not display low levels of unemployment and high net incomes between 2005 and 2009 as can be seen from Table 1.1. Furthermore, while Denmark and the Netherlands (which are countries characterized by high net wages

[1] Of course, tax competition can also have beneficial effects such as fiscal restraint and efficiency gains. For an overview, see Wilson (1999).

[2] Among the proponents of a Race to the Bottom are Brueckner (2000), Dahlberg and Edmark (2008) and Kleven et al. (2010). Other motivations for migration and tax competition prevail in research by Volden (2002), Bakija and Slemrod (2004) and Dalen and Henkens (2007).

[3] The OECD defines the tax wedge as the ratio between income tax, employer and employee social contributions minus cash transfers to labour costs. The tax wedge does not include additional compulsory contributions to privately managed pension funds or insurances.

Figure 1.1 – Emigration, immigration and net migration of "scientists" and "executives" between EU-15 countries, averaged over 2005 to 2009



"Scientists" (ISCO 2) and "executives" (ISCO 1) are classified according to the "International Standard of Occupations" (ISCO)
Adapted from Ette and Sauer (2010)

and low unemployment in European comparison) lost highly qualified taxpayers between 2005 and 2009, Germany, a country with high taxes and high unemployment in European comparison had a net migration of about zero. A common feature of Germany, Sweden and Belgium is the high publicly mandated social expenditure as a share of GDP. Thus, high taxes in combination with generous welfare transfers do not seem to be a deterrence for many migrants. This is at odds with the notion that taxpayers aim to pay as little taxes as possible, maximize disposable income and migrate accordingly.

In this chapter, I will show that a full Race to the Bottom in taxes does not need to occur under the assumptions of immobile poor welfare recipients and perfectly mobile altruistic taxpayers who cannot decide on their income tax levels. I will further distinguish between three types of altruism which are discussed in detail in section 2: pure altruism as formulated by Weichenrieder and Busch (2007), inequity

Table 1.1 – Tax wedges and welfare expenditures for selected OECD countries

Country	Average net income for a single worker, no kids, earning 170% of the average wage in $US (2005-2009)	Tax wedge for a single worker,no kids, earning 167% of the average wage in % (2009)	Net publicly mandated social expenditure in % of GDP (2007)	Average indirect tax rate in % (2007)	Average unemployment rate in % (2005-2009)
Austria	53742.82	50.1	24.8	16.4	4.58
Belgium	45383.41	60.5	26.2	15.1	7.84
Denmark	53360.46	48.6	23.9	26.0	4.40
Finland	50644.36	48.2	22.6	19.9	7.50
France	48382.80	53.1	29.9	14.4	8.84
Germany	49352.55	53.0	27.2	14.2	9.10
Luxembourg	67303.30	41.1	19.1	23.7	4.70
Mexico	N/A	20.8	9.0	6.0	4.08
Netherlands	55525.10	41.8	20.4	23.5	4.00
Norway	74285.78	43.0	20.0	23.5	3.20
Poland	12867.62	34.9	18.8	17.9	11.34
Spain	38092.14	41.6	21.6	12.5	11.08
Sweden	49578.42	50.9	26.0	20.7	7.08
Switzerland	77866.91	33.6	N/A	N/A	3.74
United Kingdom	69274.85	37.0	22.7	12.8	5.74
United States	47441.14	34.6	18.9	4.1	5.88
OECD Average	N/A	41.1	20.2	15.1	6.64

Source: OECD (2007, 2010, 2011a)

aversion as proposed by Fehr and Schmidt (1999), and warm glow as put forward by Andreoni (1990). Both inequity aversion and warm glow have so far not been used to motivate taxation.

If warm glow preferences are assumed and altruistic sentiments are sufficiently strong, an asymptotically stable unique pure strategy Nash equilibrium (NE) exists in which taxation occurs. Furthermore, if countries are asymmetric with respect to the number of poor, it is shown that there are stable pure strategy NE with pure altruism and inequity aversion preferences. The model also suggests that rich countries have an advantage in the competition for taxpayers. The aim of this chapter is to highlight a factor other than migration costs, namely altruistic preferences, which may help to explain why high tax,

high welfare benefit countries such as Germany do not suffer from a significant flight of their taxpayers.

The first economic models to deal with the tax erosion issue were mainly focussed on tax competition within federations.[4] European integration has then sparked research on the reaction of taxes and welfare states to a trans-national increase in mobility and free labour market access.[5] For a survey of the effects of factor mobility on redistribution, see Cremer and Pestieau (2004).

Directly related to this chapter is the contribution by Weichenrieder and Busch (2007). They present a framework in which zero taxation is the outcome in a federation with perfectly mobile, non-altruistic taxpayers and immobile poor who decide on the level of taxation. The same result is achieved under the assumption of immobile homogenous taxpayers with pure altruism preferences who can also decide on the tax rates, and perfectly mobile poor. Altruism is modeled such that the amount of money transferred to each individual poor person enters the utility function of the taxpayers. Imposing further restrictions on the relative numbers of poor and rich citizens, the authors predict a full Race to the Bottom in taxes in the absence of a mechanism such as "delayed integration" under both mobility assumptions.[6] Weichenrieder and Busch (2007) do not consider the case in which taxpayers are mobile, altruistic and heterogeneous with respect to the strength of their altruistic sentiment and welfare recipients are immobile. But this setting is interesting as, given the formulation of altruistic preferences, the migration decision of the rich now not only depends on the number of poor, but also on the number of other taxpayers in their jurisdiction. The altered mobility assumptions are also in line with real world observations, as explained in subsection 1.3.1.

I show that this variation of assumptions is sufficient to prevent a full Race to the Bottom with a warm glow formulation of altruism, even in the absence of the "delayed integration" mechanism. The public good character of redistribution introduces enough "stickiness" into migration decisions to allow for non-zero taxation. Furthermore, introducing asymmetry with respect to the number of immobile poor allows for stable NE with inequity aversion and pure altruism preferences. Here, the heterogeneity of taxpayers'

[4] The analysis was centered on externalities from taxation and migration, possible tax and transfer mechanisms to account for these externalities and general equilibrium effects from tax competition. See, for instance, Pauly (1973), Wildasin (1991), Crane (1992) and Mansoorian and Myers (1993). In a world without migration costs, the outcome in these models is generally zero taxation.

[5] See, for instance, Cremer and Pestieau (1998), Razin et al. (2002), Sinn (2003) and Egger and Radulescu (2009).

[6] "Delayed integration" means that a taxpayer has to pay the tax rate of the country he was living in at the start of the period, even if he migrates during the period. Tax rates are announced at the beginning of a period before migration can take place. In a tax competition game between two countries with finite number of periods, this mechanism is sufficient to prevent an outcome of zero taxation.

redistributive preferences is also crucial.

Several arguments other than altruism have been put forth in the literature to explain why a redistributive welfare state can survive in the presence of taxpayer mobility.

First, welfare transfers act as an insurance against the sudden loss of one's earning ability through, say, unemployment, and insurance through redistribution can cover risks for which no private insurance market exists (Sinn, 1996). But wealthy taxpayers with safe jobs should prefer not to insure at all or to insure themselves privately to keep out the "bad risks" as they end up being net contributors in public welfare and insurance schemes.

Second, migration costs have been put forward as a reason for the possibility of taxation: Citizens can be taxed simply because leaving the jurisdiction is more costly (in monetary or psychological terms) for them than paying their taxes (Mansoorian and Myers, 1993). But with increasingly multilingual populations, fast and cheap means of transport and advanced communication via the internet, these costs should be falling, especially for young and well educated professionals which constitute the group most likely to migrate.[7]

Third, political scientists have argued that tax competition might not take place due to domestic and transnational political constraints (Basinger and Hallerberg, 2004; Gilardi and Wasserfallen, 2010): On the one hand, the majority of the electorate could oppose lowering tax rates levied on the rich due to ideological reasons even if, for instance through a Laffer curve effect, this were to increase tax revenues. On the other hand, governments might adhere to informal, non-enforceable agreements with other countries and do not deviate unilaterally, so the Prisoner's Dilemma of the Race to the Bottom is solved by simply agreeing to play the mutually beneficial strategy. These constraints violate rationality assumptions commonly made in economics and are therefore debatable.

The next section presents different concepts of altruism which will be incorporated into a tax competition model with warm glow in section 1.3 and with pure altruism and inequity aversion in section 1.4. Section 1.5 concludes.

[7] E.g., Thompson (2009) finds a high willingness to migrate particularly in this group.

1.2 Concepts of altruism

The idea that humans are not guided purely by economic considerations, but by a divinely commanded, innate or acquired concern for their fellow man has been around for millennia.[8] However, incorporating this notion into an economic model requires modifications to the concept of the self-interested, coldly calculating homo oeconomicus. This section presents three different approaches to the idea of altruism.

A first concept is *pure altruism*. For instance, the formulations of altruism in Wildasin (1991) and Weichenrieder and Busch (2007) are in line with this notion. One could imagine that taxpayers receive utility from the tax-financed welfare benefit an individual poor person in their jurisdiction receives. This could be because they are genuinely "good" people who feel empathy for the lot of others.[9] Or they could just as well be motivated by purely egoistic reasons: Having beggars off the streets, reducing poverty-related crime or, generally speaking, "keeping the masses quiet" are motivations that can be captured by a preference for income redistribution. Furthermore, it could be the case that the productivity or income of a rich taxpayer depends on the human capital of the poor as he might need educated workers for his factories, as assistants, etc. Income redistribution to pay for the poor's education is therefore rational for taxpayers even though they do not care about the living conditions of the poor per se.[10]

But utility from pure altruism does not depend on one's own contribution in large societies and therefore suffers from free-riding issues related to public goods.[11] The individual contribution has a minimal effect on the total provision of welfare benefits, and thus each taxpayer would state zero as his own preferred tax rate. This implication of the notion of pure altruism has already been noted, albeit not in its negative implications, by the German moral philosopher J. G. Fichte in the late 18th and early 19th century. Fichte stated that a good person wants good acts to take place and does not care by whom they are performed (2012). There is also experimental evidence for this shortcoming of a purely altruistic motivation, e.g.

[8] Charity is demanded in both the Old and New Testament and the Qu'ran. The causes and effects of charity are an important issue in Thomas Aquinas' "Summa Theologiae" (Ney, 2006), and Immanuel Kant (1785) deduces the duty of charity from his notion of the categorical imperative.

[9] In Germany, wealthy taxpayers like Dietmar Hopp (one of the founders of SAP) and a club of 50 millionaires have demanded higher income taxation instead of social welfare cuts to overcome the current dire fiscal situation (Hamburger Abendblatt, 2010; ZDFinfokanal, 2010).

[10] This idea is also found in Alesina and Giuliano (2009), for instance.

[11] For a discussion of group size effects on public good provision see, for instance, Isaac and Walker (1988).

by Palfrey and Prisbrey (1997) who fail to find purely altruistic preferences in a voluntary contributions experiment.

A second concept is *inequity aversion*, which has come up in recent research as a possible driving force behind income redistribution. Here, it is not concern for the income of others, but worries about the difference between one's own income and that of others which leads to voluntary giving. Fehr and Schmidt (1999), as well as Bolton and Ockenfels (2000) find that equity preference can explain a wide range of experimental outcomes, ranging from completely selfish behavior to full cooperation, in public good and dictator games. In addition to fairness considerations as expressed in Bolton and Ockenfels' idea of "equity and reciprocity", the same basically egoistic motivations for an aversion to inequity as in the pure altruism case apply.

Finally, a third approach to motivate altruistic behavior is *warm glow altruism* which has been put forward by Andreoni (1990) and tested, amongst others, by Palfrey and Prisbrey (1997) and Crumpler and Grossman (2008). According to the warm glow theory, the act of giving generates utility for an individual as he or she experiences a good feeling from being generous. Neither the utility of the donation recipient nor the total provision of a good financed by donations matters, only the individual contribution. The opposite effect, a "cold chill", analytically works in the same way with an inverted sign and captures the pangs of conscience generated by not adhering to a social norm, to the direct request of a fund raiser or similar external demands for charity.

One could argue that warm glow can only be applied to truly voluntary giving, like donations to charities, but there are reasons why it might also be reasonable to consider warm glow preferences in connection with taxation. A mobile individual does not have to take the tax rate of a country as given but can migrate to another country, and hereby choose his or her own preferred contribution to the welfare state. Therefore, in a setting with competing countries, taxes become, at least to some extent, a choice variable for individuals. Civic duty, resulting from an upbringing in an environment in which taxation and redistribution is the acknowledged social norm, might also induce individuals to feel a warm glow (or at least avoid a cold chill) by paying their taxes as they are fulfilling their perceived obligations towards society. In this respect,

warm glow can be seen as being related to the notion of "tax morale".[12]

Finally, as Schlicht (1998) argues with his self-attribution theory, the mere fact of doing something might lead one to like it even if another salient reason, such as compulsion, is at hand. Hence, taxpayers might either try to fulfill an obligation by paying taxes or satisfy an "acquired taste" for redistribution.

It is clear that altruism, if it is only selfishness in disguise, should extend to the residents of a country the altruistic taxpayer lives in, not just to poor of the same nationality. But even if altruism stems from unselfish motives, it is reasonable to assume that altruistic feelings should be directed first and foremost towards the poor which are visible, close-by and receive local, regional or national news coverage. Thus, in the remainder of the chapter it is assumed that mobile taxpayers have altruistic sentiments towards the poor in the jurisdiction they live in.

Having established the applicability of theories of altruism on taxation, I will now turn to a model incorporating altruistic preferences in a tax competition framework.

1.3 A model of tax competition with altruistic preferences

1.3.1 General framework

In this section, I will present a model of two countries competing for mobile altruistic taxpayers. In the related literature, varying mobility assumptions for "rich" and "poor" persons have been used. However, migrants are often restricted from entering a country's social welfare system without first contributing to it.[13] Furthermore, affluent and well-educated persons usually have more options when considering employment abroad. Finally, Ette and Sauer (2010) show that the share of highly qualified personnel emigrating from Germany is disproportionately high. I therefore consider the case of mobile "rich" and immobile "poor" to be the most interesting one.

[12] "Tax morale" can be defined as the "intrinsic motivation to pay taxes arising from the moral obligation to pay taxes as a contribution to society" (Cummings et al., 2009). Particularly in Germany, a tax morale effect could be at work as minimizing the personal tax load through the myriads of deductions laid down in the German tax code can be considered the social norm, so paying the "normal" amount already amounts to something akin to voluntary giving (cf. Doerrenberg et al., 2012).

[13] In Germany, § 23 para. 3 Sozialgesetzbuch (Social Security Code) XII states that foreigners entering the country for the sole purpose of obtaining social security benefits are excluded from said benefits.

For altruistic taxpayers, income transfers can be seen as a local public good (cf. Pauly, 1973 and Orr, 1976), so they go "shopping" for their preferred rate of taxation and redistribution (Tiebout, 1956). It is important to note that altruism can call for very peculiar public goods: With warm glow altruism, only the *own* contribution creates utility, while public goods generally create utility through *total* contributions. Under the assumption of inequity aversion, the own contribution via its effect on disposable income also affects the utility from redistribution. Only redistribution motivated by pure altruism is a classic pure public good.

There are two countries, i and j, which maximize the welfare transfer they can offer to their local, immobile poor by maximizing tax revenue. The number of welfare recipients is given by n_i in country i and n_j in country j. Governments are interested in revenue maximization for redistributive purposes as their reelection depends on the welfare recipients: If the decisive voter in a country is a poor person, the government will cater for his redistribution preferences if it is interested in staying in office. The decisive role of a poor voter is ensured within the model's framework by assuming that the number of immobile poor within each country is greater than the total number of mobile taxpayers. Even if all taxpayers were to migrate to one country they would still be outnumbered and outvoted by the poor, which is an assumption also made in Weichenrieder and Busch (2007). Given the typical empirical result that the median of the income distribution is lower than its mean, and that the median voter is thus a beneficiary of a redistributive welfare system, this assumption seems justifiable (cf. Meltzer and Richard, 1981). The transfer constitutes the only income for welfare recipients. By taking into account the migration decisions of the taxpayers which are determined by their utility functions, governments implicitly also have to consider the welfare of the rich.

This model setup implies that in autarky, i.e. if taxpayers were not mobile, countries would try to fully expropriate taxpayers. To prevent full expropriation, one could assume that the possibility of taxation is restricted by bureaucratic inefficiencies so that the highest possible tax rate is smaller than the exogenous income (Weichenrieder and Busch, 2007). Countries will thus only suffer tax revenue reductions with

mobile taxpayers if tax competition drives equilibrium tax rates below those possible in autarky.[14]

Countries i and j collect a lump-sum tax b_i, b_j with $0 \leq b_i, b_j \leq x$ from a continuum K with mass 1 of costlessly mobile taxpayers. These taxpayers earn an exogenously given income $x > 0$ and incorporate some form of altruism, to be specified later, in their utility functions. As stated above, to make the decisive voter a welfare recipient it is assumed that $n_i, n_j > 1$. Taxpayers are heterogeneous with respect to the strength of their altruistic motivation. It is assumed that each country initially hosts one half of the mass of taxpayers, and that taxpayers do not have a home country preference, i.e. they do not intrinsically prefer living in one country over the other. Given the strength of his or her altruistic feeling, the tax rate and (in the case of inequity aversion and pure altruism) the number of immobile poor in each country, a taxpayer decides on whether to stay in his home country or migrate. Furthermore, taxpayers are unable to coordinate their migration decisions even if it were beneficial for them to all settle in the same country, and they take each others migration decision as given.

Taxpayer $k \epsilon K$ is assumed to have the following quasi-linear utility function if he settles in country i:[15]

$$U_{k,i} = V(x - b_i) + \alpha_k W(b_i) \tag{1}$$

V is a concave function of the taxpayer's disposable income with $V(0) = 0$, $\frac{\partial V}{\partial x}(0) = \infty$, $\frac{\partial V}{\partial x} > 0$, $\frac{\partial^2 V}{\partial x^2} < 0$. W is a linear function and can be specified to account for different types of altruism (see Table 1.2).

[14] An upper bound on redistribution could also be introduced by shedding the assumption that welfare recipients always outnumber taxpayers. But this would pose two problems. First, taxpayers would all want to settle within the same country to maximize their vote share. If the migration decision of a taxpayer depends on that of other taxpayers, a stable pure strategy NE may no longer exist as will turn out to be the case with pure altruism and inequity aversion preferences. Second, it would become necessary to calculate the decisive median voter. If he were a taxpayer, his location on the α- continuum would depend on the number of poor within the jurisdiction as all welfare recipients would prefer full expropriation. In turn, even with warm glow preferences the amount of redistribution would become dependent on the number of poor.

[15] As this chapter neither examines distributional questions nor principal-agent problems, the critique of the quasi-linearity assumption in public finance and political economy models as put forward in the introduction of Dixit et al. (1997) does not apply. As Boadway et al. (2002) notice, the quasi-linearity assumption is of course questionable but commonly used. In the context of this chapter, it makes the most sense to attribute the concave part to disposable income, as this ensures that at least for small incomes disposable income is preferred to altruistic redistribution.

Table 1.2 – Formal representation of the different types of altruistic preferences

Type of altruistic preference	Formal representation
No Altruism	$W \equiv 0$
Warm Glow	$W_i(b_i) = b_i$
Pure Altruism	$W_i(b_i, m_i, n_i) = b_i \times \frac{m_i}{n_i}$
Inequity Aversion	$W_i(x, b_i, m_i, n_i) = -(x - b_i - b_i \times \frac{m_i}{n_i})$

α_k is the strength of k's altruistic motivation, with $0 < \alpha_k \leq l < \infty$. The assumption of $0 < \alpha_k \leq l < \infty$ is needed to ensure the stability of the NE.[16] In the following sections, it is assumed that α_k is drawn from a truncated normal distribution between 0 and l with mean=median μ, $0 < \mu < l$, and standard deviation $\sigma > 0$.[17] Note that taxpayers are costlessly mobile, which leads to a zero taxation outcome in the absence of altruism. Taxpayers also only care about welfare transfers in the country they settle in.[18]

Given the tax rates b_i and b_j, it can be determined where each individual taxpayer will settle by calculating a cutoff level α^* which corresponds to a taxpayer's α who is just indifferent as to which country he lives in. This is done by setting the utility a taxpayer would gain in each country (given by (1)) equal and solving for α^*:

$$V(x - b_i) + \alpha^* W(b_i) = V(x - b_j) + \alpha^* W(b_j)$$

$$\Rightarrow \alpha^* = \frac{V(x - b_j) - V(x - b_i)}{W(b_i) - W(b_j)} \tag{2}$$

Assuming the same number of poor in each country, a taxpayer k with $\alpha_k > \alpha^*$ will settle in the country

[16] Including the zero bound makes it possible for a country to always attract marginally more taxpayers by marginally lowering the tax rate. If α were infinite, a country could always attract marginally more taxpayers by setting a higher tax rate. An unbounded distribution of altruistic preferences is also an unrealistic assumption.

[17] Experimental evidence (e.g. Andreoni and Miller (2002) and Fehr and Schmidt (1999)) supports the idea of heterogeneous individuals with respect to altruistic preferences.

[18] As Pauly (1973) argues, altruism is motivated by perceiving the plight of others, and dire living conditions close-by are more likely to be perceived than those far away. As pointed out in section 1.2, altruism that is motivated by a preference for not being confronted with poverty and its manifestations is also likely to depend on the level of poverty in the vicinity of the taxpayer.

with higher welfare transfers, while one with $\alpha_k < \alpha^*$ chooses the country with lower transfer levels.[19] Thus, the more altruistic taxpayers choose the country with higher taxation and higher welfare benefits.

Given the taxpayers' migration decision, the model is solvable by backward induction: Each country non-cooperatively and simultaneously chooses a tax level while taking into account the other country's possible decision and the resulting taxpayer migration. Taxpayers then choose whether to stay in their home country or migrate. The optimization problem for country i's tax revenues is thus

$$\max_{b_i} b_i \times m_i(x, b_i, b_j, n_i, n_j) \tag{3}$$

where m_i is the number of taxpayers who settle in country i.

Several formulations of the altruistic preferences can now be imagined, based on the different concepts of altruism presented in the previous section. These are summarized in Table 1.2. As can be seen from these formulas, in the warm glow case utility from transfers only depends on the own contribution. In the pure altruism case, the size of the transfer to each individual poor person matters, while in the inequity aversion case, the sign of W changes from $+$ to $-$ (as income differences create disutility) and disutility depends on the difference between disposable income and the transfer to each individual welfare recipient.

Given this setup, unique pure strategy NE values for taxation can be found which differ from the Race to the Bottom result of zero taxation. These equilibria will be derived in the following sections. The simple intuition for the existence of equilibria with positive taxation is that governments provide a good which is coveted by mobile taxpayers. The repelling effect of a lower disposable income is countered by the attraction of the good.

To illustrate the typical results of tax competition models lacking mobility constraints or other competition-reducing assumptions, I will briefly cover the results of the model in the absence of altruism. In this case, the utility of a taxpayer will only depend on his or her disposable income in a given country, that is, $U_{k,i} = V(x - b_i)$. Obviously, all taxpayers will choose to move to the country that levies the lowest tax

[19] Note that, depending on b_i and b_j, α^* can take values greater than l and smaller than 0. But this only means that, given the distributional boundaries on α, there is no such taxpayer in the population. Therefore, if α^* is "out of bounds", all taxpayers have either $\alpha < \alpha^*$ and will move to the low benefit country, or $\alpha > \alpha^*$, which results in a full relocation to the high benefit country.

rate as their preferred tax rate is zero.

The implication for the tax competition between two states is that a country can attract all taxpayers by marginally undercutting the other's tax rate. This will lead to ever smaller tax rates as countries continuously undercut each other, resulting in the only stable outcome of zero taxation in both countries. Any country setting a positive tax rate will not have a tax base to charge taxes from. This is also the result in the Weichenrieder and Busch (2007) model in the case of perfectly mobile, non-altruistic taxpayers without "delayed integration" and in line with the standard non-collusive result of Bertrand competition.

1.3.2 Introducing warm glow preferences

In the warm glow setting, a taxpayer receives utility from his own tax payment, regardless of the resulting individual transfer to each welfare recipient. Taxpayer k's utility in country i is now given by

$$U_{k,i} = V(x - b_i) + \alpha_k b_i \tag{4}$$

and the indifferent taxpayer's α^*, from (2), is determined by

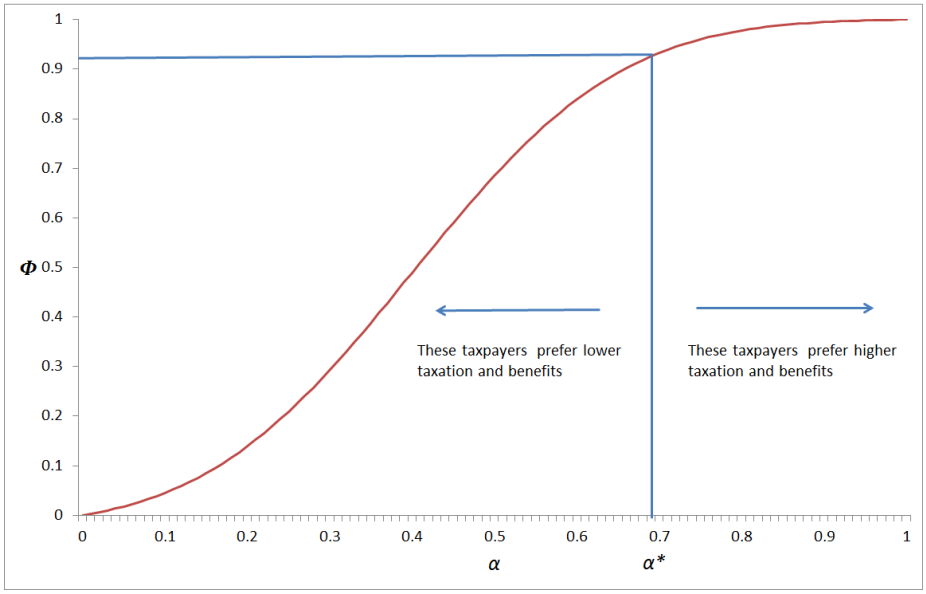
$$\alpha^* = \frac{V(x - b_j) - V(x - b_i)}{b_i - b_j} \tag{5}$$

The preferred tax rate of taxpayer k, b_k, is implicitly given as a function of the strength of his altruistic sentiment. It is derived by maximizing (4) with respect to b_i, denoting $\partial V(x - b_i)/\partial b_i$ as $V'(x - b_i)$, and replacing b_i by b_k:

$$V'(x - b_k) = \alpha_k \tag{6}$$

The number of taxpayers in countries i and j (denoted by m_i and m_j) given b_i and b_j is determined by α^*. Remember that the country setting the lower tax rate will attract all taxpayers with $\alpha < \alpha^*$ as utility from transfers is equal to tax payments in this setting. Given the distribution of α it is possible to calculate

Figure 1.2 – Cumulative distribution function of α



$\mu = 0.4$, $\sigma = 0.2$, $l = 1$

the number m of taxpayers with $\alpha < \alpha^*$ from the cumulative distribution function (cdf) of a truncated normal distribution:

$$m = \frac{\Phi(\frac{\alpha^* - \mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})} \tag{7}$$

The term on the right-hand side gives the value of the cdf at α^*, with Φ being the cdf of a standard normal distribution. See Figure 1.2 for a graphical example. As the mass of taxpayers is normalized to 1, (7) directly gives the number of taxpayers who choose the country with the lower tax rate. The number of people settling in the higher tax country is thus simply $1 - m$.

Having determined the migration decision of the taxpayers, it is possible to calculate the tax revenues for

each country. Tax revenue π_i in country i is given by

$$\pi_i = b_i \times m_i = \begin{cases} b_i \times m & if\, b_i < b_j \\ b_i \times (1-m) & if\, b_i > b_j \\ 0.5 \times b_i & if\, b_i = b_j \end{cases} \tag{8}$$

Taking the other country's taxation decision as given, country i will decide on a tax revenue maximizing tax rate.

Now define b^* as the tax rate preferred by the taxpayer whose α is equal to the median of the truncated normal distribution from which α is drawn. One half of the taxpayers will prefer a higher tax rate, one half a lower tax rate than the median taxpayer. The median of the truncated distribution, denoted as μ^*, is calculated from the mean and standard deviation of the underlying normal distribution as follows:

$$\mu^* = \Phi^{-1}\left(\frac{\frac{1}{2} \times (\Phi(\frac{l-\mu}{\sigma}) + \Phi(\frac{0-\mu}{\sigma})) - \mu}{\sigma}\right) \tag{9}$$

From (6), by substituting μ^* for α_k and b^* for b_k, b^* is implicitly given by

$$V'(x - b^*) = \mu^* \tag{10}$$

The median taxpayer will only favour redistribution if (10) holds for non-negative b^*, which becomes more likely as x and, by the properties of V, μ^* increase. Similarly, the desired amount of redistribution increases in x and μ^*.

I will now show that b^* (if non-negative) is the tax rate adopted by both countries in the unique pure strategy NE of this model. The analytical proofs for existence, stability and uniqueness can be found in the appendix.

If both countries set their tax rates equal to b^*, each country will attract exactly half of the total population of mobile taxpayers. An unilateral deviation by a country cannot increase its tax revenues: If it sets a lower tax rate, it loses taxpayers and levies a lower per capita tax rate. If it sets a higher tax rate, the

negative migratory response outweighs the beneficial effect of having higher per capita tax revenues if the distribution of α is "dense" enough around μ^* (this condition is shown in equation (A.5) in the appendix).

If one country does not set a tax rate of b^*, the other country reacts in the following way: Assume that country j deviates from b^*. If it sets a lower tax rate, country i can set a higher tax rate than country j and attract more taxpayers as more than half the number of taxpayers prefers a tax rate higher than the one set by j. If country j sets a higher tax rate than b^*, country i can marginally undercut this tax rate and attract more taxpayers at a higher tax rate than b^*. Country i's best-response function thus takes the form

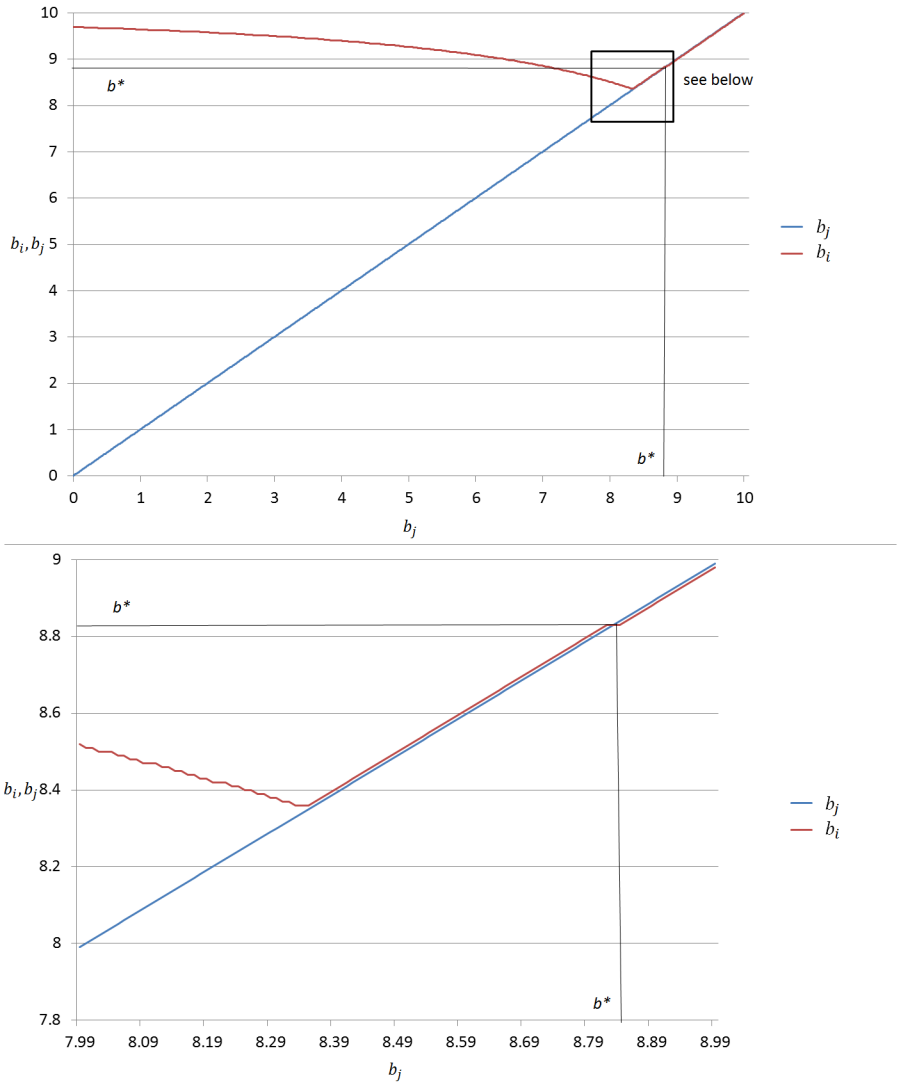
$$b_i = \begin{cases} b_j - \varepsilon & if\, b_j > b^* \\ \frac{1-m}{\partial m/\partial b_i} > b_j & if\, b_j < b^* \\ b^* & if\, b_j = b^* \end{cases} \tag{11}$$

An exemplary best-response function is shown in Figure 1.3. If $b^* > 0$, a pure strategy NE exists.[20]

The NE tax rate implicitly given by (10) displays several characteristics: First, a full Race to the Bottom is avoided as both countries will choose the same positive tax rate if (10) holds for non-negative b^*, which becomes more probable as μ, l and x increase (from (9), μ^* is a positive function of μ and l). Second, an increase in the mean value and the upper limit of the altruistic preferences distribution will increase the optimal tax rate as can be seen from (10) and (9), while the effect of an increase in σ depends on whether μ is above (negative effect) or below (positive effect) $l/2$. The reason for this mechanism is that if α were uniformly distributed between 0 and l, the optimal tax rate would be the one preferred by the taxpayer with $\alpha = l/2$. As the standard deviation of the normal distribution increases, it becomes closer in form to the uniform distribution, and therefore the equilibrium tax rate with a normal distribution will

[20] As long as (6) holds for non-negative b_i if $\alpha = l$, zero taxation is still not a possible outcome of tax competition as at least taxpayers with an α of l will still be in favour of some taxation. The marginal utility from welfare benefits is l for an individual with $\alpha = l$, so he or she prefers taxation if the marginal utility from disposable income is smaller than l, which in the quasi-linear setting is the case if $-V'(x-b) < l$. A country will be able to attract the most altruistic taxpayers and generate tax revenues by setting a tax rate between 0 and the tax rate which makes the most altruistic taxpayer just indifferent between no taxation and taxation with redistribution. However, this will only be a NE in mixed strategies as a country slightly undercutting the other's tax rate will be able to attract all taxpayers who would prefer a zero-level of taxation. But playing a mixed strategy with a positive probability of setting a non-zero tax rate dominates constantly choosing a tax rate of 0.

Figure 1.3 – Best-response function of country i to country j's tax rate with warm glow



$V(.) \equiv \sqrt{(.)}$, $x = 10$, $\mu = 0.4$, $\sigma = 0.5$, $l = 1$

converge towards the one achieved with a uniform distribution. Third, due to the quasi-linear formulation of preferences, with a sufficiently large x all further increases in income will be taxed away to provide welfare transfers. Welfare recipients can thus end up with a higher income than taxpayers. This feature of the model stems only from the quasi-linear formulation and has no implications for the real world, of course. By appropriately choosing the parameters of the model, it would be possible to rule out this result.

Proposition 1: Assuming warm glow preferences, if $b^* > 0$ *a unique and stable pure strategy NE for taxation exists in which both countries choose the non-zero tax rate that corresponds to the one preferred by the taxpayer with* $\alpha = \mu^*$.
Proof: See the appendix.

This result is not affected in any way by the number of welfare recipients as taxpayers value only the size of their own contribution, not the impact it has on individual welfare payments.

In the case of warm glow altruism, the NE is robust to the relaxation of the assumption that countries choose their tax rates simultaneously. Assume that country i moves first. As shown in the appendix, the best tax rate country i can set is b^*. If country i chooses a lower tax rate, country j will be able to attract more taxpayers than country i at a higher tax rate at the expense of country i. Country i will end up with less taxpayers and a lower tax rate if it sets $b_i < b^*$ which is clearly not optimal. If country i chooses a higher tax rate than b^*, country j will find it optimal to set a marginally lower tax rate which will lead to migration towards country j. In the case of $b_i > b_j > b^*$, the negative migratory effect offsets country i's gains from a higher tax rate, and thus setting a higher tax than b^* cannot be optimal. Therefore, as country j will never choose $b_j = b_i \neq b^*$ because it can do better by setting a higher or lower tax rate, and as country i's tax revenues will always be non-optimal if it sets $b_i \neq b^*$, the best option country i has is to choose $b_i = b^*$ as this will induce country j to also select this tax rate. The model thus confers neither a first-mover advantage nor disadvantage.

The results of the warm glow model are neither affected by asymmetry between the two countries with respect to the number of welfare recipients nor by spatial altruistic preferences (concern for the poor in

other jurisdictions) as in Pauly (1973). n_i and n_j do not enter the utility function of taxpayers, and a taxpayer's own contribution generates utility regardless of the resulting individual transfer to each welfare recipient and his location.

1.4 Introducing pure altruism and inequity aversion preferences

1.4.1 Symmetric countries

In this section I introduce pure altruism and inequity aversion as two other possible ways to model other-regarding preferences. I first consider the symmetric case, $n_i = n_j = n$. It turns out that in this case pure altruism and inequity aversion only support unstable pure strategy NE.

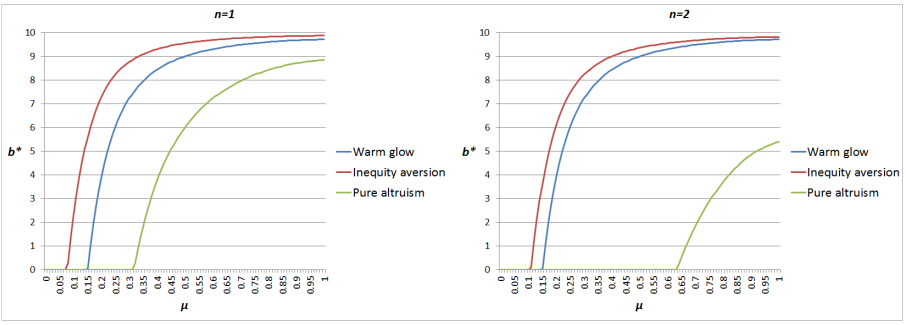
With pure altruism preferences, transfers made by all taxpayers within a country enter the utility function of each taxpayer, and so does the number of welfare recipients. Hence, taxpayer k's utility in country i is now given by

$$U_{k,i} = V(x - b_i) + \alpha_k \times \frac{b_i m_i}{n} \tag{12}$$

Note that utility now not only depends on the tax rate, but also on the number of poor and the number of taxpayers within the chosen country. Assuming pure altruism preferences and given a sufficiently large μ^* and x, an unstable unique pure strategy NE for taxation exists in which both countries choose the non-zero tax rate that is preferred by the taxpayer with median altruistic preferences (see the appendix for a proof). The equilibrium tax rate is decreasing in the number of poor. The instability stems from the fact that the migratory response induced by a tax rate change will trigger another migratory movement away from the deviating country. An outflow of taxpayers makes the deviating country less attractive for taxpayers, and emigration continues until all taxpayers are concentrated in the other country. Therefore, if a country chooses a tax rate that is higher than the equilibrium one, it cannot simply get back into equilibrium by setting the tax rate at the equilibrium value as it has already lost taxpayers and thus attractiveness for migrants.

Under the assumption of altruism motivated by inequity aversion, taxpayers care about the difference

Figure 1.4 – Equilibrium tax levels for symmetric pure altruism, inequity aversion and warm glow



$V(.) \equiv \sqrt{(.)}$, $x = 10$, $\sigma = 0.1$, $l = 1$

between their disposable income and the income (consisting solely of the transfer) of each individual welfare recipient. The transfer income in turn depends on the number of taxpayer living within a given country. The main difference to pure altruism is that, as can be seen in (13), the tax rate enters the utility function positively twice. Inequity aversion thus presents a "stronger" kind of altruism than pure altruism. Taxpayer k has a utility function of the form

$$U_{k,i} = V(x - b_i) - \alpha_k \times (x - b_i - \frac{b_i m_i}{n}) \tag{13}$$

A unique pure strategy NE exists with inequity aversion preferences but it is also unstable because the same migratory responses will follow a deviation from the optimal tax rate as in the pure altruism case. A graphical comparison between the equilibrium tax rates achieved under each preference assumption is shown in Figure 1.4.

1.4.2 Asymmetric countries

A more interesting case is the outcome of tax competition with asymmetric countries with respect to the number of welfare recipients. One could expect that countries which have to support a smaller number of poor people have an advantage in the competition for taxpayers, at least if the transfer per welfare recipient matters as in the inequity aversion and pure altruism cases. Taxation under the assumption of a

warm glow feeling from paying taxes is not affected, as a taxpayer's utility depends neither on the number of other taxpayers in his jurisdiction, nor on the income of the poor. A smaller number of poor indicates a richer country as the distribution of taxpayers is assumed to be even at the outset.[21]

Intuitively, introducing asymmetry prevents the poorer country from mimicking the richer country's taxation choices, while the richer country has no incentive to marginally undercut or exceed the poorer country's tax rate. Migratory movements are no longer all-or-nothing as in the symmetric case because tax rates have to be different for rich and poor countries in equilibrium. With sufficiently altruistic taxpayers, asymmetric countries allow for a stable NE in contrast to the symmetric case.[22]

An equilibrium in the case of asymmetric countries has to fulfill two conditions: First, no taxpayer must have an incentive to migrate given his altruistic preferences, the distribution of taxpayers and the tax rates. Second, no country must have an incentive to alter its tax rate and thereby generate higher tax revenues. It is obvious that in any equilibrium the country with the larger number of poor will set a lower tax rate than the other one as it has a disadvantage in welfare provision: For a given tax rate, the individual transfer decreases in the number of poor people. If a poor and a rich country were to set the same tax rate all taxpayers would locate in the rich country as they could then benefit from higher welfare provision at the same tax rate. Thus, the rich country could attract all taxpayers by imitating the poor country's tax rate if it were higher than its own in the first place. The rich country will also be able to provide higher welfare benefits than the poor one which means that $m_i = 1 - m$ in equilibrium, so the less altruistic taxpayers will settle in the poor country.

Taking the poor country's taxation decision as given, the rich country faces an outflow of taxpayers when increasing its tax rate which will here be illustrated for the case of pure altruism (inequity aversion is analytically similar). Assume that $n_i < n_j$, i.e. that country i is rich and decides on setting a tax rate

[21] This is not synonymous with a smaller country size. It has been argued, for instance by Chatelais and Peyrat (2008), that small countries are drivers of tax competition as their benefits (attracting taxpayers) from lowering the tax rate outweigh the drawbacks (lower tax rates) in relation to their small GDP. This is not the case for large countries.

[22] The assumption that taxpayers differ in their valuation of redistribution is crucial here. If all taxpayers were the same obviously either no or every taxpayer would migrate in reaction to a change in tax rates.

$b_i > b_j$. Country i's tax revenue function is then given by

$$\pi_i = b_i \times m_i = b_i \times (1 - \frac{\Phi(\frac{\alpha^* - \mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}) \tag{14}$$

π_i is a function of α^* which, from (2), is given by

$$\alpha^* = \frac{V(x - b_j) - V(x - b_i)}{\frac{b_i m_i}{n_i} - \frac{b_j(1-m_i)}{n_j}} \tag{15}$$

The number of taxpayers in country i falls with b_i as the derivative of (15) with respect to b_i is positive (remember that taxpayers with $\alpha < \alpha^*$ prefer to live in the country with lower welfare provision, i.e. the poor one):

$$\frac{\partial \alpha^*}{\partial b_i} = \frac{V'(x - b_i)}{(\frac{b_i m_i}{n_i} - \frac{b_j(1-m_i)}{n_j})} + \frac{m_i \times (V(x - b_i) - V(x - b_j))}{n_i \times (\frac{b_i m_i}{n_i} - \frac{b_j(1-m_i)}{n_j})^2} > 0 \tag{16}$$

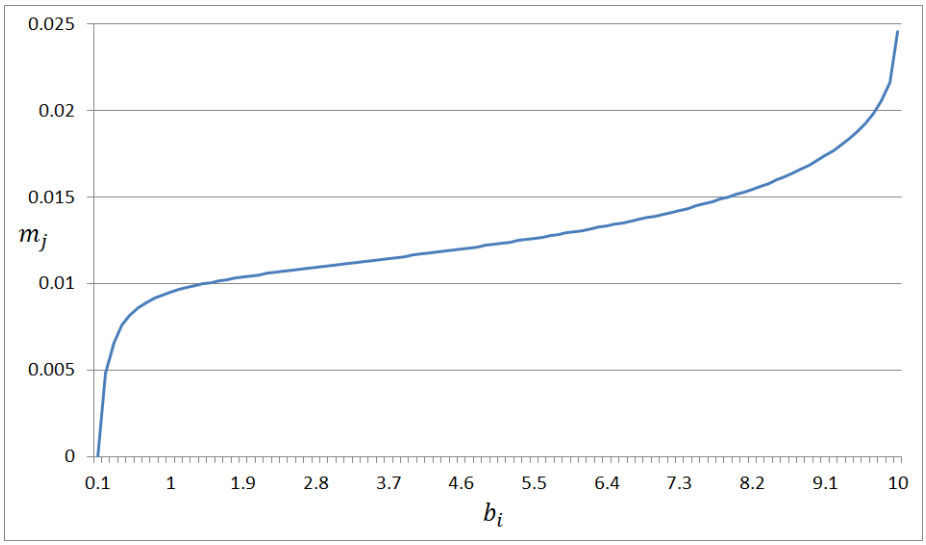
So m_i falls as α^* increases, which in turn will again increase α^*:

$$\frac{\partial \alpha^*}{\partial m_i} = -\frac{b_i \times (V(x - b_j) - V(x - b_i))}{n_i \times (\frac{b_i m_i}{n_i} - \frac{b_j(1-m_i)}{n_j})^2} < 0 \tag{17}$$

But as the second derivative of (15) with respect to m_i is positive and the second derivative of m_i with respect to α^* may be negative, the migratory response peters out (see appendix). This means that a marginal change in tax rates will not induce all taxpayers to migrate to the same country. When choosing b_i, country i thus can balance the positive effect of a higher tax rate against the negative effect of a smaller number of taxpayers. For a given b_i, the tax revenue function for country j looks similar; m_j is a decreasing function of b_j, and changes in b_j will trigger only a limited migratory response.

$m_j = m$ (the number of taxpayers settling in the low welfare benefit country) as a function of b_i is exemplarily shown in Figure 1.5. This function is strictly increasing in b_i, and thus $1 - m$ is strictly decreasing in b_i. If $\pi_i|_{b_j} = b_i \times (1 - m)$ has a global maximum in b_i and $\pi_j|_{b_i} = b_j \times m$ in b_j, a NE occurs if a combination of b_i and b_j exists for which both tax revenue functions are maximized. As shown in Figure

Figure 1.5 – m_j for varying b_i with asymmetric pure altruism



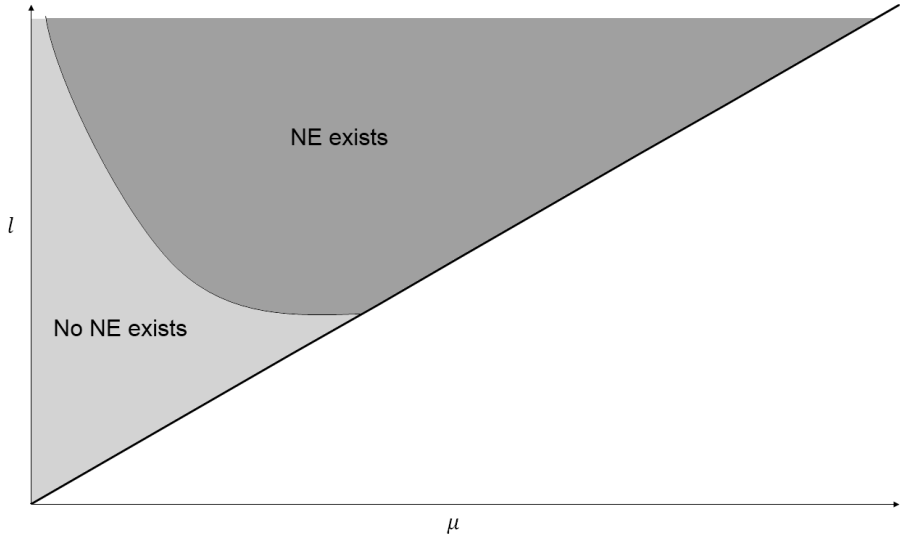
$V(.) \equiv \sqrt{(.)}$, $x = 10$, $b_j = 0.1$, $\mu = 1$, $\sigma = 1$, $l = 3$, $n_i = 1$, $n_j = 2$

1.6, the existence of a NE depends on μ and l: As both variables increase, and thus as the taxpayers become more altruistic, the existence of a NE becomes more likely. Furthermore, the resulting NE does not depend on the initial distribution of taxpayers, so it is stable because deviations from the equilibrium values of b_i and b_j will not lead to an endless cycle of tax adjustments as in the case of symmetric countries. Since explicitly solving the model if the number of poor differs between countries is impossible as the optimal tax rates are self-mappings of several nested functions, the proof in the appendix gives general conditions for the existence and stability of an equilibrium.

The model results for varying n_j given n_i are shown in Figure 1.7. Starting from an initially given distribution of taxpayers, the values were achieved by letting the countries alternately choose their optimal (tax revenue maximizing) tax rate while taking into account the migratory responses. Using this mechanism, a NE is reached if no country has an incentive to deviate from its tax rate and the distribution of taxpayers between countries remains stable.

Tax rates generally increase in μ, and inequity aversion, the stronger form of altruism, produces higher equilibrium outcomes. Increasing n_j will raise the equilibrium tax rate in both countries. For the poorer country, this is because higher taxation is required and accepted by the remaining taxpayers to compensate

Figure 1.6 – Existence of NE for pure altruism with asymmetric countries

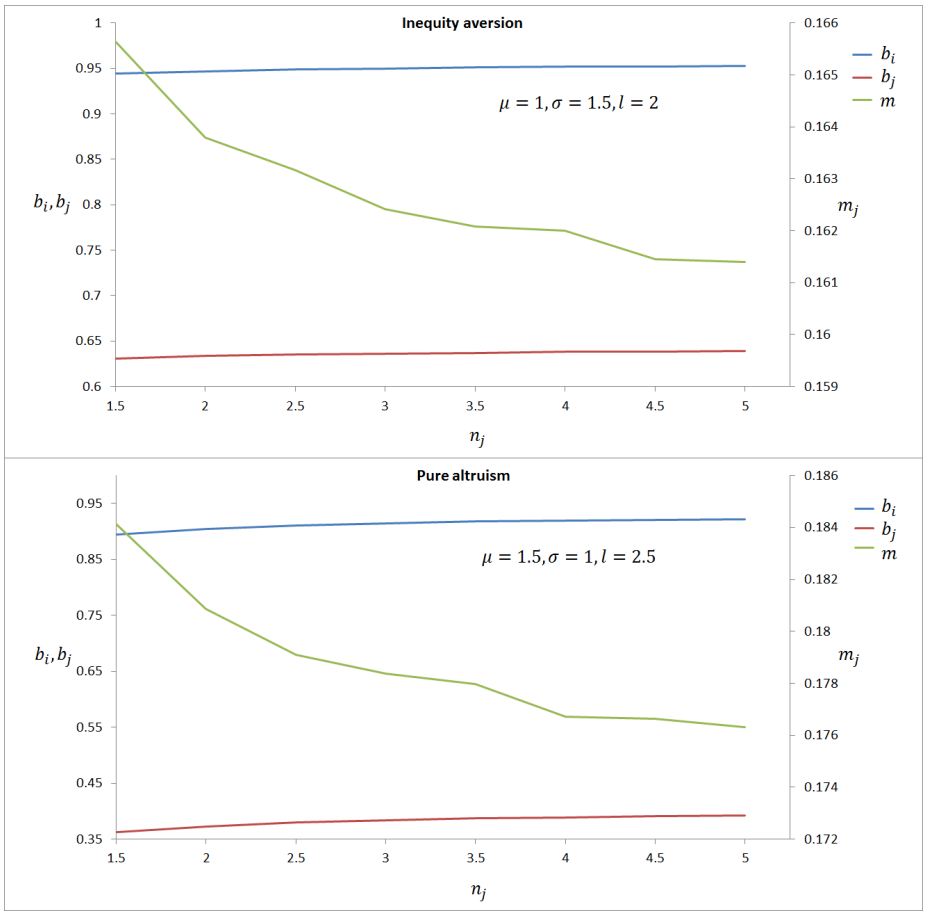


for the reduced p.c. transfer, while for the richer country the relative advantage in welfare provision p.c. increases which makes a higher tax rate feasible. It is also important to note that most taxpayer locate in the high tax/low poverty country, and that the number of taxpayers in the poor country j is falling in n_j, so having to support only few welfare recipients in comparison to other countries confers a twofold advantage: On the one hand, higher tax rates are sustainable in equilibrium, and on the other hand, most taxpayers prefer the high tax country.

Proposition 2: If countries differ with respect to the number of welfare recipients and given sufficiently high x and μ^*, a unique stable NE exists with pure altruism and inequity aversion preferences in which the country with the lower number of poor will set higher taxes and attract more taxpayers.
Proof: See the appendix.

In comparison to autarky, the richer country may be able to generate higher tax revenues if the tax revenue losses from a potentially lower tax rate are offset by the gains from a larger tax base. The poorer country suffers a reduction in tax revenues if taxpayers are mobile as it will lose taxpayers and end up with a lower tax rate as well.

Figure 1.7 – Equilibrium tax levels with asymmetric countries



$V(.) = \sqrt{(.)}$, $x = 1, n_i = 1$

1.5 Conclusion

Existing models of tax competition predict that in the absence of migration costs and other barriers to migration, countries will be forced to lower taxes and dismantle their welfare states. In contrast, the model presented in this chapter can explain the "stickiness" of taxpayers and the absence of a full Race to the Bottom due to migratory pressures by assuming an altruistic motivation of taxpayers. Warm glow preferences in general and pure altruism and inequity aversion preferences with countries asymmetric with respect to the number of poor inhabitants turn out to be sufficient to support stable NE.

The result put forward in Proposition 1 is based on a utility function that is in accordance with the notion of warm glow. The possibility of a positive welfare transfer depends only on the income and the distribution of altruistic preferences. If taxpayers are suitably characterized by this utility function, it is fair to say that the high incomes in Western countries and the degree of social cohesion and identification with the political system, which could be used as a proxy for the strength of altruistic preferences, are sufficient to maintain welfare states.[23] A dispersion of preferences is increasing tax rates in the likely case that a population is on average less altruistic than a uniform distribution would suggest. Heterogeneity of preferences is experimentally found by Andreoni and Miller (2002), who also state that three quarters of their test subjects display some form of altruistic behavior.

Pitting poor and rich countries against each other, Proposition 2 is congruent with real-world observations: Poor countries struggle to keep their taxpaying population and set lower taxes, while rich countries are attractive as they only have to distribute their tax revenues to a smaller number of welfare recipients. E.g., the tax wedge was 60.5% in Belgium in 2009 for high-earning singles, but only 20.8% in Mexico and 34.9% in Poland (OECD, 2010). Even between wealthy countries, this effect should be visible, which could explain some of the pull high tax/low poverty countries such as Sweden with a positive net migration of about $60,000$ in 2009 and Belgium exert on European migrants (Statistics Sweden, 2010).

Having stated the implications of the propositions, one should be aware that the model in this chapter is mainly applicable to economically equally developed countries with politically and culturally similar inhabitants. The distribution of altruistic preferences certainly varies between Western countries, and even more so between the West and Eastern and Asian countries.[24] The altruistic mobile tax base should be seen, also due to migration costs which are more important for migrants from other cultures and continents, in a European or at least Western context. Tax adjustments are long-term processes, so under the assumption of warm glow altruism and asymmetric pure altruism and inequity aversion one should not expect to see the predicted results at this time in European policy, but rather adjustments towards equilibrium.

[23] An economic model dealing with the state-directed strengthening of these factors is put forward by Konrad (2008). In his model, countries can invest in the loyalty of their taxpayers which alters the outcome of tax competition between countries.

[24] A recent Eurobarometer poll shows that 53% of all respondents (EU citizens) hold national governments responsible for reducing poverty (European Commission, 2009). However, on a national level this figure varies greatly (24% in France, 85% in Bulgaria).

Of course, migration decisions and the scope of welfare states do not depend on tax differentials alone, and tax competition is not the only problem arising from the free movement of production factors.[25] As various studies suggest, countries can attract migratory flows through a host of other positive characteristics, and the generosity of welfare states is also dependent on political and economic factors.[26] But the reasonable assumption of altruistic preferences when it comes to paying taxes can help to explain why the specter of the Race to the Bottom of welfare states has so far failed to materialize.

[25] For instance, Holzner et al. (2009) examine the issue of "brain drain" in Germany.
[26] See, for instance, Dalen and Henkens (2007).

Appendix to section 1.3

Proof of the existence of a NE for warm glow

There exists a symmetric NE in tax rates given by

$$b_i = b_j = b^* \tag{A.1}$$

Assume that country j sets $b_j = b^*$. The number of taxpayers per country has to be 0.5 in a symmetric equilibrium, therefore it is necessary that $m_i \to 0.5$ as $b_i \to b^*$. Utilizing L'Hôpital's rule to determine the value of (5) as $b_i \to b^*$, the limit of m_i is given by

$$\lim_{b_i \to b^*} \frac{\Phi(\frac{\alpha^* - \mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}{\Phi(\frac{1-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})} = \frac{\Phi\left(\frac{\mu^* - \mu}{\sigma}\right) - \Phi(\frac{0-\mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})} = 0.5 \tag{A.2}$$

In equilibrium, $\pi_i = \pi_j$ and therefore it is required that $\pi_i \to \pi_j$ as $b_i \to b^*$:

$$\lim_{b_i \to b^*} \pi_i = \lim_{b_i \to b^*} b_i \times \frac{\Phi(\frac{\alpha^* - \mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) \text{-} \Phi(\frac{0-\mu}{\sigma})} = \pi_j = \frac{b^*}{2} \tag{A.3}$$

What is left to prove is that π_i is strictly increasing (decreasing) in b_i below (above) b^*. For $b_i < b^*$,

$$\frac{\partial \pi_i}{\partial b_i} = b_i \times \frac{\frac{\partial \alpha^*}{\partial b_i} \times \frac{1}{\sigma}\phi(\frac{\alpha^* - \mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})} + \frac{\Phi(\frac{\alpha^* - \mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})} > 0 \tag{A.4}$$

with ϕ being the probability density function of a standard normal distribution. For $b_i > b^*$,

$$\frac{\partial \pi_i}{\partial b_i} = -b_i \times \frac{\frac{\partial \alpha^*}{\partial b_i} \times \frac{1}{\sigma}\phi(\frac{\alpha^* - \mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})} - \frac{\Phi(\frac{\alpha^* - \mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})} + 1 < 0$$

$$if\, b^* > \frac{\sigma(\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma}))}{\phi(\frac{\mu^* - \mu}{\sigma}) \times V''(x - b^*)} \tag{A.5}$$

The condition on b^* in (A.5) is obtained by solving $\frac{\partial \pi_i}{\partial b_i}$ for b_i and letting $b_i \to b^*$. It requires that the

distribution of taxpayers is "dense" enough around its median μ^* (as measured by ϕ) relative to b^* so that the marginal benefit from a higher tax rate is more than offset by the marginal loss of taxpayers. The condition is sufficient and necessary to ensure that $\frac{\partial \pi_i}{\partial b_i} < 0$.

Hence, as π_i strictly increases in b_i if $b_i < b^*$ and strictly decreases in b_i if $b_i > b^*$ and (A.5) holds, and as π_i converges towards $0.5 \times b^*$, $b_i = b_j = b^*$ constitutes a NE. ■

Proof of uniqueness of NE $b_i = b_j = b^*$ for warm glow

Asymmetric NE, i.e. $b_i \neq b_j$, can be ruled out as a country having a lower tax level than the other can always increase its tax revenue by increasing its tax level:

$$\frac{\partial \pi_i}{\partial b_i} = b_i \times \frac{\frac{\partial \alpha^*}{\partial b_i} \times \frac{1}{\sigma}\phi(\frac{\alpha^* - \mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})} + \frac{\Phi(\frac{\alpha^*-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})} > 0 \; if \; b_i < b_j \tag{A.6}$$

Now assume that $b_i = b_j < b^*$. As b^* is the tax level preferred by the taxpayer with mean altruistic preferences, one half of the voters prefers less and one half prefers more taxation and redistribution. It follows that less than half of the taxpayers prefers $b < b^*$. Thus, if country i marginally increases its tax level, it can attract all taxpayers with a preferred b larger than b_j instead of just 0.5 taxpayers. Therefore,

$$\frac{\partial \pi_i}{\partial b_i} > 0, \; if \; b_i = b_j < b^* \tag{A.7}$$

and there are no symmetric NE $b_i = b_j < b^*$.

Finally, consider the case of $b_i = b_j > b^*$. Country i has an incentive to reduce its tax rate if there exists a π_i, given $b_i < b_j$, that is greater than $\frac{b_j}{2}$. This condition can be reformulated as

$$\frac{\Phi(\frac{\alpha^*-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})} > \frac{b_j}{2b_i} \tag{A.8}$$

As $b_i \to b_j$, this inequation becomes

$$\frac{\Phi\left(\frac{V'(x-b_j)-\mu}{\sigma}\right) - \Phi(\frac{0-\mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})} > \frac{1}{2} \tag{A.9}$$

where the left-hand side gives the number of taxpayers settling in country i. Note that the left hand side converges towards a value greater than 0.5 because

$$V'(x-b_j) > V'(x-b^*)$$

$$\Rightarrow \Phi\left(\frac{V'(x-b_i)-\mu}{\sigma}\right) > \Phi\left(\frac{V'(x-b^*)-\mu}{\sigma}\right) = 0.5 \; if \; b_j > b^* \tag{A.10}$$

This inequality always holds as the tax rate $b_j > b^*$ is preferred by less than half of the taxpayers, and thus the number of taxpayers attracted by $b_j - \varepsilon = b_i > b^*$ is greater than 0.5. Therefore, country i can always increase its tax revenues by deviating from $b_i = b_j > b^*$, and thus there are no symmetric NE with $b_i = b_j > b^*$. ■

Proof of asymptotic stability of NE $b_i = b_j = b^*$ for warm glow

Assume that $b_j < b_i = b^*$. Country i may find it optimal to increase or decrease its tax level because $b_i = b^*$ may not fulfill the optimality criterion $\frac{\partial \pi_i}{\partial b_i} = 0$ if $b_j < b_i = b^*$. If, on the one hand, country i finds it optimal to set $b_i < b^*$ and attract more taxpayers at a lower tax level, then country j will find it optimal, as outlined in the proof of uniqueness, to set a tax level of $b_j = b_i + \varepsilon$ and thus have a higher number of taxpayers at a higher tax rate. As now country i will also set $b_i = b_j + \varepsilon$, this process continues and tax levels converge from below towards $b_i = b_j = b^*$.

If, on the other hand, country i sets $b_i > b^*$ to increase its tax revenues by charging a higher tax from a lower number of taxpayers, country j will also increase its tax level as $\frac{\partial \pi_j}{\partial b_j} > 0$ if $b_j < b_i$. By setting $b_j = b_i - \varepsilon$, country j will attract more taxpayers at a higher tax rate, which in turn will lead country i to adjust its tax level to $b_i = b_j - \varepsilon$. This process continues and tax levels converge from above towards $b_i = b_j = b^*$. ■

Appendix to section 1.4

Proof of the existence of a NE for pure altruism

There exists a pure strategy NE given by

$$b^* = b_i = b_j \tag{A.11}$$

where b^* is implicitly given by $V'(x - b^*) = \mu^*/2n$.

Assume that country j chooses a tax level of b^*. Tax revenues in country i are

$$\pi_i = b_i \times m_i = \begin{cases} 0.5 \times b^* & if\ b_i = b_j = b^* \\ b_i \times \frac{\Phi(\frac{\alpha^* - \mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})} & if\ \frac{b_i m_i}{n} < \frac{b_j(1-m_i)}{n} \\ b_i \times (1 - \frac{\Phi(\frac{\alpha^* - \mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}) & if\ \frac{b_i m_i}{n} > \frac{b_j(1-m_i)}{n} \end{cases} \tag{A.12}$$

α^*, however, is a function of b_i with the first derivative

$$\frac{\partial \alpha^*}{\partial b_i} = \frac{V'(x - b_i)}{(\frac{b_i m_i}{n} - \frac{b_j(1-m_i)}{n})} + \frac{m_i \times (V(x - b_i) - V(x - b_j))}{n \times (\frac{b_i m_i}{n} - \frac{b_j(1-m_i)}{n})^2} > 0 \tag{A.13}$$

That $\frac{\partial \alpha^*}{\partial b_i} > 0$ for $b_i > b_j$ can be shown by using Bernoulli's inequality. Holding m_i constant at 0.5, any tax rate deviating from b^* will be preferred by less than half of the taxpayers as b^* is just the tax rate which half of the taxpayers consider to be too low and half to be too high. This, in turn, further punishes a deviation from b^* as

$$\frac{\partial \alpha^*}{\partial m_i} = \frac{(\frac{b_i}{n} + \frac{b_j}{n}) \times (V(x - b_i) - V(x - b_j))}{(\frac{b_i m_i}{n} - \frac{b_j(1-m_i)}{n})^2} < 0\ if\ b_i > b_j \tag{A.14}$$

$$\frac{\partial \alpha^*}{\partial m_i} = \frac{(\frac{b_i}{n} + \frac{b_j}{n}) \times (V(x - b_i) - V(x - b_j))}{(\frac{b_i m_i}{n} - \frac{b_j(1-m_i)}{n})^2} > 0\ if\ b_i < b_j \tag{A.15}$$

which means that a loss of taxpayers alters α^* unfavourably for country i. By positively deviating from b^*, country i reduces its tax revenues as the outflow of taxpayers outweighs the higher tax rate per remaining

taxpayer. A negative deviation can never be optimal as it attracts less taxpayers at a lower tax rate. Thus, b^* is the optimal tax rate for country i given $b_j = b^*$, and this equilibrium is unstable as it will not be iteratively reached from any combination of b_i, b_j and m_i due to the migratory responses pointed out above. ■

Proof of the existence of a NE for inequity aversion

There exists a pure strategy NE given by

$$b^* = b_i = b_j \tag{A.16}$$

where b^* is implicitly given by $V'(x - b^*) = 1 + \mu^*/2n$.

Assume that country j chooses a tax level of b^*. Tax revenues in country i are

$$\pi_i = b_i \times m_i = \begin{cases} 0.5 \times b^* & if\ b_i = b_j = b^* \\ b_i \times \frac{\Phi(\frac{\alpha^* - \mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})} & if\ (x - b_i - \frac{b_i m_i}{n}) < (x - b_j - \frac{b_j(1-m_i)}{n}) \\ b_i \times (1 - \frac{\Phi(\frac{\alpha^* - \mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})}) & if\ (x - b_i - \frac{b_i m_i}{n}) > (x - b_j - \frac{b_j(1-m_i)}{n}) \end{cases} \tag{A.17}$$

α^*, however, is a function of b_i with the first derivative

$$\frac{\partial \alpha^*}{\partial b_i} = \frac{V'(x - b_i)}{b_i + \frac{b_i m_i}{n} - (b_j + \frac{b_j(1-m_i)}{n})} + (1 + \frac{m_i}{n}) \times \frac{(V(x - b_i) - V(x - b_j))}{(b_i + \frac{b_i m_i}{n} - (b_j + \frac{b_j(1-m_i)}{n}))^2} > 0 \tag{A.18}$$

That $\frac{\partial \alpha^*}{\partial b_i} > 0$ for $b_i > b_j$ can be shown by using Bernoulli's inequality. Holding m_i constant at 0.5, any tax rate deviating from b^* will be preferred by less than half of the taxpayers as b^* is just the tax rate which half of the taxpayers consider to be too low and half to be too high. This, in turn, further punishes a deviation from b^* as

$$\frac{\partial \alpha^*}{\partial m_i} = \frac{(\frac{b_i}{n} + \frac{b_j}{n}) \times (V(x - b_i) - V(x - b_j))}{(b_i + \frac{b_i m_i}{n} - (b_j + \frac{b_j(1-m_i)}{n}))^2} < 0\ if\ b_i > b_j \tag{A.19}$$

$$\frac{\partial \alpha^*}{\partial m_i} = \frac{(\frac{b_i}{n} + \frac{b_j}{n}) \times (V(x-b_i) - V(x-b_j))}{(b_i + \frac{b_i m_i}{n} - (b_j + \frac{b_j(1-m_i)}{n}))^2} > 0 \; if \; b_i < b_j \tag{A.20}$$

which means that a loss of taxpayers alters α^* unfavourably for country i. By positively deviating from b^*, country i reduces its tax revenues as the outflow of taxpayers outweighs the higher tax rate per remaining taxpayer. A negative deviation can never be optimal as it attracts less taxpayers at a lower tax rate. Thus, b^* is the optimal tax rate for country i given $b_j = b^*$, and this equilibrium is unstable as it will not be iteratively reached from any combination of b_i, b_j and m_i due to the migratory responses pointed out above. ■

Proof of the existence and stability of a NE for asymmetric countries with pure altruism

As has been discussed in subsection 1.4.2, if $n_i < n_j$ an equilibrium can only exist with $b_j < b_i$, so country j will attract $m_i = 1 - m$ taxpayers. The tax revenue function of country i is given by

$$\pi_i = b_i \times m_i \tag{A.21}$$

Define $P_i(z)$ as the first derivative of π_i with respect to b_i at $b_i = z$:

$$P_i(b_i) \equiv \frac{\partial \pi_i}{\partial b_i} = m_i + b_i \times \frac{\partial m_i}{\partial b_i} \tag{A.22}$$

m_i is a decreasing function of b_i,

$$\frac{\partial m_i}{\partial b_i} = -\frac{\partial \alpha^*}{\partial b_i} \times \frac{\frac{1}{\sigma}\phi(\frac{\alpha^* - \mu}{\sigma})}{\Phi(\frac{l-\mu}{\sigma}) - \Phi(\frac{0-\mu}{\sigma})} < 0 \tag{A.23}$$

as $\partial \alpha^* / \partial b_i$ is positive,

$$\frac{\partial \alpha^*}{\partial b_i} = \frac{V'(x-b_i)}{(\frac{b_i m_i}{n_i} - \frac{b_j(1-m_i)}{n_j})} + \frac{m_i \times (V(x-b_i) - V(x-b_j))}{n_i \times (\frac{b_i m_i}{n_i} - \frac{b_j(1-m_i)}{n_j})^2} > 0 \tag{A.24}$$

which can be shown by using Bernoulli's inequality. π_i is a continuous function on the interval $]b_j, x[$, $P_i(z) < 0$ as $z \to x$ and $P_i(z) > 0$ as $z \to b_j$ if $m_i|_{b_i \to b_j} > (|b_i \times \frac{\partial m_i}{\partial b_i}|)|_{b_i \to b_j}$, so π_i then has a local maximum on the interval $]b_j, x[$. Similarly, π_j has a local maximum on the interval $]0, b_i[$ if $m_j|_{b_j \to b_i} < (|b_j \times \frac{\partial m_j}{\partial b_j}|)|_{b_j \to b_i}$. The conditions on $m_i|_{b_i \to b_j}$ and $m_j|_{b_j \to b_i}$ hold if n_j is sufficiently larger than n_i and μ and l are sufficiently high. By these conditions it is ruled out that the richer country will find it optimal to set the same tax rate as the poor one and attract all taxpayers, which would prevent an equilibrium as the poor country would then again have an incentive to deviate.

Setting (A.22) equal to zero and solving for b_i gives the best response function for country i's tax rate given country j's tax rate. Define

$$Q_i \equiv -\frac{m_i}{\frac{\partial m_i}{\partial b_i}} \tag{A.25}$$

as this best response function. $\frac{\partial Q_i}{\partial b_j} > 0$ as $b_j \to 0$ and $Q_i = b_j$ as $b_j \to x$, so Q_i is increasing in b_j. Furthermore, $P_j(z) < 0$ as $z \to b_i$ and $P_j(z) > 0$ as $z \to 0$, so the optimal tax rate response of country j has to lie between 0 and b_i. Thus, an equilibrium in tax rates is reached where the positive marginal effect on Q_i (Q_j) from an increasing b_j (b_i) (which is finite) balances with the negative marginal effect on π_i (π_j) from approaching x (b_j) (which becomes infinite). I.e., country i will not want to increase its tax rate any further when the marginal gain in π_i from a higher b_i after the last increase in b_j just balances with the marginal loss in π_i from setting b_i closer to x. The same holds for country j after the last increase in b_i and its marginal gain (loss) from a higher b_j (from getting closer to b_i).

It is also necessary to see whether this equilibrium is stable. Denote by b_i^* and b_j^* an equilibrium in tax rates as given by the previous paragraphs. The second derivative of m_i with respect to α^* is positive while the second derivative of (15) with respect to m_i is negative, and thus the migratory response to a change in tax rates peters out, i.e. a deviation from equilibrium does not cause an all-or-nothing migratory response:

$$\frac{\partial^2 m_i}{\partial(\alpha^*)^2} > 0 \; if \; \alpha^* < \mu \tag{A.26}$$

$$\frac{\partial^2 \alpha^*}{\partial m_i^2} = 2 \times \frac{(\frac{b_i}{n_i} + \frac{b_j}{n_j})^2 \times (V(x - b_j) - V(x - b_i))}{(\frac{b_i m_i}{n_i} - \frac{b_j(1-m_i)}{n_j})^3} > 0 \tag{A.27}$$

Note that the condition in (A.26) is sufficient, but not necessary as the reaction of α^* to a lower m_i may become zero by (15) and (A.27) before $m_i = 0$, which will prevent further changes in m_i.

Thus, $b_i \to b_i^*$ and $b_j \to b_j^*$ if one or both countries do not initially choose their equilibrium tax rate. ■

Proof of the existence of a NE for asymmetric countries with inequity aversion

The proof for the existence of a pure strategy NE with inequity aversion is similar to the pure altruism case. The only changes occur in equations (A.24) and (A.27), but the signs of these equations are not affected and thus the proof remains valid.

Chapter 2

Immigration and Attitudes towards Day Care

2.1 Introduction

We link German household panel data and official data covering the population composition to examine the relationship between attitudes towards public funding of school children day care and the share of foreign pupils in a jurisdiction. The analysis is motivated by two recent interrelated developments in Germany. First, similar to other European countries, the fraction of inhabitants having a migration background is increasing over time and has reached 20% in 2010.[1] Relying on city-level data from the U.S, it has been argued that an ethnically more heterogeneous population in US cities reduces the provision of public goods as net-payers are loath to see their contributions go to members of other ethnicities (Alesina et al., 1999).[2] Second, while some countries such as France and Sweden have long established almost universal publicly funded day care options, other countries, including Austria and Germany, are only recently discussing the implementation of universal children day care. In light of a number of potential beneficial effects of day care for school children, it is important to understand how the increasing heterogeneity of the German population affects the current policy debate.

The background for this debate is the fact that education policy is mainly determined and funded by the states in Germany.[3] As a result, day care options vary widely in Germany. Some states, such as Berlin and Saxony, have already achieved a share of day care providing schools of 80-90%. But in other states, for

[1] See Statistisches Bundesamt (2010). Other examples in Europe are Spain where the share of non-nationals increased from 2.0% to 12.3% between 2000 and 2010 or Italy where the share of non-national population rose from 2.2% to 7.0% (Eurostat, 2012a).

[2] Razin et al. (2002) find that an influx of immigrants with low levels of education lowers taxation and social transfers. Roemer and Straeten (2005) estimate that in the French elections of 2002, the voters' choice of public-sector size was significantly reduced by immigration and subsequent "xenophobia". Hopkins (2009) argues that it is not racial and ethnic diversity, but changes in the demographic composition of an area that negatively affect the provision of public goods as these changes "destabilize residents' expectations and influence local elites". For surveys of the theoretical and empirical literature on the effects of ethnic diversity on the welfare state, see Alesina and La Ferrara (2005) and Stichnoth and Straeten (2011).

[3] In 2007, 79.4% of the funding for German primary and secondary schools was provided by the state, 18.8% by the county and 1.8% by federal sources (Sekretariat der ständigen Konferenz der Kultusminister, 2011).

instance Hamburg and Baden-Wurttemberg, only every third or fourth school offers some form of pupils' day care (Sekretariat der ständigen Konferenz der Kultusminister, 2012). In light of this dispersion, policy makers are discussing to what extent the federal level in Germany should take actions with respect to day care.

As argued above, day care for school children may serve several beneficial purposes and exhibits positive externalities which makes it a candidate for public provision (cf. Bundesministerium für Familie, Senioren, Frauen und Jugend, 2011): First, day care increases labor force participation rates as it frees up parents from having to attend to their children during work days. Second, it particularly relieves working mothers who become more flexible in planning their working hours if institutions are available to look after their children. Third, intensive professional education and care for children from disadvantaged households (due to low income or low educational level of parents or a migration background) helps bridging the opportunities gap opened by varying qualities of parental upbringing. Fourth and finally, additional afternoon hours for school children allow the teaching staff to focus more on the peculiarities of each child and to intensively promote children lagging behind due to language problems or special needs.

There are several ways in which preferences towards the public provision of day care could be affected by immigration: On the one hand, natives could resent establishing publicly funded day care programs if they do not want to pay for benefits non-natives receive due to social group loyalty (cf. Alesina et al., 1999).[4] At the same time, establishing a privately funded day care system allows an amount of segregation (by price or formal or informal entry criteria) between natives and foreigners that cannot be achieved within a publicly run system. Segregation of school children can be desirable for natives due to racism, concerns about an adverse effect of non-native children on teaching quality, negative peer group effects and the draining of school resources to provide catch-up lessons for children lacking the necessary language proficiency (Betts and Fairlie, 2003). A recent policy brief by the German "Sachverständigenrat deutscher Stiftungen für Integration und Migration" (2012) confirms that, in Berlin, many native German parents try to send their children to elementary schools with a low share of pupils with a migration background.

[4] The relationship between social group identity and political and economic preferences has been the subject of work by Lind (2007) and Shayo (2009). Individual identity and its effect on economic behaviour has been examined by Akerlof and Kranton (2000).

On the other hand, it could be the case that natives want to provide more public day care options if the share of non-native children increases to counter potential disadvantages in parental educational background, language skills and other characteristics of immigrant children. Tackling these disadvantages pays off in the short run as classes are no longer held behind by under-performing non-natives, and also in the long run as it should bring educational achievements of non-native children in line with those of native children.[5] Also, problems arising from immigration in Germany such as an increase in youth violence and deteriorating schooling environments are usually met by public and political calls for more day care programs.[6]

In order to analyse whether the aforementioned negative or positive factors (or neither) prevail in shaping the attitudes towards the provision of day care if immigration occurs, we exploit attitudinal data from the 1997 and 2002 waves of the German Socio-Economic Panel (SOEP).[7] We merge register data covering the share of foreign pupils for different levels of jurisdictions from the German "Gemeinsames Neues Statistisches Informations-System" (GENESIS, Statistische Ämter des Bundes und der Länder, 2012) database to the SOEP data. Although, to the best of our knowledge, this is the first study analyzing the link between day care and immigration, there are a number of closely related empirical studies.[8]

For example, the SOEP dataset has been used, amongst others, by Alesina and Fuchs-Schuendeln (2007) to examine different attitudes towards the welfare state in the Eastern and Western part of Germany after the German reunification of 1990. Further, Stichnoth (2012) uses the SOEP dataset to examine the relationship of the attitude towards state help for the unemployed and the share of non-German nationals amongst the unemployed. He finds that there is a statistically significant, albeit small, negative influence of the share of non-German unemployed on the preference for publicly provided support for the unemployed. He summarizes that attitudes towards redistribution are driven by self-interest, altruism and social distance (determined by ethnicity, language, social stratum etc.), and that nationality only plays a

[5] For a study examining the differences in educational attainment between natives and immigrants, see, for instance, OECD (2006). Based on the results of the 2003 PISA assessment, the authors state that "[...] immigrant students often perform at levels significantly lower than their native peers."

[6] See, for instance, Frick and Wagner (2001) and Toprak and Nowacki (2010).

[7] For a description of the SOEP, see Schupp (2009).

[8] Theoretical models dealing with the interplay between immigration/ethnic heterogeneity and the welfare state/redistribution can be found in, for instance, Alesina et al. (1999), Mayr (2007) and Shayo (2009).

subordinate role.[9]

Gerdes (2011), however, cannot discern a negative impact of an influx of immigrants on the local provision of public goods such as social services. He suggests that previous findings of negative immigration effects stem from endogeneity problems. I.e., due to the empirical design of previous studies simultaneity issues may be present as the location decision of migrants may be affected by the generosity of public good provision, which can lead to biased and inconsistent estimation results. But by utilizing a refugee placement program as instrument to account for potential endogeneity of the location decision of immigrants, Dahlberg et al. (2012) provide evidence that the preferred social benefit levels in Sweden are negatively affected by larger immigrant populations, and hence that previous results were not driven by endogeneity issues.

For the particular case of education to which day care is related, there is also evidence that ethnic heterogeneity affects schooling and funding choices. Poterba (1997) finds evidence that generational competition for public spending in the form that the elderly resent paying for the education of the young is stronger (as measured by a decrease in per pupil expenditure) the more the ethnic background of the elderly and the school-age population differs.[10]

We find that, in contrast to most of the empirical literature discussed above, the share of foreign pupils is not negatively associated with the preference for publicly funded day care provision. We provide some evidence that the relationship may actually be the other way round, i.e. that the preference for public funding becomes stronger if the share of foreign pupils increases. But this positive association turns out to be not particularly robust when only subsamples are used, and only appears at the state-level, not at the county-level. Also, as the data availability is limited and the location decisions of foreigners are arguably endogenous, our study faces the same difficulties as, for example, the study by Stichnoth (2012). One should therefore be careful with causal interpretations of the found associations, although it is important to note that our findings differ from the evidence produced by previous studies which face the same data limitations and potential endogeneity problems. Our contrasting results suggest that different aspects of

[9] Similar negative effects of immigration and ethnic heterogeneity on welfare state generosity are found by Eger (2009) for Sweden, Senik et al. (2009) for a sample of European countries, and by Luttmer (2001) for the US.

[10] Also, Gerdes (2010) for Denmark and Betts and Fairlie (2003) for the US find that native families are likely to transfer their children to (private) schools with a lower share of foreign pupils if immigration occurs.

the welfare state are affected differently by immigration. It does not seem to be the case that natives deplore to see publicly funded goods go to members of different ethnicities as long as the provision of these goods to non-natives provides a more or less visible benefit for natives themselves. This applies for day care due to the beneficial factors mentioned above, even though the public provision of day care also represents redistribution from the rich to the poor and from childless families to families with offspring, but possibly not for income transfers in the form of social security.

As a further contribution, our analysis shows the advantage of employing mixed effects models to study questions of this type. As the individual attitudes are affected on different levels of jurisdictions, e.g. states and counties, mixed effects models are useful to account for this data structure and to provide information about the extent of variation on the different levels.

The remainder of this chapter is structured as follows: Section 2.2 introduces the dataset and the empirical strategy we will use to examine the relationship between support for public provision of day care and the share of foreign pupils. Section 2.3 presents the results for state- and county-level regressions, while section 2.4 discusses various robustness checks to section 2.3's findings. Section 2.5 concludes.

2.2 Data and empirical strategy

The SOEP panel survey is a representative household survey for Germany and started in 1984 with an initial sample of $4,528$ households. We use the release v27 covering the years 1984-2010. The SOEP survey poses a range of core questions in each and every wave, for example questions with respect to employment and demographic variables like marital status.

The SOEP item concerning attitudes towards private or public provision of day care for school children belongs to the large set of additional questions that are not asked in every wave and is worded as follows: "At present a multitude of social services are provided not only by the state but also by private free-market enterprises, organizations, associations, or private citizens. What is your opinion on this?". A list of several social services, including day care for school children, then follows. Possible answers range from 1 to 5, where 1 means that "only the state" should be responsible for the provision, 3 means that private forces

and the state should be equally responsible, and 5 means that "only private forces" should be responsible. This question was only asked in the 1997 and 2002 waves.

The SOEP dataset provides different regional indicators for each household and year. We first use a variable indicating the state (Bundesland), where a particular household resides in a given year and match register data covering the share of foreign pupils in the respective state to each individual in the household. Second, we use the county-indicator to match the respective register data from the GENESIS database on the county-level to every person in the sample of households. The GENESIS database collects data from the various German federal and state statistical bureaus. A sub-dataset, called "Regionaldatenbank Deutschland" (regional database Germany), offers yearly municipal, county, state and federal information on topics such as the structure of the population, education and employment.

The share of foreign pupils varies widely across Germany. In 1997, the average (unweighted) share of foreign pupils was 8.72% across German states, with a standard deviation of 5.6. All West German states except for Hamburg, Bremen and Hesse (which had shares of 15.59% and more) lay within one standard deviation from the mean, while all Eastern German states except for Berlin lay outside one standard deviation from the mean. Eastern German states only had an average foreign pupil share of 2.36%, while Western German states had an average share of 11.42%. The upper end of the distribution of foreign pupils is given by the Western city states of Hamburg with a share of 19.5% and Bremen with a share of 16.15%, while the lower end consists of all Eastern states except for Berlin (14.13%) with a share of 0.6% or lower. Therefore, foreigners are mainly concentrated in the states which did not belong to the former German Democratic Republic (GDR). This phenomenon mainly stems from political decisions made in the GDR and the FRG in the decades before the reunification of 1990, and from poor economic conditions in the East after 1990 which deterred foreign immigration.

Between 1997 and 2002, the average share of foreign pupils in the East went up by one percentage point (2.36% in 1997 vs. 3.36% in 2002). In the same period, Western German states reduced their foreign pupil share by about 0.4% (11.42% in 1997 vs. 11.01% in 2002). However, it is not clear whether this reduction is due to an actual decrease of the migrant population share, or whether non-German pupils acquired German passports and thus fell out of the foreigners category. Nevertheless, one can see that

there is still a huge gap between Eastern and Western German shares of foreign pupils, which will motivate a later robustness check in which we consider the Eastern and Western German samples separately. It is also noteworthy that most of the variation in the sample stems from differences between states, as the foreign pupil share within most states stays fairly the same between 1997 and 2002. See Table 2.6 in the appendix for the share of foreign pupils and population figures of the German states.

Regarding the variation on the county level, the pooled share of foreign pupils for 1997 and 2002 reaches from 0.12% to 37.1%, with a mean of 9.42% and a standard deviation of 8.04. The range of foreign pupil shares is thus even greater on the county level than on the state level. But still, most of the variation comes from differences between counties, as the share of foreign pupils within most counties stays fairly constant over the observed period.

Note that individuals do not participate in each wave of the SOEP survey, and that the share of foreign pupils is not available for all counties for every year; hence the samples are unbalanced. The main sample used for the state-level estimations comprises roughly $31,000$ observations stemming from $23,600$ individuals, while the respective sample for the county-level estimations covers about $28,400$ observations from $21,532$ individuals.

The main specification is a mixed effects model that takes both the different levels of variation and the unbalanced structure of the panel dataset into account.[11] The regression equation reads

$$y_{ijt} = \beta_0 + \beta_1 share_{jt} + X'_{ijt}\Xi + \theta_t + \alpha_i + u_j + \eta_{ijt} \tag{1}$$

where the response variable y_{ijt} is individual i's attitude towards public or private provision of day care. The subscripts j and t indicate the jurisdiction (state or county) and time respectively. The central variable of interest is the share of foreign pupils in jurisdiction j in year t. The impact of this share on individual attitudes is picked up by the slope β_1. Heterogeneity across jurisdictions is modeled by a random intercept

[11] The term "mixed effects model" or "mixed model" refers to the fact that both fixed and random effects are introduced. In our context, fixed effects are covariates like the demographic control variables , while the random components model the unobserved heterogeneity on the different levels, i.e. individual and state. See, for example, Davis (2002) and Gelman and Hill (2006) for textbooks covering mixed models. Mixed models, also called "multi-level models", are commonly used to account for systematic differences between units of observation and regions, e.g. student performances in different schools in different regions.

u_j. Individual heterogeneity is modeled by entering a series of control variables X_{ijt} and additionally a random intercept α_i. Summary statistics for the items in X (which are standard socio-economic controls commonly used in the related literature) can be found in Tables 2.7 and 2.8.[12] The remaining random factors are captured by the usual error term η_{ijt}. While the main specification enters a time fixed effect θ_t, we also report results omitting the time dummy, and estimates obtained from a fixed effect model.

Given that the dataset covers only two periods of time, jurisdiction fixed effects will pick up most of the available variation in the share of foreign pupils, since the variation over time for a given jurisdiction is low. Similarly, individual fixed effects will soak up most of the available variation, because there are not many movers across jurisdictions during this short time frame. Hence, individual fixed effects and jurisdiction fixed effects would be highly collinear.

To check the robustness of the results, we consider a series of additional specifications. First, we consider different variants of the mixed model. One estimation enters only a random intercept for each individual, thereby ignoring the variability on the jurisdiction level, while another specification omits the individual random intercept and introduces a jurisdiction-specific one.

We further consider different sets of covariates, i.e. we vary the set of variables collected in X_{ijt}. These regressions will highlight the importance of correcting for intervening factors, e.g. educational background or income and employment. We also run logistic models to check whether the results of the main specification might be driven by treating the response variable as a continuous variable. Furthermore, we examine several subsamples, e.g. Eastern and Western German states separately, to determine whether only certain groups of individuals are responsible for the correlations observed in the whole sample. The regression tables of the robustness checks are relegated to the appendix.

As noted in the introduction, one should be wary about the interpretation of our results as causal effects due to possible endogeneity issues. For example, it is possible that foreigners with children may self-select into regions where day care options are readily available, and that in these regions the general attitude leans towards public provision of day care. Other factors such as unemployment rates, incomes and the

[12] As some control variables are categorical, their summary statistics are not included in the appendix, and one of their categories is taken as base category and omitted in the estimations in the following section. These base categories are *married, living together* for the marital status and *Hauptschulabschluss* (secondary school degree) for the type of school degree.

presence of an ex-pat community are arguably more important in determining where foreigners settle within a country, but these factors themselves may of course give rise to an endogeneity problem.

To tackle endogeneity issues, one can utilize the fact that fixed effects estimates might be interpreted as causal under the strong assumption that all unobserved variables that are correlated with the regressors are time invariant and therefore removed by the fixed effects; see also the discussion by Stichnoth (2012). As the next section shows, the estimated coefficient β_1 is negative regardless of whether α_i is treated as random or fixed on the state-level. Although we prefer to focus on mixed models and a correlative interpretation, one could, given the aforementioned strong assumption, infer causality from the fixed effects model.

2.3 Results

In this section, we discuss our empirical findings concerning the relationship between opinions about day care funding and the share of foreign pupils. We consider various empirical specifications and utilize data at both the state and county level. Our main results are collected in Table 2.1 for reference.

Note that we are not restricting our sample to respondents of German nationality. As can be seen in Tables 2.7 and 2.8, about 85% of the county-level and roughly 90% of the state-level respondents have a German passport. Foreigners which have already been living in Germany for some time arguably share the native attitude towards further immigration, especially when immigration affects the provision of welfare state services. Most of the non-German respondents in our dataset have been living in Germany for 18 years, which makes the aforementioned assumption applicable to the foreign share of the sample.[13] We furthermore include a dummy for German nationality to control for a potentially different basic level of public day care support between Germans and non-Germans. As Table 2.11 in the appendix shows, restricting our sample to German nationals does not affect the results of the following subsections to a significant degree.

A further caveat is that our variable of main interest measures the share of pupils without a German

[13] Of the 2,051 non-Germans in the 1997 SOEP dataset, 1,790 were already part of the first wave in 1984. Of the 1,921 non-German respondents in 2002, only 533 have been part of the SOEP survey for 4 years or less. See a cross-tabulation of sample and wave composition by the Deutsches Institut für Wirtschaftsforschung (2012), the publisher of the SOEP.

Table 2.1 – Main results - coefficients (standard errors) for *share of foreign pupils in state/county,* full set of controls

		Estimation Method						
		Mixed Effects			RE	FE	OLOGIT	OLS
		Individual	*State/ County*	*State/ County and Individual*				
J	*State*	-0.006***	-0.079***	-0.085***	-0.006***	-0.016	-0.014***	-0.006***
u		(0.002)	(0.014)	(0.014)	(0.002)	(0.010)	(0.004)	(0.002)
r								
i	*County*	0.000	0.001	0.001	0.000	-0.004	0.000	0.000
s		(0.001)	(0.003)	(0.003)	(0.001)	(0.006)	(0.002)	(0.001)
d								
i	*State*	-0.029***	-0.075***	-0.075***				
c	*w/o* θ_t	(0.002)	(0.010)	(0.010)				
t								
i								
o	*County*	-0.003***	-0.010***	-0.009***				
n	*w/o* θ_t	(0.001)	(0.003)	(0.003)				

*** $p < 0.01$

passport, not the share of pupils with a migration background which is much larger.[14] Unfortunately, data on the migration background of school children is not available for our relevant years. We also cannot distinguish between foreign pupils from culturally similar countries such as the UK and France, and pupils from countries with strongly differing cultures such as Turkey and the successor states of Yugoslavia. Our estimates are therefore likely to be too small. This is because the exclusion of ethnically and culturally differing pupils with a German passport and the inclusion of foreign pupils who are unlikely to be perceived as ethnically different in appearance and school achievement might make a possible association between the share of foreign pupils and welfare state attitudes look weaker than it actually is.

[14] The share of pupils with a migration background (at least one non-German parent) is vastly larger. For instance, the PISA-E study for 2003 shows that 16% of the pupils in Bremen do not possess a German passport, but that the share of pupils who are classified as having a migration background is 35.8%. This holds also in Eastern German states, e.g. Brandenburg has a share of foreign pupils of 1.7%, but a share of pupils with a migration background of 6% (Prenzel et al., 2005).

2.3.1 State-level

Table 2.2 collects the results for the main specification obtained from the mixed model, where the aggregation level for jurisdictions (j) is the state. The first column enters only a random intercept for each

Table 2.2 – Dependent variable: provision of day care for school children, mixed effects model, state-level

	(1)		(2)		(3)	
Random effect:	Individual		State		State and Individual	
	b	se	b	se	b	se
German	0.012	(0.025)	0.018	(0.024)	0.022	(0.025)
is employed	0.013	(0.014)	0.009	(0.014)	0.008	(0.014)
sex	0.031***	(0.011)	0.032***	(0.011)	0.030***	(0.011)
age	-0.005*	(0.002)	-0.005**	(0.002)	-0.005**	(0.002)
age squared	0.000*	(0.000)	0.000**	(0.000)	0.000**	(0.000)
log monthly hh net income	0.020*	(0.011)	0.020*	(0.011)	0.020*	(0.011)
log average yearly hh net income	0.334***	(0.107)	-2.056***	(0.429)	-2.248***	(0.414)
married but separated	-0.067	(0.043)	-0.063	(0.043)	-0.058	(0.043)
single	0.009	(0.020)	0.013	(0.019)	0.013	(0.020)
divorced	-0.092***	(0.023)	-0.080***	(0.023)	-0.083***	(0.023)
widowed	0.003	(0.026)	0.004	(0.025)	0.006	(0.025)
civil servant	-0.098***	(0.028)	-0.096***	(0.027)	-0.094***	(0.028)
kids younger than 16 in hh	-0.052**	(0.022)	-0.051**	(0.022)	-0.054**	(0.022)
owns residence	-0.046***	(0.010)	-0.052***	(0.011)	-0.050***	(0.010)
born in Germany	0.026	(0.024)	0.023	(0.023)	0.021	(0.024)
lived in GDR in 1989	-0.249***	(0.022)	-0.289***	(0.027)	-0.291***	(0.028)
has vocational degree	0.034**	(0.016)	0.032**	(0.016)	0.032*	(0.016)
has college degree	-0.024	(0.032)	-0.032	(0.031)	-0.033	(0.032)
mittlere Reife	0.053***	(0.017)	0.056***	(0.016)	0.053***	(0.017)
Fachabitur	0.089**	(0.037)	0.089**	(0.036)	0.084**	(0.037)
Abitur	0.090**	(0.044)	0.085**	(0.043)	0.077*	(0.044)
other degree	0.053*	(0.027)	0.061**	(0.027)	0.059**	(0.027)
no degree	-0.008	(0.037)	0.009	(0.037)	0.010	(0.037)
no degree yet	0.061	(0.114)	0.087	(0.114)	0.062	(0.114)
years of education	-0.002	(0.009)	-0.000	(0.008)	0.001	(0.009)
worried about the economy	0.068***	(0.009)	0.062***	(0.009)	0.058***	(0.009)
worried about own finances	0.037***	(0.009)	0.034***	(0.009)	0.037***	(0.009)
self-employed	0.158***	(0.024)	0.159***	(0.023)	0.157***	(0.024)
nr. of kids younger than 16 in hh	-0.006	(0.011)	-0.008	(0.011)	-0.005	(0.011)
share of foreign pupils in state	-0.006***	(0.002)	-0.079***	(0.014)	-0.085***	(0.014)
year=2002	0.467***	(0.016)	0.743***	(0.050)	0.765***	(0.048)
β_0	-1.007	(1.031)	22.476***	(4.121)	24.367***	(3.984)
$ln\sigma_u$			-0.323	(0.284)	-0.250	(0.257)
$ln\sigma_\alpha$	-1.001***	(0.035)			-0.998***	(0.036)
N	31277		31277		31277	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

individual and is therefore comparable to a standard random effects model. This specification is comparable to a standard random effects model (for individuals) and allows to check whether the two estimation methods (REML for the mixed model and the usual GLS estimator for RE models) generate similar results. Column (2) enters a random intercept u_j for each state, while omitting the individual random component.

Finally, column (3) additionally enters the subject-specific intercept and therefore corresponds to the full specification outlined in equation (1) of the previous section.

Starting the discussion with the results of the regressor of main interest, the three specifications indicate that individuals who live in states with larger shares of foreign pupils report on average a stronger preference for public provision of day care. For example, the point estimate in column (3) suggests that a one-unit increase in the share of foreign pupils is associated with a decrease of 0.085 points of the 5-point attitude scale (remember that a lower number indicates more support for public provision). This decrease is a meaningful association which is, for instance, of almost the same size as the shift towards state provision reported by civil servants (point estimate 0.094).

The specifications are also informative with respect to the heterogeneity across individuals and states. The parameter modeling the subject-specific intercepts is precisely estimated across all specifications. The point estimate for the standard deviation of $\exp(-1) = 0.3679$ indicates that the random intercepts roughly cover a range between $-2 * 0.3679 \approx -0.74$ and 0.74. The large standard error for the jurisdiction-parameter (σ_u) indicates that this parameter might be removed from the model. The imprecise estimate is likely to be driven by the inclusion of the variable measuring state average yearly income that apparently picks up most of the variation on the jurisdiction-level. We investigate this issue further below (see Table 2.3).

It is informative with respect to the size of coefficients to calculate how the dependent variable is affected by a change of one standard deviation in the share of foreign pupils. Using the full specification of column (3), it turns out that an increase of one standard deviation in the share of foreign pupils, which is roughly the difference between Baden-Wurttemberg (13.58%) and Bavaria (8.16%) in 1997, decreases *provision of day care for schoolchildren* by about 44% of its standard deviation. This translates into about 0.42 points on the $1-5$ attitude scale. This reduction of support for private provision is of meaningful size given that an Eastern German background is connected with a decrease of *provision of day care for schoolchildren* of only about 29% of its standard deviation, or 0.29 points.

Table 2.3 sequentially introduces different sets of covariates into the mixed model with random intercepts on the state- and the subject-level. All specifications indicate a strong and positive relationship between the share of foreign pupils and attitudes towards public provision of day care. Therefore, this positive

Table 2.3 – Dependent variable: provision of day care for school children, mixed effects model with differing controls, state-level

	(1)		(2)		(3)		(4)		(5)	
	b	se	b	se	b	se	b	se	b	se
share of foreign pupils in state	-0.069***	(0.013)	-0.049***	(0.012)	-0.020***	(0.006)	-0.094***	(0.014)	-0.085***	(0.014)
German			0.061**	(0.025)	0.072***	(0.025)	0.020	(0.025)	0.022	(0.025)
sex			0.029**	(0.011)	0.038***	(0.011)	0.031***	(0.011)	0.030***	(0.011)
age			-0.001	(0.002)	-0.003	(0.002)	-0.007***	(0.002)	-0.005**	(0.002)
age squared			0.000	(0.000)	0.000**	(0.000)	0.000***	(0.000)	0.000**	(0.000)
married but separated			-0.056	(0.044)	-0.045	(0.044)	-0.063	(0.043)	-0.058	(0.043)
single			0.046**	(0.020)	0.040**	(0.020)	0.017	(0.020)	0.013	(0.020)
divorced			-0.074***	(0.023)	-0.074***	(0.023)	-0.086***	(0.023)	-0.083***	(0.023)
widowed			-0.023	(0.026)	-0.025	(0.026)	0.011	(0.025)	0.006	(0.025)
kids younger than 16 in hh			-0.052**	(0.023)	-0.051**	(0.023)	-0.057***	(0.022)	-0.054**	(0.022)
born in Germany			0.040	(0.024)	0.048*	(0.024)	0.023	(0.024)	0.021	(0.024)
has vocational degree			0.026	(0.017)	0.037**	(0.017)	0.031*	(0.016)	0.032*	(0.016)
has college degree			-0.068**	(0.033)	-0.040	(0.033)	-0.033	(0.032)	-0.033	(0.032)
mittlere Reife			0.079***	(0.017)	0.095***	(0.017)	0.055***	(0.017)	0.053***	(0.017)
Fachabitur			0.161***	(0.038)	0.160***	(0.038)	0.089**	(0.037)	0.084**	(0.037)
Abitur			0.120***	(0.045)	0.141***	(0.045)	0.086**	(0.044)	0.077*	(0.044)
other degree			0.076***	(0.028)	0.081***	(0.028)	0.063**	(0.027)	0.059**	(0.027)
no degree			-0.020	(0.038)	-0.022	(0.038)	0.018	(0.037)	0.010	(0.037)
no degree yet			-0.154	(0.118)	-0.165	(0.118)	0.078	(0.114)	0.062	(0.114)
years of education			0.012	(0.009)	0.007	(0.009)	0.001	(0.009)	0.001	(0.009)
nr. of kids younger than 16 in hh			-0.002	(0.011)	-0.007	(0.011)	-0.004	(0.011)	-0.005	(0.011)
is employed					0.016	(0.014)	0.011	(0.014)	0.008	(0.014)
civil servant					-0.077***	(0.028)	-0.081***	(0.028)	-0.094***	(0.028)
lived in GDR in 1989					-0.341***	(0.028)	-0.298***	(0.028)	-0.291***	(0.028)
self-employed					0.170***	(0.025)	0.151***	(0.024)	0.157***	(0.024)
log monthly hh net income							0.030***	(0.011)	0.020*	(0.011)
log average yearly hh net income							-2.363***	(0.418)	-2.248***	(0.414)
owns residence							-0.051***	(0.010)	-0.050***	(0.010)
year=2002							0.790***	(0.048)	0.765***	(0.048)
worried about the economy									0.058***	(0.009)
worried about own finances									0.037***	(0.009)
β_0	3.268***	(0.172)	2.741***	(0.176)	2.673***	(0.121)	25.651***	(4.021)	24.367***	(3.984)
$ln\sigma_u$	-0.632**	(0.297)	-0.861**	(0.360)	-1.883***	(0.282)	-0.160	(0.243)	-0.250	(0.257)
$ln\sigma_\alpha$	-1.284***	(0.069)	-1.269***	(0.066)	-1.300***	(0.070)	-0.993***	(0.035)	-0.998***	(0.036)
N	31277		31277		31277		31277		31277	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

relationship is robust to the inclusion of control variables such as age and employment. The results are also informative regarding the level of variation of these controls. In the first three specifications, the estimates for the random effects pick up heterogeneity on both the individual- and the state-level. For example, the coefficients in column (3) indicate that the state-level-intercepts u_j roughly cover the range $[-0.16, 0.16]$, while the corresponding range for the subject-level-intercepts is $[-0.27, 0.27]$. Once the average yearly income per capita of the state is introduced into the model (columns (4) and (5)), there is virtually no variation on the state-level left that could be picked up by the intercepts u_j. Consequently, columns (4) and (5) indicate a very imprecise estimate for σ_u.

Table 2.4 checks the robustness of the results with respect to the estimation method by comparing linear

Table 2.4 – Dependent variable: provision of day care for school children, linear and logistic models, state-level

Estimation method:	(1) RE		(2) FE		(3) OLOGIT		(4) OLS	
	b	se	b	se	b	se	b	se
German	0.012	(0.025)	0.276**	(0.116)	0.046	(0.049)	0.008	(0.024)
is employed	0.013	(0.014)	0.002	(0.032)	0.028	(0.028)	0.014	(0.014)
sex	0.031***	(0.011)			0.073***	(0.022)	0.033***	(0.011)
age	-0.005**	(0.002)	0.123***	(0.014)	-0.009*	(0.005)	-0.004*	(0.002)
age squared	0.000*	(0.000)	0.000	(0.000)	0.000*	(0.000)	0.000*	(0.000)
log monthly hh net income	0.020*	(0.011)	0.024	(0.032)	0.037	(0.023)	0.020*	(0.011)
log average yearly hh net income	0.330***	(0.108)	-1.301***	(0.424)	0.790***	(0.211)	0.356***	(0.105)
married but separated	-0.066	(0.043)	-0.082	(0.092)	-0.161*	(0.086)	-0.073*	(0.043)
single	0.010	(0.020)	-0.013	(0.065)	0.027	(0.040)	0.009	(0.020)
divorced	-0.092***	(0.023)	-0.182**	(0.075)	-0.171***	(0.046)	-0.089***	(0.023)
widowed	0.003	(0.026)	0.054	(0.094)	-0.002	(0.051)	0.001	(0.025)
civil servant	-0.098***	(0.028)	-0.072	(0.116)	-0.195***	(0.055)	-0.100***	(0.027)
kids younger than 16 in hh	-0.052**	(0.022)	-0.057	(0.050)	-0.100**	(0.045)	-0.049**	(0.022)
owns residence	-0.046***	(0.010)	-0.039***	(0.015)	-0.103***	(0.021)	-0.047***	(0.011)
born in Germany	0.025	(0.024)			0.052	(0.048)	0.028	(0.023)
lived in GDR in 1989	-0.250***	(0.022)			-0.475***	(0.044)	-0.243***	(0.022)
has vocational degree	0.034**	(0.016)	-0.008	(0.042)	0.079**	(0.033)	0.035**	(0.016)
has college degree	-0.024	(0.032)	-0.091	(0.099)	-0.038	(0.063)	-0.025	(0.032)
mittlere Reife	0.053***	(0.017)	-0.075	(0.055)	0.119***	(0.034)	0.056***	(0.017)
Fachabitur	0.088**	(0.037)	-0.105	(0.107)	0.184**	(0.074)	0.094**	(0.037)
Abitur	0.090**	(0.044)	-0.264**	(0.128)	0.189**	(0.088)	0.096**	(0.044)
other degree	0.053*	(0.027)	-0.058	(0.063)	0.118**	(0.056)	0.054**	(0.027)
no degree	-0.008	(0.037)	-0.056	(0.083)	-0.022	(0.076)	-0.008	(0.037)
no degree yet	0.056	(0.114)	-0.361*	(0.202)	0.123	(0.231)	0.094	(0.115)
years of education	-0.002	(0.009)	0.036	(0.024)	-0.005	(0.017)	-0.002	(0.009)
worried about the economy	0.068***	(0.009)	0.030	(0.020)	0.138***	(0.019)	0.071***	(0.009)
worried about own finances	0.037***	(0.009)	0.077***	(0.020)	0.064***	(0.018)	0.033***	(0.009)
self-employed	0.158***	(0.024)	0.093	(0.072)	0.323***	(0.048)	0.160***	(0.024)
nr. of kids younger than 16 in hh	-0.006	(0.011)	0.055*	(0.028)	-0.019	(0.023)	-0.010	(0.011)
share of foreign pupils in state	-0.006***	(0.002)	-0.016	(0.010)	-0.014***	(0.004)	-0.006***	(0.002)
year=2002	0.467***	(0.016)			0.935***	(0.034)	0.464***	(0.016)
β_0	-0.972	(1.034)	8.523**	(3.619)			-1.224	(1.008)
N	31277		31277		31277		31277	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

and logistic models. The first column shows the estimation results obtained from a standard linear model including random intercepts for individuals fitted by GLS. The results are almost identical to the results obtained from the mixed effects including only individual-specific intercepts (column 1, Table 2.2) and lends support to the REML method employed for the mixed models in Table 2.2. Column (2) considers a fixed effect specification for the individual heterogeneity. It shows the expected result that these fixed effects pick up most of the available variation, thereby driving up the standard error of the shares-variable. Column (3) provides coefficients from an ordered logit model (the cutoff points are omitted). As the ratio of marginal effects in the model is equal to the ratio of coefficients, it is possible to use this proportionality for

a comparison to other models. For example, in both the RE (column (1)) and the ordered logit model the coefficient picking up the effect regarding worries with respect to the economic situation is roughly ten times larger than the shares coefficient. Summarizing the robustness checks so far, the additional regressions support the results from the linear mixed model. Treating the response variable as a continuous variable (as in the mixed models) does not lead to qualitatively different results compared to an ordered logit model. Furthermore, the standard random-effects model fitted by GLS (which can model only a single random intercept) leads to very similar results as the mixed model involving only a single random intercept. Note that the standard errors obtained in the robustness regressions should be treated with caution, as they ignore the variability on the state-level.

With respect to related empirical work, it is also interesting to discuss some of the control variables. The three estimations in Table 2.2 confirm patterns found in previous studies. For example, individuals who lived in East Germany in 1989 report a very strong preference for the public provision of day care compared to subjects who lived in West Germany. The corresponding coefficient ranges from -0.249 in column (1) to roughly -0.29 in columns (2) and (3). These estimates confirm the findings by Alesina and Fuchs-Schuendeln (2007).

Further, worries about one's own finances and the general economic situation are associated with an increase in the support for the welfare state in the form of day care.[15] The association is particular strong for the variable capturing worries about the general economic situation; the coefficient is roughly equal to one fourth to one fifth of the *lived in GDR in 1989* coefficient.

Moreover, individuals living in a household with a higher monthly net income report reduced levels for the support for the welfare state. As citizens with a high income and a positive economic outlook are generally net-contributors of any redistributive system, these results are expected and consequently in line with previous literature (Stichnoth, 2012; Alesina and Fuchs-Schuendeln, 2007). Note, however, that the income coefficient is small and imprecisely estimated.

At first glance, support for private provision of day care increases with the average yearly net income per household of a state (see column (1)). However, given that the average income in a certain state and

[15] Note that the variables *worried about the economy* and *worried about own finances* are coded as 1: very concerned, 2: somewhat concerned and 3: not concerned at all.

the income of a particular household are correlated, this variable masks to some extent the relationship between household income and welfare state attitudes. This coefficient is therefore difficult to interpret. Once random intercepts for states and/or individuals are introduced (columns (2) and (3)), the coefficient becomes negative and larger in absolute terms.

Finally, the relationship between the presence of children in the household and the preference towards the provision of day care is checked by two variables. The first variable is a dummy indicating whether children under the age of 16 live in the household and the second variable is the number of children under the age of 16 in the household. In terms of magnitude, both coefficients are quite robust across the three specifications. The *nr. of kids younger than 16 in hh* coefficient is imprecisely estimated across the three models, while the standard error for the variable indicating the presence of children is smaller. Note that both variables are correlated with each other. Even when we regard the (negative) *nr. of kids younger than 16 in hh* coefficient as sampling error, the (negative) *kids younger than 16 in hh*-coefficient indicates a strong positive relationship between the presence of children and the preference for public provision of day care. The point estimate of -0.052 indicates that the shift towards public provision of day care amounts to roughly one third of the corresponding shift towards private provision by self-employed individuals. The strong relationship between the presence of children in the household and attitudes towards public provision of day care is consistent with the idea that these households are more likely to be net-beneficiaries of this particular good provided by the welfare state.

2.3.2 County-level

We now turn to the results on the county-level which are summarized in Table 2.5. The first column introduces only a subject-specific intercept, while column (2) additionally enters a county-level intercept. Both columns omit the time dummy. Columns (3) and (4) sequentially introduce the two random parameters and also enter a time dummy.

Overall, with respect to control variables, the results are similar to the previous state-level results. For example, once again, the coefficient for an East German background is large and precisely estimated across the four specifications. The point estimate of -2.93 in column (4) is very close to the corresponding state-

Table 2.5 – Dependent variable: provision of day care for school children, mixed effects model, county-level

	(1)		(2)		(3)		(4)	
Random effect:	Individual		County and Individual		Individual		County and Individual	
	b	se	b	se	b	se	b	se
German	0.097***	(0.026)	0.106***	(0.026)	0.084***	(0.026)	0.102***	(0.026)
is employed	-0.024	(0.015)	-0.028**	(0.014)	-0.024	(0.015)	-0.028*	(0.014)
sex	0.027**	(0.012)	0.025**	(0.011)	0.024**	(0.012)	0.023**	(0.011)
age	-0.007***	(0.002)	-0.006***	(0.002)	-0.008***	(0.002)	-0.007***	(0.002)
age squared	0.000*	(0.000)	0.000*	(0.000)	0.000**	(0.000)	0.000**	(0.000)
log monthly hh net income	0.046***	(0.012)	0.039***	(0.012)	0.031**	(0.012)	0.031***	(0.012)
log average monthly p.c. net income	0.481***	(0.054)	1.089***	(0.084)	0.051	(0.062)	-0.067	(0.135)
married but separated	-0.050	(0.047)	-0.039	(0.045)	-0.061	(0.046)	-0.042	(0.045)
single	-0.046**	(0.021)	-0.039*	(0.020)	-0.070***	(0.021)	-0.052**	(0.020)
divorced	-0.061**	(0.025)	-0.059**	(0.025)	-0.070***	(0.025)	-0.063**	(0.025)
widowed	0.022	(0.027)	0.028	(0.026)	0.026	(0.027)	0.030	(0.026)
civil servant	-0.089***	(0.030)	-0.085***	(0.029)	-0.093***	(0.030)	-0.086***	(0.029)
kids younger than 16 in hh	-0.036	(0.024)	-0.025	(0.023)	-0.040*	(0.024)	-0.028	(0.023)
owns residence	-0.026**	(0.011)	-0.023**	(0.011)	-0.030***	(0.011)	-0.025**	(0.011)
born in Germany	0.048*	(0.026)	0.029	(0.025)	0.041	(0.025)	0.026	(0.025)
lived in GDR in 1989	-0.195***	(0.019)	-0.224***	(0.028)	-0.249***	(0.019)	-0.293***	(0.029)
has vocational degree	0.033*	(0.018)	0.025	(0.018)	0.028	(0.018)	0.024	(0.017)
has college degree	-0.052	(0.036)	-0.053	(0.035)	-0.048	(0.035)	-0.053	(0.034)
mittlere Reife	0.039**	(0.018)	0.035**	(0.018)	0.036*	(0.018)	0.033*	(0.018)
Fachabitur	0.075*	(0.040)	0.064*	(0.039)	0.065	(0.040)	0.057	(0.039)
Abitur	0.040	(0.048)	0.016	(0.047)	0.033	(0.048)	0.011	(0.047)
other degree	0.065**	(0.029)	0.047	(0.028)	0.062**	(0.029)	0.046	(0.028)
no degree	0.024	(0.040)	0.057	(0.039)	0.038	(0.040)	0.065*	(0.039)
no degree yet	0.078	(0.125)	0.108	(0.122)	0.165	(0.125)	0.148	(0.122)
years of education	0.011	(0.009)	0.014	(0.009)	0.011	(0.009)	0.014	(0.009)
worried about the economy	0.129***	(0.010)	0.095***	(0.010)	0.119***	(0.010)	0.091***	(0.010)
worried about own finances	0.043***	(0.010)	0.047***	(0.009)	0.048***	(0.010)	0.050***	(0.009)
self-employed	0.188***	(0.026)	0.183***	(0.025)	0.191***	(0.026)	0.182***	(0.025)
nr. of kids younger than 16 in hh	-0.024**	(0.012)	-0.027**	(0.012)	-0.024**	(0.012)	-0.026**	(0.012)
share of foreign pupils in county	-0.003***	(0.001)	-0.009***	(0.003)	0.000	(0.001)	0.001	(0.003)
year=2002					0.195***	(0.014)	0.205***	(0.020)
β_0	-1.404***	(0.395)	-5.624***	(0.600)	1.761***	(0.453)	2.588***	(0.961)
$ln\sigma_u$			-1.939***	(0.253)			-2.095***	(0.345)
$ln\sigma_\alpha$	-1.297***	(0.072)	-1.346***	(0.049)	-1.390***	(0.086)	-1.443***	(0.048)
N	28423		28423		28423		28423	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

level coefficient. As before, a further variable with a large coefficient is the type of employment. The estimate for the *self-employed*-coefficient ranges between 0.182 and 0.189 which is close to the estimate in the state-level-model.

Turning to our central explanatory variable, the association between attitudes towards public provision of day care and the shares-variables is weaker compared to the state-level results. The point estimate for the shares-coefficient is equal to -0.009 in column (2) which indicates the same direction as on the state-level, but is smaller in terms of magnitude. This is also the case in Stichnoth's (2012) work in which the

coefficients for the share of the foreign unemployed are smaller on the county-level throughout. One could argue that, as the primary and secondary educational system is mainly financed by the states (see footnote 3), individual attitudes should be more influenced by state-wide conditions which mainly determine the funding of day care programs, instead of county conditions which may vary greatly within a state and do not strongly affect funding.

Once the time dummy is entered (columns (3) and (4)), the shares-coefficient is practically equal to zero. This finding obviously raises the question which of the specifications is more appropriate. On the one hand, exploiting time-variation of the explanatory variable (columns (1) and (2)) is more in line with the idea that individual attitudes vary after observing changes of the share of foreign pupils within their "home jurisdiction". On the other hand, one may argue that the publication of the PISA study in 2001 has caused a shock to variables capturing attitudes towards the education system that should be controlled for.[16] In any case, it is conceivable that the pattern of changes in the share of foreign pupils is less clear on the county- than on the state-level. Some (especially small) counties exhibit almost no time variation in the share of foreign pupils, while others exhibit a large amount of time variation. Thus, the association on the county-level should be reassessed, once more data is available. We have also considered logistic models and regressions with different sets of covariates. These checks indicate that the qualitative findings are unchanged and are therefore presented in the appendix.

2.4 Robustness checks

In this section, we conduct further checks to test the robustness of the results obtained in the previous section. We will reestimate our main specification in (1) using different sample compositions. We also replace the share of foreign pupils with the total share of foreigners within a jurisdiction, and substitute attitudes towards the provision of day care for preschool children for the attitude variable used so far. It turns out that some of the robustness checks conducted in this section challenge the finding of a positive association between the share of foreign pupils and a preference for public provision of day care to a serious

[16] The OECD-run "Programme for International Student Assessment" (PISA) studies measure student abilities in the core competencies reading comprehension, maths and natural sciences. In 2001, Germany was ranked at a dire twentieth place in maths and natural sciences and came twenty-first in reading comprehension.

degree. However, the regression tables, which can be found in the appendix, provide no evidence that the two variables may be negatively connected.

The robustness checks on the county-level are not discussed as they do not contradict the findings from the previous section, but the regression tables can be found in the appendix.

2.4.1 Waves 1997 and 2002 separately

As argued in the previous section, the publication of the PISA study in late 2001 may have caused a shock to attitudinal variables regarding the education system between 1997 and 2002. The mean of the dependent variable *provision of day care for school children* rose from 2.37 in 1997 to 2.92 in 2002, which indicates a significantly reduced propensity to support the public provision of day care (t-test for equal means $p < 0.01$). This shift in means provides an argument to examine both waves separately. Separating the sample in this manner, as will be shown below, qualitatively produces the same results as a full sample regression with a year fixed effect, but the estimates are no longer significant at common confidence levels.

On the state level, the coefficient for the share of foreign pupils is negative in both waves. The coefficient is reduced to -0.004 (1997) and -0.012 (2002), values which are much smaller than if both waves are pooled and a time dummy is utilized (coefficient -0.085). It thereby loses statistical significance on conventional levels. As argued above, splitting the dataset by wave removes whatever within-individuals variation exists in the sample. Including this variation is more in line with the idea that individuals adjust their attitudes after observing changes in the fraction of foreign pupils. Hence, the less precise estimates for the share coefficient are not surprising.

There are similar considerations with respect to entering a time fixed effect. On the one hand, entering a time fixed effect removes some of the important within-individuals variation. On the other hand, it seems desirable to account for a possible shock between 1997 and 2002 that caused a shift of the attitudes towards day care which is unrelated to changes in the population composition.

If the year fixed effect is omitted, a slightly smaller coefficient of -0.75 is found for the full sample. Hence, with respect to the direction of the association, all specifications indicate a positive relationship between

public provision of day care and the share of foreign pupils (see Table 2.13). However, the estimates are imprecise and should be reassessed, once more data is available.

2.4.2 East and West Germany separately

As there are big differences in income, living conditions and attitudes between the states of the former GDR and the rest of Germany, it could be the case that the findings of subsection 2.3.1 are driven by only a part of the country. Thus, we split the sample into Western and Eastern German subsamples (see Table 2.15).

The positive association between the share of foreign pupils and the preference for public provision of day care observed in the main regressions is hard to discern in the split sample. The East German sample is only about one third as big (8,561 observations) as the West German one (22,716 observations) which leads to less precise estimates in the first column. Although the coefficients for share of foreign pupils is still negative in both subsamples, their magnitude and precision is greatly reduced. The share coefficient becomes virtually zero for the Eastern sample and -0.004 for the Western sample in contrast to -0.085 for the full sample. It appears that the combined variation of both subsamples is needed to produce the significantly negative coefficient found in the main specifications. Splitting the sample into an Eastern and Western subsample leads to similar puzzling results in the related study of Stichnoth (2010), and thus recommends caution with regard to the validity of the significant association between the share and attitudes variables found in the full sample.

The findings of the split-sample appear not to be driven by issues of multicollinearity between the share of foreign pupils, the average household income and the random intercepts for states in the full specification which are highly correlated with each other. Re-estimating the model with a random intercept only for the individuals and omitting the average household income yields qualitatively the same results as the estimations in Table 2.15. Hence, this sample split should be reconsidered once more data is available.

2.4.3 Households with children separately

One may argue that the central explanatory variable –the share of foreign pupils in the jurisdiction– is likely to be perceived more correctly or to be perceived at all by parents. Further, parents could be more concerned about the potential effects of immigration on the quality of children care as their offspring is likely to be directly affected. We therefore divide the sample into a group with and a group without children under the age of 16 in the household.

On the state level (see Table 2.17), the association between the share of foreign pupils and the preference towards public provision of day care is similar for the sample excluding households with children and the full sample. Moreover, the estimates for the random components are also very similar. The share coefficient for the sample consisting only of households with children is reduced to -0.014 in contrast to -0.085 in the full sample, thereby becoming insignificant. It is unclear, however, whether this reduction in importance is due to the smaller sample which provides only one third of total observations, or whether individuals living in households with children are less affected by the share of foreign pupils in their opinions about the provision of day care.

2.4.4 Share of foreigners as explanatory variable

It is possible that it is not the share of foreign pupils that is observed when people think of immigration, but the total share of foreigners within the population. We therefore reestimate equation (1) using the share of foreigners as the main explanatory variable in Table 2.19. As the correlation between the share of foreign pupils and the total share of foreigners is 0.97, it is not surprising that the results of Table 2.2 are mostly replicated. What is interesting is that the coefficients for the share of foreigners are smaller in value if state-level random effects (-0.016 vs. -0.079) and state and individual specific random effects (-0.051 vs. -0.085) are used. In the first case, the share-variable even becomes insignificant at common significance levels. This lends support to using the share of foreign pupils in our main specification as it indeed seems to be more important in shaping attitudes towards day care provision than the mere share of foreigners in a population.

2.4.5 Attitudes towards preschool day care as dependent variable

If attitudes towards school children day care are in some way connected with the share of foreign pupils, then one should also be able to see a relationship between attitudes towards preschool day care and a measure of the share of foreigners. Thus, we replace the attitude variable on the left hand side used so far with a variable, coded in the same way, measuring attitudes towards preschool day care. The results of this specification are given in Table 2.21.

As expected, we find a positive correlation between the share of foreign pupils and the preference for the public provision of preschool day care. Although this correlation is weaker than the one found between the share of foreign pupils and school children day care, this check also supports the view that different aspects of the welfare state are affected differently by immigration. The relationships with the other covariates are also mostly similar to the ones found in the main specification. One difference compared to the main specification is that the estimate for the time fixed effect is smaller, thereby becoming statistically insignificant in most of the regressions. A possible explanation is that the 2001 PISA shock mostly affected attitudes towards the German schooling system and school children day care, while leaving sentiments about preschool care untouched.

2.5 Conclusion

This chapter exploits the 1997 and 2002 waves of the SOEP dataset to examine the correlation between the share of foreign pupils and attitudes towards the funding of day care programs. In contrast to a large literature that analyses the link between immigration and attitudes towards the welfare state, our study does not provide evidence for a negative association between the share of foreign pupils on the state- and county-level and preferences for the public provision of day care.[17] We find indications on the state-level for the existence of a link in the opposite direction. In comparison with other explanatory variables, the magnitude of this association is meaningful. An increase of one standard deviation in the share of foreign pupils results in an increase of the dependent variable of 44% of the standard deviation of the preference

[17] See, for example, Stichnoth (2012), Dahlberg et al. (2012) and Senik et al. (2009).

for public provision of day care. However, the significance and magnitude of this association is not robust to the division of the full sample by region and time, and it cannot be discerned on the county-level once time is controlled for.

The contradictory evidence to other studies we find in this chapter suggests that different aspects of the welfare state such as unemployment assistance and public day care options are connected differently with immigration. If there is an obvious benefit from the provision of public goods to foreigners for natives themselves, natives seem to put back potential issues with increasing ethnic heterogeneity. One should therefore be careful to deduct general conclusions about the effects of immigration from examining only particular welfare state components.

The regressions in this chapter further replicate the commonly found effects of control variables such as income on preferences for public provision of welfare services. Wealthier individuals and the self-employed tend to be more in favour of a private day care system. In contrast, civil servants, respondents socialized in the former GDR, and individuals who are worried about their own financial situation and the economy as a whole are more supportive of a publicly funded day care system.

Our analysis also highlights the benefits of using mixed effects models to take the multi-level structure of the dataset into account and to provide information about the extent of variation on the different levels. Similar to most of the previous studies, the data limitations recommend that one should be careful when interpreting the estimates as causal effects, unless one is willing to make strong assumptions. Although the usage of an individual-level panel dataset somewhat ameliorates the endogeneity problem stemming from a possible reverse causality between attitudes and the share of foreign pupils, this relationship should be reassessed, once more waves of the panel data and/or exogenous variation in the share of foreign pupils is available.[18] This has to be left for future research.

[18] Dahlberg et al. (2012) use an instrumental variables approach building on a refugee-placement-program in Sweden that generated exogenous variation. As the share of immigrants subject to a refugee placement program is small in Germany, and particularly so between 1997 and 2002, such an approach cannot be applied to our data.

Appendix to section 2.2

Table 2.6 – Foreign pupil share and population of German states, 1997 and 2002

State	Share of foreign pupils in %		Total population	
	Year		Year	
	1997	2002	1997	2002
Schleswig-Holstein	5.45	5.35	2,756,473	2,816,507
Hamburg	19.50	18.17	1,704,731	1,728,806
Lower Saxony	7.41	7.54	7,845,398	7,980,472
Bremen	16.15	15.60	673,883	662,098
North Rhine-Westphalia	13.59	13.29	17,974,487	18,076,355
Hesse	15.59	14.73	6,031,705	6,091,618
Rhineland-Palatinate	7.35	7.66	4,017,828	4,057,727
Baden-Wurttemberg	13.58	12.71	10,396,610	10,661,320
Bavaria	8.16	8.01	12,066,375	12,387,351
Saarland	7.35	8.48	1,080,790	1,064,988
West Germany	11.42	11.01	64,548,280	65,527,242
Berlin	14.13	16.07	3,425,759	3,392,425
Brandenburg	0.60	1.25	2,573,291	2,582,379
Mecklenburg-Vorpommern	0.48	1.16	1,807,799	1,744,624
Saxony	0.52	1.34	4,522,412	4,349,059
Saxony-Anhalt	0.60	1.41	2,701,690	2,548,911
Thuringia	0.51	0.94	2,478,148	2,392,040
East Germany	2.36	3.36	17,509,099	17,009,438
Germany	8.72	9.08	82,057,379	82,536,680

Source: Statistische Ämter des Bundes und der Länder - GENESIS (2012)

Table 2.7 – Summary statistics state-level

	mean	sd	min	max
age	46.845	16.608	17.000	99.000
born in Germany	0.856	0.352	0.000	1.000
provision of day care fore preschool children	2.641	0.912	1.000	5.000
provision of day care for school children	2.726	0.961	1.000	5.000
civil servant	0.043	0.202	0.000	1.000
has college degree	0.178	0.382	0.000	1.000
has vocational degree	0.645	0.479	0.000	1.000
is employed	0.599	0.490	0.000	1.000
German	0.896	0.306	0.000	1.000
kids younger than 16 in hh	0.337	0.473	0.000	1.000
lived in GDR in 1989	0.273	0.446	0.000	1.000
log monthly hh net income	7.773	0.565	3.912	11.531
log average yearly hh net income	9.670	0.124	9.371	9.937
nr. of kids younger than 16 in hh	0.558	0.917	0.000	9.000
owns residence	0.450	0.497	0.000	1.000
sex	1.515	0.500	1.000	2.000
self-employed	0.055	0.228	0.000	1.000
share of foreign population in state	8.382	3.953	1.472	15.245
share of foreign pupils in state	8.906	5.258	0.476	19.501
worried about the economy	1.684	0.603	1.000	3.000
worried about own finances	2.085	0.688	1.000	3.000
years of education	11.764	2.621	7.000	18.000

Table 2.8 – Summary statistics county-level

	mean	sd	min	max
age	45.116	16.550	17.000	98.000
born in Germany	0.809	0.393	0.000	1.000
provision of day care for preschool children	2.633	0.906	1.000	5.000
provision of day care for school children	2.570	0.947	1.000	5.000
civil servant	0.033	0.178	0.000	1.000
has college degree	0.136	0.342	0.000	1.000
has vocational degree	0.621	0.485	0.000	1.000
is employed	0.584	0.493	0.000	1.000
German	0.851	0.356	0.000	1.000
kids younger than 16 in hh	0.368	0.482	0.000	1.000
lived in GDR in 1989	0.271	0.444	0.000	1.000
log monthly hh net income	7.665	0.484	4.625	9.926
log average yearly hh net income	7.111	0.142	6.804	7.624
nr. of kids younger than 16 in hh	0.621	0.966	0.000	9.000
owns residence	0.444	0.497	0.000	1.000
sex	1.512	0.500	1.000	2.000
self-employed	0.048	0.213	0.000	1.000
share of foreign population in county	8.652	5.940	0.700	26.000
share of foreign pupils in county	9.421	8.035	0.120	37.097
worried about the economy	1.626	0.588	1.000	3.000
worried about own finances	2.033	0.672	1.000	3.000
years of education	11.286	2.458	7.000	18.000

Appendix to section 2.3

Table 2.9 – Dependent variable: provision of day care for school children, mixed effects model with differing controls, county-level

	(1)		(2)		(3)		(4)		(5)	
	b	se	b	se	b	se	b	se	b	se
share of foreign pupils in county	0.008***	(0.002)	0.010***	(0.002)	-0.000	(0.002)	0.001	(0.003)	0.001	(0.003)
German			0.108***	(0.026)	0.114***	(0.026)	0.103***	(0.026)	0.102***	(0.026)
sex			0.023**	(0.011)	0.030**	(0.012)	0.025**	(0.011)	0.023**	(0.011)
age			-0.006**	(0.002)	-0.008***	(0.002)	-0.010***	(0.002)	-0.007***	(0.002)
age squared			0.000**	(0.000)	0.000***	(0.000)	0.000***	(0.000)	0.000**	(0.000)
married but separated			-0.077*	(0.046)	-0.059	(0.045)	-0.050	(0.045)	-0.042	(0.045)
single			-0.028	(0.020)	-0.030	(0.020)	-0.048**	(0.020)	-0.052**	(0.020)
divorced			-0.082***	(0.024)	-0.080***	(0.024)	-0.068***	(0.025)	-0.063**	(0.025)
widowed			0.006	(0.026)	0.007	(0.026)	0.038	(0.026)	0.030	(0.026)
kids younger than 16 in hh			-0.027	(0.023)	-0.025	(0.023)	-0.031	(0.023)	-0.028	(0.023)
born in Germany			0.039	(0.025)	0.046*	(0.025)	0.029	(0.025)	0.026	(0.025)
has vocational degree			0.010	(0.018)	0.022	(0.018)	0.023	(0.018)	0.024	(0.017)
has college degree			-0.089**	(0.035)	-0.058*	(0.035)	-0.054	(0.035)	-0.053	(0.034)
mittlere Reife			0.029	(0.018)	0.051***	(0.018)	0.035*	(0.018)	0.033*	(0.018)
Fachabitur			0.086**	(0.039)	0.089**	(0.039)	0.060	(0.039)	0.057	(0.039)
Abitur			0.013	(0.047)	0.037	(0.047)	0.020	(0.047)	0.011	(0.047)
other degree			0.051*	(0.029)	0.058**	(0.029)	0.051*	(0.028)	0.046	(0.028)
no degree			0.072*	(0.039)	0.070*	(0.039)	0.079**	(0.039)	0.065*	(0.039)
no degree yet			0.094	(0.123)	0.087	(0.123)	0.160	(0.123)	0.148	(0.122)
years of education			0.025***	(0.009)	0.019**	(0.009)	0.015	(0.009)	0.014	(0.009)
nr. of kids younger than 16 in hh			-0.018	(0.012)	-0.025**	(0.012)	-0.026**	(0.012)	-0.026**	(0.012)
is employed					-0.006	(0.014)	-0.025*	(0.014)	-0.028*	(0.014)
civil servant					-0.063**	(0.029)	-0.068**	(0.029)	-0.086***	(0.029)
lived in GDR in 1989					-0.330***	(0.027)	-0.307***	(0.029)	-0.293***	(0.029)
self-employed					0.180***	(0.025)	0.173***	(0.025)	0.182***	(0.025)
log monthly hh net income							0.044***	(0.012)	0.031***	(0.012)
log average monthly p.c. net income							-0.048	(0.137)	-0.067	(0.135)
owns residence							-0.026**	(0.011)	-0.025**	(0.011)
year=2002							0.211***	(0.020)	0.205***	(0.020)
worried about the economy									0.091***	(0.010)
worried about own finances									0.050***	(0.009)
β_0	2.679***	(0.024)	2.381***	(0.106)	2.592***	(0.107)	2.621***	(0.975)	2.588***	(0.961)
$ln\sigma_u$	-1.325***	(0.046)	-1.325***	(0.046)	-1.405***	(0.048)	-1.421***	(0.048)	-1.443***	(0.048)
$ln\sigma_\alpha$	-1.775***	(0.188)	-1.809***	(0.200)	-1.867***	(0.223)	-2.316***	(0.537)	-2.095***	(0.345)
N	28423		28423		28423		28423		28423	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2.10 – Dependent variable: provision of day care for school children, linear and logistic models, county-level

Estimation method:	(1) RE		(2) FE		(3) OLOGIT		(4) OLS	
	b	se	b	se	b	se	b	se
German	0.083***	(0.026)	0.670***	(0.131)	0.174***	(0.050)	0.078***	(0.025)
is employed	-0.024	(0.015)	-0.114***	(0.035)	-0.042	(0.029)	-0.021	(0.015)
sex	0.024**	(0.012)			0.054**	(0.023)	0.025**	(0.012)
age	-0.008***	(0.002)	0.010	(0.013)	-0.016***	(0.005)	-0.008***	(0.002)
age squared	0.000**	(0.000)	0.000	(0.000)	0.000**	(0.000)	0.000**	(0.000)
log monthly hh net income	0.031**	(0.012)	-0.019	(0.035)	0.056**	(0.024)	0.031**	(0.012)
log average monthly p.c. net income	0.051	(0.062)	-0.488	(0.340)	0.135	(0.120)	0.053	(0.061)
married but separated	-0.061	(0.046)	0.024	(0.106)	-0.126	(0.090)	-0.064	(0.046)
single	-0.069***	(0.021)	-0.444***	(0.069)	-0.119***	(0.040)	-0.066***	(0.021)
divorced	-0.070***	(0.025)	-0.009	(0.084)	-0.133***	(0.049)	-0.070***	(0.025)
widowed	0.026	(0.027)	0.459***	(0.105)	0.038	(0.053)	0.022	(0.027)
civil servant	-0.093***	(0.029)	-0.163	(0.129)	-0.166***	(0.057)	-0.094***	(0.029)
kids younger than 16 in hh	-0.040*	(0.024)	0.003	(0.056)	-0.080*	(0.046)	-0.039*	(0.024)
owns residence	-0.030***	(0.011)	0.019	(0.017)	-0.067***	(0.022)	-0.032***	(0.011)
born in Germany	0.041	(0.025)			0.074	(0.050)	0.041*	(0.025)
lived in GDR in 1989	-0.249***	(0.019)			-0.459***	(0.037)	-0.247***	(0.019)
has vocational degree	0.028	(0.018)	-0.007	(0.049)	0.063*	(0.035)	0.028	(0.018)
has college degree	-0.048	(0.035)	-0.133	(0.115)	-0.086	(0.067)	-0.050	(0.035)
mittlere Reife	0.036**	(0.018)	-0.064	(0.063)	0.071**	(0.035)	0.036**	(0.018)
Fachabitur	0.065	(0.040)	-0.124	(0.124)	0.112	(0.077)	0.067*	(0.040)
Abitur	0.033	(0.048)	-0.305**	(0.148)	0.048	(0.093)	0.036	(0.048)
other degree	0.062**	(0.029)	-0.061	(0.072)	0.122**	(0.058)	0.062**	(0.029)
no degree	0.038	(0.040)	0.054	(0.095)	0.079	(0.079)	0.036	(0.040)
no degree yet	0.165	(0.125)	0.036	(0.235)	0.306	(0.255)	0.172	(0.125)
years of education	0.011	(0.009)	0.039	(0.028)	0.022	(0.018)	0.011	(0.009)
worried about the economy	0.119***	(0.010)	0.169***	(0.023)	0.229***	(0.020)	0.118***	(0.010)
worried about own finances	0.048***	(0.010)	0.134***	(0.023)	0.083***	(0.019)	0.046***	(0.009)
self-employed	0.191***	(0.026)	0.176**	(0.082)	0.371***	(0.050)	0.190***	(0.026)
nr. of kids younger than 16 in hh	-0.024**	(0.012)	-0.006	(0.032)	-0.047**	(0.023)	-0.024**	(0.012)
share of foreign pupils in county	0.000	(0.001)	-0.004	(0.006)	0.000	(0.002)	0.000	(0.001)
year=2002	0.195***	(0.014)			0.394***	(0.028)	0.203***	(0.014)
β_0	1.760***	(0.453)	4.437**	(2.087)			1.742***	(0.447)
N	28423		28423		28423		28423	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix to section 2.4

Table 2.11 – Dependent variable: provision of day care for school children, Germans and non-Germans separately, state-level

	(1) Germans		(2) Non-Germans		(3) Full sample	
	b	se	b	se	b	se
is employed	0.006	(0.015)	0.008	(0.043)	0.008	(0.014)
sex	0.030***	(0.012)	0.019	(0.039)	0.030***	(0.011)
age	-0.006**	(0.002)	0.001	(0.010)	-0.005**	(0.002)
age squared	0.000**	(0.000)	-0.000	(0.000)	0.000**	(0.000)
log monthly hh net income	0.016	(0.012)	0.045	(0.038)	0.020*	(0.011)
log average yearly hh net income	-2.268***	(0.424)	0.298	(0.883)	-2.248***	(0.414)
married but separated	-0.049	(0.045)	-0.125	(0.143)	-0.058	(0.043)
single	0.007	(0.021)	0.121*	(0.067)	0.013	(0.020)
divorced	-0.087***	(0.024)	-0.034	(0.094)	-0.083***	(0.023)
widowed	-0.002	(0.026)	0.155	(0.134)	0.006	(0.025)
civil servant	-0.100***	(0.027)	0.319	(0.357)	-0.094***	(0.028)
kids younger than 16 in hh	-0.062***	(0.024)	-0.013	(0.064)	-0.054**	(0.022)
owns residence	-0.050***	(0.011)	-0.004	(0.043)	-0.050***	(0.010)
born in Germany	0.048*	(0.027)	-0.078	(0.065)	0.021	(0.024)
lived in GDR in 1989	-0.295***	(0.028)	-0.078	(0.331)	-0.291***	(0.028)
has vocational degree	0.034**	(0.017)	-0.013	(0.076)	0.032*	(0.016)
has college degree	-0.033	(0.032)	-0.119	(0.189)	-0.033	(0.032)
mittlere Reife	0.058***	(0.017)	-0.106	(0.086)	0.053***	(0.017)
Fachabitur	0.083**	(0.039)	0.034	(0.160)	0.084**	(0.037)
Abitur	0.080*	(0.047)	-0.063	(0.176)	0.077*	(0.044)
other degree	0.073**	(0.036)	0.039	(0.054)	0.059**	(0.027)
no degree	-0.045	(0.049)	0.030	(0.096)	0.010	(0.037)
no degree yet	0.053	(0.120)	0.207	(0.364)	0.062	(0.114)
years of education	0.002	(0.009)	0.007	(0.038)	0.001	(0.009)
worried about the economy	0.054***	(0.010)	0.108***	(0.032)	0.058***	(0.009)
worried about own finances	0.044***	(0.009)	-0.035	(0.029)	0.037***	(0.009)
self-employed	0.158***	(0.025)	0.141	(0.095)	0.157***	(0.024)
nr. of kids younger than 16 in hh	-0.002	(0.012)	-0.029	(0.029)	-0.005	(0.011)
share of foreign pupils in state	-0.097***	(0.015)	0.008	(0.018)	-0.085***	(0.014)
year=2002	0.773***	(0.049)	0.478***	(0.109)	0.765***	(0.048)
German					0.022	(0.025)
β_0	24.692***	(4.077)	-1.115	(8.421)	24.367***	(3.984)
$ln\sigma_u$	-0.157	(0.248)	-1.506***	(0.342)	-0.250	(0.257)
$ln\sigma_\alpha$	-1.030***	(0.040)	-0.880***	(0.101)	-0.998***	(0.036)
N	28053		3224		31277	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2.12 – Dependent variable: provision of day care for school children, Germans and non-Germans separately, county-level

	(1) Germans		(2) Non-Germans		(3) Full Sample	
	b	se	b	se	b	se
is employed	-0.034**	(0.015)	-0.005	(0.043)	-0.033**	(0.015)
sex	0.018	(0.012)	0.042	(0.040)	0.021*	(0.012)
age	-0.008***	(0.003)	-0.006	(0.010)	-0.008***	(0.002)
age squared	0.000**	(0.000)	0.000	(0.000)	0.000*	(0.000)
log monthly hh net income	0.029**	(0.013)	0.025	(0.040)	0.032***	(0.012)
log average monthly p.c. net income	-0.091	(0.137)	0.118	(0.351)	-0.074	(0.135)
married but separated	-0.019	(0.048)	-0.209	(0.148)	-0.037	(0.046)
single	-0.065***	(0.022)	0.013	(0.069)	-0.060***	(0.021)
divorced	-0.076***	(0.026)	0.080	(0.098)	-0.065***	(0.025)
widowed	0.027	(0.027)	0.237*	(0.135)	0.036	(0.027)
civil servant	-0.095***	(0.029)	0.209	(0.360)	-0.086***	(0.029)
kids younger than 16 in hh	-0.042*	(0.025)	0.055	(0.067)	-0.028	(0.023)
owns residence	-0.024**	(0.011)	0.047	(0.044)	-0.022**	(0.011)
born in Germany	0.068**	(0.029)	-0.105	(0.068)	0.024	(0.026)
lived in GDR in 1989	-0.301***	(0.029)	-0.371	(0.337)	-0.293***	(0.029)
has vocational degree	0.025	(0.018)	0.022	(0.078)	0.024	(0.018)
has college degree	-0.047	(0.036)	-0.004	(0.196)	-0.052	(0.035)
mittlere Reife	0.041**	(0.019)	-0.052	(0.088)	0.031*	(0.018)
Fachabitur	0.069*	(0.041)	-0.022	(0.163)	0.052	(0.039)
Abitur	0.028	(0.051)	-0.105	(0.182)	0.005	(0.047)
other degree	0.067*	(0.038)	0.038	(0.056)	0.045	(0.029)
no degree	-0.010	(0.052)	0.129	(0.100)	0.065*	(0.039)
no degree yet	0.183	(0.126)	-0.283	(0.458)	0.134	(0.122)
years of education	0.011	(0.010)	0.025	(0.040)	0.015	(0.009)
worried about the economy	0.094***	(0.011)	0.122***	(0.034)	0.095***	(0.010)
worried about own finances	0.059***	(0.010)	-0.002	(0.031)	0.053***	(0.009)
self-employed	0.185***	(0.026)	0.194*	(0.101)	0.185***	(0.026)
nr. of kids younger than 16 in hh	-0.026**	(0.013)	-0.040	(0.030)	-0.027**	(0.012)
share of foreign pupils in county	0.001	(0.003)	-0.001	(0.005)	0.001	(0.003)
year=2002	0.196***	(0.020)	0.093	(0.059)	0.188***	(0.019)
German					0.114***	(0.026)
β_0	2.907***	(0.975)	1.240	(2.543)	2.640***	(0.961)
$ln\sigma_u$	-1.447	(0.000)	-1.023	(0.000)	-1.448	(0.000)
$ln\sigma_\alpha$	-0.991	(0.000)	-0.969	(0.000)	-0.982	(0.000)
N	25377		3046		28423	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, no random component standard error due to expectation-maximization estimation

Table 2.13 – Dependent variable: provision of day care for school children, waves 1997 and 2002 separately, state-level

	(1) 1997		(2) 2002		(3) Full Sample		(4) Full Sample	
	b	se	b	se	b	se	b	se
German	-0.053	(0.037)	0.056*	(0.031)	0.022	(0.025)	0.026	(0.025)
is employed	0.013	(0.023)	0.007	(0.017)	0.008	(0.014)	0.008	(0.014)
sex	0.083***	(0.018)	0.005	(0.013)	0.030***	(0.011)	0.031***	(0.011)
age	-0.004	(0.004)	-0.005*	(0.003)	-0.005**	(0.002)	-0.005**	(0.002)
age squared	0.000	(0.000)	0.000*	(0.000)	0.000**	(0.000)	0.000**	(0.000)
log monthly hh net income	0.019	(0.022)	0.015	(0.014)	0.020*	(0.011)	0.028**	(0.011)
log average yearly hh net income	0.188	(0.430)	0.265	(0.577)	-2.248***	(0.414)	4.158***	(0.094)
married but separated	0.016	(0.079)	-0.089*	(0.051)	-0.058	(0.043)	-0.053	(0.043)
single	0.035	(0.033)	0.004	(0.024)	0.013	(0.020)	0.017	(0.020)
divorced	0.039	(0.042)	-0.125***	(0.027)	-0.083***	(0.023)	-0.078***	(0.023)
widowed	-0.008	(0.042)	0.013	(0.031)	0.006	(0.025)	0.003	(0.025)
civil servant	-0.126**	(0.051)	-0.078**	(0.032)	-0.094***	(0.028)	-0.094***	(0.028)
kids younger than 16 in hh	0.003	(0.036)	-0.084***	(0.028)	-0.054**	(0.022)	-0.051**	(0.022)
owns residence	0.003	(0.020)	-0.050***	(0.014)	-0.050***	(0.010)	-0.039***	(0.010)
born in Germany	-0.017	(0.038)	0.041	(0.030)	0.021	(0.024)	0.021	(0.024)
lived in GDR in 1989	-0.089*	(0.047)	-0.367***	(0.033)	-0.291***	(0.028)	-0.280***	(0.028)
has vocational degree	0.002	(0.031)	0.042**	(0.019)	0.032*	(0.016)	0.034**	(0.016)
has college degree	-0.076	(0.061)	-0.025	(0.037)	-0.033	(0.032)	-0.032	(0.032)
mittlere Reife	0.016	(0.029)	0.070***	(0.020)	0.053***	(0.017)	0.057***	(0.017)
Fachabitur	0.065	(0.071)	0.097**	(0.043)	0.084**	(0.037)	0.096***	(0.037)
Abitur	-0.010	(0.082)	0.113**	(0.051)	0.077*	(0.044)	0.091**	(0.044)
other degree	-0.036	(0.044)	0.114***	(0.034)	0.059**	(0.027)	0.055**	(0.027)
no degree	-0.015	(0.057)	0.028	(0.050)	0.010	(0.037)	0.001	(0.037)
no degree yet	0.075	(0.121)	0.945	(0.911)	0.062	(0.114)	0.013	(0.114)
years of education	0.016	(0.016)	-0.005	(0.010)	0.001	(0.009)	-0.001	(0.009)
worried about the economy	0.078***	(0.016)	0.053***	(0.012)	0.058***	(0.009)	0.065***	(0.009)
worried about own finances	0.023	(0.015)	0.037***	(0.011)	0.037***	(0.009)	0.035***	(0.009)
self-employed	0.116***	(0.043)	0.173***	(0.028)	0.157***	(0.024)	0.158***	(0.024)
nr. of kids younger than 16 in hh	-0.036**	(0.017)	0.008	(0.014)	-0.005	(0.011)	-0.007	(0.011)
share of foreign pupils in state	-0.004	(0.008)	-0.012	(0.012)	-0.085***	(0.014)	-0.075***	(0.010)
year=2002					0.765***	(0.048)		
β_0	0.170	(4.078)	0.295	(5.513)	24.367***	(3.984)	-37.109***	(0.894)
$ln\sigma_\alpha$	-0.171	(0.000)	-0.161	(0.000)	-0.998***	(0.036)	-1.033***	(0.038)
$ln\sigma_u$	-2.472	(0.000)	-1.756	(0.000)	-0.250	(0.257)	-1.160***	(0.191)
N	10714		20563		31277		31277	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, no random component standard error due to expectation-maximization estimation

Table 2.14 – Dependent variable: provision of day care for school children, waves 1997 and 2002 separately, county-level

	(1) 1997		(2) 2002		(3) Full Sample		(4) Full Sample	
	b	se	b	se	b	se	b	se
German	0.032	(0.040)	0.130***	(0.033)	0.114***	(0.026)	0.117***	(0.026)
is employed	-0.033	(0.024)	-0.019	(0.018)	-0.033**	(0.015)	-0.033**	(0.015)
sex	0.039**	(0.019)	0.017	(0.014)	0.021*	(0.012)	0.022*	(0.012)
age	0.001	(0.004)	-0.013***	(0.003)	-0.008***	(0.002)	-0.007***	(0.002)
age squared	-0.000	(0.000)	0.000***	(0.000)	0.000*	(0.000)	0.000*	(0.000)
log monthly hh net income	0.036	(0.023)	0.018	(0.015)	0.032***	(0.012)	0.039***	(0.012)
log average monthly p.c. net income	-0.123	(0.183)	0.009	(0.158)	-0.074	(0.135)	1.009***	(0.082)
married but separated	-0.066	(0.080)	-0.030	(0.055)	-0.037	(0.046)	-0.035	(0.046)
single	-0.047	(0.034)	-0.055**	(0.025)	-0.060***	(0.021)	-0.047**	(0.021)
divorced	0.007	(0.044)	-0.084***	(0.030)	-0.065***	(0.025)	-0.061**	(0.025)
widowed	0.104**	(0.043)	-0.006	(0.033)	0.036	(0.027)	0.034	(0.027)
civil servant	-0.113**	(0.055)	-0.077**	(0.033)	-0.086***	(0.029)	-0.085***	(0.029)
kids younger than 16 in hh	-0.019	(0.038)	-0.038	(0.029)	-0.028	(0.023)	-0.025	(0.023)
owns residence	0.024	(0.022)	-0.043***	(0.016)	-0.022**	(0.011)	-0.020*	(0.011)
born in Germany	0.019	(0.040)	0.026	(0.031)	0.024	(0.026)	0.027	(0.026)
lived in GDR in 1989	-0.218***	(0.047)	-0.309***	(0.034)	-0.293***	(0.029)	-0.225***	(0.029)
has vocational degree	-0.026	(0.034)	0.040*	(0.021)	0.024	(0.018)	0.025	(0.018)
has college degree	-0.115*	(0.068)	-0.042	(0.040)	-0.052	(0.035)	-0.053	(0.035)
mittlere Reife	0.004	(0.031)	0.045**	(0.022)	0.031*	(0.018)	0.034*	(0.018)
Fachabitur	0.005	(0.076)	0.069	(0.045)	0.052	(0.039)	0.059	(0.039)
Abitur	-0.061	(0.089)	0.025	(0.055)	0.005	(0.047)	0.010	(0.048)
other degree	0.006	(0.046)	0.071**	(0.036)	0.045	(0.029)	0.046	(0.029)
no degree	0.090	(0.061)	0.049	(0.053)	0.065*	(0.039)	0.058	(0.039)
no degree yet	0.191	(0.130)	0.957	(0.917)	0.134	(0.122)	0.098	(0.122)
years of education	0.031*	(0.018)	0.011	(0.011)	0.015	(0.009)	0.015	(0.009)
worried about the economy	0.120***	(0.017)	0.081***	(0.012)	0.095***	(0.010)	0.099***	(0.010)
worried about own finances	0.053***	(0.016)	0.042***	(0.012)	0.053***	(0.009)	0.050***	(0.009)
self-employed	0.139***	(0.045)	0.197***	(0.030)	0.185***	(0.026)	0.185***	(0.026)
nr. of kids younger than 16 in hh	-0.039**	(0.018)	-0.018	(0.015)	-0.027**	(0.012)	-0.027**	(0.012)
share of foreign pupils in county	0.001	(0.003)	0.002	(0.003)	0.001	(0.003)	-0.008***	(0.003)
year=2002					0.188***	(0.019)		
β_0	2.590**	(1.318)	2.483**	(1.145)	2.640***	(0.961)	-5.058***	(0.585)
$ln\sigma_u$	-1.390	(0.000)	-1.371	(0.000)	-1.448	(0.000)	-1.364	(0.000)
$ln\sigma_\alpha$	-0.166	(0.000)	-0.158	(0.000)	-0.982	(0.000)	-0.973	(0.000)
N	9694		18729		28423		28423	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, no random component standard error due to expectation-maximization estimation

Table 2.15 – Dependent variable: provision of day care for school children, East and West Germany separately, state-level

	(1) East		(2) West		(3) Full Sample	
	b	se	b	se	b	se
German	0.046	(0.113)	0.013	(0.026)	0.022	(0.025)
is employed	0.003	(0.023)	0.004	(0.017)	0.008	(0.014)
sex	0.089***	(0.019)	0.009	(0.014)	0.030***	(0.011)
age	-0.006	(0.004)	-0.004	(0.003)	-0.005**	(0.002)
age squared	0.000	(0.000)	0.000	(0.000)	0.000**	(0.000)
log monthly hh net income	0.068***	(0.021)	0.006	(0.013)	0.020*	(0.011)
log average yearly hh net income	-0.790*	(0.412)	-1.014	(0.764)	-2.248***	(0.414)
married but separated	0.137*	(0.072)	-0.127**	(0.052)	-0.058	(0.043)
single	0.069*	(0.036)	-0.012	(0.024)	0.013	(0.020)
divorced	-0.055	(0.037)	-0.095***	(0.029)	-0.083***	(0.023)
widowed	-0.033	(0.042)	0.027	(0.031)	0.006	(0.025)
civil servant	0.006	(0.060)	-0.109***	(0.032)	-0.094***	(0.028)
kids younger than 16 in hh	-0.006	(0.041)	-0.090***	(0.026)	-0.054**	(0.022)
owns residence	-0.023	(0.017)	-0.052***	(0.013)	-0.050***	(0.010)
born in Germany	-0.003	(0.077)	0.025	(0.026)	0.021	(0.024)
lived in GDR in 1989	-0.237***	(0.043)	-0.299***	(0.037)	-0.291***	(0.028)
has vocational degree	0.022	(0.026)	0.038*	(0.021)	0.032*	(0.016)
has college degree	-0.059	(0.044)	-0.018	(0.045)	-0.033	(0.032)
mittlere Reife	0.042	(0.030)	0.047**	(0.021)	0.053***	(0.017)
Fachabitur	0.043	(0.077)	0.084*	(0.043)	0.084**	(0.037)
Abitur	0.103	(0.076)	0.059	(0.055)	0.077*	(0.044)
other degree	-0.044	(0.068)	0.065**	(0.030)	0.059**	(0.027)
no degree	0.128	(0.094)	-0.008	(0.042)	0.010	(0.037)
no degree yet	-0.111	(0.193)	0.119	(0.138)	0.062	(0.114)
years of education	0.004	(0.014)	-0.000	(0.011)	0.001	(0.009)
worried about the economy	0.024	(0.016)	0.069***	(0.011)	0.058***	(0.009)
worried about own finances	0.014	(0.015)	0.045***	(0.011)	0.037***	(0.009)
self-employed	0.104**	(0.042)	0.175***	(0.029)	0.157***	(0.024)
nr. of kids younger than 16 in hh	0.014	(0.024)	-0.004	(0.013)	-0.005	(0.011)
share of foreign pupils in state	-0.000	(0.008)	-0.004	(0.016)	-0.085***	(0.014)
year=2002	0.471***	(0.054)	0.675***	(0.087)	0.765***	(0.048)
β_0	9.242**	(3.895)	12.035*	(7.302)	24.367***	(3.984)
$ln\sigma_\alpha$	-0.990***	(0.050)	-1.018***	(0.047)	-0.998***	(0.036)
$ln\sigma_u$	-2.276***	(0.372)	-1.613***	(0.308)	-0.250	(0.257)
N	8561		22716		31277	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2.16 – Dependent variable: provision of day care for school children, East and West Germany separately, county-level

	(1) East		(2) West		(3) Full Sample	
	b	se	b	se	b	se
German	0.706***	(0.244)	0.103***	(0.027)	0.114***	(0.026)
is employed	-0.037	(0.027)	-0.033*	(0.017)	-0.033**	(0.015)
sex	0.074***	(0.022)	0.008	(0.014)	0.021*	(0.012)
age	-0.008*	(0.005)	-0.007**	(0.003)	-0.008***	(0.002)
age squared	0.000	(0.000)	0.000	(0.000)	0.000*	(0.000)
log monthly hh net income	0.021	(0.025)	0.033**	(0.014)	0.032***	(0.012)
log average monthly p.c. net income	-0.118	(0.443)	0.068	(0.164)	-0.074	(0.135)
married but separated	0.117	(0.089)	-0.072	(0.053)	-0.037	(0.046)
single	0.028	(0.041)	-0.093***	(0.024)	-0.060***	(0.021)
divorced	-0.028	(0.044)	-0.082***	(0.030)	-0.065***	(0.025)
widowed	-0.044	(0.047)	0.066**	(0.032)	0.036	(0.027)
civil servant	0.117	(0.072)	-0.115***	(0.033)	-0.086***	(0.029)
kids younger than 16 in hh	0.046	(0.047)	-0.069**	(0.027)	-0.028	(0.023)
owns residence	-0.035*	(0.020)	-0.014	(0.013)	-0.022**	(0.011)
born in Germany	0.070	(0.115)	0.020	(0.027)	0.024	(0.026)
lived in GDR in 1989	-0.244***	(0.079)	-0.312***	(0.039)	-0.293***	(0.029)
has vocational degree	-0.009	(0.030)	0.044**	(0.022)	0.024	(0.018)
has college degree	-0.132***	(0.051)	0.005	(0.047)	-0.052	(0.035)
mittlere Reife	0.017	(0.035)	0.029	(0.022)	0.031*	(0.018)
Fachabitur	0.068	(0.093)	0.057	(0.045)	0.052	(0.039)
Abitur	0.022	(0.090)	0.013	(0.057)	0.005	(0.047)
other degree	0.042	(0.084)	0.039	(0.031)	0.045	(0.029)
no degree	0.108	(0.118)	0.039	(0.044)	0.065*	(0.039)
no degree yet	0.117	(0.236)	0.141	(0.142)	0.134	(0.122)
years of education	0.029*	(0.017)	0.006	(0.012)	0.015	(0.009)
worried about the economy	0.045**	(0.019)	0.107***	(0.012)	0.095***	(0.010)
worried about own finances	0.022	(0.018)	0.062***	(0.011)	0.053***	(0.009)
self-employed	0.154***	(0.049)	0.191***	(0.030)	0.185***	(0.026)
nr. of kids younger than 16 in hh	0.008	(0.028)	-0.026**	(0.013)	-0.027**	(0.012)
share of foreign pupils in county	0.025	(0.028)	0.002	(0.003)	0.001	(0.003)
year=2002	0.119*	(0.064)	0.193***	(0.023)	0.188***	(0.019)
β_0	2.275	(3.081)	1.665	(1.176)	2.640***	(0.961)
$ln\sigma_u$	-1.569	(0.000)	-1.423	(0.000)	-1.448	(0.000)
$ln\sigma_\alpha$	-1.027	(0.000)	-0.972	(0.000)	-0.982	(0.000)
N	6434		21989		28423	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, no random component standard error due to expectation-maximization estimation

Table 2.17 – Dependent variable: provision of day care for school children, households with children under the age of 16 separately, state-level

	(1) Kids in hh		(2) No Kids in hh		(3) Full Sample	
	b	se	b	se	b	se
German	0.031	(0.037)	0.019	(0.033)	0.022	(0.025)
is employed	-0.008	(0.023)	0.015	(0.017)	0.008	(0.014)
sex	0.041**	(0.020)	0.028**	(0.014)	0.030***	(0.011)
age	-0.013**	(0.006)	-0.006**	(0.003)	-0.005**	(0.002)
age squared	0.000**	(0.000)	0.000**	(0.000)	0.000**	(0.000)
log monthly hh net income	0.031	(0.024)	0.010	(0.013)	0.020*	(0.011)
log average yearly hh net income	-0.201	(0.403)	-2.102***	(0.498)	-2.248***	(0.414)
married but separated	-0.065	(0.073)	-0.068	(0.053)	-0.058	(0.043)
single	-0.039	(0.037)	0.004	(0.025)	0.013	(0.020)
divorced	-0.114***	(0.044)	-0.084***	(0.027)	-0.083***	(0.023)
widowed	-0.231**	(0.095)	0.017	(0.026)	0.006	(0.025)
civil servant	-0.098**	(0.044)	-0.091***	(0.035)	-0.094***	(0.028)
owns residence	-0.035**	(0.018)	-0.056***	(0.013)	-0.050***	(0.010)
born in Germany	-0.015	(0.038)	0.041	(0.031)	0.021	(0.024)
lived in GDR in 1989	-0.257***	(0.046)	-0.301***	(0.035)	-0.291***	(0.028)
has vocational degree	0.023	(0.029)	0.042**	(0.020)	0.032*	(0.016)
has college degree	-0.001	(0.056)	-0.037	(0.039)	-0.033	(0.032)
mittlere Reife	0.033	(0.029)	0.055***	(0.021)	0.053***	(0.017)
Fachabitur	0.104*	(0.062)	0.082*	(0.046)	0.084**	(0.037)
Abitur	0.081	(0.075)	0.083	(0.054)	0.077*	(0.044)
other degree	0.046	(0.043)	0.064*	(0.035)	0.059**	(0.027)
no degree	0.085	(0.062)	-0.050	(0.046)	0.010	(0.037)
no degree yet	0.205	(0.199)	-0.004	(0.139)	0.062	(0.114)
years of education	-0.006	(0.015)	0.001	(0.011)	0.001	(0.009)
worried about the economy	0.044***	(0.017)	0.068***	(0.011)	0.058***	(0.009)
worried about own finances	0.056***	(0.015)	0.030***	(0.011)	0.037***	(0.009)
self-employed	0.199***	(0.036)	0.128***	(0.031)	0.157***	(0.024)
nr. of kids younger than 16 in hh	-0.001	(0.011)			-0.005	(0.011)
share of foreign pupils in state	-0.014	(0.009)	-0.084***	(0.016)	-0.085***	(0.014)
year=2002	0.539***	(0.049)	0.747***	(0.058)	0.765***	(0.048)
kids younger than 16 in hh					-0.054**	(0.022)
β_0	4.232	(3.818)	23.041***	(4.781)	24.367***	(3.984)
$ln\sigma_\alpha$	-1.014***	(0.070)	-0.981***	(0.045)	-0.998***	(0.036)
$ln\sigma_u$	-2.077***	(0.244)	-0.249	(0.312)	-0.250	(0.257)
N	10572		20705		31277	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2.18 – Dependent variable: provision of day care for school children, households with children under the age of 16 separately, county-level

	(1) Kids in hh		(2) No Kids in hh		(3) Full Sample	
	b	se	b	se	b	se
German	0.092**	(0.040)	0.143***	(0.035)	0.114***	(0.026)
is employed	-0.037	(0.025)	-0.032*	(0.018)	-0.033**	(0.015)
sex	0.015	(0.021)	0.027*	(0.014)	0.021*	(0.012)
age	-0.017***	(0.006)	-0.007**	(0.003)	-0.008***	(0.002)
age squared	0.000**	(0.000)	0.000	(0.000)	0.000*	(0.000)
log monthly hh net income	0.035	(0.025)	0.021	(0.014)	0.032***	(0.012)
log average monthly p.c. net income	-0.094	(0.170)	-0.045	(0.162)	-0.074	(0.135)
married but separated	-0.023	(0.073)	-0.066	(0.058)	-0.037	(0.046)
single	-0.098***	(0.038)	-0.071***	(0.026)	-0.060***	(0.021)
divorced	-0.040	(0.047)	-0.083***	(0.030)	-0.065***	(0.025)
widowed	-0.163	(0.100)	0.041	(0.028)	0.036	(0.027)
civil servant	-0.120**	(0.047)	-0.064*	(0.037)	-0.086***	(0.029)
owns residence	-0.031	(0.019)	-0.018	(0.013)	-0.022**	(0.011)
born in Germany	-0.029	(0.040)	0.070**	(0.033)	0.024	(0.026)
lived in GDR in 1989	-0.211***	(0.045)	-0.317***	(0.036)	-0.293***	(0.029)
has vocational degree	-0.002	(0.031)	0.035	(0.022)	0.024	(0.018)
has college degree	-0.063	(0.061)	-0.046	(0.043)	-0.052	(0.035)
mittlere Reife	-0.020	(0.032)	0.051**	(0.022)	0.031*	(0.018)
Fachabitur	0.045	(0.066)	0.067	(0.049)	0.052	(0.039)
Abitur	-0.041	(0.081)	0.034	(0.059)	0.005	(0.047)
other degree	0.014	(0.045)	0.072*	(0.037)	0.045	(0.029)
no degree	0.061	(0.067)	0.063	(0.049)	0.065*	(0.039)
no degree yet	0.148	(0.212)	0.136	(0.149)	0.134	(0.122)
years of education	0.016	(0.016)	0.012	(0.011)	0.015	(0.009)
worried about the economy	0.085***	(0.018)	0.102***	(0.012)	0.095***	(0.010)
worried about own finances	0.069***	(0.016)	0.048***	(0.012)	0.053***	(0.009)
self-employed	0.232***	(0.039)	0.158***	(0.034)	0.185***	(0.026)
nr. of kids younger than 16 in hh	-0.018	(0.012)			-0.027**	(0.012)
share of foreign pupils in county	-0.002	(0.003)	0.003	(0.003)	0.001	(0.003)
year=2002	0.201***	(0.028)	0.184***	(0.024)	0.188***	(0.019)
kids younger than 16 in hh					-0.028	(0.023)
β_0	2.960**	(1.223)	2.441**	(1.153)	2.640***	(0.961)
$ln\sigma_u$	-1.447	(0.000)	-1.294	(0.000)	-1.448	(0.000)
$ln\sigma_\alpha$	-0.920	(0.000)	-0.950	(0.000)	-0.982	(0.000)
N	9732		18691		28423	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, no random component standard error due to expectation-maximization estimation

Table 2.19 – Dependent variable: provision of day care for school children, share of foreigners as independent variable, state-level

	(1)		(2)		(3)	
Random effect:	Individual		State		State Individual	
	b	se	b	se	b	se
German	0.012	(0.025)	0.022	(0.024)	0.025	(0.025)
is employed	0.012	(0.014)	0.010	(0.014)	0.008	(0.014)
sex	0.031***	(0.011)	0.032***	(0.011)	0.030***	(0.011)
age	-0.004*	(0.002)	-0.005**	(0.002)	-0.005**	(0.002)
age squared	0.000*	(0.000)	0.000*	(0.000)	0.000**	(0.000)
log monthly hh net income	0.020*	(0.011)	0.020*	(0.011)	0.020*	(0.011)
log average yearly hh net income	0.341***	(0.121)	-0.893**	(0.390)	-1.406***	(0.412)
married but separated	-0.068	(0.043)	-0.065	(0.043)	-0.060	(0.043)
single	0.011	(0.020)	0.013	(0.019)	0.013	(0.020)
divorced	-0.094***	(0.023)	-0.084***	(0.023)	-0.086***	(0.023)
widowed	0.000	(0.026)	0.000	(0.025)	0.003	(0.025)
civil servant	-0.098***	(0.028)	-0.095***	(0.027)	-0.093***	(0.028)
kids younger than 16 in hh	-0.050**	(0.022)	-0.048**	(0.022)	-0.051**	(0.022)
owns residence	-0.046***	(0.010)	-0.052***	(0.011)	-0.052***	(0.010)
born in Germany	0.025	(0.024)	0.023	(0.023)	0.020	(0.024)
lived in GDR in 1989	-0.246***	(0.022)	-0.296***	(0.027)	-0.294***	(0.028)
has vocational degree	0.034**	(0.016)	0.035**	(0.016)	0.034**	(0.016)
has college degree	-0.025	(0.032)	-0.027	(0.031)	-0.030	(0.032)
mittlere Reife	0.051***	(0.017)	0.057***	(0.017)	0.054***	(0.017)
Fachabitur	0.086**	(0.037)	0.089**	(0.036)	0.084**	(0.037)
Abitur	0.088**	(0.044)	0.090**	(0.043)	0.082*	(0.044)
other degree	0.051*	(0.027)	0.060**	(0.027)	0.059**	(0.027)
no degree	-0.010	(0.037)	0.002	(0.037)	0.005	(0.037)
no degree yet	0.058	(0.114)	0.081	(0.115)	0.059	(0.114)
years of education	-0.002	(0.009)	-0.001	(0.008)	-0.000	(0.009)
worried about the economy	0.068***	(0.010)	0.064***	(0.009)	0.061***	(0.009)
worried about own finances	0.037***	(0.009)	0.034***	(0.009)	0.037***	(0.009)
self-employed	0.159***	(0.024)	0.160***	(0.023)	0.157***	(0.024)
nr. of kids younger than 16 in hh	-0.007	(0.011)	-0.010	(0.011)	-0.006	(0.011)
share of foreign population in state	-0.008***	(0.003)	-0.016	(0.014)	-0.051***	(0.018)
year=2002	0.465***	(0.018)	0.611***	(0.046)	0.665***	(0.049)
β_0	-1.067	(1.155)	10.801***	(3.668)	15.990***	(3.893)
$ln\sigma_u$			-1.550***	(0.376)	-0.912	(0.637)
$ln\sigma_\alpha$	-0.996***	(0.035)			-0.997***	(0.036)
N	31188		31188		31188	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2.20 – Dependent variable: provision of day care for school children, share of foreigners as independent variable, county-level

	(1)		(2)		(3)	
Random effect:	Individual		County		County and Individual	
	b	se	b	se	b	se
German	0.099***	(0.026)	0.101***	(0.025)	0.115***	(0.026)
is employed	-0.028*	(0.015)	-0.027*	(0.014)	-0.034**	(0.015)
sex	0.022*	(0.012)	0.024**	(0.011)	0.021*	(0.012)
age	-0.009***	(0.002)	-0.007***	(0.002)	-0.008***	(0.002)
age squared	0.000**	(0.000)	0.000**	(0.000)	0.000*	(0.000)
log monthly hh net income	0.032**	(0.012)	0.031***	(0.012)	0.031***	(0.012)
log average monthly p.c. net income	-0.009	(0.065)	-0.137	(0.139)	-0.142	(0.139)
married but separated	-0.057	(0.047)	-0.043	(0.045)	-0.038	(0.046)
single	-0.078***	(0.021)	-0.051**	(0.020)	-0.060***	(0.021)
divorced	-0.071***	(0.026)	-0.063***	(0.024)	-0.065***	(0.025)
widowed	0.032	(0.028)	0.030	(0.026)	0.036	(0.027)
civil servant	-0.092***	(0.030)	-0.086***	(0.029)	-0.086***	(0.029)
kids younger than 16 in hh	-0.042*	(0.024)	-0.028	(0.023)	-0.028	(0.023)
owns residence	-0.029***	(0.011)	-0.026**	(0.011)	-0.022**	(0.011)
born in Germany	0.041	(0.026)	0.026	(0.025)	0.025	(0.026)
lived in GDR in 1989	-0.243***	(0.020)	-0.289***	(0.029)	-0.289***	(0.029)
has vocational degree	0.029	(0.018)	0.024	(0.017)	0.024	(0.018)
has college degree	-0.046	(0.036)	-0.053	(0.034)	-0.052	(0.035)
mittlere Reife	0.034*	(0.019)	0.033*	(0.018)	0.031*	(0.018)
Fachabitur	0.062	(0.040)	0.058	(0.039)	0.052	(0.039)
Abitur	0.027	(0.049)	0.012	(0.047)	0.005	(0.047)
other degree	0.060**	(0.029)	0.046	(0.028)	0.045	(0.029)
no degree	0.039	(0.040)	0.065*	(0.039)	0.065*	(0.039)
no degree yet	0.151	(0.125)	0.150	(0.122)	0.134	(0.122)
years of education	0.011	(0.010)	0.014	(0.009)	0.015	(0.009)
worried about the economy	0.121***	(0.010)	0.091***	(0.010)	0.095***	(0.010)
worried about own finances	0.052***	(0.010)	0.049***	(0.009)	0.053***	(0.009)
self-employed	0.192***	(0.026)	0.182***	(0.025)	0.185***	(0.026)
nr. of kids younger than 16 in hh	-0.023*	(0.012)	-0.026**	(0.012)	-0.027**	(0.012)
share of foreign population in county	0.313**	(0.141)	0.496	(0.354)	0.509	(0.353)
year=2002	0.188***	(0.014)	0.215***	(0.020)	0.197***	(0.020)
β_0	2.172***	(0.477)	3.054***	(0.987)	3.094***	(0.986)
$ln\sigma_u$			-1.445	(0.000)	-1.451	(0.000)
$ln\sigma_\alpha$	-0.915	(0.000)			-0.982	(0.000)
N	28423		28423		28423	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, no random component standard error due to expectation-maximization estimation

Table 2.21 – Dependent variable: provision of day care for preschool children, state-level

	(1)		(2)		(3)	
Random effect:	Individual		State		State and Individual	
	b	se	b	se	b	se
German	-0.019	(0.024)	-0.011	(0.023)	-0.006	(0.024)
is employed	0.004	(0.014)	0.001	(0.013)	0.001	(0.014)
sex	0.039***	(0.011)	0.039***	(0.011)	0.038***	(0.011)
age	-0.005**	(0.002)	-0.005**	(0.002)	-0.005**	(0.002)
age squared	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)
log monthly hh net income	0.025**	(0.011)	0.027**	(0.011)	0.025**	(0.011)
log average yearly hh net income	0.744***	(0.106)	0.266	(0.307)	0.226	(0.296)
married but separated	-0.042	(0.042)	-0.046	(0.042)	-0.040	(0.042)
single	0.031	(0.020)	0.032*	(0.019)	0.031	(0.020)
divorced	-0.065***	(0.023)	-0.061***	(0.022)	-0.059***	(0.023)
widowed	-0.024	(0.025)	-0.021	(0.024)	-0.023	(0.025)
civil servant	-0.074***	(0.027)	-0.069***	(0.027)	-0.071***	(0.027)
kids younger than 16 in hh	-0.051**	(0.022)	-0.052**	(0.022)	-0.055**	(0.022)
owns residence	-0.002	(0.010)	-0.006	(0.010)	-0.006	(0.010)
born in Germany	0.032	(0.024)	0.029	(0.023)	0.027	(0.024)
lived in GDR in 1989	-0.188***	(0.022)	-0.224***	(0.027)	-0.226***	(0.028)
has vocational degree	0.036**	(0.016)	0.038**	(0.016)	0.036**	(0.016)
has college degree	0.033	(0.032)	0.032	(0.031)	0.032	(0.032)
mittlere Reife	0.068***	(0.017)	0.076***	(0.016)	0.071***	(0.017)
Fachabitur	0.079**	(0.037)	0.088**	(0.036)	0.079**	(0.036)
Abitur	0.118***	(0.044)	0.130***	(0.043)	0.117***	(0.043)
other degree	0.049*	(0.027)	0.055**	(0.026)	0.056**	(0.027)
no degree	0.017	(0.037)	0.029	(0.036)	0.027	(0.036)
no degree yet	0.152	(0.112)	0.178	(0.114)	0.150	(0.112)
years of education	-0.003	(0.009)	-0.004	(0.008)	-0.003	(0.008)
worried about the economy	0.063***	(0.009)	0.064***	(0.009)	0.058***	(0.009)
worried about own finances	0.040***	(0.009)	0.037***	(0.009)	0.040***	(0.009)
self-employed	0.146***	(0.024)	0.142***	(0.023)	0.143***	(0.024)
nr. of kids younger than 16 in hh	-0.012	(0.011)	-0.013	(0.011)	-0.011	(0.011)
share of foreign pupils in state	-0.014***	(0.002)	-0.015**	(0.007)	-0.015**	(0.007)
year=2002	-0.061***	(0.016)	-0.006	(0.036)	0.002	(0.035)
β_0	-4.757***	(1.021)	-0.188	(2.905)	0.233	(2.808)
$ln\sigma_u$			-1.948***	(0.210)	-1.933***	(0.214)
$ln\sigma_\alpha$	-0.863***	(0.026)			-0.876***	(0.027)
N	31278		31278		31278	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2.22 – Dependent variable: provision of day care for preschool children, county-level

Random effect:	(1) Individual		(2) County		(3) County and Individual	
	b	se	b	se	b	se
German	0.016	(0.025)	0.028	(0.024)	0.035	(0.025)
is employed	0.012	(0.014)	0.010	(0.014)	0.009	(0.014)
sex	0.041***	(0.012)	0.042***	(0.011)	0.041***	(0.011)
age	-0.005*	(0.002)	-0.004*	(0.002)	-0.004*	(0.002)
age squared	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)
log monthly hh net income	0.023*	(0.012)	0.024**	(0.011)	0.024**	(0.012)
log average monthly p.c. net income	0.245***	(0.061)	0.192	(0.132)	0.197	(0.131)
married but separated	-0.058	(0.044)	-0.050	(0.043)	-0.043	(0.043)
single	0.030	(0.020)	0.040**	(0.019)	0.039**	(0.020)
divorced	-0.060**	(0.025)	-0.048**	(0.023)	-0.046*	(0.024)
widowed	-0.028	(0.027)	-0.027	(0.025)	-0.027	(0.026)
civil servant	-0.070**	(0.029)	-0.051*	(0.027)	-0.056**	(0.028)
kids younger than 16 in hh	-0.032	(0.023)	-0.025	(0.022)	-0.024	(0.022)
owns residence	0.000	(0.010)	-0.001	(0.011)	0.002	(0.010)
born in Germany	0.033	(0.025)	0.023	(0.024)	0.020	(0.025)
lived in GDR in 1989	-0.157***	(0.019)	-0.201***	(0.028)	-0.194***	(0.028)
has vocational degree	0.030*	(0.017)	0.033**	(0.017)	0.031*	(0.017)
has college degree	0.013	(0.035)	0.012	(0.033)	0.012	(0.034)
mittlere Reife	0.056***	(0.018)	0.060***	(0.017)	0.056***	(0.017)
Fachabitur	0.056	(0.039)	0.066*	(0.037)	0.057	(0.038)
Abitur	0.093**	(0.047)	0.092**	(0.045)	0.083*	(0.045)
other degree	0.045	(0.028)	0.041	(0.027)	0.042	(0.027)
no degree	0.052	(0.038)	0.090**	(0.037)	0.079**	(0.037)
no degree yet	0.287**	(0.119)	0.301**	(0.118)	0.274**	(0.116)
years of education	0.001	(0.009)	0.002	(0.009)	0.002	(0.009)
worried about the economy	0.070***	(0.010)	0.046***	(0.010)	0.044***	(0.010)
worried about own finances	0.046***	(0.009)	0.047***	(0.009)	0.050***	(0.009)
self-employed	0.160***	(0.025)	0.140***	(0.024)	0.147***	(0.025)
nr. of kids younger than 16 in hh	-0.008	(0.012)	-0.012	(0.011)	-0.011	(0.011)
share of foreign pupils in county	0.001	(0.001)	-0.000	(0.003)	0.000	(0.003)
year=2002	-0.036***	(0.013)	-0.035*	(0.019)	-0.037**	(0.019)
β_0	0.442	(0.448)	0.831	(0.939)	0.799	(0.932)
$ln\sigma_u$			-1.452	(0.000)	-1.466	(0.000)
$ln\sigma_\alpha$	-0.762	(0.000)			-0.837	(0.000)
N	28354		28354		28354	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, no random component standard error due to expectation-maximization estimation

Chapter 3

Look like the innocent flower but be the serpent under it: Mimicking behaviour of growth-oriented terrorist organizations

3.1 Introduction

Terrorism is one of the big challenges of the 21st century to be overcome by developed Western democracies, emerging nations and developing countries alike.[1] In 2009, about 11,000 terror attacks took place worldwide, resulting in the death or injury of almost 58,000 people (US Department of State, 2010). In the same year, Europe alone was hit by about 300 terror attacks (Europol, 2010). Apart from very salient attacks in large and developed countries such as 9/11, the bombings in the public transport systems of Madrid and London in 2004 and 2005 and the 2011 attack on the Domodedowo airport in Moscow, most acts of terrorism are perpetrated in developing regions and go largely unreported in Western media. Their direct and indirect effects on the lives and happiness of affected people and on political and economic outcomes are immense, nevertheless.[2,3,4,5] Terrorism in countries as diverse as Pakistan, Indonesia, Afghanistan and Iraq proves to be a severe danger to the stability of the political system and can seriously hamper economic growth.[6] Terrorism also harms individual firms, distorts trade and forces governments to divert

[1] As Frey and Luechinger (2003) point out, there is no universally accepted definition of terrorism. In this chapter terrorism is thus considered to be any obviously illegal action taken by an organization classified as terrorist which harms the country in which the action is perpetrated.

[2] For an extensive overview over terrorism-related economic research, see Schneider et al. (2010).

[3] The impact of terrorism on individual happiness has been the subject of research by Frey et al. (2007). Terrorism-induced fear is the topic of recent work by Becker and Rubinstein (2011), while the socioeconomic determinants of this fear have been examined by Brück and Müller (2009).

[4] Terrorism in Israel has led to a significant shift of parties' political stances towards accommodation of Palestinian interests and "left" policies (Gould and Klor, 2010).

[5] The immediate and short-run impact of terrorism, i.e. the destruction of physical and human capital, may be minor in comparison to long-run effects like additional transactions costs and changes in behaviour and factor prices. See, for instance, Krugman (2004) and cost calculations of the 9/11 aftermath by Penm et al. (2004).

[6] Macroeconomic consequences of terrorism have been examined by, for instance, Abadie and Gardeazabal (2003, 2008), Enders et al. (2006), Blomberg and Mody (2005), Gupta et al. (2004) and Blomberg et al. (2004), with the general result that high levels of terrorism hamper growth, deter investment and have the worst effects in developing countries.

public spending to prevent acts of terror.[7,8,9]

Starting with the Al-Qaeda attacks against the USA in 2001, economic research into the economic causes and consequences of terrorism has intensified. It is obvious that in order to develop optimal responses to terrorism, one has to understand the structure of terrorist organizations and the nature of the decisions they make. For this purpose game theory is particularly suited.[10]

The aim of this chapter is to characterize the interaction between a growth-oriented terrorist organization and a government that tries to protect itself from terrorism. To this end the two period signaling game approaches as in Lapan and Sandler (1993), Overgaard (1994) and Arce and Sandler (2007) are combined with an organizational growth framework as in Feinstein and Kaplan (2010).[11] Terrorists choose their attack strategies according to their initial manpower and expected government counter-terrorism response in order to maximize their manpower at the end of period 2, while governments attempt to infer the size of the terrorist group by its first period actions and adjust their counter-terrorism spending accordingly. The governments' counter-terrorism efforts also depend on their ex-ante beliefs about the terrorist group size and the damage governments suffer from attacks.

It turns out that in contrast to the common assumption that (bigger) terrorist attacks increase counter-terrorism efforts, the government response to an attack in the first period is not necessarily higher than if no attack occurs. This is because a government might take a small first period attack as a sign that the resources of the terrorists are not sufficient for a big second period attack. Also, while Lapan and Sandler (1993) and Overgaard (1994) claim that terrorists want to appear as strong as possible, this chapter finds that, given that they pursue a growth strategy or derive utility from other sources than government concessions, terrorists may want to appear weaker than they are. This is due to the terrorists' strategic

[7] In a trade context, terrorism has been modeled as a strategic game played between rational and utility-maximizing governments and terrorist organizations, in which governments decide on border controls and counter-terrorism measures while terror organizations accordingly choose what and how to attack (Mirza and Verdier, 2008).

[8] As measured by market capitalization, Royal Dutch Shell, BP and Coca Cola alone have lost over $US 20 billion by terror attacks between 1995 and 2002 (Karolyi and Martell, 2006).

[9] Between 2001 and 2011, the USA has spent $US 1.3 trillion on its self-proclaimed "War on Terror" (Belasco, 2010).

[10] For instance, Sandler and Arce (2003) present a variety of game theoretic applications to the issue of terrorism, including choice of targets, deterrence vs. pre-emption and others. A different game theoretic approach has been taken by Konrad (2004) to determine the investment decisions of terrorist organizations and subsequent conflict outcomes. For an overview over game theoretic developments in terrorism research, see Sandler and Siqueira (2009).

[11] The signaling games usually contain a third period in which actions are already determined by the two previous periods. I will thus refer to these games as consisting of two periods.

interest to provoke as little counter-terrorism effort as possible so as not to endanger their operations in period 2. This idea is also put forward by Arce and Sandler (2007), but the belief set and response strength of the government are exogenously given. The behaviour of contemporary terrorist groups and counter-terrorism spending trends suggest that the theoretical findings of this chapter may be at work in the "real" world. For instance, German right-wing terrorists did not publicly claim responsibility for assassinations of foreign shop owners in the past decade, and there is no obvious connection between terror attacks and the budgets of the main German counter-terrorism agencies. Attacks like the Al-Qaeda parcel bombs originating in Yemen in 2010 are exploited particularly for their propaganda value, and it is not clear whether these relatively small attacks should be regarded as a sign of strength and an altered strategy as Al-Qaeda claims, or of a lack of resources and weakness (Die Zeit, 2010, November 2).

As pointed out above, the contributions by Lapan and Sandler (1993), Overgaard (1994) and Arce and Sandler (2007) which focus on "military" and "political" terrorists (these terms are discussed in section 3.2) in two period signaling games with asymmetric information are directly related to this chapter. Lapan and Sandler (1993) develop a model of military terrorism in which terrorists try to appear as strong as possible to force concessions from a government. Terrorists do this by signaling their strength with an attack in the first period which is used by the government as an indicator whether standing firm and suffering further attacks or giving in and suffering from concessions is the better strategy. Overgaard (1994) models a similar game with political terrorists. Arce and Sandler (2007) present a model in which terrorists differ by type (military or political), and in which the government attempts to distinguish between terrorist types by the size of a first period attack. The authors mention the possibility that military terrorists hold back in period 1 so government retaliation to their second period attack will be lower, but do not endogenously determine the extent of the government response. Furthermore, they assume that the government response will always be stronger if a "spectacular" attack took place in the first period than if only a small attack was perpetrated. In contrast, this chapter allows for an endogenous government response that can be less severe even if an attack is observed in the first period. The terrorists' attack decision in the first period is explicitly derived as a function of the endogenous government response.

The structure of this chapter is as follows: Section 3.2 discusses the different strategies a terrorist orga-

nization may choose and gives examples of particular terrorist groups pursuing these strategies. Sections 3.3 and 3.4 develop a model of terrorist-government interaction, while section 3.5 discusses the results and section 3.6 concludes.

3.2 Terrorist strategies

One can distinguish between three different general strategies of terrorist organizations: Influence through violence with violence as an end in itself (military strategy), influence through violence with violence as a mean (political strategy), and growth through violence with violence as a propaganda and advertising tool (growth strategy).[12]

In the case of military terrorists, terrorists act "nihilistic" or vengeful in the sense that attacks are still perpetrated even if there is no chance that the targeted entity will agree to the terrorists' demands. Examples for this strategy are terrorist organizations without affiliated political parties, e.g. the RAF (Rote Armee Fraktion) in Germany. The RAF carried out attacks even though it was clear that the German government would not concede to their demands.[13] Bernholz (2004) argues that the military type of terrorism is inspired by "supreme values" which are non-negotiable fundamental beliefs. Terrorism is used as a means to violently propagate demands a government would or could never agree to, such as the expulsion of all Jews from the Near East.

In the political case, violence will only be used as long as it has a chance of influencing decisions. If violence has no effect, funds are used for political activities. Terrorists pursuing a political strategy are usually connected with political parties, such as the IRA (Irish Republican Army) with its links to Sinn Fein and the ETA (Euskadi Ta Askatasuna) with its ties to Herri Batasuna.[14] Organizations engaging in political terrorism usually have limited and negotiable demands such as partial independence or stronger minority rights.

Finally, growth strategies are utilized when a terrorist organization is just starting out, stands in compe-

[12] A further differentiation of these strategies and examples can be found in Kydd and Walter (2006).
[13] Amongst these demands were the abolition of capitalism and of the liberal democratic system.
[14] Herri Batasuna was banned by Spain in 2003 due to its terrorist affiliations.

tition with other similar organizations or tries to acquire a certain manpower and fund level to enable a particular operation. Epstein and Gang (2007) argue that terrorist groups benefit from being larger in a rent-seeking contest between terrorist groups where benefits are not related to government concessions. Pursuing a growth strategy which is aimed at becoming the largest terrorist group would also be sensible in this context.

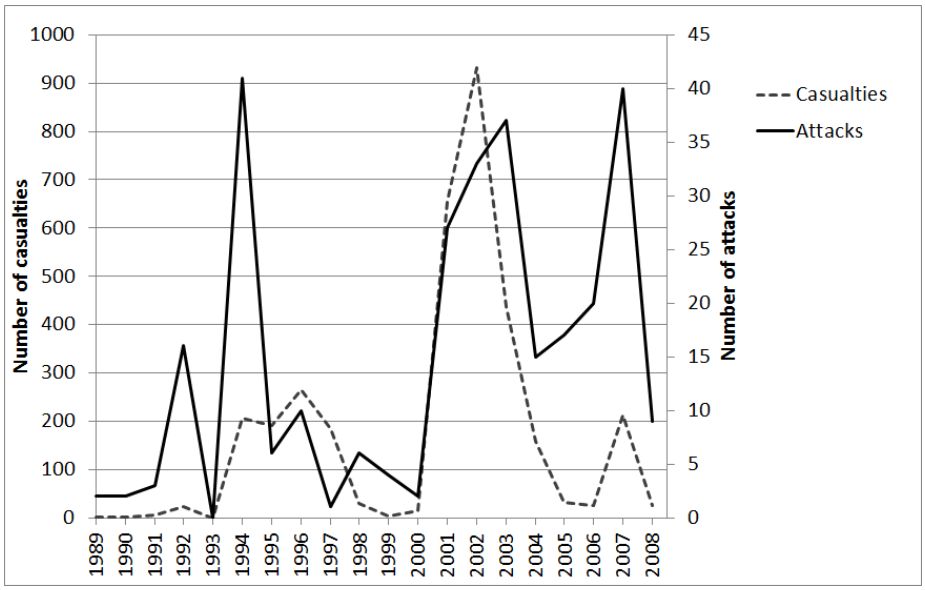
For an exogenous government response, terrorist organizations acting according to a growth strategy have been examined by Feinstein and Kaplan (2010) who find that the scale and type of attacks are determined by the initial size of the organization and its "natural growth rate", modeled as a kind of interest on unused manpower. The goal of attacks under this strategy is not primarily to coerce the government into concessions, but to advertise the organization's determination and capabilities to attract recruits and funds by attacks with a high propaganda value.[15] For instance, Wright (2006, p. 331) notes that after the 2000 attack on the USS Cole in the port of Aden, "Al-Qaeda camps in Afghanistan filled with new recruits, and contributors from the Gulf States arrived carrying Samsonite suitcases filled with petrodollars." Further examples of terrorist activities which are aimed at increasing the organization's manpower are the Schleyer kidnapping by the RAF and the "Landshut" hijacking by the PFLP (Popular Front for the Liberation of Palestine) in 1977 which were perpetrated to free the first-generation RAF leadership from Stammheim prison.

Amongst the terrorist organizations which found themselves in competition with other groups or had to grow from humble beginnings are the FLN (Front de Libération Nationale) in Algeria, the Tamil Tigers in Sri Lanka and various groups such as Hamas, Fatah, PIJ (Palestinian Islamic Jihad) and PFLP (Popular Front for the Liberation of Palestine) in Palestine.[16] It can make sense for the terrorist organization to lure governments into a false sense of security to prevent a heavy crackdown in its early stages or to abstain from small attacks with low propaganda value in order not to jeopardize a major attack that is being planned. When observing a terrorist organization pursuing a growth strategy, one would expect an increasing number of attacks with rising intensity over time, as the terrorist group gathers more and more

[15] For a treatise on the interplay between terrorist attacks, propaganda and the media see Rohner and Frey (2007).

[16] The FLN initially tried to unite the various anti-colonial groups in Algeria and focussed on fighting "non-revolutionary" elements in the population, and the Tamil Tigers faced a plethora of similar Tamil groups during the 70's. Ideological and political divisions have led to the creation of several competing Palestinian terrorist groups which vie for public support and influence. See Hoffman and McCormick (2004), Bloom (2004) and Clauset et al. (2010).

Figure 3.1 – Number and casualties of Hamas attacks, 1989-2008



Source: National Consortium for the Study of Terrorism and Responses to Terrorism (2012)

manpower which can in turn be used for further attacks. As shown in Figure 3.1, this pattern exemplarily becomes visible in the early activities of Hamas, a Palestinian terrorist group, from 1989 until around 1994. For the years following 1994, a change in strategy becomes visible as Hamas focussed on fewer but more lethal suicide attacks, which can be seen as a shift towards more expensive, but also more cost-effective large attacks (in comparison to the previous attacks by means of melee weapons and firearms) as predicted by Feinstein and Kaplan (2010). "Expensive" in this context has to be seen in connection with more sophisticated manpower, as particularly fanatical activists are necessary to perpetrate suicide attacks.[17]

3.3 Model

Assume that the world is populated by two actors, a government and a terrorist organization. These entities are only active in two periods. I first turn to the characterization of the terrorist organization in the absence of an endogenous government response. This basically constitutes a simplified version of the

[17] The effectiveness of Israeli counter-terrorism measures such as the West Bank barrier during the Second Intifada becomes visible in the drastic reduction of casualties per attack after 2002.

model presented in Feinstein and Kaplan (2010). Feinstein and Kaplan additionally include a choice of scale for terrorist attacks, but this element is not necessary for the analysis of the signaling aspect of the game.[18]

3.3.1 Terrorist organization

The terrorist organization, by attacking the government and benefiting from a positive propaganda effect, maximizes its manpower at the end of the second period, given its available manpower M_1 at the beginning of the first period.[19] The focus on manpower is justified as it constitutes the main constraint on the extent of terrorist activities (Feinstein and Kaplan, 2010).

Terrorists have two attack options: The first is an attack that requires little planning and manpower effort C_s and yields low propaganda benefits s. It is carried out at the end of the period in which its planning costs are paid. This kind of attack is called small/type s. Given sufficient initial manpower, terrorists are able to perpetrate one small attack in each period. Examples for this kind of terrorist activity are the attacks by the "Juba Sniper" against targets of opportunity (i.e., unsuspecting US soldiers who happened to be at the wrong place at the wrong time) and suicide bombings in public places as in Israel during the Second Intifada.[20] Hoffman and McCormick (2004) state that only a few days to a few weeks are necessary to recruit, train and deploy a suicide bomber, with very low planning effort and a material cost of around $US 150.

The second attack option, called big/type b, requires a high manpower and planning effort C_b and generates a propaganda benefit of b, but also takes two periods to prepare. This means that if the terrorist organization wants to initiate this kind of attack, it can only do so and has to employ the manpower at the beginning of the first period, while the actual attack will not take place until the end of the second period.

[18] If terrorists choose both attack type (big/small, see subsection 3.3.1) and scale (continuous function), the government's counter-terrorism response will affect the optimal scale, too. The optimization problem of the terrorists is thus not as straightforward as in the simplified case presented in this chapter, but the ordering of attacks with regard to initial manpower would still be the same.

[19] The increase in manpower after an attack does not have to come from its propaganda value alone. There are numerous instances in which terrorist organizations attempted to free imprisoned fellow terrorists through their attacks which is an even more direct way of raising the available human resources than propaganda.

[20] The "Juba Sniper" was an individual or a group of individuals who ambushed US soldiers in the Iraqi city of Baghdad with a single sniper gunshot, usually inflicting a casualty.

A prime example of this kind of terrorist attack is 9/11 which took several years to prepare, involved dozens of operatives and required flight lessons for the terrorist pilots. Manpower is completely used up in an attack, e.g. because the involved operatives are killed or the planners and perpetrators of an attack are subsequently discovered by anti-terror agencies.

In the first period, attacks go through unhindered, but in the second period counter-terrorism efforts are in place which reduce the chance of successfully perpetrating attacks. The success probability of an attack, given by θ, constitutes a negative function of government counter-terrorism spending, but is assumed to be exogenous in this section.[21] θ will be discussed in detail in subsection 3.3.2, and at this point it suffices to say that $\theta = 1$ means that the government does nothing at all to prevent terror attacks and that the success probability of an attack is therefore 1. Similarly, $\theta = 0$ implies that every attack attempt is doomed to fail, i.e. the success probability is zero. In the case of a foiled attack attempt, the manpower costs of initiating the attack are lost and no propaganda benefit is generated.

Given sufficient manpower, a terrorist organization can plan both types of attacks in the same period, i.e. it is possible to perpetrate a small attack in the first period while also starting preparations for a big attack in period 2. At the same time, terrorists can only plan one attack of each type in each period, so the set of possible actions is given by $\{no\,attacks,\ s_1,\ s_2,\ s_1s_2,\ b_2,\ s_1b_2,\ s_1s_2b_2,\ s_2b_2\}$, where the subscripts denote the period in which the attack takes place.

The expected value of the terrorists' utility function U_T (similar to the expected amount of manpower at the end of period 2) is given by the expected net benefit of attacks. This net benefit is an attack's propaganda value times its success probability minus its manpower costs. At the same time, a terrorist group is constrained by its available manpower in each period. Therefore, the terrorist organization's expected utility function and its budget constraints look as follows:

[21] Introducing exogenous counter-terrorism in the first period would just reduce the benefits terrorists can reap in this period. Thus, the θ-parameter for the first period is omitted as it does not add to the dynamics of the model. It is also possible to assume that the attack in period 1 is directed against another country and thus inflicts no damage upon the government, but is observed nevertheless and thus conveys information about the terrorist group size.

$$E(U_T) = (s - C_s)_{|s_1} + (\theta s - C_s)_{|s_2} + (\theta b - C_b)_{|b_2}$$

$$M_1 \geq (C_s)_{|s_1} + (C_b)_{|b_2}$$

$$M_2 = M_1 + s_{|s_1} - (C_s)_{|s_1} - (C_b)_{|b_2} \geq (C_s)_{|s_2} \tag{1}$$

The subscripts $|s_1$, $|s_2$, $|b_2$ indicate that the term only enters the budget constraint and utility function if an attack of type s, b is planned in period 1, 2. In the first period the terrorist organization can only plan attacks if its initial manpower endowment is sufficiently high to afford at least a small attack. In the second period, terrorists reap the manpower benefit s if they perpetrated a small attack in period 1 and can use this manpower and the manpower left over from period 1 to plan another small attack. The initial manpower M_1 is drawn from a distribution μ with support $[0, \infty[$ and cumulative distribution function G.

To determine a terrorist organization's best course of action it will also be assumed that the manpower gained through the propaganda value of an attack is higher than the manpower cost of this attack. Furthermore, the cost-benefit ratio of a big attack is sufficiently high in relation to that of a small attack so that given the choice, terrorists would rather perpetrate one big attack instead of two small ones. This is another way of expressing the higher returns to scale of a big attack which are assumed in Feinstein and Kaplan (2010). E.g., Al-Qaeda's costs of perpetrating the 9/11 attacks are estimated to be between \$US $400,000$ and \$US $500,000$ (9/11 Commission Report, 2003), while the resulting direct costs in capital and human losses alone supposedly lie between \$US 20 and \$US 60 billion (Schneider et al., 2010). Including further costs which are difficult to measure such as distortions in consumption behaviour, additional unproductive protection spending and expenditures for the War on Terror which, one could argue, served partly as propaganda for terrorists, makes it clear that the 9/11 attacks had an unprecedented net benefit for the terrorists.[22] The net benefit of small attacks (which are also not infinitely often repeatable) can be assumed to be much lower. Formally, these conditions can be expressed as

$$s > C_s,\ b > C_b,\ b - C_b > 2(s - C_s) \tag{2}$$

[22] The direct costs of the London tube bombings in 2005, for instance, are assumed to be less than £1 billion (GLA Economics, 2006).

Given this setup and an exogenous $\theta > C_s/s$ and M_1, it is possible to determine a terrorist organization's attack strategy.[23] The strategy yielding the highest benefit, i.e. the highest manpower at the end of period 2, is to plan both small attacks and also the big attack. If resources are not sufficient for this strategy, only planning the big attack is optimal. And if resources at the beginning of period 1 do not allow the planning of a big attack, perpetrating small attacks twice is optimal. Terrorist organizations can thus be classified according to their initial size (see Table 3.1): A "large"-type organization can perpetrate all attacks, a "medium"-type one has sufficient manpower for a big attack, a "small"-type organization can only afford to plan small attacks, and "none"-type terrorists do not have the resources for any kind of attack.

3.3.2 Government

I will now characterize the government's utility function and optimization problem. In the world presented in this model the government faces a tradeoff between investing an exogenously given budget B in an anti-terror technology t which lowers the success probability θ of utility-reducing terrorist attacks, and investing in a consumption technology χ with input x from which it derives immediate utility. It is not necessary to be more specific about the exact nature of the anti-terror technology. For the purpose of this chapter, protecting vulnerable sites works in the same way as infiltrating terrorist networks and uncovering terrorist plots.[24] The nature of the consumption technology can also be left fairly general. One could think of non-security related government spending or even of security-related pork-barrel spending that does not enhance protection from terrorist attacks. Coats et al. (2006), for instance, find that funds from the 2004 US Homeland Security grant were allocated to states on a vote-per-capita base rather than in proportion to a state's population, leading to an over-protection of small states with a low terrorism risk.

The utility of the government depends only on the second period. It is assumed that in the first period, the government is simply surprised by the emergence of a terrorist organization or has fixed policies in place which cannot be altered before the second period. In the second period, the government bases its spending decisions on full knowledge about all parameters and the distribution of M_1. I.e., it knows the

[23] $\theta > C_s/s$ ensures that the expected benefit from a second period attack outweighs its costs.

[24] An extensive literature exists on the choice of counter-terrorism strategy and the allocation of security spending. See, for instance, Powell (2007), Golany et al. (2009), Arce and Sandler (2005) and Enders and Sandler (1993).

damage incurred from each attack type and probability of a particular terrorist organization to emerge, but not which type is really active at the beginning of period 2 and which attacks are being planned. It seems reasonable to assume that governments can infer a somewhat precise distribution and potential damage assessment of the current terrorist threat through intelligence gathering activities, informers and other sources.[25]

The government derives utility from consumption and disutility from the damage inflicted by terrorist attacks which is equal to the propaganda benefit for the terrorists.[26] The expected value of its utility function U_G and its budget constraint thus take the form

$$E(U_G) = \chi(x) - \theta(t) \times ((\alpha_{small} + \alpha_{large})s + (\alpha_{medium} + \alpha_{large})b + \alpha_{none} \times 0)$$

$$B = x + t \tag{3}$$

α_{small} gives the probability (derived from the distribution of the initial manpower μ and the manpower necessary to initiate an attack) that a small terrorist organization is present in the world and will launch a small attack. Similarly, α_{medium}, α_{large} and α_{none} denote the probabilities that a terrorist organization of this type is present and will strike in period 2 according to its optimal strategy (see Table 3.1). The alphas have to add up to one. The characteristics of χ and θ are as follows:

$$\chi(0) = 0,\ \chi'(0) = \infty,\ \chi' > 0,\ \chi'' < 0 \tag{4}$$

$$\theta(0) = 1,\ \theta(\infty) > 0,\ \theta'(0) = -\infty,\ \theta' < 0,\ \theta'' > 0 \tag{5}$$

These conditions ensure that the success probability of an attack is greater than 0 and equal or smaller than 1 and that it is impossible to have full protection against terrorism. Furthermore, the government

[25] For instance, two months before the 9/11 attacks the CIA reported strong evidence of an imminent Al-Qaeda attack. The US government chose not to act on this information, however (Washington Post, 2006, October 1).

[26] Making the government's damage and the terrorists' benefit from an attack asymmetric would simply require the introduction of a scaling parameter.

Table 3.1 – Optimal terrorist organization strategies based on M_1 with exogenous government response and corresponding stylized examples

Type of terror organization	Initial size	Optimal strategy	Example
None	$M_1 < C_s$	No attacks	-
Small	$C_s \leq M_1 < C_b$	s_1, s_2	NSU (Germany), nine assassinations of foreign businessmen between 2000 and 2006 and two bomb attacks
Medium	$C_b \leq M_1 < C_s + C_b$	b_2	Al-Qaeda, simultaneous bombings of the American embassies in Kenya and Tanzania in 1998
Large	$C_b + C_s \leq M_1$	s_1, s_2, b_2	RAF (Germany), bank robberies, assassinations/kidnappings of prominent Germans, Stockholm embassy attack in the '70s

will always expend its budget on both technologies. The α-probabilities are constructed as follows:

$$\alpha_{none} = G(C_s),\ \alpha_{small} = G(C_b) - G(C_s)$$

$$\alpha_{medium} = G(C_b + C_s) - G(C_b),\ \alpha_{large} = 1 - G(C_b + C_s) \tag{6}$$

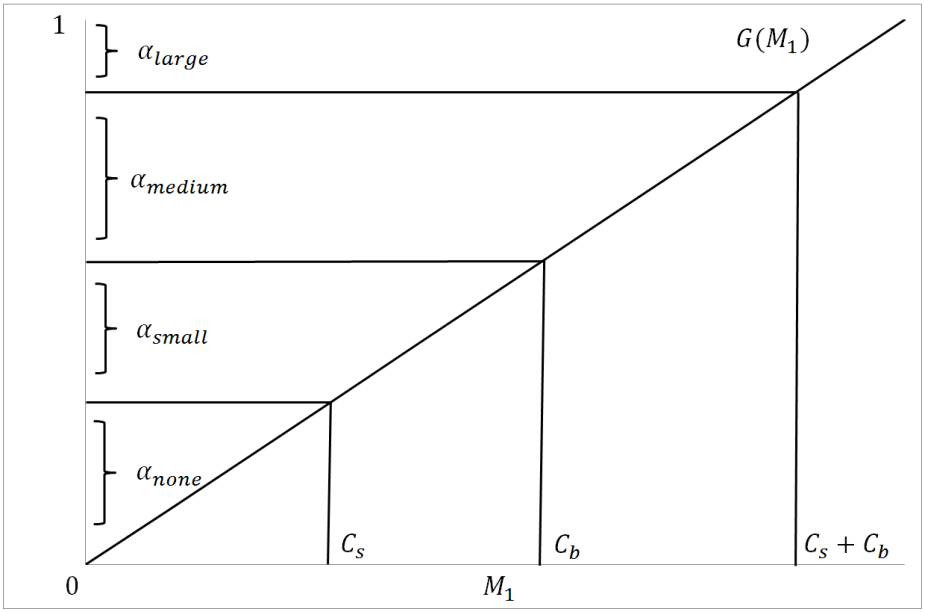
See Figure 3.2 for a graphical representation.

By differentiating (3) with respect to x and t, setting these derivatives equal and utilizing the conditions in (4) and (5) the optimal choices of t and x are implicitly given by

$$\frac{\partial \chi}{\partial x} = -\frac{\partial \theta}{\partial t} \times ((\alpha_{small} + \alpha_{large})s + (\alpha_{medium} + \alpha_{large})b + \alpha_{none} \times 0)) \tag{7}$$

From (7), it is obvious that an increase in the damage from attacks and a decrease in the probability that a terror organization of type "none" is present will increase the benefit from spending the budget on t. The α-probabilities are also linked to the costs of terror attacks (see Figure 3.2). As these costs decrease, the

Figure 3.2 – α given M_1



probability of the emergence of a more powerful terror organization rises, and thus a higher t-spending becomes optimal.

3.4 Terrorist attacks and government responses

Having described the autonomous decisions of the terrorist organization and the government I will now turn to the interaction between the two actors. Here, as commonly assumed in game theoretic models of terrorist-government interactions, terrorists are fully informed about the government's preferences and can thus perfectly anticipate the government's reaction to their actions (cf. Lapan and Sandler (1993), Overgaard (1994)). The information structure is thus asymmetric, with the government having an informational disadvantage as it does not know which terrorist group size is drawn from the distribution μ.

It will be necessary to determine the government's reaction in two possible cases: First, if a small attack takes place in the first period, and second, if no small attack is launched in the first period. The government

will be aware that terrorist organizations might try to hide their true strength, and terrorists will no longer take θ as exogenous. This implies that terrorists in period 1 might want to avoid provoking a severe government response which hampers attacks in period 2 and therefore abstain from attacking in period 1. I call this pattern of behaviour in which a terror organization wants to appear smaller than it is "mimicking".

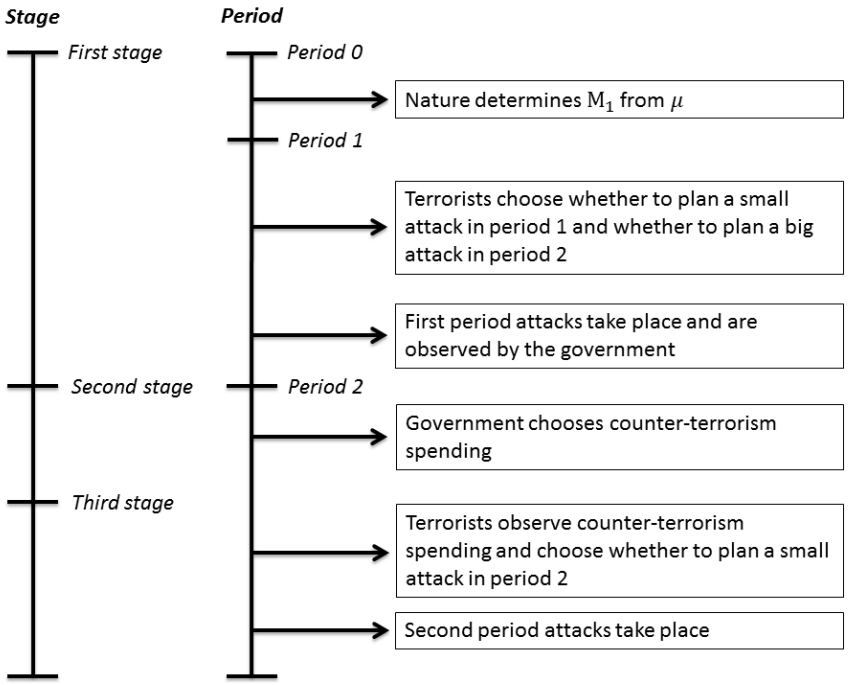
To restrict the number of possible scenarios assume that $\theta(B) \times s - C_s > 0$, so a small attack in period 2 would still be beneficial for the terrorist organization even if the government were to spend its entire budget on counter-terrorism measures.[27] For example, the number of possible targets within a country could be so large that it is not possible to protect all of them sufficiently with a given counter-terrorism budget. This assumption rules out cases in which terrorists abstain from attacking in the second period as the success probability of attacks is too low to justify the planning costs. Under this assumption, the game is solvable by backwards induction. The terrorists' attack decision in the second period which is contingent on the government's counter-terrorism expenditure and the terrorists' first period choice of attacks forms the third stage of the game. The second stage consists of the government's counter-terrorism spending decision which is driven by the terrorist behaviour observed in period 1. Finally, in the first stage it is determined whether the terrorists opt for a small first period and a big second period attack or not. The decision stages and timing of events are given in Figure 3.3.

3.4.1 Naive government

In this subsection, the government no longer bases its budget allocation decision on μ, s and b alone, but also on the terrorists' behaviour it observes in period 1. This allows the government to rule out the existence of particular organization types and thus optimize its spending on t by reducing uncertainty. It does not yet, however, take into account the strategic aspect of its decision, i.e. that terrorist behaviour in the first period also depends on the expected counter-terrorism efforts. The model with this kind of naive government is more straightforward and will thus be presented first, but qualitatively the same results are achieved with a fully strategic government as shown in the next subsection.

[27] This implies that a large attack is also beneficial as its benefit-cost ratio is higher.

Figure 3.3 – Decision stages and timing of events



First, consider the case that the government is hit by a small attack in period 1. The government correctly deduces that neither a terrorist organization of type none nor of type medium can be present as a none type cannot afford to start an attack at all, and a medium type saves its manpower for a big attack in period 2.[28] The government thus forms posterior beliefs β about the odds of facing a small or large terror organization and has an expected utility function of the following form:

$$E(U_G) = \chi(x) - \theta(t) \times ((\beta_{small} + \beta_{large})s + (\beta_{large})b) \tag{8}$$

The β-terms are constructed by utilizing Bayes' theorem. In this setup, this amounts to scaling up the

[28] The case in which a medium sized group acts like a small sized one will not be considered here. If the counter-terrorism response in period 2 is sufficiently stiff, a medium sized group may find it beneficial to perpetrate two small attacks (one of them unopposed) instead of one big attack. However, this change of strategy cannot be properly described as mimicking because the second period attack can then only be of the small type. The medium terrorist organization not only appears to be a small one in the first period, it also behaves like one in the second period. Also, for a portrayal of the interaction between terrorists and government it is sufficient to show the mimicking behaviour of one type of terrorists and the subsequent government response. To formally rule out the case in which a medium sized group changes its strategy to two small attacks, it would be sufficient to assume that $2 \times (s - C_s) < \theta(B) \times b - C_b$.

prior probability of the emergence of a particular terrorist organization with the remaining probability mass after subtracting the probabilities of terrorist types which cannot be present:

$$\beta_{large} = \frac{\alpha_{large}}{\alpha_{large} + \alpha_{small}}$$

$$\beta_{small} = \frac{\alpha_{small}}{\alpha_{large} + \alpha_{small}} \tag{9}$$

After having determined the government's belief if an attack takes place in the first period, assume now the opposite case in which the government is not attacked in period 1. The government infers that no small terror organization can be active because terrorists of the small type cannot gain anything from abstaining from a first period attack; the benefits from an unopposed small attack in period 1 and a subsequent risky attack in period 2 are always greater than the benefit from initiating just a risky small attack in period 2. Terrorist types none and medium are following their optimal and possible strategies if they do not attack in period 1, but large terror organizations could mimic a medium one to keep the government's response in period 2 at a lower level. The government therefore updates its prior beliefs α to the new probabilities γ in the same way as described above and arrives at an expected utility function of the form

$$E(U_G) = \chi(x) - \theta(t) \times ((\gamma_{large})s + (\gamma_{large} + \gamma_{medium})b + \gamma_{none} \times 0) \tag{10}$$

The γ-terms are derived in the same way as the β-terms in (9):

$$\gamma_{large} = \frac{\alpha_{large}}{\alpha_{large} + \alpha_{medium} + \alpha_{none}}$$

$$\gamma_{medium} = \frac{\alpha_{medium}}{\alpha_{large} + \alpha_{medium} + \alpha_{none}}$$

$$\gamma_{none} = \frac{\alpha_{none}}{\alpha_{large} + \alpha_{medium} + \alpha_{none}} \tag{11}$$

It is now possible to predict in which case (small attack/no attack in period 1) the counter-terrorism

reaction of the government will be stronger. This is done by calculating the optimal responses for (8) and (10) as in (7) and comparing the terms attached to $\partial\theta/\partial t$. If the expected damage in period 2, calculated from the updated beliefs about the terrorist group size, is higher if no attack is observed in period 1 than if a small attack takes place, the government will react more strongly in the absence of an attack. Thus, t will be higher when no first period attack takes place if

$$(\gamma_{large})s + (\gamma_{large} + \gamma_{medium})b > (\beta_{large})b + (\beta_{large} + \beta_{small})s \tag{12}$$

On the left hand side is the damage from a particular attack times the probability of this attack taking place for the no attack case, and on the right hand side the equivalent expression for the attack case. This can be rewritten as

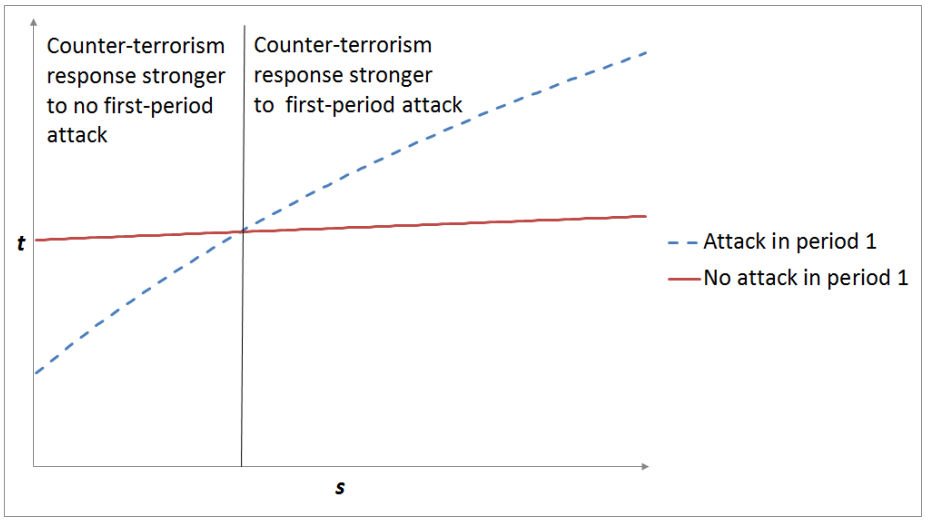
$$(\beta_{small} + \beta_{large} - \gamma_{large})s + (\beta_{large} - \gamma_{large} - \gamma_{medium})b < 0 \tag{13}$$

For a non-degenerate μ (that is, a distribution that does not attach probability 1 to a single type), the first term in brackets is always positive. Thus, a necessary but not sufficient condition for (13) to hold is that $\gamma_{large} + \gamma_{medium} > \beta_{large}$, i.e. that the probability of either a large or medium terrorist organization being present in the no attack case has to be higher than the probability of a large terrorist organization being present in the attack case. Furthermore, the damage the government suffers from a big attack has to be large relative to the damage from a small attack for (13) to hold. A higher s will decrease the likelihood that the counter-terrorism reaction in the case of no attack in period 1 is larger. This probability is also decreasing in β_{large} and increasing in γ_{large}. This can be summarized in:

Proposition 1: A naive government will engage in higher counter-terrorism spending if no first period attack takes place, if the expected second period damage given the updated government beliefs is higher in the no attack case.

Figure 3.4 gives a graphical example for Proposition 1. Intuitively, the government might reason that

Figure 3.4 – Optimal government response t for varying s



the terrorist organization does not have sufficient resources to mount a larger attack in the next period if it observes a small attack in period 1. This is particularly the case when the government draws the conclusion from the assumed distribution of terrorist organization sizes that the existence of a large organization is very unlikely. An observed attack will thus strengthen the belief that a small terrorist organization is active which will only perpetrate a small attack in the next period. Similarly, the absence of an attack may lead the government to believe that a medium terrorist organization or a large terrorist organization mimicking a medium one is plotting against it. It will therefore employ heavier security measures than if an attack in the first period were to take place.

The terrorists will take the aforementioned government decision into account when deciding on their optimal strategy at the onset of period 1, as it is assumed that they can perfectly anticipate the counter-terrorism response. The mimicking strategy I will focus on here is when a large terrorist organization mimics a medium one by not attacking in period 1. The case in which a medium terrorist organization acts like a small one will not be considered. A large terrorist organization will find it optimal to abstain from launching a small attack in period 1 if the benefit from a lower counter-terrorism response in period 2 outweighs the loss from foregoing the small attack in period one. Denote by $t_{|\gamma}$ ($t_{|\beta}$) the t resulting from the government's belief set γ (β). Then, suppressing variables which appear in the same form on both

sides, large terrorists will display mimicking behaviour if

$$\theta(t_{|\gamma}) \times (b+s) \geq \theta(t_{|\beta}) \times (b+s) + (s - C_s) \tag{14}$$

While possibly lowering the government's vigilance in period 2, foregoing a small attack in period 1 means giving up the benefit $(s - C_s)$. From (13), s lowers $\theta(t_{|\beta})$ relative to $\theta(t_{|\gamma})$ and thus it is indeterminate whether mimicking behaviour becomes less or more attractive in s as s enters the right-hand side of (14) both positively and negatively. From (14), it is obvious that a large terror organization will never mimic a medium one if (13) holds, that is, if the government's reaction in the absence of an attack is stronger than to an attack. Also, from (13), the more probability the government attaches to β_{large} and the less to γ_{large}, the higher is the incentive for a large terrorist group to mimic a medium sized one. I.e., the more the government expects a large group to be present in the case of a first period attack and the less in the absence of an attack, the more large groups benefit from hiding their true strength. The extensive-form game of the government-terrorist interaction is shown in Figure 3.5. The mimicking behaviour of large terrorist organizations is summarized in:

Proposition 2: Large terrorist organizations facing a naive government will mimic medium ones and abstain from launching a small attack in period 1 if the additional expected damage from an increased attack success probability in period 2 is larger than the foregone benefit from a small first period attack.

See Figure 3.6 for an illustration of Proposition 2. As pointed out in the introduction, terrorists with the goal of exacting concessions from a government, such as the ones in the models by Overgaard (1994) and Lapan and Sandler (1993) will want to appear as serious a threat as possible. But this no longer holds if terrorists pursue a growth strategy as in this chapter. More generally, if terrorist attacks generate a benefit for the perpetrator apart from the possibility of government concessions, terrorists may want to lure governments into a false sense of security to strike unopposed on a greater scale.

Figure 3.5 – Extensive-form game for a naive government

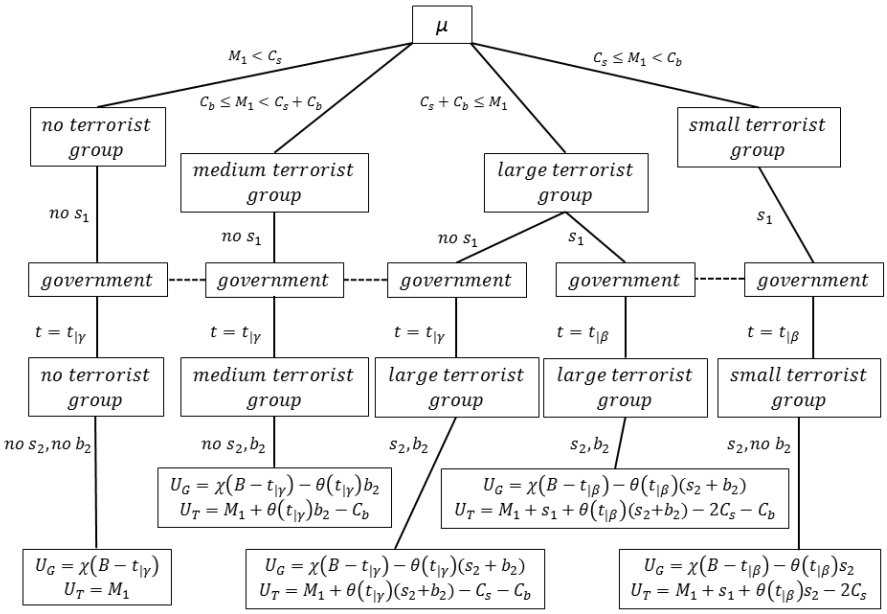
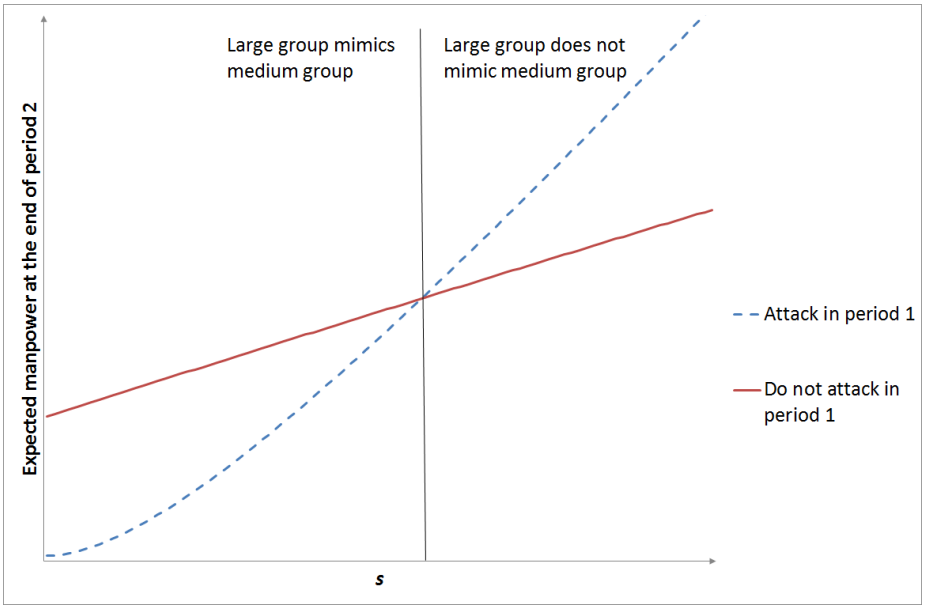


Figure 3.6 – Expected manpower for a large terrorist organization for varying s



3.4.2 Fully rational government

In the previous subsection, the government considered that large terrorist groups can mimic medium-sized ones, and can thus be present regardless of whether an attack is observed in the first period or not. However, the government did not take into account that its counter-terrorism spending may not be optimal in the sense that large terrorist groups may have an incentive to always or never mimic, if the government reacts to events in the first period according to the β and γ probabilities. The updating of the government's beliefs is therefore not fully rational in the previous subsection, as it ignores the strategic implications of the government's actions for the terrorists.

For example, a naive government does not rule out the possibility of a large terrorist group being present when it observes no attack in the first period, and chooses t according to the γ probabilities. It could now be the case that, given this t which is anticipated by the terrorists, a large terrorist group would have no incentive to mimic as (14) does not hold. The government's counter-terrorism spending level, which is based on updated beliefs erroneously factoring in the possible presence of a large terrorist group, would thus be too high.

This subsection examines the case in which the government acts fully rational, so it takes into account that the mimicking decision of a large terrorist organization in period 1 depends on the expected reaction of the government in period 2: terrorists anticipate the government's reaction to their first period actions and choose their strategy accordingly. The incidents in the first period are still exogenous for the government as it has no possibility to credibly commit to a counter-terrorism strategy before the terrorists choose their actions. This means that the government's counter-terrorism spending decision does not have to consider the damage that could be averted if the government's strategy encourages large terrorist organizations to abstain from attacking in the first period.

Any strategy a fully rational government would choose has to be consistent with its beliefs about the behaviour of the terrorist organizations. Equilibrium strategies of the government and the terrorists therefore have to constitute a perfect Bayesian equilibrium (PBE) in which the terrorists' and government's

beliefs about each other's strategy are consistent with their own strategies and vice versa.[29]

A large terrorist organization is indifferent between mimicking and not mimicking a medium-sized one if the gain in expected utility from a lower level of counter-terrorism in the second period is equal to the loss in utility from foregoing a small attack in the first period. This is the case if (14) holds with equality.

Let t_A (t_{NA}) be the counter-terrorism spending level the government chooses if an attack (no attack) takes place in period 1. Furthermore, denote by $t_{|\bar{\gamma}}$ the counter-terrorism spending if no first period attack takes place that, given $t_{|\beta}$, would make (14) an equality. Similarly, denote by $t_{|\bar{\beta}}$ the value of $t_{|\beta}$ that, given $t_{|\gamma}$, would make (14) an equality if an attack takes place. Thus, by rearranging (14),

$$t_{|\bar{\gamma}} = \theta^{-1}(\theta(t_{|\beta}) + \frac{(s - C_s)}{(b + s)}) \tag{15}$$

$$t_{|\bar{\beta}} = \theta^{-1}(\theta(t_{|\gamma}) - \frac{(s - C_s)}{(b + s)}) \tag{16}$$

First, I examine the case $t_{|\bar{\gamma}} < t_{|\gamma}$, so (14) does not hold. If a first period attack takes place, choosing $t_A = t_{|\beta}$ is optimal for the government as it correctly anticipates the presence of either a small or large terrorist group. But the government knows that if $t_{|\bar{\gamma}} < t_{|\gamma}$, a large terrorist organization will never mimic a medium one if it sets $t_{NA} = t_{|\gamma}$ as by doing so it loses the benefits from the first period attack and is not sufficiently compensated by a reduction in counter-terrorism measures. Thus, $t_{|\gamma}$ is an higher-than-optimal level of counter-terrorism as it incorrectly assumes the presence of a large terrorist organization and thus too severe a threat.

Ruling out $t_{NA} = t_{|\gamma}$ as optimal response leads to two further cases: If the probability of the presence of a medium-sized group is sufficiently high, the government will still engage in higher counter-terrorism spending than $t_{|\bar{\gamma}}$ as it faces a high risk of a big attack by a group of type medium. Denote the optimal level of counter-terrorism spending if the government expects a none- or medium-type terrorist organization to be present by $t_{|m}$, and assume that $t_{|\bar{\gamma}} < t_{|m}$.[30] The government's strategy $t_A = t_{|\beta}$, $t_{NA} = t_{|m}$ then

[29] I also require that beliefs are "structurally consistent" (Mas-Colell et al., 1995, section 9C). I.e., if the government knows that terrorists are indifferent between two options, it cannot possibly assume that one option is chosen with a higher probability than the other.

[30] $t_{|m}$ is implicitly given by $\frac{\partial \chi}{\partial x} = -\frac{\partial \theta}{\partial t}\left(\frac{\alpha_{medium}}{\alpha_{medium}+\alpha_{none}} \times b\right)$.

constitutes a PBE: If no attack takes place in the first period and the government chooses $t_{NA} = t_{|m}$, large terrorist groups will never opt for a mimicking strategy and $t_{NA} = t_{|m}$ is optimal for the expected presence of either a terrorist organization of medium or none type. Similarly, if an attack takes place, $t_A = t_{|\beta}$ is optimal given the possibility that either a small or large group is active, and large groups always perpetrate a small attack in the first period.

In the aforementioned equilibrium, the government chooses a higher level of counter-terrorism spending if it is not attacked in the first period if $t_{|\beta} < t_{|m}$. From the construction of $t_{|\beta}$ and $t_{|m}$ this condition is given as

$$\frac{\alpha_{large}}{\alpha_{large} + \alpha_{small}} + \frac{s}{b} < \frac{\alpha_{medium}}{\alpha_{medium} + \alpha_{none}} \tag{17}$$

(17) holds if the ratio $\frac{s}{b}$ is small and if the probability of the emergence of a small or medium group is high in comparison to the emergence of a group of type none or large. The behaviour of the government can therefore be summarized in:

Proposition 3: If $t_{|\bar{\gamma}} < t_{|m} < t_{|\gamma}$, a fully rational government will engage in higher counter-terrorism spending if no first period attack takes place

- *if the damage from a big attack is large in comparison to the damage from a small attack and*
- *if the probability of either a small or medium group being active is large in comparison to the probability of the emergence of a group of type none or large.*

However, if the probability of the emergence of a medium-sized group is low, $t_{|m} < t_{|\bar{\gamma}}$ and $t_{|m}$ cannot be the optimal level of counter-terrorism spending as at this spending level, mimicking again becomes the strategy of choice for large terrorist organizations. $t_{NA} = t_{|m}$ would therefore be lower than optimal as it omits the possible presence of a large terrorist group. It turns out that a pure strategy PBE generally does not exist if $t_{|m} < t_{|\bar{\gamma}} < t_{|\gamma}$. The best the government can do if it does not have a belief-consistent optimal strategy that induces large groups to always or never mimic is to make large groups indifferent. However,

a strategy that makes large groups indifferent is belief-consistent only in special cases. The reasoning for these two results is presented in the appendix.

Now assume that $t_{|\bar{\gamma}} > t_{|\gamma}$, so (14) holds. If no attack is observed the government sets $t_{NA} = t_{|\gamma}$ as it correctly expects the presence of either a none-, medium- or large-type terrorist-organization. But if an attack occurs in the first period, $t_A = t_{|\beta}$ is no longer optimal as the government knows that at this counter-terrorism spending level large terrorist groups will pursue a mimicking strategy. So only a small terrorist group can be the perpetrator. Denote by $t_{|s}$ the optimal counter-terrorism spending if the government expects a small terrorist group to be active.[31] If $t_{|s} > t_{|\bar{\beta}}$, the government will set $t_A = t_{|s}$ as the possible existence of a small terrorist group warrants higher spending than $t_{|\bar{\beta}}$. The government's belief that large terrorist organizations will never attack in the first period, in combination with the strategy $t_A = t_{|s}$, $t_{NA} = t_{|\gamma}$, therefore constitutes a PBE as large terrorist groups will indeed never choose to initiate a first period attack given these t_A and t_{NA}.

If $t_{|s} < t_{|\bar{\beta}}$, $t_A = t_{|s}$ cannot be optimal as at this counter-terrorism level large terrorist groups would abandon the mimicking strategy and always attack in the first period. So $t_A < t_{|\bar{\beta}}$ would be too low, and the government would want to increase its spending. Again, as in the case of $t_{|m} < t_{|\bar{\gamma}} < t_{|\gamma}$, if $t_{|\bar{\gamma}} > t_{|\gamma}$ and $t_{|s} < t_{|\bar{\beta}}$ a pure strategy PBE generally will not exist (see the appendix). The mimicking behaviour of large terrorist organizations if they face a fully rational government is summarized in:

Proposition 4: If $t_{|\gamma} < t_{|\bar{\gamma}}$ and $t_{\bar{\beta}} < t_{|s}$, large terrorist organizations facing a fully rational government will mimic medium ones and abstain from launching a small attack in period 1.

The assumption of a fully rational government thus changes the results of the model in the following ways: There are three mutually exclusive PBE for an appropriate choice of parameter values. In two of these the government will be able to tell which strategy a large terrorist organization will pursue as its choice of counter-terrorism spending uniquely determines the terrorists' optimal strategy. In the third, the government chooses its reaction so as to make large terrorist groups indifferent with regard to attacking

[31] $t_{|s}$ is implicitly given by $\frac{\partial \chi}{\partial x} = -\frac{\partial \theta}{\partial t}(\alpha_{small} \times s)$.

or not in the first period. There also exists a range of parameter values for which the model has no pure strategy PBE. Note that there are no fully separating equilibria in which the government can uniquely identify the type of terrorist organization by the observed attack strategy in period 1, as there are two types of terrorist organizations (none and medium) which never attack in the first period, and one type (small) which always attacks in the first period.

It is still possible that in the absence of an attack counter-terrorism efforts will be higher than if an attack took place. If $t_{|\bar{\gamma}} < t_{|m} < t_{|\gamma}$ and $t_{|\beta} < t_{|m}$ a fully rational government will react stronger if no first period attack takes place. In contrast, a naive government as shown in subsection 3.4.1 requires that $t_{|\beta} < t_{|\gamma}$ to have higher counter-terrorism spending in the absence of an attack.

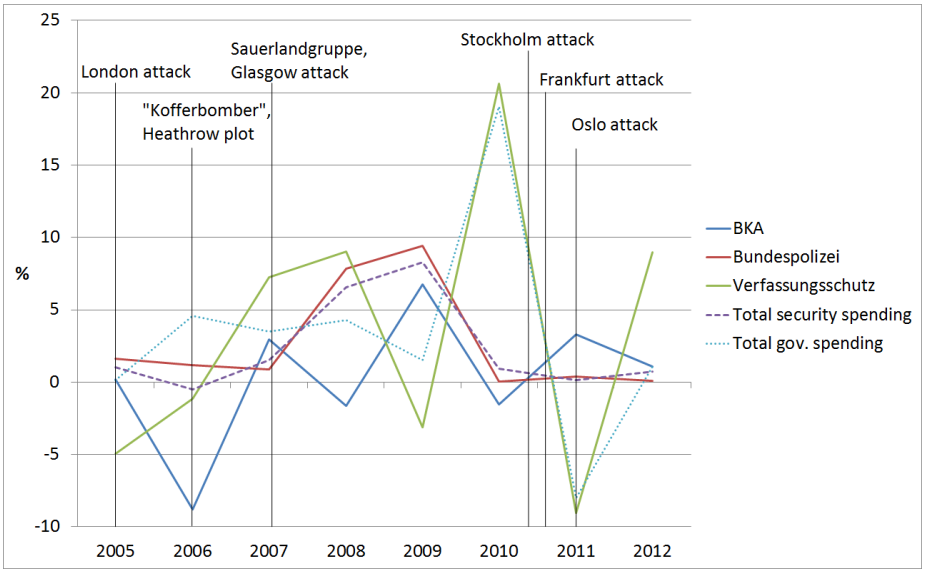
A mimicking strategy is still viable for terrorists given appropriate parameter values, but it occurs under different conditions than in subsection 3.4.1 where (14) was required to hold. A large terrorist organization will now pursue a mimicking strategy if $t_{|\gamma} < t_{|\bar{\gamma}}$ and $t_{\bar{\beta}} < t_{|s}$.

3.5 Discussion

The previous section has developed a framework to analyse the attack decisions of terrorists and the subsequent counter-terrorism expenditures of governments. This section will discuss the results with attention to real-world observations.

Propositions 1 and 3 state that a terrorist organization's choice to attack does not necessarily evoke a heavier government counter-terrorism response than the choice not to attack. Evidence from Germany shows no clear connection between (attempted) terrorist attacks and expenditures on counter-terrorism measures, i.e. the commonly assumed positive response of counter-terrorism efforts to recent attacks is hard to discern in reality. Figure 3.7 illustrates that attempted and successful terror attacks (description in Table 3.2) in Europe and Germany did not systematically drive up German counter-terrorism spending. Total government expenditures increased faster than security-related spending from 2005 to 2007 regardless of several attacks. In 2008 and 2009, the opposite was the case during a lull of terrorist activity, although

Figure 3.7 – (Attempted) terror attacks in Europe, year-to-year change of total government spending and the budgets of main counter-terrorism agencies in Germany in %, 2005-2012



Federal Criminal Agency (BKA), German Federal Police (Bundespolizei), Federal Office for the Protection of the Constitution (Verfassungsschutz), total government spending without investments and debt service.
Source: Bundesministerium der Finanzen (2004-2012)

one could argue that the 2007 attacks triggered the security spending increases. The Verfassungsschutz, however, one of the main German agencies to combat terrorism, slightly reduced its budget in 2009 and increased it again in 2010 by 20%. From 2010 to 2012, three attacks took place and counter-terrorism spending was fairly stable while total government spending varied wildly due to the financial crisis.[32] The absence of a discernible positive relationship between terrorist attacks and counter-terrorism budgets is supportive of the notion laid down in Propositions 1 and 3; governments may take an attack as an indicator that a terrorist organization has very limited resources or is not of a particularly dangerous size.

Propositions 2 and 4 claim that terrorist organizations may want to appear weaker than they are to avoid a strong government counter-terrorism response which could endanger future operations. While non-growth oriented terrorists are known to threaten attacks if countries do or do not take a particular course of action

[32]German counter-terrorism efforts are divided between the BKA, the Bundespolizei and the Verfassungsschutz. Further involved agencies are the federal secret service (Bundesnachrichtendienst) and the military intelligence service (Militärischer Abschirmdienst). It is difficult to determine the funds which are specifically used to combat terrorism within these organizations.

Table 3.2 – Description of terror attacks plotted in Figure 3.7

Name	Date	Description	Outcome	Casualties
London attack	July 2005	Suicide attacks on London's public transport system.	4 suicide terrorists successfully detonated their bombs during the morning rush-hour.	52 dead, over 700 injured
"Kofferbomber"	July 2006	Attempt to blow up two German suburban trains.	Bombs did not explode and were discovered, 2 terrorists arrested.	-
Heathrow plot	August 2006	Attempt to detonate bombs on at least 10 transatlantic flights.	Plot discovered before the attack could be carried out, several terrorists arrested.	-
Sauerlandgruppe	September 2007	Preparations for assassinations and bomb attacks.	No attacks perpetrated, 4 alleged terrorists arrested.	-
Glasgow attack	June 2007	Car loaded with propane gas canisters driven into Glasgow International Airport.	No serious fire ensued, both terrorists were apprehended.	5 injured
Stockholm attack	December 2010	Car bomb and a backpack with pipe bombs detonated in Stockholm.	Car bomb went off, terrorist killed by his own pipe bomb.	2 injured
Frankfurt attack	March 2011	Islamist gunman attacking a USAF bus at Frankfurt airport.	Gunman shot several soldiers and was then apprehended by the police.	2 dead, 2 injured
Oslo attack	July 2011	Car bomb detonated in Oslo, gunman attacks youth summer camp.	Car bomb went off, gunman was apprehended after a shooting spree.	77 dead, 151 injured

(e.g., Al-Qaeda threatened to attack Germany if chancellor Merkel were to be reelected in 2009), terrorists with a focus on manpower building should keep quiet so as not to alert the authorities. For instance, the NSU (Nationalsozialistischer Untergrund), a German neo-nazi terror group, did not publicly claim responsibility for its attacks, but circulated propaganda videos of their deeds within the neo-nazi milieu. German authorities did not even attribute most of the attacks to a terrorist organization, but considered them to be part of a turf war between non-native criminals. As current investigations begin to uncover, the three "active" members of the NSU were supported by a considerable network of sympathizers they had built over a decade.

Assessing the real strength of terrorist organizations is a particularly difficult undertaking due to their clandestine nature, loosely affiliated groups and global networks. While terrorist groups often boast about their capabilities, communiques in which they claim to be on the wane or weak are rare. But terrorism has been found to follow a cyclical pattern which is indicative of strategic behaviour, i.e. terrorists who engage in inter-temporal substitution to catch governments unprepared (Enders and Sandler, 2002). The intelligence-based updating of beliefs about the magnitude of the terrorist threat in the absence of specific attack announcements shows that some terrorists attempt to appear weak or non-existent prior to attacking. E.g., in late 2010 the German Ministry of the Interior announced an increased threat level based on new intelligence and the discovery of several parcel bombs. The terror organizations responsible for this increased threat obviously did not announce their demands or attack plans in advance. Without any attacks taking place, the level of alertness was lowered again in early 2011 (Bundesministerium des Inneren, 2011).

3.6 Conclusion

This chapter has integrated the signaling game structure of terrorist attacks as in Lapan and Sandler (1993) into a framework of organizational growth of terrorist groups as in Feinstein and Kaplan (2010). The main findings are that terrorists act rational if they try to hide their true strength and appear weaker than they are, and that governments do not necessarily increase counter-terrorism measures more strongly if they observe a terrorist attack than if no attack takes place. In contrast to the Arce and Sandler (2007) model

in which a mechanical government response to a "spectacular" attack can encourage the inter-temporal substitution of attacks by carrying forward resources between periods, this chapter shows that first period restraint on part of the terrorists can be aimed at raising the level of uncertainty the government faces.

The driving factor behind these results is that terrorists are interested in organizational growth, not in concessions from the government. Furthermore, their attacks are assumed to have a propaganda value which attracts new recruits. Governments therefore need to be aware that it not only matters whether their terrorist opponents are political or military, but also whether they are currently pursuing a growth strategy. For the prediction and interpretation of terrorist behaviour the differing motivations play an important role, which, as in Arce and Sandler (2007), emphasizes the role of intelligence in the fight against terrorism.

The model could be expanded to include a commitment device such as long-term counter-terrorism investments on the part of the government. This would allow to examine costs and benefits of commitment to a particular counter-terrorism strategy, and shed light on the value of real-world policies which create long-term commitments for governments in the struggle against terrorism.

As this chapter, in contrast to the discussed literature, argues that terrorists may have an incentive to appear weaker than they are, a further fruitful avenue of research lies in developing a model in which terrorists can signal both weakness and strength. This would allow to examine the interaction of governments and terrorists if the world is populated by small terrorist groups who may want to appear stronger than they are, and large groups who prefer to appear weak.

Appendix to section 3.4

Absence of PBE if $t_{|m} < t_{|\bar{\gamma}} < t_{|\gamma}$ or $t_{|\gamma} < t_{|\bar{\gamma}}$, $t_{|s} < t_{|\bar{\beta}}$

With a non-indifferent large terrorist group

There are two belief-consistent strategies for the government with non-indifferent large terrorist groups: One in which the government chooses its spending so as to make large terrorist groups always attack in the first period, and one in which the counter-terrorist spending makes a large terrorist group always mimic a medium one. However, neither of these strategies is optimal if the chance of the appearance of a medium-sized terrorist group is low ($t_{|m} < t_{|\bar{\gamma}} < t_{|\gamma}$) or if it is unlikely that a small group is active ($t_{|\gamma} < t_{|\bar{\gamma}}$, $t_{|s} < t_{|\bar{\beta}}$). The government is either over- or underspending and always wants to readjust its counter-terrorism efforts to the point where the strategies are no longer belief-consistent.

Assume first that $t_{|m} < t_{|\bar{\gamma}} < t_{|\gamma}$. If the government sets $t_{|m} < t_{|\bar{\gamma}} < t_{NA}$, $t_A = t_{|\beta}$ and expects large groups to always attack, large terrorist groups indeed always attack in the first period, but the government is overspending if no first period attack occurs. It thus wants to reduce t_{NA} to $t_{|m}$. But once the spending (if no attack occurs) makes large terrorist groups indifferent with regard to mimicking (at $t_{NA} = t_{|\bar{\gamma}}$) , the government's belief that large terrorist groups always attack is no longer correct.

Alternatively, the government expects large groups to always mimic and sets $t_A = t_{|s}$ and t_{NA} so low that large groups prefer not to attack, the strategy is belief-consistent, but the government is underspending if no first period attack occurs. It therefore wants to increase t_{NA} to $t_{|\gamma}$, but once the spending (if no attack occurs) makes large terrorist groups indifferent with regard to mimicking, the government's belief that large terrorist groups never attack is no longer correct.

Now assume that $t_{|\gamma} < t_{|\bar{\gamma}}$, $t_{|s} < t_{|\bar{\beta}}$. If the government sets $t_{NA} = t_{|m}$ and t_A so low that large groups always want to attack, the government's beliefs are consistent with the terrorist group's behaviour, but it is underspending if a first period attack occurs. Therefore, the government wants to increase t_A to $t_{|\beta}$, but once the spending if an attack occurs becomes high enough to make large terrorist groups indifferent with regard to mimicking, the government's belief that large terrorist groups always attack is no longer correct.

If the government sets $t_{NA} = t_{|\gamma}$, $t_{|s} < t_{|\bar{\beta}} < t_A$ and expects large groups to mimic medium ones, large terrorist groups indeed never attack in the first period, but the government is overspending if a first period attack occurs. It thus wants to reduce t_A to $t_{|s}$, but once the spending if no attack occurs makes large terrorist groups indifferent with regard to mimicking (at $t_A = t_{|\bar{\beta}}$) , the government's belief that large terrorist groups never attack is no longer correct.

It follows from this discussion that the only belief-consistent and optimal strategy the government can pick in all cases is to choose t_A and t_{NA} so as to make large groups indifferent with regard to mimicking, while taking into account that t_A and t_{NA} have to maximize its utility under the belief that large groups choose to attack half of the time. But, as shown below, such a combination of t_A and t_{NA} does generally not exist.

With an indifferent large terrorist group

Assume that $t_{|m} < t_{|\bar{\gamma}}$ and $t_{|s} < t_{|\bar{\beta}}$. The government wants to optimize its counter-terrorism spending when large terrorist groups are indifferent between attacking and not attacking in the first period, and thus choose each strategy with the same probability.

The government knows that the chance of a large group being active in both the attack and no attack case is half the conditional probability of a large group being active. If it is attacked in the first period the government hence forms the following belief set, denoted by δ:

$$\delta_{large} = \frac{0.5 \times \alpha_{large}}{0.5 \times \alpha_{large} + \alpha_{small}}$$

$$\delta_{small} = \frac{\alpha_{small}}{0.5 \times \alpha_{large} + \alpha_{small}} \tag{A.1}$$

If the government is not attacked it forms the belief set φ:

$$\begin{aligned}
\varphi_{large} &= \frac{0.5 \times \alpha_{large}}{0.5 \times \alpha_{large} + \alpha_{medium} + \alpha_{none}} \\
\varphi_{medium} &= \frac{\alpha_{medium}}{0.5 \times \alpha_{large} + \alpha_{medium} + \alpha_{none}} \\
\varphi_{none} &= \frac{\alpha_{none}}{0.5 \times \alpha_{large} + \alpha_{medium} + \alpha_{none}}
\end{aligned} \tag{A.2}$$

From these probabilities, the counter-terrorism levels $t_A = t_{|\delta}$ and $t_{NA} = t_{|\varphi}$ are constructed according to (7). These spending levels are only optimal and consistent with the government's belief that large terrorist groups are indifferent if large groups obtain the same utility regardless of whether they attack or not. This, from (14), is the case if

$$\theta(t_{|\varphi}) \times (b + s) = \theta(t_{|\delta}) \times (b + s) + (s - C_s) \tag{A.3}$$

or, equivalently,

$$\theta(t_{|\varphi}) = \theta(t_{|\delta}) + \frac{s - C_s}{b + s} \tag{A.4}$$

Here, it becomes visible that (A.4) only holds for particular value combinations of α, s, b and C_s. It is therefore only in special cases that the government's strategy to set $t_A = t_{|\delta}$, $t_{NA} = t_{|\varphi}$ under the belief that large terrorist groups are indifferent constitutes a PBE.

Outlook

This thesis has dealt with the impact the mobility of individuals has on the possibility of redistributive taxation and the welfare state. I find in the first chapter that tax competition in the face of mobile taxpayers will be less fierce if these taxpayers are altruistic towards the recipients of income transfers. Furthermore, the empirical second chapter shows that the public funding of day care, a particular aspect of the welfare state, is unlikely to be negatively affected by an increase of ethnic heterogeneity caused by immigration. Taken together, these two chapters thus draw an optimistic picture of the future of redistributive welfare states in a world of open borders.

The final chapter of this dissertation has examined the likely behaviour of terrorist groups which put the expansion of their organizations at least temporarily before other goals. It has been found that counter-intuitive behaviour on the parts of terrorists and governments, such as foregoing possible attacks and increasing counter-terrorism efforts if no terrorist attacks have taken place, can be perfectly rational.

This outlook will briefly illustrate the enduring socio-economic importance of migration and terrorism issues and thus justify their treatment by various economic disciplines.

As the current crisis of the EU unfolds, it becomes clear that public finances and social protection systems will be exposed to severe strains for years to come. As the example of Greece shows, cutbacks in the social sector are usually the first remedy of choice to put government finances on an even keel. Rising unemployment figures in countries such as Ireland and Spain, which are currently hit hard by recessions, are putting additional pressure on welfare systems as the number of recipients increases while the number of contributors falls. For instance, almost half the Irish population was receiving social welfare payments in 2011, and a third of Irish government expenditures went into social protection (Dervan, 2011).

Tax competition between countries for firms and individuals will certainly not lessen if government budgets are strained by poor lending conditions, diminishing tax revenues and an increased need for welfare services. Economic research can thus contribute to policy making by predicting the outcomes of tax competition and by showing optimal strategies for governments in differing tax competition situations. As the first chapter of this dissertation illustrates, economic reasoning based on experimentally found human behaviour can

help to alleviate fears about the outcome of income tax competition, although the chapter also implies that worsening economic conditions, such as an increase in the number of income transfer recipients, may reduce the scope of redistribution.

A further current development is that the demographic structure in most developed countries is undergoing a fundamental change. In addition to the aging of populations which is accompanied by serious challenges itself, the share of citizens with non-native roots is bound to increase. This is due to a combination of immigration and higher reproduction rates. Even though fertility rates tend to converge quickly, immigrants from most emerging or developing countries have a higher fertility rate than Western natives for quite some time. In the case of Germany, the fertility rate per woman of German nationals was 1.34 in 2008, but that of non-nationals was 1.61 (Statistisches Bundesamt, 2009). Even though there is no separate statistic for German citizens with a migration background, it can be safely assumed that naturalized Germans from countries such as Turkey (which has a fertility rate of 3.0 amongst first-generation immigrants (Schmid and Kohls, 2008)) which are included in the figure for German nationals reproduce at a higher rate for at least one or two generations.

While this will of course not change the domestic majority autochthonous natives currently possess, it is important to examine which effects this increase of ethnic heterogeneity will have on the provision of public goods and welfare services from which non-EU immigrants, once naturalized, cannot be excluded.[1] This issue has been approached in both theoretical and empirical ways by sociologists and economists. This dissertation contributes to the existing literature by providing empirical evidence that particular aspects of the welfare state may not be as threatened by this development as one might expect from theoretical considerations.

The final contemporary issue which is treated in this thesis is the fight against terrorism which will continue to be a serious concern of governments for the foreseeable future. Terrorist groups show a remarkable capability for regenerating themselves even after their funding, manpower and leadership has been severely diminished by counter-terrorism efforts. Al-Qaeda, for instance, has been likened to a "hydra-headed monster" by the Economist (2008), and continues to be globally active even after key figures such

[1] EU citizens are currently eligible for unemployment benefits not only in their home country, but in most other EU countries as well.

as Khalid Sheikh Mohammed and Osama bin Laden have been put out of action.

The examples of Mali, of which the Northern part was recently conquered by Tuareg separatists and Islamist terrorists, and Nigeria, in which some Northern areas are virtually controlled by Boko Haram, an Islamist terrorist organization, show that currently the territorial integrity and sheer existence of some states is threatened by terrorism. The Gaza strip, which, since 2006, has been under the rule of Hamas, an organization classified as terrorist by the EU and the US, gives a cautionary tale of what can happen if whole countries are run by terrorists. The neighbouring state of Israel is under constant threat from rocket and suicide attacks as the Hamas' charta calls for the eradication of Israel and the expulsion of all Jews from the region.

Further economic research on the internal structure and goals of terrorist organizations, on the economic impact of terrorism and on terrorist-government interactions can help governments and their agencies to devise optimal strategies to tackle the problem of terrorism and to determine the optimal trade-off between security, economic performance and openness. As this thesis illuminates, with the use of economic tools the actions of terrorist organizations can be predicted dependent upon their "type", e.g. whether they are "political", "militant" or interested in organizational growth. This matters for governments to correctly interpret observed terrorist behaviour and act accordingly.

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