

Essays on Discrimination and Corruption

Gisela Waisman



Stockholm University

© Gisela Waisman, Stockholm 2008

ISBN 978-91-7155-557-1

Cover Picture: Niklas Frank

Printed in Sweden by Edita Västra Aros AB, Stockholm 2008

Distributor: Institute for International Economic Studies

Abstract

The thesis consists of four papers, summarized as follows.

"Do attitudes towards immigrants matter?" analyses the consequences of negative attitudes towards immigrants to Sweden. If attitudes changed from the average level to the most positive level, the wage earned by a well educated immigrant from a non developed country would increase by 12%. This change in attitudes would increase the welfare of immigrants from Africa and Asia, through their wage and local amenities, by an equivalent to one third of their wage and the welfare of immigrants from South America and Eastern Europe by one fourth of their wage if they are well educated, and one tenth otherwise.

In "Who is hurt by discrimination?", the effects of discrimination of immigrants on the labour market are studied in a search and wage-bargaining setting, including a risk of losing skills during the experience of unemployment. The negative effects of discrimination in the form of higher unemployment and lower wages spread to all workers, immigrants and natives, in all sectors of the economy. An increase in the share of immigrants in the economy exacerbates the problem of discrimination.

In "Complementary controls of corruption", a theoretical model shows that when the judiciary and the media are more dependent and the elections less competitive, corruption flourishes. The three institutions are shown to be complementary. The empirical analysis indicates that the dependence of the judiciary and the media has a positive effect on perceived corruption and that the media is complementary with both the judiciary and the electoral system.

"Decision making in the ECB's Governing Council -- Should minutes and forecasts be published ?" analyses if the publication of forecasts and minutes of the meetings of the Governing Council could have a negative effect due to the influence of governments on their representatives' votes. The information provided is shown to reduce their influence and benefit the Executive Board.

A mis amores,
David, Katja y Niklas.

Acknowledgments

When I moved to Sweden I thought that starting a Ph.D. in Economics would be a relatively easy way of beginning my new life, as I did not need to be able to speak Swedish for my studies. I knew already then that I would have my children soon (due to an age constraint), but I did not really understand what I was getting myself into. During all these years, I have had permanent bad conscience for not giving enough time and concentration to both my thesis and my family. I am happy today that I did not understand how tough it would be. Despite all the remorse, stress and dissatisfaction with my own papers, I have enjoyed the experience and met many smart and interesting people during the process.

I have no words to thank my supervisor, Torsten Persson, enough for all his support during these years. Whenever I felt like burning a paper, I would go and talk to him and, after a while, I would start believing that maybe it was not so bad after all. His patience and support have been invaluable and I am deeply grateful to him for sharing his impressive knowledge of and enthusiasm for economics. His course in political economics showed me how the kind of problems I care about could be analysed, making the study of economics more meaningful.

I would like to thank David Strömberg for his time, patience and advice. Chapter two would look very different without David's help. I am indebted to Ethan Kaplan for his encouragement and his enthusiasm in trying to unveil the discrimination of immigrants in Sweden. Discussing with Ethan was a great pleasure, even if I was not always able to follow his advice.

Nicola Gennaioli was the first one who offered to read something I had written, I am still surprised and grateful for that. I would also like to thank Mårten Palme for discussing chapter two and giving me good advice over some lunches, and for getting LINDA. Anna Larsson and Åsa Rosén were kind enough to read chapter three. Peter Fredriksson patiently answered many questions during his visit to the IIES. I would also like to thank Per Krusell for discussing chapter two during nice walks in Smögen.

I owe the IIES a great deal for offering me such a rich and stimulating research environment (and excellent coffee). During my years as a student, I have benefitted from numerous seminars, lunches and even dinners, where different issues in economics have been discussed at a high level. And I have also enjoyed the affability of the whole staff, faculty and fellow students. I would particularly like to thank Lars Calmfors, Harry Flam, John Hassler, Assar Lindbeck, Mats Persson, Dirk Niepelt, Kjetil Storesletten and Jakob Svensson for their cordiality.

Without the editorial assistance of Christina Lönnblad, my thesis would be much more difficult to read, except for "Spanglish" experts. I am grateful for her great support, patience, time, help, friendship and for company on many trips to Nacka. I am also grateful to Annika Andreasson and Astrid Wåke for their kindness and company in the gym now and then and to Åsa Bornström.

I gratefully acknowledge the financial support provided by the IIES, Stockholm University and Handelsbanken's Research Foundations.

I started the Ph.D. at the Stockholm School of Economics (HHS) and keep warm memories from that time. I am particularly grateful to Jörgen Weibull for his friendliness during my first years as a student and even after I left for the IIES. I greatly enjoyed sharing an office with my fellow first year students at HHS and thank them for many good times in the bunker. I also met many kind students at the IIES and the Department of Economics, among them Lars Persson (and his lovely wife, Alessandra), Anders Olofsgård, Åsa Johansson, Charlotta Groth, Bård Harstad, Jesper Roine, Anne Boschini, Jan Pettersson and Per Pettersson-Lidbom. Since I had my children, I have not participated much in the student life, but I have still been able to interact with many nice fellow students at the IIES. I would like to thank them all and especially José Mauricio Prado, Jr for sharing the "Latin office" with me and for his kindness and friendliness.

I met my co-author Birthe Larsen at the London School of Economics a long time ago. The decision to move to Sweden was easier for me thanks to Birthe. I had never been here before moving, but I had been to Denmark and thought that the two Scandinavian countries should not be too different. It has been a great pleasure working together, mixing our communication on economic problems and long complicated

equations with family and life experiences. Writing my thesis became much more fun and less frustrating after she had become my coauthor.

I would like to take this chance of thanking all my teachers, from the Universidad Nacional de Cuyo (especially Hugo Balacco for keeping in touch so long), the Instituto Torcuato di Tella and the London School of Economics.

Moving to a new country means that one needs to find new friends and I am grateful for every friend I found. Here I want to mention Jianying Liu Wijkander and Eva Krutmeijer. I greatly appreciate their friendship and hope to be able to meet them (and their families) more often from now on. Eva has practically been part of my Swedish family and I am enormously gratefully for the fact that my kids feel at home with her (and Niklas and I do too).

I want to thank my parents, Gloria and José, for their loving support, Norma for her care all my life, my sister Viviana for holding on after scaring me to death ten years ago. I am happy I still have all of you, including Vivi's family, even if you are so far away.

I am also grateful to my Swedish family. Thanks Gun and Katarina for your kindness since my arrival to Sweden. I know Bo would have given me the biggest flower bouquet had he still been with us.

The one person who has suffered most during all these years of stress and frustration is Niklas. I am forever indebted to you for your support, encouragement, love and endless patience. The task of writing a thesis is small compared with the task of helping one's children become good, kind and happy individuals. I am enormously grateful to my kids, David and Katja, for teaching me the meaning of life, and that happiness lies in the small everyday experiences like getting them to smile. Los quiero mucho a los tres.

Stockholm, January 2008

Gisela Waisman

Table of Contents

Chapter1: Introduction	1
Chapter 2: Do attitudes towards immigrants matter?	5
Chapter 3: Who is hurt by discrimination ?	41
Chapter 4: Complementary Controls of Corruption	75
Chapter 5: Decision making in the ECB's Governing Council – Should minutes and forecasts be published ?	115

Chapter 1

Introduction

"Me dijeron que en el Reino del Revés nadie baila con los pies, que un ladrón es vigilante y otro es juez y que dos y dos son tres."	I was told that in the Reverse Kingdom Nobody dances with his feet, That a thief is a policeman and another is a judge And that two and two are three.
---	---

"En el pais del no me acuerdo Doy tres pasitos y me pierdo Un pasito para alli, no recuerdo si lo di. Un pasito para alla ¡Ay, que miedo que me da!"	In the country of I-Can't-Remember I take three steps and now I'm lost: One little step this way Did I take it I can't say. One little step that way ah! how it scares me...
---	---

Verses from "El Reino del Revés" and "En el pais del no me acuerdo", Argentinean children's songs, by Maria Elena Walsh

None of the chapters of my thesis deals directly with my country of origin, Argentina. However, I would claim that my origins have had an enormous influence on my view of institutions and individuals. Being born in "el reino del revés" and "el pais del no me acuerdo" turns one into a disbeliever.

My thesis deals with different problems but it has a unifying factor, the need to question whether agents act the way they are supposed to act. In my papers, governments try to have more influence than they should and to get as much personal benefit as possible from being in power. Individuals harm the welfare of other individuals just because they are different and vulnerable. Had I been born in Sweden, I would have been much more likely to believe that these offenses do not

happen. I still believe that it is healthy to question, just in case.

I will take this chance of excusing myself for studying the problem of discrimination in Sweden. The choice of country is obviously due to the fact that I live here. But I am the first to acknowledge that this country has been enormously generous in receiving refugees since the 70s and is still one of the countries receiving most refugees and with the most favourable attitudes towards immigrants in Europe. But not even Sweden has managed to completely avoid discrimination. Reading newspapers and listening to other immigrants/refugees suggest that even here, immigrants may face more difficulties than natives.

Chapters two and three study the discrimination of immigrants and are written together with Birthe Larsen¹. Chapter two is empirical and studies the situation of immigrants to Sweden, while chapter three is theoretical.

In chapter two, we study the effect of discrimination of immigrants to Sweden. We cannot directly measure labour market discrimination, so we use a measure of negative attitudes towards immigrants that we think are systematically related to discrimination. We concentrate on a group of immigrants for which there is an exogenous source of variation in their first location in Sweden. This variation is given by a refugee settlement policy pursued in 1985-1994, whereby newly arrived refugees were placed in different regions according to certain well-defined criteria. There were no restrictions on mobility afterwards, however. Many immigrants moved soon after arrival. This led us to investigate whether the mobility decision was affected by negative attitudes. We found that a well educated immigrant from a non developed country who lives in a municipality with strong negative attitudes earns less than she would earn if she lived in a municipality where natives are more positive. If attitudes changed from the average level to the most positive level, her wage would increase by 12%. This would reduce the wage gap to well-educated immigrants from developed countries by 70%. We interpret this effect as evidence of labour market discrimination. The same reduction in negative attitudes would increase the welfare of immigrants from Africa and Asia, through their wage and local amenities, by an equivalent to one third of their wage. The analogous amount for immigrants

¹Centre for Business Research (CEBR) and Copenhagen Business School.

from South America and Eastern Europe is one fourth of their wage if they are well educated, and one tenth otherwise.

In chapter three, we analysed how discrimination affects the labour market in a search and wage-bargaining setting, including a risk of losing skills during the experience of unemployment. Discrimination implies that wages received by immigrants are lower than wages received by natives, even when they face a non-discriminatory employer. Immigrants suffer from higher unemployment rates, despite receiving lower wages, and face a higher risk of losing their skills. The negative effects of discrimination in one sector, in the form of higher unemployment and lower wages, spread to all workers, immigrants and natives, in all sectors of the economy. The effect is stronger for immigrants, but natives also suffer. An increase in the share of immigrants in the economy exacerbates the problem of discrimination.

Chapters four and five deal with the general subject of corruption. In chapter four, I study conventional rent seeking by a corrupt incumbent. In chapter five, governments try to influence the decisions taken by the Governing Council of the ECB, even if this is against the rules of operation of the European System of Central Banks (ESCB).

In the fourth chapter, I analyse how important it is to have checks and balances by the judiciary, the electoral system and the media in relation to the problem of corruption. I develop a simple model which shows that when the judiciary and the media are more dependent and the elections are less competitive, corruption flourishes. The three institutions are shown to be complementary; strengthening one increases the marginal effectiveness of the others in the control of corruption. The empirical analysis indicates that the dependence of the judiciary and the media has a positive effect on the level of perceived corruption and that the media is complementary with both the judiciary and the electoral system.

In chapter five, I build a model of decision making in the Governing Council of the ECB, where the pressure of the national governments on their representatives affects the decision taken by the Council. Governments seem to have some influence on the decisions taken by the Governing Council of the ECB. It has been argued that the publication of forecasts and minutes of the meetings of the Governing Council would

have a negative effect due to the influence of governments on their representatives' votes. In my model, the information provided reduces their influence and benefits the Executive Board. The governments benefit from the publication of minutes, while they sometimes disagree with respect to the publication of forecasts. The model suggests that the current EMU members may want to withhold the publication of forecasts when taking enlargement with a more heterogeneous group of countries into account.

Chapter 2

Do attitudes towards immigrants matter?

*

1 Introduction

Attitudes toward immigration reveal deep views about economic self-interest and social identity. If natives' attitudes are based on their economic interests, those who benefit from immigration will support it, and those who are economically hurt by immigration will oppose it. A second reason for negative attitudes is racism, xenophobia or milder forms of nationalist sentiment that turn natives against foreigners¹. We identify attitudes towards immigration through attitudes towards the immigrants themselves.

Unlike in the US, immigration to Sweden is a relatively recent phenomenon, yet it has reached similar proportions. The share of foreign born in the population in Sweden was less than one percent in 1900. By 1960, 4% of the population were born abroad. The share of foreign born had increased to almost 13% in 2006, while the same share was 12.5% in the US.

* This is a joint work with Birthe Larsen, Centre for Business Research (CEBR) and Copenhagen Business School. We are grateful to Torsten Persson for his advice, to Anders Björklund, Ethan Kaplan, Mårten Palme, David Strömberg and seminar participants at the 1st Nordic Summer Symposium in Macroeconomics, SULCIS, SOFI and the Economics Department, Stockholm University for helpful comments and to Christina Lönnblad for editorial assistance. Financial support to G. Waisman was given by Handelsbanken's Research Foundations and Mannerfelts Fond. All errors are ours.

¹ Card et. al. (2005) describe models of economic self-interest, and then discuss broader sociological models focused on aspects of identity and group affiliation.

Immigration to Sweden was insignificant until World War II. During the first post-war decades, there was a sharp increase in demand for labour and workers were recruited from other European countries, first from other Nordic countries and later from Turkey, Greece, Yugoslavia, Poland and Italy. These immigrants were accepted because they were wanted in the labour market. There are no reliable opinion polls dealing with people's views on immigration from that time, but the early labour immigrants adapted fairly well and gradually became accepted in the cities where they settled.

Since the 1970s, when there was a change in the economic conditions and the need for labour all but disappeared, immigration to Sweden has become increasingly restricted to political refugees and their families. Refugees then mainly came from Chile, Iran, Iraq, Somalia and former Yugoslavia. Many studies have detected the existence of negative attitudes towards immigrants in Sweden since the 1970s². The rise in the share of votes for anti-immigration parties since the late 1980s is further evidence of the prevalence of such attitudes. Still, studies making a comparison across countries in Europe find that Sweden is one of the countries with the most generous attitudes. For example, Card et. al. (2005) study how attitudes differ with the immigrants' characteristics. People tend to be more negative to immigrants of a different ethnicity and immigrants from less prosperous countries. Respondents who favour a tighter immigration policy tend to put more weight on being a Christian or being of white ethnicity. Thus, immigrants do not constitute a homogeneous group and the attitudes towards subgroups can differ substantially.

In this paper, we are not interested in the causes of negative attitudes towards immigrants; instead we want to analyse the consequences of such attitudes on immigrants' welfare. Even though we recognize that not every native with negative attitudes would discriminate, we think that negative attitudes are systematically related to discrimination. Thus, we will be referring to discrimination in the paper despite the fact that we can only measure attitudes.

We formulate a simple model where negative attitudes affect immigrants' welfare through two channels: i) immigrants' wages through discrimination in the labour market and ii) immigrants' amenities, that is, the attractiveness of a geographic location, discrimination in the housing market, schools, hospitals, treatment in the

² Some examples are the Intolerance Report (Intolerans 2004) and Westin(2000).

streets, etc. Immigrants maximize their welfare by making a location choice where local attitudes play a major role.

The immigrants' geographic sorting is usually based on both observable and unobservable factors, which makes it difficult to study the effect of negative attitudes on their labour market outcomes and location decisions. To avoid (part of) that problem, we concentrate on a group of immigrants for which there is an exogenous source of variation in their first location in Sweden. This variation is given by a refugee settlement policy pursued by the government from 1985 to 1994, whereby newly arrived refugees were placed in different regions according to certain well-defined criteria. There were no restrictions on mobility after this first placement, however.

We take into account that natives' attitudes towards immigrants can differ by considering two kinds of heterogeneity, by origin and by level of education. We define three origin groups. Refugees belong to group B if they come from Africa and non developed countries in Asia and to group G if they come from South America or Eastern Europe. We expect group B to be more affected by attitudes than group G, as the members of this group are ethnically more distant from Swedes and come from less prosperous countries. A third group, W, composed by immigrants from developed countries, is also defined. These immigrants are not refugees, they were never placed and we expect them to be much less affected by negative attitudes. They are included as a placebo group. When it comes to education, we call those immigrants who have attained at least high school "well educated".

The placement of refugees in a region may exacerbate negative attitudes towards them. This problem is addressed by considering the data on attitudes measured prior to the refugee settlement policy. We obtain our measure of attitudes towards immigrants from five surveys on Swedish Opinion (Svensk opinion), collected from 1979 to February 1985 by Stiftelsen för Opinionsanalyser.

The empirical purpose of this paper is to exploit the regional variation in negative attitudes towards immigrants to analyse whether labour market outcomes and the mobility decisions of immigrants (refugees) are systematically related to such attitudes.

In a nutshell, we find that attitudes towards immigrants matter; they affect both labour market outcomes and location decisions. Well educated immigrants

from non developed countries receive lower wages when they live in a municipality with more negative attitudes. If attitudes became more positive and changed from their average level to the most positive level, this would increase these immigrants' wages by 12%.

Immigrants from non developed countries prefer to live in municipalities where attitudes towards them are less negative. Our estimates imply that less educated immigrants from Africa and Asia are willing to sacrifice as much as 34% of their wages to enjoy living in a municipality with zero negative attitudes rather than average attitudes. Well educated immigrants from Africa and Asia would accept a reduction of 23% of their wages and immigrants from South America and Eastern Europe a reduction of 11%, independent of their level of education.

Related Research

Our paper relates to research on the discrimination of immigrants in the labour market, and in particular, the empirical research related to Sweden.

The relationship between wages and discrimination in our simple model is justified by the results of a companion paper, Larsen and Waisman (2007), that introduces labour market discrimination in a search model (following Borjas and Bronars (1989)).

The model in our paper relates both to research on individual's migration decision (Sjaastad (1962)) and self-selection (Roy (1951)). Nakosteen and Zimmer (1980) and Borjas et. al. (1992) apply Roy's self-selection framework to internal migration. Our paper considers self selection in the migration decision in the spirit of a Roy model.

There are some empirical studies analysing the internal migration decision in Scandinavia. Åslund (2001) finds that immigrants to Sweden are attracted to regions with many immigrants from their own country of birth and, in general, better labour market opportunities and many welfare recipients. Damm and Rosholm (2005) find that the hazard rate into first job of refugee immigrants to Denmark is decreasing in the local population size and the local share of immigrants and that geographical mobility had large, positive effects on the hazard rate into first job, thus suggesting that restrictions on placed refugees' subsequent out-migration would hamper the labour market integration of refugees. None of these studies considers the effect of different attitudes towards immigrants on their migration decision.

Several empirical studies (for example Bevelander and Skyt Nielsen (1999), Arai et. al. (1999) and Arai and Vilhelmsson (2004)) have found lower income and employment rates for immigrants than for comparable natives in Sweden. These studies cannot tell us if the differences are caused by ethnic discrimination or differences in unobserved characteristics of the two populations. By analysing the difference in labour market outcomes in regions with different attitudes towards immigrants, we intend to test discrimination in a more direct way.

There are other studies performing different types of more direct tests of discrimination in Sweden. Rooth (2001) analysed the labour market performance of adoptees with dissimilar looks to natives and concluded that discrimination against skin colour may exist in the Swedish labour market. Åslund and Rooth (2005) found no sign of increased discrimination against certain immigrants to Sweden after the temporary change of attitudes caused by the terrorist attacks on September 11, 2001. Carlsson and Rooth (2006) performed a field experiment in May 2005 to February 2006 which showed every fourth employer to discriminate against men with Arabic sounding names in the hiring process. Compared to these studies, ours is more general as it is not restricted to certain groups of immigrants.

In the next section, we will present a simple model that can help us understand how negative attitudes affect immigrants.

2 Some Simple Theory

Consider an immigrant who derives utility from the consumption of goods afforded by her wage and amenities, that is, different features that increase quality of life. In the same spirit as a Roy model, different geographical areas are modelled as having different earnings and different amenity benefits for different immigrants. These local amenities affect quality of life because people have preferences for certain types of areas; they may prefer to live in temperate climates more than in severe ones, for instance³.

Each geographic location is characterized by a level of negative attitudes towards immigrants, determined by the share of the population that dislikes immigrants.

³ Graves (1979), Mueser and Graves (1995) and Huffman and Feridhanusetyawan (2007) show evidence of amenities affecting people's migration decisions and welfare.

Negative attitudes towards immigrants potentially affect both components of the utility function. When we model how negative attitudes affect immigrants, we will think of discrimination. In a companion paper, Larsen and Waisman (2007), we study the effects of discrimination of immigrants on the labour market within a search and wage-bargaining setting. In such a setting, discrimination implies that the wages received by immigrants are lower than the wages received by natives, even when they face a non-discriminatory employer. Amenities or quality of life may be affected by negative attitudes in many different ways. For example, negative attitudes can induce discrimination in the housing market, at schools or in hospitals.

We represent the utility for individual i in region j by the following equation

$$U_i^j(d^j) = w_i^j(d^j) + A_i^j(d^j), \quad (2.1)$$

where w_i^j denotes wage, A_i^j the amenities and d^j the level of negative attitudes in region j .

Every immigrant maximizes utility by making a location choice. When deciding where to live, he/she considers the level of wages and the quality of life he/she expects to receive in different geographical locations. He/she will move to region k if

$$U_i^k(d^k) > U_i^j(d^j) + C_i, \quad (2.2)$$

where C_i reflects the immigrant's individual costs of moving.

According to this simple location model, we expect more immigrants to move into or stay in regions with less negative attitudes. If two groups of immigrants are differently affected by attitudes and have similar costs for moving, then we expect a higher frequency of movement in the most affected group. The effect of negatives attitudes on wages and the location decision will be studied in the empirical section.

3 Empirical Background, Data and Method

Immigrants choose where to live on basis of many factors. They may choose to live where natives are not negative towards them, where the labour market opportunities are good, where the weather and other geographic conditions are more similar to their home countries, where many other immigrants speak their own language, etc.

Immigrants' sorting is based on both observable and unobservable factors which makes it generally difficult to study the effect of negative attitudes on labour market outcomes and location decisions. We will therefore study a group of immigrants for which there is an exogenous source of variation in their first location in Sweden given by a refugee settlement policy that the government pursued from 1985 to 1994.

The refugee settlement policy placed newly arrived refugees in different local municipalities according to certain well-defined criteria. The idea of the programme was to get a more even distribution of immigrants and facilitate integration. In practice, the distribution was mainly determined by housing availability. There was no interaction between municipal officers and refugees, so the selection was, by definition, purely made on basis of observed characteristics; language, formal qualifications, and family size seem to have been the main criteria. Preferences were given to highly educated individuals and individuals that spoke the same language as some members of the resident immigrant stock. The assignment of municipality was not the immigrants' choice and was independent of unobserved individual characteristics giving a quasi-experimental character to the data, as described by Edin, Fredriksson and Åslund (2003). These authors argue that the housing market was booming, thus making it difficult to find vacant housing in attractive areas.

The government settlement policy clearly increased the dispersion of immigrants. Before 1985, refugees were allowed to choose where to settle. In 1985, the immigrant shares in Stockholm and the north of Sweden were at 36% and 5%, respectively. By 1991, the share living in Stockholm had been reduced by more than 3%, while the share residing in the north had increased by 2%. Formally, the policy of assigning refugees to municipalities was in place from 1985 to 1994. However, the strictest application of the assignment policy took place between 1987 and 1991. During this period, almost 90% of the refugees were assigned an initial municipality of residence by the Immigration Board. There were no restrictions on ex post mobility, except that the refugees lost some activities granted in an introduction programme of about 18 months.

We exploit this natural experiment to analyse whether the mobility decisions of immigrants and their labour market outcomes are systematically related to attitudes in the different regions. We mainly use an unbalanced panel of data from 1996 to

2003, including only those immigrants that arrived in the period 1987 to 1991⁴.

Immigrants are not a homogeneous group and we believe that not all of them are equally affected by negative attitudes. We will divide the immigrants into three groups by origin. Group B consists of immigrants from Africa and non developed countries of Asia. Group G consists of immigrants from South America and Eastern Europe. The third group called W is composed by immigrants from developed countries. These immigrants are not refugees, they were never placed and we expect them to be much less affected by negative attitudes. We include them as a placebo group.

We also differentiate immigrants by their level of education. We call those immigrants who have attained at least high school "well educated".

We recognize that the placement of immigrants in a region may exacerbate negative attitudes towards them. This problem is addressed by considering the data on attitudes measured prior to the refugee settlement policy. For this reason, we assume attitudes to be constant in the short run. If we allow attitudes to vary over time, they will be strongly influenced by the refugees' arrival. Note that almost 60% of the immigrants living in Sweden in 2003 arrived after February 1985, the last period of our attitude data. We will use a measure of negative attitudes that is not directly caused by these last large waves of immigration.

3.1 Data

Data on the labour market performance of immigrants is available in the Longitudinal Individual Data Base (LINDA) stored at Statistics Sweden. Income registers and population census data constitute the core of the data set⁵. It contains information on 300 000 individuals annually plus a non-overlapping sample of 20% of all immigrants. From this database, we obtain information about the immigrants' monthly wage⁶, country of origin, year of immigration, the municipality where she lived upon arrival and where she lives now, her level of education, age, civil status,

⁴ In section 5 we repeat the same analysis in a larger sample, composed by all immigrants that arrived in the period 1985 to 1994, that is, the whole official period of application of the refugee settlement policy as a robustness test.

⁵ See Edin and Fredriksson (2000) for a presentation of this data set.

⁶ In 1996 and 1997, the data on monthly wage rates was not available for all individuals employed in the private sector, while it covered all public employees incorporated in this sample. LINDA contains full data on monthly wage rates from 1998, but not for all family members.

etc.

We cannot observe which immigrants in LINDA are refugees, so we concentrate our analysis to those coming from non developed countries, i.e. those that are more likely to have been placed by the government. In our groups of interest, B and G, we include immigrants from countries outside Western Europe that were not members of the OECD in 1985 and from Turkey. Immigrants from developed countries constitute the group of "white" immigrants, W.

We obtain our measure of attitudes towards immigrants from five cross-sectional surveys on Swedish Opinion collected from 1979 to February 1985 by Stiftelsen för Opinionsanalyser (SSD 0099, Göteborg University). The data was collected through a mail survey sent to around 2 000 individuals aged 17-80. We add the answers of all surveys to get more observations per municipality, all in all 11 539 answers.

We are interested in the question: How important do you think less immigration is? The possible answers (frequency in parenthesis) are: (1) very important (25.75%), (2) quite important (23.45%), (3) not very important (11.35%), (4) not important at all (fine now) (17.69%), (5) better with more immigrants (3.13%), (6) hesitant (13.83%), (7) no answer (4.80%).

We construct a measure of negative attitudes by adding the number of individuals answering (1) or (2) and deducting the number of individuals answering (5). This variable is normalized to vary between 0 and 1. A map of Sweden in Figure 1 shows how attitudes are distributed throughout the country.

Table I includes descriptive statistics of the variables of interest in our study. These include individual characteristics of the immigrants and municipal characteristics of their location.

Table II has a richer description of the municipal characteristics where immigrants are divided by group and separated into stayers and movers. Stayers are immigrants who still live in the municipality where they were placed. Movers are immigrants who left their municipality of placement in any period from the arrival to the year studied. Most immigrants moved before 1996 and very few during the period 1996 to 2003. Stayers constitute 47% of group B and 60% of group G immigrants. As is evident from the table, stayers were placed in municipalities with less negative attitudes towards immigrants, a higher share of immigrants from non developed countries, a larger population, better labour market conditions and more

social benefits than movers. Those who moved chose municipalities with more positive attitudes, a higher share of immigrants, a larger population, better labour market conditions and more social benefits than the municipalities where they were placed. Well educated immigrants (those who have attained at least high school) chose to move to a higher extent than less educated immigrants. Group B immigrants moved to a higher extent than group G immigrants. Movers appear to earn higher wages than stayers for both levels of education.

Table III characterizes the initial and final location of immigrants who came from developed countries in the same period. The "white" immigrants were never placed, they chose themselves where to live already upon arrival and 62% stayed in that first location. Those who moved chose municipalities with a smaller share of immigrants from non developed countries, a smaller population, better labour market conditions and lower social benefits.

The location choices of immigrants suggested by these means are consistent with our theory. Both the average group B mover and the average group G mover chose to move towards more positive attitudes. Those who decided to stay had been placed in municipalities with more positive attitudes. Group B immigrants (ethnically more distant from Swedes and coming from less prosperous countries) moved to a higher extent than group G immigrants and both groups moved more than group W immigrants. But this is just a comparison of means, we need a deeper analysis of the data to measure the effect of negative attitudes.

3.2 Empirical Strategy

We want to estimate the effect of negative attitudes on the wages and the location decision of immigrants represented in equation (2.2). Larsen and Waisman (2007) show that, in the presence of discrimination, immigrants' wages are negatively affected by the share of immigrants in the economy. Living in a region with many immigrants could also be positive, if immigrants form social networks that allow members to help each other in the labour market. Both the direct effect and the incentive to form networks may depend on how negative the attitudes towards immigrants are in the region. Similarly, the effect of attitudes on local amenities may vary depending on how many other immigrants live in the municipality. We take this into account and incorporate a term allowing for an interaction between nega-

tive attitudes and the share of immigrants in our wage and amenities equations. We assume the wage and amenity functions in equation (2.1) above to take the form

$$\begin{aligned}
w_{it}^j(d^j) &= d^{j'}\alpha_1 + (d^j * M_t^j)' \alpha_2 + X_t^{j'}\alpha_3 + Y_{ti}'\alpha_4 + \varepsilon_{it}^j \\
&= E(w_{it}^j(d^j)) + \varepsilon_{it}^j, \quad \varepsilon_{it}^j \sim N(0, \sigma^2) \quad \text{for } j = p, m \\
A_{it}^j(d^j) &= d^{j'}\beta_1 + (d^j * M_t^j)' \beta_2 + Z_t^{j'}\beta_3, \quad \text{for } j = p, m \\
C_i &= Y_{ti}'\gamma,
\end{aligned}$$

where M_t^j is the share of immigrants from non developed countries living in municipality j in period t , X_t^j are municipal characteristics that affect wages, ε_{it}^j is a residual term or shock to individual i 's wage, Z_t^j are municipal characteristics that affect amenities and Y_{ti} are individual characteristics. We will call p the municipality of placement and m the municipality where an immigrant is considering to move. The cost of moving is assumed to depend on individual characteristics only.

When we estimate equation (2.2) above for the movers, we observe the wage that the immigrant received in municipality m , $w_{it}^m(d^m)$, but we need to estimate the wage he/she had received if he/she had stayed in the municipality of placement, $w_{it}^p(d^p)$. An immigrant is a mover if

$$\begin{aligned}
w_{it}^m(d^m) + A_{it}^m(d^m) &> w_{it}^p(d^p) + A_{it}^p(d^p) + C_i, \\
w_{it}^m(d^m) - E(w_{it}^p(d^p)) + [A_{it}^m(d^m) - A_{it}^p(d^p)] - C_i &> \varepsilon_{it}^p, \tag{2.3}
\end{aligned}$$

where

$$A_{it}^m(d^m) - A_{it}^p(d^p) = \left\{ \begin{array}{l} -(d^{p'} - d^{m'})' \beta_1 - [(d^p * M_t^p)' - (d^m * M_t^m)'] \beta_2 \\ -(Z_t^{p'} - Z_t^{m'})' \beta_3 \end{array} \right\}.$$

For a stayer, we observe the wage she receives in the municipality of placement, but we need to estimate what she would counterfactually receive in a target municipality. We cannot observe to which municipality an immigrant considered moving, if she decided to stay. We define the target municipality of stayers as the average municipality where all immigrants have chosen to live in our sample. In this way, we use the immigrants' own revealed preferences when we determine what the potential

target would have been⁷. The alternative destinations are therefore collapsed into a single alternative, the target municipality. An immigrant is a stayer if

$$w_{it}^m(d^m) + A_{it}^m(d^m) \leq w_{it}^p(d^p) + A_{it}^p(d^p) + C_i,$$

$$w_{it}^p(d^p) - E(w_{it}^m(d^m)) + [A_{it}^p(d^p) - A_{it}^m(d^m)] + C_i > \varepsilon_{it}^m. \quad (2.4)$$

We initially assume that the residuals in the wage equations for movers (2.3) and stayers (2.4), ε_{it}^p and ε_{it}^m , are independent of each other. This assumption may not be realistic. High ability immigrants that have positive residuals upon placement are likely to also have positive residuals after moving. We can actually test if this is the case by looking at the small group of immigrants that moved from the municipality where they had been placed upon arrival (1987-1991) during the period 1996-2003 and for which we can observe wages in both the municipality of placement and the municipality of their final location⁸. For this particular group of immigrants, we can calculate an average wage throughout the period both upon placement and where they chose to move and estimate the correlation between these average wages. The correlation turns out to be positive and high. For this reason, we will present results where the residuals are assumed to be independent, as well as results where we incorporate the estimated correlation among residuals.

We include several covariates and controls, so that the differences in the wages and amenities are not determined by differences in the labour market opportunities or geographical characteristics of the regions themselves. Controlling by fixed effects at the individual level does not help because we have very few individuals that moved during the period in our sample and for which we can observe wages both before and after moving. We consider as movers all immigrants that chose to move from their first location in the country, even if this happened before the period in our analysis.

Identification rests on the assumption that the effect of negative attitudes on the wages and location decisions of group B and G immigrants are independent of the residual terms in (2.3) and (2.4), ε . Identification fails if some other factor determines

⁷ We have tried with other potential targets, for example an average of the ten most preferred municipalities (as revealed by immigrants' choices). There was no substantial change in the results.

⁸ This group only includes about 100 individuals. Most of the refugees that moved until 2003 had already moved by 1996.

both the level of attitudes and the differences in wages and amenities in the region, through its effect on the residual terms. It could be imagined, for example, that a generally bad labour market causes poor outcomes for recent immigrants as well as negative attitudes among natives. The attitudes we capture in our measure were displayed more than ten years before the period of analysis, but a bad labour market may be persistent over time.

Attitudes are more negative in municipalities that had a high share of immigrants from non developed countries (0.08), higher average days of unemployment (0.11), and lower average wages (-0.17) in the period 1996 to 2003. If we go back in time, closer to the period in which these attitudes were revealed, we can see that municipalities with more negative attitudes had lower employment in 1985 (-0.14) and more immigrants in 1979 (0.05). The correlation coefficients in parenthesis (weighted by population) are all significantly different from zero at the 1% level.

To check whether some other factor determines both the level of attitudes and the differences in wages and amenities in the region, we include a third group in our analysis, immigrants from developed countries, that we expect not to be affected by attitudes. The idea is that if our estimation of the effect of attitudes on wages and amenities is the result of some other factor that produces lower wages, we should estimate the same effect on this placebo group.

There is no considerable difference among the three groups of immigrants with respect to individual characteristics. They have a similar average age (37.6 for group W, 35.6 for group G and 34.6 for group B), a similar gender composition (50% of group W immigrants are women, 56% of group G and 50% of group B) and a similar civil status (56% of group W immigrants are married or cohabitants, 52% of group G and 54% of group B). Most importantly, their education level is not that different. We can compare the different education levels of immigrants in a measure that scales from 0 (no education at all) to 6 (Ph.D. level). A value of 3 in this education measure corresponds to high school education, so the variable "well educated" in our study corresponds to values 4, 5 and 6. The average level of education of white immigrants is 3.4 (with a standard deviation of 1.47), while it is 3.2 (with a standard deviation of 1.4) for immigrants from South America and Eastern Europe and 2.9 (with a standard deviation of 1.4) for immigrants from Africa and non developed countries in Asia.

3.3 Estimation Method

We estimate equations (2.3) and (2.4) for each group of immigrants separately. Recall that group B consists of immigrants from Africa and non developed countries of Asia, group G consists of immigrants from Eastern Europe and South America and group W consists of immigrants from developed countries. Imposing the same slope coefficients on all regressors in a common specification (with dummy variables to allow for a different effect of attitudes only) is not very attractive as we want to allow for heterogeneity across groups.

In the model, we have assumed that the effect of negative attitudes on wages is the same for stayers and movers. We have tried an alternative specification, separating the effect of the variables of interest on the wages of stayers and movers. The effects of negative attitudes are somewhat stronger for movers than for stayers, but the coefficients are not very different for the two groups, so we have chosen this specification to make the presentation simpler.

We estimate the effect of negative attitudes on wages and the location decision by maximum likelihood. The maximum likelihood principle says that out of all possible values for the different coefficients and the residual's variance, the values that make the likelihood of the observed data largest should be chosen.

The log likelihood function is

$$\sum_{s_i=0} \ln(\Pr(s_i = 0)) f(w_{it} | s_i = 0) + \sum_{s_i=1} \ln(\Pr(s_i = 1)) f(w_{it} | s_i = 1),$$

where $s_i = 1$ if the individual is a stayer and $s_i = 0$ if she is a mover. When errors ε_{it}^p and ε_{it}^m are uncorrelated, we can write the log likelihood contributions, based on (2.3) and (2.4), for the stayers

$$\Phi\left(\frac{w_{it}^p - E(w_{it}^m) + (A_{it}^p - A_{it}^m + C_i)}{\sigma}\right) \varphi(w_{it}^p, E(w_{it}^p), \sigma^2),$$

and for the movers

$$\Phi\left(\frac{w_{it}^m - E(w_{it}^p) - (A_{it}^p - A_{it}^m + C_i)}{\sigma}\right) \varphi(w_{it}^m, E(w_{it}^m), \sigma^2).$$

When we allow for correlated residuals, $\varepsilon_{it}^p \sim N(0, \sigma^2)$ and $\varepsilon_{it}^m = \rho\varepsilon_{it}^p + u_{it}^m \sim$

$N(0, \sigma^2)$, where $u_{it}^m \sim N(0, \sigma^2(1 - \rho^2))$ and ρ is the correlation coefficient, the log likelihood contributions become

$$\Phi \left(\frac{w_{it}^p - E(w_{it}^m) + (A_{it}^p - A_{it}^m + C_i) - \rho(w_{it}^p - E(w_{it}^p))}{\sigma(1 - \rho^2)^{\frac{1}{2}}} \right) \varphi(w_{it}^p, E(w_{it}^p), \sigma^2),$$

and

$$\Phi \left(\frac{w_{it}^m - E(w_{it}^p) - (A_{it}^p - A_{it}^m + C_i) - \rho(w_{it}^m - E(w_{it}^m))}{\sigma(1 - \rho^2)^{\frac{1}{2}}} \right) \varphi(w_{it}^m, E(w_{it}^m), \sigma^2).$$

4 Results

Even if the effect of attitudes on wages and location comes out of the same regression, we present these results in two separate tables to simplify the exposition. Table IV presents the estimation of the α coefficients, while table V presents the estimation of the β and γ coefficients in equations (2.3) and (2.4).

4.1 Results for Wages

Table IV reports our results on the effect of negative attitudes on wages for the three groups of immigrants. To differentiate immigrants by level of education, we interact each variable of interest with a dummy that is equal to one for "well educated" individuals, that is, those who have attained at least high school. For groups B and G, we report both the results considering only negative attitudes and the results where negative attitudes are interacted with the share of immigrants from non developed countries. We report results both with independent and correlated residuals. All specifications include individual controls, municipal controls, region effects, year effects, dummies for the country of origin and the number of refugees that arrived from the same country to the same municipality in the period 1987 to 1991.

The individual controls are age, age squared, level of education, sex, civil state and the years since immigration. The municipal controls include the average level of wages, the average days of unemployment and the average level of social benefits received in the municipality each year. The regional effects are considered at the county level (there were 24 counties and 288 municipalities in Sweden in 1996).

We cannot include fixed effects at the municipal level because our measure of discrimination is constant. We estimate standard errors that are robust to individual correlation by clustering per individual.

Negative attitudes reduce the wages of well educated group B immigrants in all specifications. Less educated immigrants' wages are not affected by negative attitudes. We will mainly concentrate on the last column for each group, where residuals are correlated and the interaction between negative attitudes and the share of immigrants is taken into account. If attitudes improved from the average level (0.5) to the most positive level (0), this would increase these immigrants' wages by 12%. The share of immigrants from non developed countries is associated with higher wages for all group B immigrants. An increase in this share from the minimum possible level (0) to the average level (0.10) would increase group B immigrants' wages by 6%. In this sense, the effect of improving attitudes is twice as high as the potential network effect or the effect of increasing the share of immigrants.

The effect of negative attitudes on the wages of well educated group G immigrants has the same order of magnitude, still negative, but less precisely estimated. It turns out to be significantly different from zero only when the interaction with the share of immigrants is considered. The share of immigrants has no direct effect on wages for group G, but a positive interaction term attenuates the effect of negative attitudes when we assume independent residuals. The interaction term is still positive but much smaller and not significantly different from zero when we take residual correlation into account. According to the results in the last column, an improvement in attitudes from the average to the most positive level would increase the well educated group G immigrants' wages by 13%.

Negative attitudes have no effect at all on the wages of immigrants from developed countries, our placebo group W. We interpret these results as evidence of discrimination in the labour market for well educated immigrants from less developed countries. The average wages of well educated group W immigrants in our sample are 20% (15%) higher than the average wages of well educated group B (G) immigrants. A large part of this difference could thus be explained by discrimination⁹. The effects of the controls on immigrants' wages are relatively similar across

⁹ Note that the comparison is made with similar immigrants that have been in the country for an equally long period.

groups. Wages are higher for immigrants living in municipalities with higher average wages and immigrants that are well educated, older, male, married or cohabitants and that have been longer in Sweden. In our estimation, the direct effect of being well educated (attaining high school or higher) is an increase in wages by 30% for group B and G immigrants, but almost half of that increase is lost due to discrimination. The direct effect of being well educated is a rise in wages by 12% for group W immigrants.

4.2 Results for Mobility

Table V reports the results for the effect of negative attitudes on the location decision. The explanatory variables in this table represent, for each individual, the difference in the characteristics of the municipality of placement and the target municipality. "Negative attitudes" denote the difference between negative attitudes upon placement and at the final or prospective location, that is, $(d^p - d^m)$. The municipal and individual controls are the same as those in Table IV. The individual controls represent the cost of moving in the location decision. There are additional controls that are assumed to affect the location decision, but not the wage of the immigrants. These "geographical variables" are the ten-year average minimum temperature in the winter (January to March), latitude (that influences how dark a region is in the winter) and the size of the population. In the literature on amenities, it is common to hypothesize that people prefer moderate climates.

More negative attitudes reduce quality of life in a region for both group B and group G immigrants, but the coefficients are somewhat unstable across specifications. Immigrants in the placebo group W are not affected by the difference in negative attitudes in their location decision. Once more, we concentrate on the results with correlated residuals that incorporate the interaction between negative attitudes and the share of immigrants from non developed countries. For group B immigrants, the interaction term strengthens the effect of the difference in negative attitudes on amenities, especially for less educated individuals. The average share of immigrants is 0.10, so the total effect for less educated individuals in the average municipality is -0.69 ($-0.29 - 4 * 0.1$) and for well educated immigrants, it is -0.46 [$-0.29 - (4 - 2.35) * 0.1$]. This means that less (well) educated immigrants in group B are willing to sacrifice 34% (23%) of their wages to enjoy living in a municipality

with no negative attitudes instead of the average level of negative attitudes. Group G immigrants are willing to sacrifice 11% of their wages for an improvement in attitudes.

Immigrants in group B and G enjoy living in a municipality with more immigrants around, while "white" immigrants feel that the attractiveness of a region decreases with the difference in the share of immigrants from non developed countries. Group W immigrants are willing to sacrifice 11% ($-1.14 * 0.1$) of their wages to live in a municipality without immigrants from non developed countries, instead of the average share.

Also in the location decision are the effects of the controls relatively similar across groups. The value of amenities increases with the difference in average wages and decreases with the difference in average days of unemployment and social benefits received in the municipality. Immigrants in group B value having a higher temperature in the winter, especially the well educated ones, while immigrants in group G instead value lower latitudes. The difference in the size of the population does not seem to be of any importance after controlling for all other municipal and geographical variables. Group W immigrants care more about the winter temperature than the latitude. In groups B and G, older immigrants, less educated, women and those who are married or cohabitants have a higher cost of moving. In group W, age seems to be the only factor determining the cost of moving.

Negative attitudes do affect all immigrants from non developed countries, but the effect varies in strength and character. Negative attitudes affect the welfare of well educated immigrants through both wages and amenities, but only the low educated immigrants' amenities. Well educated immigrants from South America and Eastern Europe are more affected than less educated immigrants of the same origin. All immigrants from Africa and non developed countries in Asia suffer more from negative attitudes than South Americans and Eastern Europeans. This is consistent with the observation that group B immigrants are ethnically and culturally more distant from Swedes and come from less prosperous countries and that they moved to a higher extent than group G immigrants. Similarly, well educated immigrants, whose wages are more affected by attitudes in our results, moved to a higher extent than less educated immigrants.

5 Robustness Tests

5.1 Alternative Specification

An alternative way of analysing the effect of negative attitudes is to concentrate on the wages of those immigrants that still live where they were placed by the government according to the refugee settlement policy. If we do so, we need to correct for the selection bias created by the fact that these individuals chose themselves to stay in their placement municipality. We estimate the effect of negative attitudes on the wages of stayers using a Heckman-style selection bias correction.

The results of the estimation are presented in table VI. The first two columns show the effect of the variables of interest on the stayers' wages. The last two columns show the effect of the "differences" in the variables of interest, the variables upon placement minus the variables in the target municipality, on the location decision. In this case, we have not been able to compute the results for the three groups of origin in separate regressions, due to lack of convergence. Therefore, we used dummy variables to distinguish the effects of the variables of interest on the wages and location decisions of the stayers in group B, G and W. In this way, we are restricting the coefficients for the individual and the municipal controls in the wage equation to be the same for all three groups. We use dummies to allow for different coefficients for the municipal and geographical variables in the location equation.

In the interpretation of the results, we concentrate on the results in the second and fourth columns which allow for the interaction between attitudes and the share of immigrants from non developed countries. In this setting, we find that negative attitudes reduce the wages of well educated stayers from Africa and Asia, even though a positive interaction effect attenuates this reduction in municipalities with many immigrants from non developed countries. Improving attitudes from the average level to zero would reduce the stayers' wages by 6% in the average municipality, if we take the interaction term into account. The wages of South American and Eastern European stayers are not affected by negative attitudes.

The wages of immigrants from developed countries that stayed in the first chosen location (they were never placed) are positively related to negative attitudes and the share of immigrants from non developed countries in the region. We have no good explanation for these positive coefficients, but the fact that group W wages

increase with the negative attitudes shows that we are not capturing the effect of a third factor that affects negative attitudes positively and wages negatively for all workers.

With respect to the location decision, all immigrants from non developed countries are less likely to stay in a municipality with more negative attitudes. The effect is stronger for immigrants from Africa and Asia, both directly (a more negative coefficient) and indirectly, through the interaction term. Immigrants from developed countries prefer to stay in a municipality with more negative attitudes, as shown by a positive interaction term. Immigrants from Africa and Asia prefer to live in regions with a higher share of immigrants from non developed countries. Immigrants from developed countries instead move away from such regions.

In summary, the results in this alternative specification do not contradict our main findings.

5.2 Alternative Sample

We now repeat the same analysis in a larger sample, composed by all immigrants that arrived in the period 1985 to 1994, that is, the whole official period of application of the refugee settlement policy. In the additional years, however, the placement of immigrants was less strict, meaning that more refugees were allowed to choose their first location. The exogenous source of variation in the immigrants' first location in Sweden is thus potentially a worse assumption for this larger sample.

Tables VII and VIII report the results arising from repeating the same analysis as in tables IV and V in the larger sample. We once more concentrate on the results that incorporate the interaction with the share of immigrants and the correlation in the residuals of stayers and movers, that is, the last column for each group of immigrants.

The results are very similar to those obtained with the smaller sample for immigrants from Africa and non developed countries in Asia. If negative attitudes were reduced from the average level to zero, the wages of well educated group B immigrants would increase by 11% and the value of amenities they enjoy would rise by 17%. The same improvement in attitudes would increase the value of amenities for low educated group B immigrants by 27%. So the total utility cost of negative attitudes is equivalent to 27% of the wages for less educated and 28% of the wages

for well educated immigrants from Africa and Asia. This utility cost is smaller than that estimated in the smaller sample (35%), but the magnitude is still quite high. Immigrants from Africa and Asia receive higher wages and a larger value of amenities if they live in a municipality with a higher share of immigrants from non developed countries.

For immigrants from South America and Asia, the effect on wages is very small and has the wrong sign. A reduction in negative attitudes from the average effect to zero would increase wages by 2.5% through the interaction term. The same reduction in negative attitudes increases the value of amenities for these immigrants by 10%. So, the total utility cost of negative attitudes is equivalent to 7.5% of the wages for all group G immigrants. Once more, the total effect is smaller than in the more restricted sample.

Negative attitudes do not affect the wages of immigrants from developed countries, while they increase the value of their amenities. Group W immigrants prefer to live in a municipality with less immigrants from non developed countries and more negative attitudes. The controls are the same as in tables IV and V and have the expected signs.

The estimation of the effect of attitudes on wages is less precise for group G immigrants on this larger sample. Out of all immigrants in this group, 60% came to Sweden between 1992 and 1994 and as many as 95% of the late arrivals came from former Yugoslavia. It may be the case that these immigrants were more similar to Swedes than the immigrants coming from the rest of Eastern Europe and Latin America. This would explain why their wages were less affected by negative attitudes. Negative attitudes still influence their location decisions as much as it did for the group B immigrants in the benchmark sample. Immigrants from Africa and Asia are more affected than immigrants from South America and Eastern Europe. Immigrants from developed countries actually benefit from negative attitudes which, once more, shows that we are not capturing the effect of a third factor that affects negative attitudes positively and utility negatively for all workers.

6 Conclusions

We find that attitudes towards immigrants matter: they affect both their labour market outcomes and their quality of life. Well educated immigrants from non developed countries receive lower wages when they live in a municipality with more negative attitudes towards immigration. The average wages of well educated immigrants from developed countries in our sample are 17% higher than the average wages of well educated immigrants from non developed countries. If negative attitudes were to disappear, this would increase these immigrants' wages by 12%. In other words, 70% of the wage gap could be explained by discrimination. The potential effect of more positive attitudes is twice as high as the potential network effect or the effect of increasing the share of immigrants from non developed countries from zero to its average value.

All immigrants from non developed countries prefer to live in municipalities where attitudes towards them are less negative. Our model implies that less educated immigrants from Africa and Asia are willing to sacrifice as much as 34% of their wages to enjoy living in a municipality with zero negative attitudes, instead of the average level. Well educated immigrants from Africa and Asia would accept a reduction of 23% of their wages and immigrants from South America and Eastern Europe a reduction of 11%, independently of their level of education.

By their revealed location choices, immigrants from non developed countries enjoy living in a municipality where there are similar immigrants, while "white" immigrants appear to believe that the attractiveness of a region decreases with the share of immigrants from non developed countries.

The fact that the wages and the quality of life of immigrants from developed countries, our placebo group, are not affected (or are affected in the opposite way) by negative attitudes indicates that we are not capturing the effect of omitted variables that have a positive effect on negative attitudes and a negative effect on wages or amenities for all workers in a region.

A reduction in negative attitudes from the average level to zero would increase the total welfare of immigrants from Africa and Asia, consisting of their wage and quality of life, by an equivalent to the utility provided by one third of their wage. The same amount for immigrants from South America and Eastern Europe is one fourth of their wage if they are well educated and one tenth otherwise. These effects

are really strong. If the attitudes towards immigrants became more positive, it would make a large difference for these individuals.

We end with two examples that may give a better concrete illustration of how much attitudes matter.

The first example is Lund, a municipality with much less negative attitudes than the average. Placed immigrants tend to stay and many immigrants placed in other municipalities choose to move to Lund. Lund is a municipality in Skåne, southern Sweden. The city of Lund has more than 76 000 inhabitants and is believed to have been founded around the year 990, when the Scanian lands belonged to Denmark. It soon became the Christian centre of Northern Europe with an archbishop and the towering Lund Cathedral. Lund University, established in 1666, is Sweden's largest university. Lund is an island of immigrants' acceptance ($A = 0.302$) in a county where attitudes are very negative. In our sample, 66 immigrants from Africa and non developed countries of Asia were placed in Lund during the period 1987 to 1991. As many as 59 immigrants with the same continents of origin that were placed in other municipalities chose to move to Lund. Out of the 54 immigrants placed in Lund who decided to stay, our model estimates that almost 90% would not have stayed had the attitudes not been so much more negative in the target municipality.

The second example is Orust, a municipality where attitudes are more negative than the average. Most placed immigrants have chosen to move away from Orust. Orust is an island and municipality in Bohuslän on the West Coast, Sweden's third-largest island with an area of 346 km². The island has just over 15 000 residents, but this figure increases in the summer. Most of the municipality consists of countryside, with a number of small population centres. Eight immigrants from Africa and non developed countries in Asia were placed in Orust, where our measure of attitudes is higher than the average ($A = 0.545$). One of them stayed, one moved to a municipality with even more negative attitudes, while the remaining six moved to municipalities with more positive attitudes. According to our estimation, half of these immigrants would not have moved had the attitudes to them in Orust not been negative.

Bibliography

- [1] Arai M, H Regnér and L Schröder (1999) Är arbetsmarknaden öppen för alla?, Bilaga 6 till Långtidsutredningen 1999 (SOU 2000:7), Fritzes, Stockholm.
- [2] Arai, M. and R. Vilhelmsson (2001), "Immigrants' and Natives' Unemployment-risk: Productivity Differentials or Discrimination?", FIEF Working Paper Series Nr. 169.
- [3] Bevelander P. and H. Skyt Nielsen (1999), "Declining Employment Assimilation of Immigrants in Sweden: Observed or Unobserved Characteristics?", CEPR Discussion Paper No. 2132.
- [4] Borjas, G., S. Bronars and S. Trejo (1992), "Self-Selection and Internal Migration in the United States", NBER Working Papers 4002, National Bureau of Economic Research, Inc.
- [5] Borjas G. and S. Bronars (1989), "Consumer Discrimination and Self-employment", *Journal of Political Economy*, 97(3), pp. 581-605.
- [6] Card, D., C. Dustmann and I. Preston (2005), "Understanding Attitudes to Immigration: The Migration and Minority Module of the First European Social Survey", Centre for Research and Analysis of Migration (CReAM) Discussion Paper Series 0503, Department of Economics, University College London.
- [7] Carlsson, M. and D.-O Rooth (2006), "Evidence of Ethnic Discrimination in the Swedish Labor Market Using Experimental Data", IZA Discussion Papers No. 2281.
- [8] Damm, A.P. and M. Rosholm (2004), "Employment Effects of Dispersal Policies on Refugee Immigrants: Empirical Evidence", IZA Discussion Papers No 925.

- [9] Edin, P.-A. and P. Fredriksson (2000), "LINDA - Longitudinal INdividual DAta for Sweden", Working Paper 2000:19, Department of Economics, Uppsala University.
- [10] Edin, P.-A., P. Fredriksson and O. Åslund (2003), "Ethnic Enclaves and the Economic Success of Immigrants - Evidence from a Natural Experiment", *Quarterly Journal of Economics*, 118(1), pp. 329-357.
- [11] Graves, P.E. (1979), "A Life-Cycle Empirical Analysis of Migration and Climate, by Race", *Journal of Urban Economics*, VI, pp. 135-147.
- [12] Huffman W. and T. Feridhanusetyawan (2007), "Migration, Fixed Costs, and Location-Specific Amenities: A Hazard Analysis for a Panel of Males", *American Journal of Agricultural Economics*, 89(2), pp. 368-382.
- [13] Intolerans – Antisemitiska, homofobiska, islamofobiska och invandrarfientliga tendenser bland unga, 2004, Forum för Levande Historia och Brottsförebyggande Rådet, Stockholm.
- [14] Larsen, B. and G. Waisman (2007), "Who is Hurt by Discrimination?", mimeo.
- [15] Mueser P. and P. Graves (1995), "Examining the Role of Economic Opportunity and Amenities in Explaining Population Redistribution," *Journal of Urban Economics*, Elsevier, vol. 37(2), pages 176-200.
- [16] Nakosteen, R. and M. Zimmer (1980), "Migration and Income: The Question of Self- Selection", *Southern Economic Journal*, 46, pp. 840-851.
- [17] Rooth D.-O. (2001), "Adopted Children in the Labour Market – Discrimination or Unobserved Characteristics?", mimeo, Högskolan i Kalmar.
- [18] Roy, A. (1951), "Some Thoughts on the Distribution of Earnings", *Oxford Economic Papers*, 3, pp. 135-146.
- [19] Sjaastad, L. (1962), "The Costs and Returns of Human Migration", *Journal of Political Economics (Supplement)*, 70, pp. 80-93.
- [20] Westin, C. (2000), "Settlement and Integration Policies towards Immigrants and their Descendants in Sweden". *International Migration Papers 34*. ILO, Geneva, 2000.

- [21] Åslund, O. (2001), "Now and Forever? Initial and Subsequent Location Choices of Immigrants", Working Paper 2001:11, Institute for Labour Market Policy Evaluation, Uppsala.
- [22] Åslund, O. and D.-O. Rooth (2005), "Shifts in Attitudes and Labor Market Discrimination: Swedish Experiences after 9-11", *Journal of Population Economics*, 18, pp. 603-629.

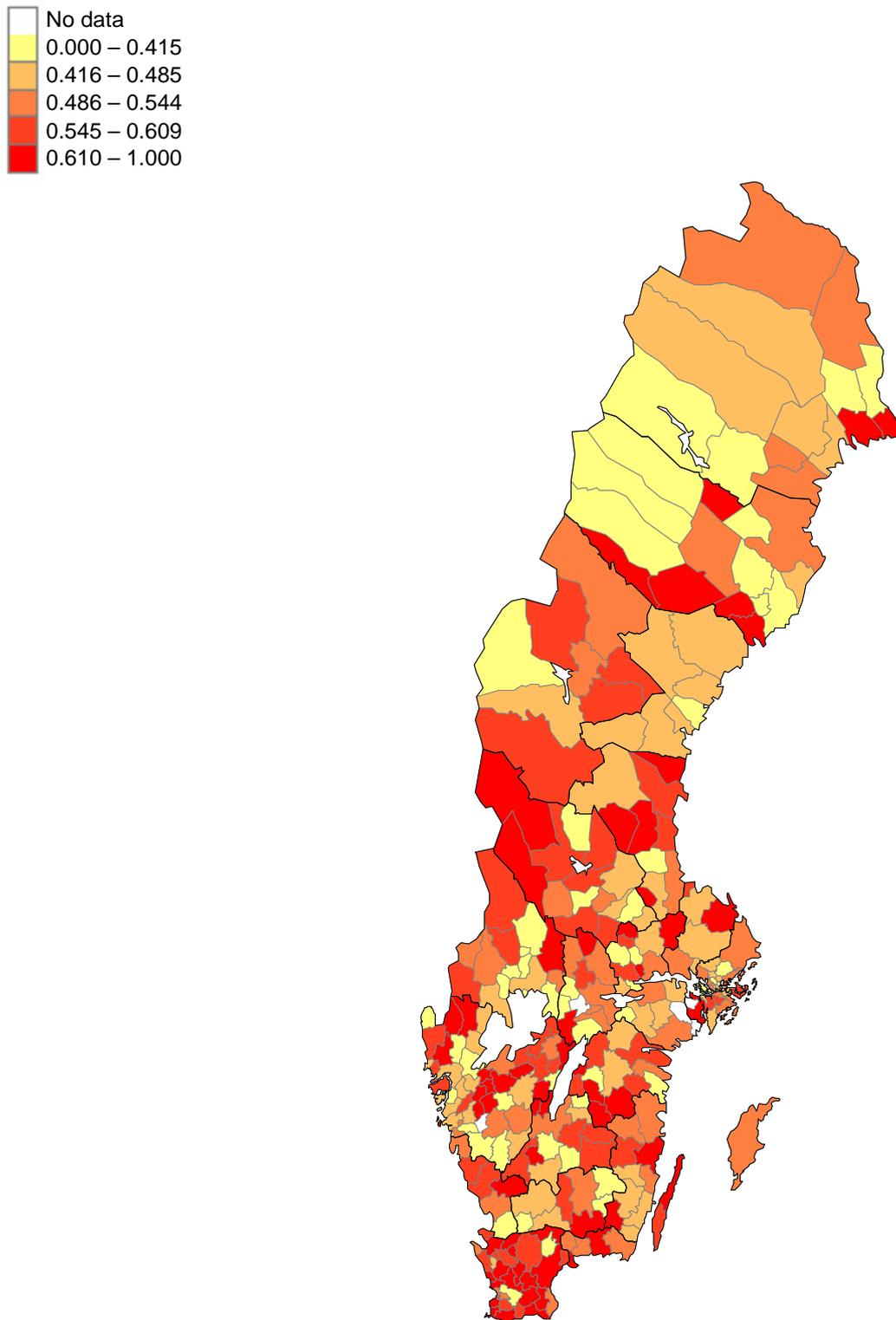
Figure 1: Attitudes 1979-85

Table I : Immigrants who arrived from Non-Developed Countries 1987 – 1991
Panel Data 1996 - 2003

Variable	Obs.	Mean	Std Dev.	Min.	Max.
Individual characteristics					
Log of wages	15739	9.74	0.26	7.60	12.33
Share of Well Educated	15739	0.33	0.47	0	1
Age	15739	38.2	9.23	18	64
Women	15739	0.56	0.50	0	1
Married / Cohabitant	15739	0.64	0.48	0	1
Years in Sweden	15739	11.4	2.51	5	16
Characteristics of the municipality where they live					
Negative Attitudes	15739	0.50	0.08	0.17	1
Share of Immigrants from ND countries	15739	0.10	0.05	0.01	0.25
Average log of wages	15739	9.88	0.10	9.61	10.38
Average days unemployment	15739	6.27	2.87	1.16	21.04
Average social benefits received	15739	1326	942	0	13846
Average minimum temperature in winter	15739	-4.57	2.28	-20	-1.3
Latitude	15739	58.56	1.69	55.37	67.85
Population (1000)	15739	228	262	2.6	762

Table II : Immigrants from Non-Developed Countries 1987 – 1991
Means for 1996 to 2003

	Stayers			Movers		
	Placement			Last location		
	All	Well educated	Placement	All	Well educated	All
Group B: Africa and non developed countries in Asia						
Observations	4448	1185	5028	1911	5028	1911
Individual wages	16272	18073	0.513	0.515	17222	19900
Negative Attitudes	0.504	0.503	0.056	0.055	0.500	0.495
% immigrants ND countries	0.099	0.094	95	111	0.106	0.103
Population (1000)	248	245	18902	18977	248	245
Average wages (municipality)	19484	19549	6.63	6.70	19701	19811
Av. days unemployment (m)	6.27	6.19	883	894	5.95	5.99
Av. social benefits (m)	1349	1321			1306	1274
Group G: South America and Eastern Europe						
Observations	3734	1125	2524	1043	2524	1043
Individual wages	16963	19343	0.523	0.516	17869	20737
Negative Attitudes	0.509	0.506	0.068	0.071	0.513	0.506
% immigrants ND countries	0.091	0.096	111	121	0.094	0.090
Population (1000)	205	225	18956	19055	185	183
Average wages (municipality)	19172	19314	6.39	6.27	19271	19406
Av. days unemployment (m)	6.67	6.67	945	954	6.33	6.31
Av. social benefits (m)	1367	1408			1262	1211

Table III : Immigrants from Developed Countries 1987 – 1991

Means for 1996 to 2003

	Stayers			Movers		
	First location			Last location		
	All	Well educated		All	Well educated	
Group W: OECD countries (in 1985) except Turkey						
Observations	2481	997		1489	715	1489
Individual wages	19275	22320		20500	23675	20500
Negative Attitudes	0.504	0.500		0.501	0.496	0.501
% immigrants ND countries	0.071	0.074		0.078	0.081	0.074
Population (1000)	156	194		190	208	135
Average wages (municipality)	18822	19092		19157	19284	19291
Av. days unemployment (municipality)	7.04	6.78		6.88	6.77	6.34
Av. social benefits (municipality)	1146	1195		1188	1220	1000
						1081

Table IV : Immigrants that arrived 1987 – 1991
Effects on Wages

	Group B		Group G		Group W	
	no	yes	no	yes	no	yes
Negative Attitudes	0.00 (0.05)	0.04 (0.05)	0.04 (0.07)	0.02 (0.06)	-0.07 (0.10)	-0.06 (0.09)
Neg. Attitudes *	-0.28 ** (0.11)	-0.23 ** (0.11)	-0.24 ** (0.12)	-0.26 * (0.15)	-0.26 * (0.16)	0.07 (0.16)
Well Educated						
% Immigrants	0.91 *** (0.22)	0.64 *** (0.20)	0.64 *** (0.20)	-0.46 (0.33)	-0.41 (0.31)	-0.81 (0.90)
from NDC						
% Immigrants *	-0.29 (0.50)	-0.22 (0.49)	-0.22 (0.49)	-0.11 (0.99)	-0.41 (1.05)	1.77 (1.52)
Well Educated						
Neg. Attitudes *	-0.29 (0.37)	-0.33 (0.33)	-0.33 (0.33)	1.18 ** (0.52)	0.79 (0.49)	1.66 (1.51)
% Immigrants	0.72 (0.93)	0.53 (0.90)	0.53 (0.90)	0.76 (1.77)	1.19 (1.91)	-1.96 (2.73)
Neg. Attitudes *						
% Immig * Ed						
Correlated residuals	no	yes	no	yes	no	yes
Observations	9452	3293	6252	1947	3941	1129
Clusters						

All columns include the following controls: individual controls (age, age squared, level of education, sex, civil status and years since immigration), municipal controls (average level of wages, average days of unemployment, average level of social benefits), regional effects at the county level, year effects, country of origin dummies and controls for the number of refugees coming from the same country to the municipality during 1987 – 1991. * significant at 10%; ** significant at 5% and *** significant at the 1% level.

Table V : Immigrants that arrived 1987 – 1991
Effects on Location

	Group B		Group G		Group W	
	no	yes	no	yes	no	yes
Negative Attitudes	-0.12 (0.08)	-0.51 *** (0.10)	-0.27 ** (0.12)	-0.43 ** (0.15)	-0.23 *** (0.06)	0.14 (0.18)
Neg. Attitudes * Well Educated	-0.14 (0.14)	-0.02 (0.07)	0.17 (0.24)	0.03 (0.26)	0.12 (0.12)	-0.10 (0.30)
% Immigrants from NDC		2.31 *** (0.24)	1.22 *** (0.14)	1.16 *** (0.33)	0.63 *** (0.17)	-1.14 *** (0.34)
% Immigrants * Well Educated		-0.08 (0.39)	-0.12 (0.21)	-0.02 (0.57)	-0.13 (0.29)	0.42 (0.49)
Neg. Attitudes * % Immigrants		-7.30 *** (1.44)	-4.00 *** (0.86)	-1.26 (2.06)	-0.84 (1.15)	0.62 (2.57)
Neg. Attitudes * % Immig * Ed		3.32 (2.42)	2.35 * (1.34)	-3.21 (3.26)	-1.05 (1.77)	-1.96 (2.58)
Correlated residuals	no	yes	no	yes	no	yes

All columns include the same controls as the ones in table IV plus geographical variables (ten years average minimum temperature in winter and latitude) and population size. * significant at 10%; ** significant at 5% and *** significant at the 1% level.

Table VI : Heckman Selection Bias Correction
Immigrants that arrived 1987 - 1991

Effects on:	Wages		Location
Negative Attitudes * group B	-0.02 (0.05)	0.01 (0.07)	-0.21 (0.14)
Negative Attitudes * group B * well educated	-0.24 ** (0.11)	-0.52 ** (0.21)	0.16 (0.29)
Negative Attitudes * group G	0.05 (0.05)	0.11 (0.07)	-0.50 ** (0.24)
Negative Attitudes * group G * well educated	-0.09 (0.12)	-0.33 (0.21)	0.22 (0.44)
Negative Attitudes * group W	0.22 *** (0.05)	0.19 *** (0.07)	-0.30 (0.27)
Negative Attitudes * group W * well educated	0.01 (0.11)	-0.22 (0.20)	0.16 (0.53)
% immigrants ND countries * group B		-0.38 (0.50)	3.92 *** (0.36)
% immigrants NDC * group B * well educated		-1.67 (1.28)	0.11 (0.75)
% immigrants ND countries * group G		-0.76 (0.62)	0.48 (0.55)
% immigrants NDC * group G * well educated		-2.34 (1.76)	1.38 (1.22)
% immigrants ND countries * group W		2.20 ** (1.01)	-2.32 *** (0.72)
% immigrants NDC * group W * well educated		-0.63 (2.10)	-1.82 (1.46)
Neg. Attitudes * % immigrants NDC * group B		1.04 (0.87)	-11.45 *** (2.32)
Neg. Attitudes * % immig. NDC * group B * well educated		4.00 * (2.28)	-3.58 (4.45)
Neg. Attitudes * % immig. NDC * group G		1.34 (1.08)	-0.83 (3.68)
Neg. Attitudes * % immig. NDC * group G * well educated		4.87 (3.15)	-6.96 (6.20)
Neg. Attitudes * % immig. NDC * group W		-2.75 (1.85)	7.78 * (4.00)
Neg. Attitudes * % immig. NDC * group W * well educated		1.64 (3.89)	-7.17 (8.69)
Lambda			-0.01 -0.03
Observations	92044		
Individuals (clusters)	15886		

Controls: same as in Tables IV (effects on wages) and V (effects on location).

* significant at 10% ; ** significant at 5% and *** significant at the 1% level.

Table VII : Immigrants that arrived 1985 - 1994
Effects on Wages

	Group B			Group G			Group W				
	no	yes	yes	no	yes	yes	no	yes	no	yes	
Negative Attitudes	0.03 (0.04)	-0.02 (0.05)	0.06 (0.04)	0.04 (0.04)	-0.05 (0.04)	-0.08** (0.04)	-0.01 (0.03)	-0.02 (0.03)	-0.08 (0.09)	-0.08 (0.08)	
Neg. Attitudes * Well Educated	-0.28*** (0.09)	-0.26** (0.10)	-0.24*** (0.09)	-0.21** (0.10)	-0.10 (0.08)	-0.16* (0.09)	-0.07 (0.08)	-0.12 (0.09)	0.10 (0.17)	0.17 (0.15)	
% Immigrants from ND countries	0.77*** (0.18)		0.54*** (0.17)			-0.05 (0.18)		-0.12 (0.17)	-0.85 (0.69)	-0.26 (0.67)	
% Immigrants NDC * Well Educated	-0.03 (0.40)		0.04 (0.38)			-0.31 (0.55)		-0.51 (0.56)	1.71 (1.16)	1.84 (1.15)	
Neg. Attitudes * % Immigrants NDC	-0.03 (0.30)		-0.14 (0.27)			0.63** (0.27)		0.52** (0.25)	1.62 (1.16)	1.18 (1.15)	
Neg. Attitudes * % Immig * Ed.	0.22 (0.73)		-0.07 (0.70)			0.98 (1.00)		1.16 (1.04)	-2.34 (2.10)	-2.75 (2.10)	
Correlated residuals	no	no	yes	yes	no	no	no	yes	yes	no	yes
Observations		15393				17255			6441		
Clusters		5486				5799			1858		

Controls: same as in table IV. * significant at 10%; ** significant at 5% and *** significant at the 1% level.

Table VIII : Immigrants that arrived 1985 - 1994
Effects on Location

	Group B		Group G		Group W					
	no	yes	no	yes	no	yes				
Negative Attitudes	-0.12* (0.06)	-0.43*** (0.09)	-0.07** (0.03)	-0.25*** (0.05)	-0.28*** (0.06)	-0.36*** (0.08)	-0.17*** (0.03)	-0.20*** (0.04)	0.26 (0.16)	0.16* (0.09)
Neg. Attitudes * Well Educated	-0.14 (0.12)	0.00 (0.16)	-0.02 (0.06)	0.08 (0.08)	-0.02 (0.12)	-0.17 (0.14)	0.04 (0.06)	0.00 (0.07)	-0.20 (0.26)	-0.16 (0.13)
% Immigrants from NDC		2.02*** (0.18)		1.05*** (0.10)		0.64*** (0.19)		0.34*** (0.10)	-2.04*** (0.52)	-1.03*** (0.27)
% Immig NDC * Well Educated		0.28 (0.32)		0.07 (0.16)		0.49 (0.34)		0.12 (0.17)	0.14 (0.77)	0.03 (0.40)
Neg. Attitudes * % Immig NDC		-4.89*** (1.23)		-2.89*** (0.68)		-1.24 (1.16)		-0.74 (0.65)	2.57 (2.50)	1.31 (1.39)
Neg. Attitudes * % Immig * Ed.		2.70 (2.11)		1.97* (1.08)		-2.32 (1.89)		-0.59 (1.01)	0.36 (3.79)	-0.03 (2.13)
Correlated residuals	no	no	yes	yes	no	no	yes	yes	no	yes

Controls: same as in table V. * significant at 10%; ** significant at 5% and *** significant at the 1% level.

Chapter 3

Who is hurt by discrimination?^{*}

1 Introduction

Labour market discrimination is a situation where individuals who are equally productive are treated unequally. Specifically, they may receive lower wages or face lower demands for their services at a given wage in a way that is related to an observable characteristic, such as race or ethnicity.

In 2003, 90% of the respondents to the "Integrationsbarometer" (Swedish Integration Barometer), a survey carried out by Integrationsverket (The Swedish Integration Board), thought that immigrants are discriminated against in Sweden. Furthermore, 9% of the respondents declared that they had witnessed ethnic discrimination at their own workplace. Field experiments provide further evidence of the existence of discrimination. Carlsson and Rooth (2006) performed a field experiment in May 2005 to February 2006 that showed every fourth Swedish employer to discriminate against men with Arabic sounding names in the hiring process. Similar field experiments find evidence of discrimination in the selection of job interviews in Australia (Riach and Rich (1991)) and the US (Bertrand and Mullainathan (2003)).

The present paper takes as a starting point that workers may end up in occupations below their qualifications due to discrimination. The problem of discrimination

* This is a joint work with Birthe Larsen, Centre for Business Research (CEBR) and Copenhagen Business School. We are grateful to Torsten Persson for his advice, to Anders Björklund, Ethan Kaplan, Mårten Palme, David Strömberg and seminar participants at the 1st Nordic Summer Symposium in Macroeconomics, SULCIS, SOFI and the Economics Department, Stockholm University for helpful comments and to Christina Lönnblad for editorial assistance. Financial support to G. Waisman was given by Handelsbanken's Research Foundations and Mannerfelts Fond. All errors are ours.

becomes more severe if workers are subject to the risk of losing skills during a spell of unemployment. If a worker's attachment to the labour market becomes fragile due to discrimination, her skills potentially deteriorate and the worker ends up searching for less qualified jobs. Hence, discrimination may not only result in natives and immigrants getting different pay for the same work, but also in natives and immigrants with similar skill levels ending up in different occupations, if in any occupation at all. This issue has previously been ignored in the theoretical literature.

Our purpose in this paper is to theoretically study the effects of discrimination of immigrants on labour market performance for both natives and immigrants, given that all workers are subject to the risk of losing skills during a period of unemployment.¹

We formulate a model of Becker-style taste discrimination within a search and wage-bargaining setting. In this model, even an employer who does not dislike immigrants himself may think that it is against his interests to employ immigrants if he expects that co-workers and clients will disapprove of them. Not all firms discriminate against immigrants, however. For simplicity, we assume that neither job searchers nor firms opening a vacancy know whether discrimination will take place before they enter a given match. Formally, we assume that each firm has many interviewers, some of which dislike immigrants, but the firm cannot observe if a particular interviewer has such discriminating tastes. A discriminating interviewer does not offer a job to an immigrant. Discrimination therefore implies that immigrants face a lower probability of getting a job.

An alternative way of modelling discrimination is to assume that immigrants are discriminated against when they separate from a job instead of upon entry. An immigrant worker would then be fired, or forced to resign, due to discrimination with a probability that is higher than that for a native worker. This alternative set-up would fit better with the assumption that neither job searchers nor employers can observe whether discrimination will take place in a particular firm. However, we believe that discrimination upon entry is more common in the labour market. Moreover, the two modelling strategies yield qualitatively similar results.

For simplicity, we assume that all workers enter the labour market as skilled

¹ See Larsen (2001) for a related set-up which does not distinguish between immigrants and natives, however.

workers. Unemployed workers face the risk of losing their skills. If this happens, they can only search for jobs in the low productivity sector. Low productivity workers may regain their skills by accumulating work experience or training when unemployed.

The model delivers the following results. Discrimination directly reduces an immigrant worker's transition probability out of unemployment and thereby deteriorates her wage-bargaining position. Therefore, discrimination implies that wages received by immigrants are lower than wages received by natives, even when they face a non-discriminating employer. A lower hiring probability also implies that immigrants suffer from higher unemployment rates, despite receiving lower wages. By being unemployed more often, immigrants are subject to a higher risk of skill loss and the economy ends up with a higher proportion of immigrants than natives in low productivity jobs. One further important result of the model is that not only immigrants are affected by discrimination, so are the native workers in the economy. We perform comparative statics analyses where we consider the effect on wages and unemployment for all workers of an increase in the level of discrimination and the share of immigrants in the economy. Who is hurt by discrimination ?

Finally, we endogenize training which allows us to examine how discrimination affects the relative skill levels of natives and immigrants.

Related Research

Empirical evidence supports the idea that employment below the individual's qualifications and loss of skills are important issues to consider. Arai et al (2000) compare the percentage of immigrants in different occupations with the percentage of immigrants in the labour force in Sweden. Immigrants are overrepresented in only three occupations out of 29, all of which require no education or training.² The authors estimate the likelihood of getting a qualified job, controlling for the years since immigration and the level of education. Immigrants born in the other Nordic countries or in Western Europe have a 25% lower probability of getting a qualified

² Immigrants are overrepresented in handicraft (such as baker, butcher, tailor), service work that requires no vocational education / training (such as salesman, cleaner, newspaper distributor) and other work that requires no vocational education / training (such as unskilled labour in building and construction and other factory work). The underrepresentation in all other occupations is stronger for immigrants from Africa, Asia or Latin-America than for those born in Europe.

job than natives. The probability of getting a qualified job is 50% lower for immigrants born in Latin America and 70% lower for those born in East Europe, Asia or Africa, than for natives. Reitz (2001) shows that the under-utilization of immigrant skills is significant in Canada. In an empirical study for Denmark, Nielsen et al (2004) show that a large fraction of the wage gap between immigrants and natives would disappear if only immigrants could find employment and thus accumulate work experience.

Most existing theoretical models studying discrimination in the labour market emphasize either of two broad types of discrimination. The first is prejudice, which Gary Becker formalizes as a “taste” of at least some members of the majority group for not interacting with members of the minority group. The second is statistical discrimination by employers in the presence of imperfect information about the skills or behaviour of members of the minority group.

Simple models of taste-based discrimination often predict the elimination of discrimination through competition or segregation. Borjas and Bronars (1989) and subsequent papers merge ideas from search models of the labour market with Becker-style models of taste discrimination and obtain a number of important results. Rosén (1997), Flabbi (2004) and our own model belong to this group. The difference between our model and the models of Rosén, Flabbi and Borjas is that in a thorough analysis of unemployment, we incorporate the risk that workers potentially lose skills.

The paper is organized as follows. The model is set up in section 2. Section 3 incorporates the comparative statics. In section 4 we show the effect of relaxing simplifying assumptions and endogenizing the training decision when unemployed. Section 5 concludes.

2 The model

We develop a model with two types of agents, workers and firms. Both workers and firms are risk-neutral and infinitely-lived and have a common discount rate. Workers may either be employed or unemployed. To hire new workers, firms must create a vacancy at a cost k . Free entry drives the discounted profits from creating a vacancy to zero.

The economy is divided into two different sectors, called h and l . Firms in sector h require skilled workers with high productivity, while firms in sector l employ low productivity workers. The skills of workers are observable, implying that low productivity workers never get a job offer in sector h .

The economy is populated by native and immigrant workers and the labour force is normalized to one. The proportion of native workers, n , is exogenously given.

To acknowledge that not all firms discriminate against immigrants, we consider the following set-up:

- All firms in a sector have interviewers that meet job seekers, a proportion d_s of which dislikes immigrants ($s = h, l$).
- When a discriminating interviewer meets a skilled immigrant, she does not get a job offer.
- Firms cannot observe whether their own interviewers discriminate against immigrants or not. Neither job searchers nor the firm opening a vacancy know whether discrimination will take place before the match.
- Firms and workers only know that, with a given probability d_s ($s = h, l$), an immigrant worker will not get a job, and a vacancy will not be filled due to discrimination.

For simplicity, we assume that all workers enter the labour market as skilled workers. A more realistic set-up where we assume that a proportion of workers are low skilled to start with does not substantially modify the results. When unemployed, skilled workers lose their skills with probability λ . Workers who have lost their skills are only able to search for jobs in the low productivity sector. Workers may regain skills in two different ways: i) they can train while unemployed and become skilled unemployed, which happens at the rate γ and ii) they can get a low productivity job and regain their skills at rate a . For simplicity, γ and a are assumed to be exogenous and identical for natives and immigrants. The alternative where workers decide whether they want to make an effort to train and once more become skilled is considered as an extension below.

2.1 Matching

Unemployed workers search for jobs in sector h or l , depending on their productivity level. The matching function for sector s is assumed to have the functional form $(v_s)^\alpha (u_s)^{1-\alpha}$, where v_s is the sectoral vacancy rate and u_s is the unemployment rate in sector $s = h, l$ and $0 < \alpha < 1$.

A native worker with productivity s gets a job offer at rate f_s^N . The transition rate into employment for a native worker with productivity s is given by $f_s^N = f(\theta_s) = \theta_s^\alpha$, $s = h, l$, where $\theta_s = v_s/u_s$ captures sectorial labour market tightness. An immigrant faces a discriminating interviewer with probability d_s , so the transition rate into employment for an immigrant worker of productivity s is reduced relative to the transition rate of natives to $f_s^I = f(\theta_s)(1 - d_s) = \theta_s^\alpha(1 - d_s)$, $s = h, l$. The rate at which vacant jobs become filled is $q_s = q(1/\theta_s) = \theta_s^{\alpha-1}$, $s = h, l$.

2.2 Workers and firms

The arbitrage equation facing unemployed workers in sector h is given by

$$\rho U_h^J = f_h^J (W_h^J - U_h^J) + \lambda (U_l^J - U_h^J), \quad J = N, I. \quad (3.1)$$

The present discounted value (PDV) of being an unemployed skilled worker of origin $j = N, I$ (natives or immigrants) is given by the likelihood that the worker changes state. With probability f_h^J , she gets a job in the high productivity sector and receives the value W_h^J and with probability λ she loses skills and becomes a low skilled unemployed with value U_l^J .

$$\rho U_l^J = f_l^J (W_l^J - U_l^J) + \gamma (U_h^J - U_l^J), \quad J = N, I. \quad (3.2)$$

Low skilled unemployed workers get a job in the low productivity sector with probability f_l^J and regain skills by training while unemployed at the rate γ . The value of γ is assumed to be exogenous but will be endogenized in an extension.

The present discounted utility for a skilled employed worker of origin J satisfies

$$\rho W_h^J = w_h^J + \sigma (U_h^J - W_h^J), \quad (3.3)$$

where w_{jh} is the wage received by skilled workers of origin J and σ is the rate of job separation, assumed to be the same for all workers. Similarly

$$\rho W_l^J = w_l^J + \sigma (aU_h^J + (1-a)U_l^J - W_l^J). \quad (3.4)$$

We assume that workers separated from their jobs regain their skills and join the pool of skilled unemployed at rate a , while they join the pool of low skilled unemployed at a rate $(1-a)$.

The present discounted value of a new vacancy in sector s is

$$\rho V_s = q_s (\phi_s (X_s^N - V_s) + (1 - \phi_s) (1 - d_s) (X_s^I - V_s)) - k, \quad s = h, l. \quad (3.5)$$

q_s is the likelihood that a firm matches with any worker, ϕ_s is the proportion of natives among the unemployed workers of productivity s and k is the cost of opening a vacancy. With probability $q_s \phi_s$, the vacancy can be filled by a native and provide a value X_s^N to the firm, while the probability of filling it with an immigrant is $q_s (1 - \phi_s) (1 - d_s)$, creating the value X_s^I .

Interviewers always hire the native worker with whom they are matched, but if they are discriminating, they do not hire an immigrant. As a consequence, there is an instantaneous probability $q_s (1 - \phi_s) d_s$ that the vacancy is not filled. Firms would prefer to avoid discriminating interviewers in this setting, but they cannot since this characteristic is not observable.

The PDV of a job occupied by a worker of origin J , X_s^J satisfies

$$\rho X_s^J = y_s - w_s^J + \sigma (V_s - X_s^J), \quad s = h, l \text{ and } J = N, I. \quad (3.6)$$

Productivities y_h and y_l and the exogenous separation rate σ are assumed to be the same for natives and immigrants. Free entry drives the value of vacancies to zero in both sectors. Using equations (3.5) and (3.6) and setting $V_s = 0$, we obtain two equations to determine labour market tightness, θ_s $s = h, l$.

$$g_h = k \frac{1}{q_h} (\rho + \sigma) - \phi_h [y_h - w_h^N] - (1 - \phi_h) (1 - d_h) [y_h - w_h^I] = 0, \quad (3.7)$$

$$g_l = k \frac{1}{q_l} (\rho + \sigma) - \phi_l [y_l - w_l^N] - (1 - \phi_l) (1 - d_l) [y_l - w_l^I] = 0. \quad (3.8)$$

The matching function relates the rates at which vacant jobs become filled to labour market tightness. Note that, for given wages, a firm's outside option deteriorates when there are many unemployed immigrants in the unemployment pool, that is when ϕ_s is small. In the next subsection, we derive equilibrium wages which depend on labour market tightness through the transition rates into employment.

2.3 Wages

Wages are determined by Nash Bargaining with bargaining power equal to one half, so they are set to equalize the parties' outside options,

$$W_s^J - U_s^J = X_s^J.$$

For skilled workers, this equalization implies a wage

$$w_h^J = \frac{1}{2} (y_h + \rho U_h^J), \quad J = N, I, \quad (3.9)$$

while, for low skilled workers, the equilibrium wage is

$$w_l^J = \frac{1}{2} (y_l + \rho U_l^J - \sigma a (U_h^J - U_l^J)). \quad J = N, I. \quad (3.10)$$

The wage of a low skilled worker decreases with σa , the rate at which an employed worker separates from the present match having regained skills. The possibility of regaining skills makes employment more attractive, so the worker is willing to accept a lower wage in the bargaining process.

Substituting equation (3.2) into the wages of low skilled workers, we obtain

$$w_l^J = \frac{1}{2} [y_l + f_l^J (W_l^J - U_l^J) + \gamma (U_h^J - U_l^J) - \sigma a (U_h^J - U_l^J)].$$

For simplicity, we assume that $\gamma = \sigma a$, that is, the rate at which a low skilled worker moves to the pool of skilled unemployed by training during unemployment equals the rate at which she enters that pool after separating from a job where she regained skills. This assumption implies that the last two terms in w_l^J cancel and the wages of low skilled workers become independent of the transition rate of skilled workers. The model becomes recursive and can be solved analytically.

Inserting the PDV from equation (3.1)-(3.4) in equations (3.9) and (3.10) and solving the two equations, we obtain:

$$w_l^J = \frac{\rho + \sigma + f_l^J}{2(\rho + \sigma) + f_l^J} y_l \quad J = N, I, \quad (3.11)$$

$$w_h^J = \frac{[(\rho + \sigma)(\rho + \lambda + \gamma) + (\rho + \gamma)f_h^J] y_h + \lambda f_l^J \frac{\rho + s}{2(\rho + s) + f_l^J} y_l}{2(\rho + \sigma)(\rho + \lambda + \gamma) + (\rho + \gamma)f_h^J} \quad (3.12)$$

where $f_s^N = f_s$ and $f_s^I = f_s(1 - d_s)$, $s = h, l$ and $J = N, I$.

Proposition 1 *Native workers receive higher wages than immigrants whatever their sector, $w_s^N > w_s^I$, $s = h, l$ as $f_s^N > f_s^I$. Moreover, skilled workers, whatever their origin, receive higher wages than low skilled workers, $w_h^J > w_l^J$, $J = N, I$ if $f_h > f_l$.*

Wages are increasing in the transition rates out of unemployment. Due to discrimination, skilled natives have a higher transition rate than skilled immigrants. This gives them a better bargaining position after a match, so they receive higher wages. Skilled workers receive higher wages than low skilled workers, due to their higher productivity.

Equations (3.11) and (3.12), together with equations (3.7) and (3.8), determine labour market tightness for the two sectors, $\theta_h = v_h/u_h$ and $\theta_l = v_l/u_l$.

A sufficient condition for the labour market tightness facing skilled workers to be higher than that facing low skilled workers, $\theta_h > \theta_l$ is that there is more discrimination in the low productivity sector, $d_h \leq d_l$, when the match efficiency $\alpha = \frac{1}{2}$. This implies that it is easier for a skilled worker than for a low skilled worker to find a job, $f_h > f_l$, irrespective of country of origin. This is only a sufficient condition and we can easily obtain $f_h > f_l$ even if discrimination is higher in the high productivity sector, as long as the productivity difference is sufficiently large.

2.4 Unemployment

Steady state employment and unemployment for skilled and low skilled workers are derived by considering the flows into and out of employment and the fact that $e_l^N + e_h^N + v_h^N + v_l^N = n$ and $e_l^I + e_h^I + v_h^I + v_l^I = 1 - n$, where e_s^J (v_s^J) denotes employment (unemployment). We obtain the following unemployment rates for immigrants and

natives:

$$u_s^N = \frac{v_s^N}{e_s^N + v_s^N} = \frac{\sigma}{\sigma + f_s}, s = h, l \quad (3.13)$$

$$u_s^I = \frac{v_s^I}{e_s^I + v_s^I} = \frac{\sigma}{\sigma + f_s(1 - d_s)}, s = h, l. \quad (3.14)$$

Proposition 2 *Immigrants face higher unemployment than natives in both sectors. That is, the unemployment rates faced by immigrants relative to those of natives for both high and low skilled workers, u_h^I/u_h^N and u_l^I/u_l^N are higher than one. The rate of unemployment facing skilled workers is lower than that experienced by low skilled workers as long as $f_h > f_l$.*

Both skilled and low skilled immigrants face an additional negative impact through discrimination, which increases the unemployment of immigrants relative to the unemployment of natives. This is easily seen using equations (3.13)-(3.14).

The proportion of native workers among unemployed high and low productivity workers is given by

$$\phi_h = \frac{1}{1 + \frac{(1-n)}{n}\kappa}, \quad \phi_l = \frac{1}{1 + \frac{(1-n)}{n} \frac{(\sigma+f_l)}{(\sigma+f_l(1-d_l))}\kappa},$$

where we assume that $\gamma = \sigma a$ and define $\kappa = \frac{\lambda+a(f_h+\sigma)}{\lambda+a(f_h(1-d_h)+\sigma)} > 1$. The additional negative impact of discrimination on low skilled immigrant workers results in relatively more natives among the skilled unemployed, $\phi_h > \phi_l$.

We now consider some partial impacts on the proportion of natives among the unemployed. When more immigrants are searching for jobs, a lower n , this directly reduces the share of native unemployed workers. If discrimination increases, a higher d_s , there will be relatively more immigrants among the unemployed workers. When labour market tightness increases, workers' transition rates increase, in particular reducing unemployment for natives since their transition rate is higher.

The unemployment facing high productivity workers is

$$v_h = v_h^N + v_h^I = \frac{n\sigma a}{\lambda + (\sigma + f_h) a} + \frac{(1-n)\sigma a}{\lambda + (\sigma + f_h(1 - d_h)) a}$$

and the unemployment facing low productivity workers is

$$v_l = \frac{\lambda n \sigma}{(\sigma + f_l)(\lambda + (\sigma + f_h) a)} + \frac{\lambda (1 - n) \sigma}{(\sigma + f_l (1 - d_l))(\lambda + (\sigma + f_h (1 - d_h)) a)}.$$

The unemployment rate facing natives and immigrants is

$$u^J = \frac{u_h^J + u_l^J}{u_h^J + u_l^J + e_h^J + e_l^J} = \frac{\sigma (a (\sigma + f_l^J) + \lambda)}{(a (\sigma + f_h^J) + \lambda) (\sigma + f_l^J)}, \quad J = N, I. \quad (3.15)$$

Discrimination reduces the transition rates for immigrants with respect to natives, $f_s^I < f_s^N$, so that the unemployment rate facing immigrants is higher than the one facing natives.

2.5 Skills

For simplicity, we have assumed that all workers enter the labour market as skilled workers. The difference in unemployment rates derived in the previous subsection has consequences for the distribution of skills in the steady state.

Proposition 3 *Due to discrimination, the proportion of low skilled immigrants is higher than the proportion of low skilled natives in the economy.*

Proof. The proportion of high productivity workers among immigrants and natives is

$$\begin{aligned} \frac{v_h^I + e_h^I}{1 - n} &= \frac{a (\sigma + f_h (1 - d_h))}{(\lambda + a (f_h (1 - d_h) + \sigma))}, \\ \frac{v_h^N + e_h^N}{n} &= \frac{a (\sigma + f_h)}{(\lambda + a (f_h + \sigma))}. \end{aligned}$$

We observe that

$$\frac{v_h^I + e_h^I}{1 - n} < \frac{v_h^N + e_h^N}{n}, \quad \frac{v_l^I + e_l^I}{1 - n} > \frac{v_l^N + e_l^N}{n}.$$

■

In our model where natives and immigrants enter the economy with the same distribution of skills, immigrants become less skilled just because some interviewers refuse to offer them a job. Note that this result is independent of whether we have

discrimination of low skilled workers, due to the fact that the rate of regaining skills during the spell of unemployment is equal to the rate of regaining skills during the spell of employment. On the other hand, if there is no discrimination of high skilled workers, the proportion of natives and immigrants among both high and low skilled workers is identical.

Next, we consider comparative statistics of an increase in the level of discrimination and an increase in the share of immigrants in an economy where some interviewers discriminate immigrants.

3 Comparative Statics

We consider two shocks to labour market conditions: an increase in the level of discrimination and an increase in the share of immigrants. When there is a change in the labour market conditions, this affects the bargaining position of a worker in the match. If her position is strengthened, because of a better outside option, then she will be able to negotiate a higher wage. This is the direct effect of the change. But there is a further indirect effect. Firms become discouraged by the fact that at least some workers require higher wages to accept the job and thus, they offer less vacancies. This reduces labour market tightness and thus, the probability of any worker in that sector (independently of the origin) becoming employed. Therefore, the indirect effect affects both natives and immigrants in the sector.

In each of the following subsections, we need to identify how the comparative statics affect the position of the different workers to assess the direct and indirect effect on wages and unemployment rates.

3.1 Effects of higher discrimination

In this section, we perform comparative statics regarding the impact of an increase in the share of discriminating interviewers on the rates of unemployment, the distribution of unemployment, wages and the distribution of wages. The proofs easily follow from differentiation of the appropriate expression(s) stated in sections 2.3 and 2.4.

It is easier to understand the intuition behind the results if we concentrate on discrimination in a single sector at a time. First, we consider the case when discrim-

ination only appears in the high productivity sector. Then, we describe the effect of an increase in the level of discrimination when it exists only in the low productivity sector. Finally, we describe the effect of having discrimination in the whole economy. Empirical evidence is not conclusive with respect to which sector is most affected by discrimination, but most theoretical papers assume that the problem is more acute for skilled immigrants.³

3.1.1 Discrimination of skilled workers

If discrimination is only present in the high productivity sector, it has no effect on the transition rates in the low productivity sector and the wage received by low skilled natives equals that of low skilled immigrants, due to the simplifying assumption ($\gamma = \sigma a$) that makes the model recursive. Furthermore, the proportion of natives among the unemployed is the same for skilled and non skilled workers, that is, $\phi_h = \phi_l$, as low skilled immigrants are only indirectly affected by discrimination in sector h .

When only skilled immigrants are discriminated, the sufficient condition that $d_h \leq d_l$ to ensure that $f_h > f_l$ no longer holds. If productivity differences are not sufficiently large, $f_h(1 - d_h) < f_l$ is a possibility. In this case, it would be optimal for high skilled workers to search for low skilled jobs. In order to rule out this possibility, we therefore assume that productivity differences are sufficiently large so that $f_h(1 - d_h) > f_l$ holds.

Proposition 4 *All wages in the high productivity sector decrease whenever the discrimination of skilled workers, d_h , increases. The wages of low skilled workers are not affected. The relative wage of skilled immigrants vs. skilled natives, w_h^I/w_h^N , decreases.*

As d_h increases, the wages of skilled immigrants are directly reduced by the deterioration in the bargaining position caused by higher discrimination and indirectly by the lower transition rate faced by all skilled workers. The wages of skilled natives

³ In a companion paper, Waisman and Larsen (2007), we show that well educated immigrants suffer more than less educated immigrants in Swedish municipalities where the attitudes against them are more negative. We interpret this result as evidence that discrimination has a larger effect on skilled workers.

are only affected by the lower transition rates, so the relative wages of immigrants in the high productivity sector are reduced.

Due to the simplifying assumption that makes the model recursive, discrimination in the high productivity sector has no impact on the labour market tightness faced by low skilled workers, which implies that their wages are not affected.

Proposition 5 *The unemployment of all skilled workers goes up when the discrimination of skilled workers, d_h , increases. Skilled immigrants are more affected than skilled natives. Unemployment of low skilled workers is not affected by d_h .*

The direct effect of higher discrimination is that more skilled immigrants become unemployed and risk losing their skills, which would imply that they join the pool of low skilled unemployed. This direct effect affects immigrants only, thereby increasing their relative unemployment rate among skilled workers, (u_h^I/u_h^N) .

The indirect effect is a reduction in the transition rates into employment for all skilled workers when less vacancies are opened. At the same time, discrimination conducted by some interviewers generates a reduction in wages which provides a positive externality on firms with non discriminating interviewers. The first impact dominates and the total impact on labour market tightness is negative. Due to discrimination, natives are over-represented among skilled workers and more affected by this negative indirect effect.

The impact on skilled natives' unemployment is smaller than the total impact on skilled immigrants' unemployment if

$$\frac{\lambda + \gamma}{\lambda + af_h + \gamma} \left(\frac{d_h}{f_h} \right) \frac{df_h}{dd_h} + 1 > 0.$$

If this is the case, (u_h^I/u_h^N) increases when d_h rises. The relative unemployment rate of low skilled vs. high skilled workers decreases for both immigrants (u_l^I/u_h^I) and natives (u_l^N/u_h^N) .

3.1.2 Discrimination of low skilled workers

Wages are affected in the following way:

Proposition 6 *All wages go down whenever the discrimination of low skilled workers, d_l , increases. The relative wages of immigrant vs. native low skilled workers,*

w_l^I/w_l^N , decrease with discrimination.

Low skilled immigrants suffer from both the direct and the indirect effect of discrimination. Low skilled natives only suffer from the indirect effect; hence their wages decrease less than those of low skilled immigrants. More discrimination in the low productivity sector reduces vacancy supply and thus, the outside option even for low skilled natives and skilled workers, since they are subject to the risk of losing skills. Skilled workers' bargaining position is then damaged and all skilled workers accept lower wages. The wage reduction increases their transition rate which, in turn, has a positive effect on wages, but this effect is smaller than the wage reduction. The total impact on wages is then negative for all skilled workers.

The impact on relative wages of immigrants vs. native skilled workers, w_h^I/w_h^N , is ambiguous as there are several diverging effects. As d_l increases, there is a direct negative impact on relative wages. In addition, there is an increase in the transition rate of high productivity sector workers, which tends to decrease relative wages. Finally, the reduction in the transition rate of low productivity workers has an ambiguous impact on relative wages as immigrants' wages already being lower dampens the impact.

Proposition 7 *When discrimination of low skilled workers, d_l , increases, unemployment of skilled workers falls and unemployment of low skilled workers increases. The relative unemployment of immigrant vs. native low skilled workers increases when d_l becomes higher.*

The direct effect of higher discrimination in the low productivity sector is that more low skilled immigrants cannot get a job. But all low skilled workers face higher unemployment, due to the indirect effect that reduces the transition rates in this sector. This indirect effect hits immigrants more strongly as they are over-represented in the low productivity sector. The relative unemployment of low skilled workers, (u_l^I/u_l^N) , increases with d_l as a result of both the direct and the indirect effect.

When the value of being a low skilled worker decreases, all skilled workers accept a lower wage in order to avoid losing skills during the experience of unemployment. The lower wage makes skilled workers more attractive for firms and therefore, more

vacancies are opened in the high productivity sector. Hence, in this case, the existence of discrimination in the low productivity sector provides a positive externality on the high productivity sector by weakening the skilled workers' outside option. This raises the labour market tightness in the high productivity sector and therefore, reduces the unemployment of skilled workers. Hence, the discrimination of low skilled immigrants improves the employment perspectives of all skilled workers.

The relative unemployment of immigrants (u_l^I/u_h^I) and natives (u_l^N/u_h^N) increases as u_l^J increases and u_h^J falls for $J = N, I$.

3.1.3 Discrimination in both sectors

When discrimination prevails in both sectors, we can no longer obtain analytical results and instead turn to numerical solutions. The following parameter values are used (annual values) in the solutions: the discount rate is set to $\rho = 0.08$; the separation rate is set to $\sigma = 0.10$ (see Millard and Mortensen 1997); the match efficiency is assumed to be $\alpha = 0.5$ (Pissarides 1995); y_l is normalized to one; y_h is set equal to 1.3 to obtain a relatively large difference between productivity levels in the two sectors. Hiring costs are assumed to be $k = 0.6$ (60% of an annual low skilled wage). These costs are set in relation to the productivity of high skilled workers in order to generate reasonable unemployment rates. The fraction of natives was around $n = 0.9$ in Sweden in 2005 (www.scb.se). The rest of the parameters are set to approximately match unemployment in Sweden in 2005, $u = 0.073$ (www.oecd.org), the fact that the unemployment of natives was 59% of the unemployment of immigrants (Integrationsverket⁴) and that the fraction of long-term unemployed (more than 12 months of unemployment) was 19% (www.scb.se and www.oecd.org). In our model, the long-term unemployed correspond to the workers that have lost their skills. We assume $\lambda = 0.25$ and $\gamma = 0.08$, which implies that $a = \gamma/\sigma = 0.8$. We assume in the benchmark that one fourth of the interviewers discriminates against immigrants in both sectors⁵. Table I shows the wages and unemployment rates of all workers in the economy as well as the share of skilled natives and immigrants.

⁴ <http://ivpxweb.digitalinformation.se/Database/Integrationsverket/Arbetslivet/Arbetslöshet/Arbetslöshet.asp>

⁵ Consistent with the results by Carlsson and Rooth (2006).

We can start by comparing our benchmark with an economy where immigrants are not discriminated at all. Discrimination reduces all wages, increases the rates of unemployment faced by all workers and reduces the share of skilled natives and immigrants. But the negative effect is much stronger for immigrants than for natives. In our numerical exercise, immigrants' wages are reduced by 3%, while natives' wages are reduced by less than 0.1%. The rates of unemployment faced by immigrants increase by more than 30%, while those faced by natives increase by less than 1%. The share of skilled natives decreases by almost 5% compared to less than 0.1% for natives. In this numerical analysis, natives are only marginally affected by discrimination.

The share of low skilled workers obtained in the exercise is close to the share of long-term unemployed workers in Sweden, that is, those workers who are most likely to have lost their skills. Our numerical exercise shows that, due to discrimination, immigrants end up being less skilled than natives even if they entered the economy being as productive. The share of skilled workers would be smaller had we not, for simplicity, assumed that all workers enter the economy being skilled. Furthermore, the difference in the skill composition of natives and immigrants would be larger if we had assumed that immigrants enter the economy with low skills to a higher extent.

In the rest of this subsection, the benchmark with $d_h = d_l = 0.25$ constitutes the basis from which we will study the effect of increasing the level of discrimination in one sector at a time.

Doubling the share of interviewers that discriminate in the high productivity sector reduces the wages of skilled immigrants by 4% and increases the unemployment rate they face from 6.63% to 9.77%. The unemployment rate faced by skilled natives increases slightly from 5.05% to 5.14%. The reduction in skilled natives' wages and the increase in the unemployment rate faced by all low skilled workers are very small (they all change by less than 1%). The share of skilled immigrants falls by almost 9%, while the share of skilled natives decreases by only 0.3%.

The same increase in the level of discrimination in the low productivity sector mainly affects low skilled immigrants, whose wages decrease by 5.3% while the unemployment rate they face increases from 8.6% to 12.53%. The unemployment rate faced by low skilled natives increases from 6.59% to 6.69%. All other wages and

unemployment rates change by 1% at most. There is a slight increase in the share of skilled workers, both natives and immigrants.

The simulations basically confirm the results derived in the previous subsections. In general, the effect of an increase in the level of discrimination on wages has a smaller order of magnitude than the effect on unemployment rates.

When we allow for different levels of discrimination in the two sectors, we find the following additional results that are worth noting:

- When discrimination is higher in the low productivity sector, the relative wages of immigrants vs. natives are higher for skilled workers and vice versa, that is, $(w_h^I/w_h^N) \geq (w_l^I/w_l^N)$ when $d_h \leq d_l$.
- When discrimination is higher in the high productivity sector, the relative unemployment of immigrants vs. natives is larger for skilled workers than for low skilled workers and vice versa, that is, $(u_h^I/u_h^N) \geq (u_l^I/u_l^N)$ when $d_l \leq d_h$.
- When discrimination is higher in the high productivity sector, the relative unemployment of low skilled vs. skilled natives is higher than that of low skilled vs. skilled immigrants and vice versa, that is, $(u_l^N/u_h^N) \geq (u_l^I/u_h^I)$ when $d_l \leq d_h$.

3.2 Effects of higher share of immigrants

In this subsection, we perform comparative statistics on an increase in the proportion of immigrants in the population, while the total work force is still normalized to one. If there is discrimination in one sector, then an increase in the share of immigrants searching for a job in that sector makes vacancies less attractive, as the probability of their being filled is now smaller. We will describe the effect of an increase in the share of immigrants on wages and unemployment rates. The results are easily derived by differentiation.

3.2.1 Discrimination of skilled immigrants

Proposition 8 *When the share of immigrants rises in an economy where only skilled immigrants are discriminated, then the wages received by all skilled workers decrease. The impact on relative skilled wages across population groups is ambiguous. Wages received by low skilled workers remain unchanged.*

When there are more immigrants in the work force, the likelihood of a high productivity firm with a discriminating interviewer matching with one of them is higher, which makes vacancies less attractive. The bargaining position of all workers in the sector is weakened, so they accept lower wages. The reduction in wages itself increases the transition rates for skilled workers which, in turn, leads to a smaller reduction in wages. The impact on the relative wages of immigrant vs. natives skilled workers (w_h^I/w_h^N) is ambiguous. When there is an increase in the transition rates of high productivity sector workers, this tends to decrease the wages of immigrants relative to natives. However, this impact is modified due to the immigrants' transition rate already being the lower.

Due to the simplifying assumption on the rates at which workers regain skills, discrimination in the high productivity sector has no impact on the labour market tightness faced by low skilled workers. This implies that their wages are not affected.

Proposition 9 *When the share of immigrants increases in an economy where only skilled immigrants are discriminated against, the unemployment rate of all skilled workers increases. The unemployment rate of skilled natives increases relatively more than that of skilled immigrants. The unemployment of low skilled workers remains unchanged.*

When vacancies become less attractive, more skilled immigrants end up being unemployed. Note that the impact is purely a result of discrimination, which reduces the rate at which an open vacancy is filled and thereby reduces the equilibrium number of vacancies supplied in the economy. The prevalent discrimination means that skilled natives are working to a higher extent, so that they are more affected by the reduction in the transition rates in the high productivity sector. As a consequence, the relative unemployment rate of immigrant vs. native skilled workers (u_h^I/u_h^N) decreases. The relative unemployment of low skilled vs. skilled workers (u_l^J/u_h^J) decreases for both natives and immigrants, because u_l^J is constant and u_h^J increases for $J = N, I$.

3.2.2 Discrimination of low skilled workers

Proposition 10 *In an economy where low skilled immigrants are discriminated against, a higher proportion of immigrants, a higher $(1 - n)$, reduces the wages re-*

ceived by all low skilled workers. The impact on skilled workers' wages and relative wages is ambiguous.

An increase in the share of immigrants makes opening a vacancy in the low productivity market less attractive. The fall in the transition rate of low skilled workers when less vacancies are opened deteriorates their bargaining position, causing them to accept lower wages. Even skilled workers are induced to accept lower wages to avoid unemployment and the risk of losing skills, but the lower wages themselves lead to an increase in the transaction rate that once more raises wages. The total effect on skilled workers' wages is ambiguous.

As natives are employed to a higher extent, they are more affected by the reduction in wages. But the fact that immigrants' wages were already lower dampens the impact. The effects on relative wages for immigrant vs. native skilled workers (w_h^I/w_h^N) and low skilled workers (w_l^I/w_l^N) are ambiguous.

Proposition 11 *When the share of immigrants, $(1 - n)$, increases in an economy where only low skilled immigrants are discriminated against, the unemployment rates of all low skilled workers increase, while the unemployment rates of all skilled workers fall. The unemployment of low skilled natives increases more than the unemployment of low skilled immigrants. The relative unemployment of skilled workers is kept unchanged.*

Fewer vacancies reduce the transition rate of all low skilled workers and increase their unemployment. As low skilled natives are employed to a higher extent, they suffer a higher increase in unemployment, whereby the relative unemployment rate for immigrant vs. native low skill workers (u_l^I/u_l^N) decreases.

The fall in the transition rate of low skilled workers even deteriorates the wage-bargaining position of skilled workers. Skilled workers accept lower wages to avoid unemployment and the potential loss of skills. As there is no discrimination in the high productivity sector, all workers in this sector are equally affected by the indirect effect, so that the relative unemployment for immigrant vs. native skilled workers (u_h^I/u_h^N) remains unchanged.

3.2.3 Discrimination in both sectors

The comparative analysis when discrimination is present in both sectors is only possible in a numerical exercise. We start from the same benchmark defined in subsection 3.1.3 and analyse two different increases in the share of immigrants in the economy: i) we double the share of immigrants and ii) we increase this share by the same amount of percentage points as we increased the level of discrimination. These two exercises allow us to compare the effect on wages, unemployment rates and skills of an increase in the share of immigrants with the effect of an increase in the level of discrimination.

A doubling of the share of immigrants in the economy decreases the wages of all agents by 0.1% at most and increases the unemployment rates they face by 0.6% at most. If the share of immigrants in the economy increases from 10% to 35%, the wages of all agents still increase by 0.1% at most while the unemployment rates increase by 1.2% at most. In both exercises, there is a slight decrease in the share of skilled workers (natives and immigrants).

Our numerical example shows that the effect of an increase in the share of immigrants has a much smaller order of magnitude than the effect of an increase in discrimination.

4 Extensions

4.1 Comparative analysis with $\gamma \neq \sigma a$

In the main body of the paper, we have assumed that $\gamma = \sigma a$ as a device for making the model recursive. When we relax this assumption, wages in the low productivity sector depend on the difference in the value of being a high skilled vs. a low skilled unemployed, according to the following equation:

$$w_l^J = \frac{1}{2} [y_l + f_l^J (W_l^J - U_l^J) + (\gamma - \sigma a) (U_h^J - U_l^J)]. \quad (3.16)$$

Let us compare this with the case where $\gamma = \sigma a$. When $\gamma > \sigma a$, the low skilled worker's outside option improves, as the probability of regaining skills is higher while unemployed. This tends to increase the wages of low skilled workers. When $\gamma < \sigma a$, the opposite holds: low skilled workers are more eager to get a job as

training opportunities are now relatively higher while employed.

The new equilibrium wages and shares of natives among the unemployed in both sectors in the economy are presented in Appendix 1. The unemployment rates are defined by the same functions as before; they are only affected through the changes in the transition rates.

We now examine the impact on wages and unemployment of increasing the probability of regaining skills in a numerical exercise where parameters have the same values as in subsection 3.1.3. In Figures 1 and 2, we observe that both wages and unemployment rates increase when the probability of regaining skills when unemployed, γ , increases for a given σa . An increase in the probability of regaining skills while unemployed raises the low skilled worker's outside option and increases the wages of low skilled workers. It also improves the outside option of skilled workers since, if they happen to lose their skills, they will more easily regain them and, furthermore, they face higher wages when unskilled. A better outside option means that skilled workers also get better wages. Fewer vacancies are therefore created in both sectors.

The effect of an increase in γ is stronger for low skilled workers, as they are more directly affected. The stronger negative impact on labour market tightness and on the transition rate of low skilled workers implies that they face a stronger increase in unemployment. Hence, a larger increase in the rate at which low skilled workers regain skills induces a negative impact on workers due to the increase in unemployment and a positive impact on workers due to the increase in wages.

However, simulations show that relaxing this simplifying assumption entails a small change in the effect on wages and unemployment rates of an increase in discrimination or the share of immigrants. The main difference is that discrimination in the high productivity sector now also affects low skilled workers' wages. When $\gamma > \sigma a$, the wages received by low skilled immigrants fall, while w_l^f was unaffected by d_h when $\gamma = \sigma a$. The reduction in wages received by skilled workers causes an increase in labour market tightness in the low productivity sector, which reduces low skilled workers' unemployment. When $\gamma < \sigma a$, the wages of low skilled immigrants instead increase by d_h . This is the case since low skilled workers are more eager to get a job when $\gamma < \sigma a$ because they more frequently regain skills while employed than when unemployed. Therefore, when discrimination of high skilled workers in-

creases, their outside option deteriorates and they become relatively less eager to get a job which corresponds to an improvement in their bargaining position. The wage induces a negative impact on vacancy supply in the low productivity sector, whereby labour market tightness falls. However, the effect on unemployment is very small in our numerical example.

4.2 Endogenous training

In the previous subsection, we showed the effect on wages and unemployment of an increase in the exogenous rate at which skills are regained by an unemployed low skilled worker. This rate was assumed to be identical for natives and immigrants. Now, we will ask two different questions. To which extent would low skilled unemployed individuals choose to train and regain skills if they could do it at a cost? How is this decision affected by discrimination?

We assume that low skilled unemployed individuals face different costs of training every period. This cost is assumed to be measured in terms of effort. The exact amount of effort needed by a worker to retrain in a particular period depends on the location and time where this training is provided, whether she is healthy or sick, etc. These factors vary over time, so the worker does not know in advance how costly it would be for her to train. Each worker only knows the distribution of these costs in the population, which is assumed to be the same for natives and immigrants. This distribution determines the percentage of natives and immigrants choosing to train, which is equal to the probability that each worker will regain her skills. Once the choice to train becomes endogenous, immigrants will face different probabilities of regaining skills than natives because discrimination alters the value of skills.

In every period where they happen to be low skilled unemployed, natives and immigrants compare the value of skills with the cost of regaining skills they face in that particular period and decide whether to train or not. Notice that a worker who chose to train because he had a low cost of training in one period may instead have a very high cost next time he happens to become unemployed. The costs a worker gets over time are completely independent of each other. This is equivalent to assuming that the low skilled unemployed draw costs from a lottery in each period.

Let the distribution of the cost of training c_i be uniformly distributed between 0 and 1 and identical for natives and immigrants. The value of skills is the same for

all natives irrespective of the cost and the same is true for immigrants. All workers will choose to train if their cost is lower or equal to the value of skills for them.

The value of regaining skills for a given share of low skilled unemployed of origin J that decide to train γ^J is defined as

$$\begin{aligned} \rho Z^J (\gamma^J) &= \rho U_h^J (\gamma^J) - \rho U_l^J (\gamma^J) , \\ &= \rho U_h^J (\gamma^J) - \frac{\rho}{(\rho + sa)} [2w_{jl} - y_l + sa U_h^J (\gamma^J)] , \\ &= \rho [2w_h^J (\gamma^J) - y_h] - \frac{\rho}{(\rho + sa)} [2w_{jl} - y_l + sa (2w_h^J (\gamma^J) - y_h)] \\ &= \frac{\rho}{(\rho + sa)} \{ [2w_h^J (\gamma^J) - y_h] - [2w_l^J (\gamma^J) - y_l] \} . \end{aligned}$$

Workers choose to train as long as $\rho Z^J \geq c_i$. Let \hat{c}^J be the cost of the marginal low skilled unemployed of origin J that chooses to train, so that $\rho Z^J = \hat{c}^J$. Given that c_i is uniformly distributed between 0 and 1 for $J = N, I$, the proportion of workers of origin J that chooses to train is equal to \hat{c}^J . So far, we have called this proportion γ^J . This means that the equilibrium condition that determines the optimal proportion of low skilled unemployed choosing to train is $\rho Z^J (\gamma^J) = \hat{c}^J = \gamma^J$. The optimal proportion is then solved as a fixed point:

$$\frac{\rho}{(\rho + sa)} \{ [2w_h^J (\gamma^J) - y_h] - [2w_l^J (\gamma^J) - y_l] \} = \gamma^J, \quad J = N, I. \quad (3.17)$$

Incorporating equation (3.17) into the model for natives and immigrants, we can solve for the optimal choice in our numerical exercise.

If discrimination prevails in the high productivity sector, skills are more valuable for natives than for immigrants, so they choose to train to a larger extent. Consequently, $\gamma^N > \gamma^I$ when $d_h > 0$ and $d_l = 0$. If discrimination instead exists in the low productivity sector only, the value of being able to regain skills is highest for low skilled immigrants. Training means that they can escape the sector where they are discriminated against and move into a sector where productivity is larger and where they are as likely to get jobs as natives. This means that $\gamma^I > \gamma^N$ when $d_l > 0$ and $d_h = 0$.

Figures 3 and 4 show the results of the comparative statics analysis of increasing discrimination in one sector at a time in the presence of discrimination in both sectors when the decision to train is endogenous. We assume that $d_s = 0.25$ in the

sector where discrimination is constant.

As discrimination in the high productivity sector increases, the value of skills decreases for all workers, so less of them choose to train. The effect is much stronger for immigrants who directly suffer from discrimination. When $d_h > d_l$, then $\gamma^N > \gamma^I$. When d_h is much lower than d_l , then $\gamma^I > \gamma^N$. But natives choose to train to a higher extent than immigrants already when $d_h < d_l$. The reason for this is that discrimination has a larger impact on wages in the high productivity sector than in the low productivity sector, as wages in the high productivity sector are relatively higher.

As discrimination in the low productivity sector increases, the value of skills increases for all workers. As a consequence, more workers of both origins choose to train. The effect is much stronger for immigrants. When d_l is low relative to d_h , then $\gamma^N > \gamma^I$. When d_l is much larger than d_h , then $\gamma^I > \gamma^N$. But natives still choose to train to a higher extent than immigrants when $d_l > d_h$, until the difference in discrimination becomes sufficiently high. This is the case for the same reason as above: discrimination has a larger impact on wages in the high productivity sector than in the low productivity sector, as wages in the high productivity sector are relatively higher.

The numerical analysis shows that when the same level of discrimination prevails in both sectors, $d_l = d_h = 0.25$ and the share of immigrants increases, the effect of d_h prevails and the value of skills decreases for all workers. This means that less workers of both origins choose to train and the optimal share is higher for natives than for immigrants for all shares n .

5 Conclusion

We have formulated a model of employer discrimination within a search and wage-bargaining setting, where workers are subject to the risk of losing skills during a spell of unemployment. We have allowed low skilled workers to regain skills both during employment and during training while unemployed. Discrimination was assumed to take the form of a share of interviewers that refuses to offer a job to immigrants. Based on these assumptions, we have analysed the equilibrium implication of discrimination and how the economy responds to higher discrimination facing high and

low productivity workers and a larger share of immigrants.

Discrimination directly reduces an immigrant worker's transition out of unemployment and thereby deteriorates her outside option in the wage-bargaining situation. Consequently, discrimination causes wages received by immigrants to be lower than wages received by natives, even when immigrants face a non-discriminating employer. A lower transition rate also implies that immigrants suffer from higher unemployment rates, despite receiving lower wages. As immigrants experience more unemployment, they also face a higher risk of losing their skills. Therefore, the economy ends up with a higher proportion of immigrants than natives in low productivity jobs.

When discrimination increases in the high productivity sector, unemployment increases and skilled sector wages fall. Skilled immigrants' labour market outcomes are affected to a larger extent than those of natives. The share of skilled immigrants decreases more than that of skilled natives.

When the share of discriminating interviewers in the low productivity sector increases, low skilled workers face lower wages and higher unemployment. Low skilled immigrants are once more worse hit by discrimination than low skilled natives. However, skilled workers accept lower wages facing a worsened outside option and thereby, there is a fall in the unemployment rate they face. More discrimination in the low productivity sector enhances the share of skilled natives and immigrants.

An increase in the share of immigrants in the economy exacerbates the negative impacts on labour market performance due to discrimination. If discrimination could be eliminated, an increase in the share of immigrants would have no effect in this model.

Even when we assume discrimination to only exist in one sector of the economy, its negative effects spread to all workers in both sectors. The effect is stronger for immigrants, especially those that are directly discriminated against, but natives also suffer, even if they work in the sector in which discrimination is absent.

Finally, we endogenized the decision to train in order to regain skills while unemployed. When only high skilled workers face discrimination, skills are more valuable for natives as they are more likely to keep them. Therefore, more natives than immigrants choose to train and regain skills. If, instead, low skilled workers are subject to discrimination, immigrants value skills more than natives, as skills allow them to

escape discrimination. Hence, a relatively larger number of immigrants than natives regain skills.

Even when we assume discrimination to only exist in one sector of the economy, its negative effects spread to all workers in both sectors. The effect is stronger for immigrants, especially those that are directly discriminated against, but natives also suffer, even if they work in the sector in which discrimination is absent.

Bibliography

- [1] Arai M., H. Regnér and L. Schröder (2000), "Invandrare på den svenska arbetsmarknad", bilaga 3 till Näringsdepartementets Mångfaldsprojekt.
- [2] Bertrand, M. and S. Mullainathan (2003), "Are Emily and Greg More Employable than Lakisha and Jamal? A Field Experiment on Labor Market Discrimination", No 9873, NBER Working Papers.
- [3] Borjas G. and S. Bronars (1989), "Consumer Discrimination and Self-employment," *Journal of Political Economy*, 97(3), pp. 581-605.
- [4] Black D. (1995), "Discrimination in an Equilibrium Search Model", *Journal of Labor Economics*, 13(2), pp. 309-333
- [5] Carlsson, M. and D.-O Rooth (2006), "Evidence of Ethnic Discrimination in the Swedish Labor Market Using Experimental Data", IZA Discussion Papers No. 2281.
- [6] Flabbi L. (2004), "Gender Discrimination Estimation in a Search Model with Matching and Bargaining", Georgetown University, Department of Economics WP No 04-08.
- [7] Larsen, B., (2001), "Minimum Wages, Technological Progress and Loss of Skill", *European Economic Review*, 45, pp. 1521-1544.
- [8] Millard, S.P. and D.T. Mortensen (1997), "The Unemployment and Welfare Effects of Labour Market Policy: A Comparison of the USA and UK", in Snower, D. and G. de la Dehesa, (eds), *Unemployment Policy: Government Options for the Labour Market*. Oxford University Press, Oxford.

- [9] Nielsen, H., S., M. Rosholm, N. Smith and L. Husted (2004), "Qualifications, Discrimination, or Assimilation? An Extended Framework for Analysing Immigrant Wage Gaps", *Empirical Economics*, Springer, 29(4), pp. 855-883.
- [10] Pissarides, C.A. (1986), "Unemployment and Vacancies in Britain", *Economic Policy*, 3, pp. 499-559.
- [11] Reitz, J.G. (2001), "Immigrant Skill Utilization in the Canadian Labour Market: Implications of Human Capital Research", *Journal of International Migration and Integration*, 2(3), pp. 347-378.
- [12] Riach, P. and J. Rich (1991), "Testing for Racial Discrimination in the Labour Market", *Cambridge Journal of Economics*, 15(3), pp. 239-56.
- [13] Rosén, Å. (1997), "An Equilibrium Search-Matching Model of Discrimination", *European Economic Review*, 41, pp. 1589-1613.
- [14] Waisman, G. and B. Larsen (2007), "Do Attitudes towards Immigrants Matter?", mimeo.

Appendix

In Section 4, subsection 4.1, we relax the assumption that $\gamma = \sigma a$. This makes the model non-recursive and makes it impossible for us to obtain analytical solutions for the comparative statistics. But we can still solve the model numerically. The equilibrium wages when $\gamma \neq \sigma a$ are:

$$w_l^J = \frac{\left\{ \begin{array}{l} \left[\begin{array}{l} (2(\rho + \sigma)(\rho + \lambda + \gamma) + (\rho + \gamma)f_h^J)^* \\ (y_l(\rho + \sigma + f_l^J)(\rho + \lambda + \gamma) + (\gamma - \sigma a)(f_h^J y_h - f_l^J y_l)) \end{array} \right] \\ -(\gamma - \sigma a)f_h^J(y_h((\rho + \sigma)(\rho + \lambda + \gamma) + (\rho + \gamma)f_h^J) + \lambda f_l^J y_l) \end{array} \right\}}{\Omega},$$

$$w_h^J = \frac{\left\{ \begin{array}{l} -\lambda f_l(y_l(\rho + \sigma + f_l^J)(\rho + \lambda + \gamma) + (\gamma - \sigma a)(f_h^J y_h - f_l^J y_l)) \\ + \left[\begin{array}{l} ((2(\rho + \sigma) + f_l^J)(\rho + \lambda + \gamma) + f_l^J(\sigma a - \gamma))^* \\ (y_h((\rho + \sigma)(\rho + \lambda + \gamma) + (\rho + \gamma)f_h^J) + \lambda f_l^J y_l) \end{array} \right] \end{array} \right\}}{\Omega},$$

where $\Omega = \left\{ \left[\begin{array}{l} ((2(\rho + \sigma) + f_l^J)(\rho + \lambda + \gamma) + f_l^J(\sigma a - \gamma))^* \\ ((2(\rho + \sigma)(\rho + \lambda + \gamma) + (\rho + \gamma)f_h^J)) \\ -\lambda f_l^J(\gamma - \sigma a)f_h^J \end{array} \right] \right\}.$

The shares of natives among the unemployed becomes:

$$\phi_h = \frac{1}{1 + \frac{1-n}{n} \frac{(\gamma + a f_l(1-d_l))}{(\gamma + a f_l)} \kappa}, \quad \phi_l = \frac{1}{1 + \frac{1-n}{n} \kappa},$$

where

$$\kappa = \frac{((\sigma + f_l)\lambda + (\sigma + f_h)(\gamma + a f_l))}{(\sigma + f_l(1-d_l))\lambda + (\sigma + f_h(1-d_h))(\gamma + a f_l(1-d_l))}.$$

The unemployment rates are defined by the same functions as before; they are only affected by the changes in the transition rates.

Table I

	No Discrim.	Benchmark	$\uparrow d_h$	$\uparrow d_l$	$\uparrow (1-n)$
Discrimination in the high productivity sector	0.00	0.25	0.50	0.25	0.25
Discrimination in the low productivity sector	0.00	0.25	0.25	0.50	0.25
Share of immigrants in the economy	0.10	0.10	0.10	0.10	0.20
Wages :					
Skilled Natives (W_h^N)	1.155	1.155	1.153	1.155	1.154
Low-Skilled Natives (W_l^N)	0.891	0.890	0.890	0.889	0.889
Skilled Immigrants (W_h^I)	1.155	1.120	1.075	1.109	1.118
Low-Skilled Immigrants (W_l^I)	0.891	0.863	0.863	0.818	0.862
Unemployment Rates :					
Skilled Natives (u_h^N)	5.03%	5.05%	5.14%	5.03%	5.08%
Low-Skilled Natives (u_l^N)	6.55%	6.59%	6.60%	6.69%	6.67%
Skilled Immigrants (u_h^I)	5.03%	6.63%	9.77%	6.59%	6.66%
Low-Skilled Immigrants (u_l^I)	6.55%	8.60%	8.61%	12.53%	8.70%
Share of skilled workers:					
Natives	0.836	0.835	0.833	0.836	0.835
Immigrants	0.836	0.794	0.724	0.795	0.794

Figure 1: Effect on wages of an increase in the probability of regaining skills when unemployed, γ , when discrimination prevails in both sectors ($d_h = d_l = 0.25$).

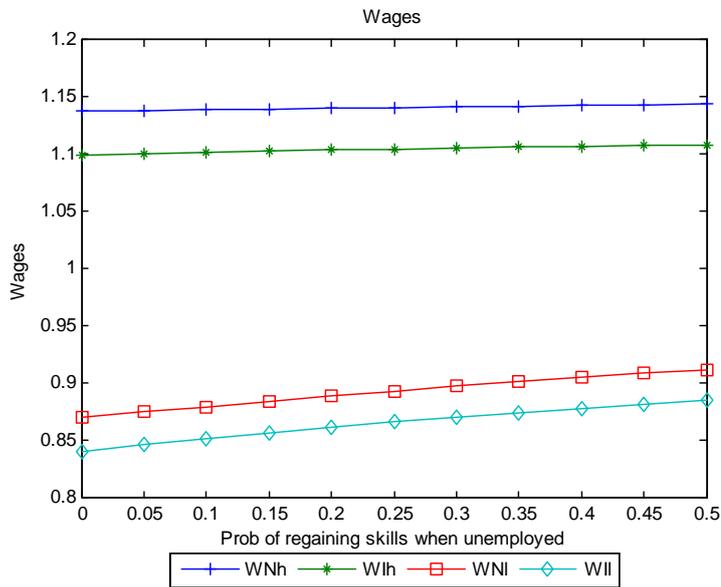


Figure 2: Effect on the unemployment rates of an increase in the probability of regaining skills when unemployed, γ , when discrimination prevails in both sectors ($d_h = d_l = 0.25$).

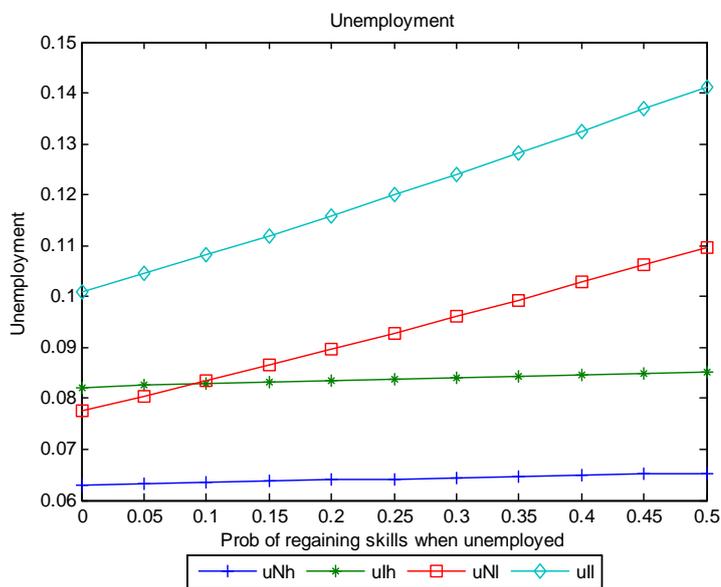


Figure 3: Effect on the probability of regaining skills by training (γ) of an increase in the level of discrimination in the high productivity sector. The level of discrimination in the low productivity sector is assumed to be constant at $d_l = 0.25$.

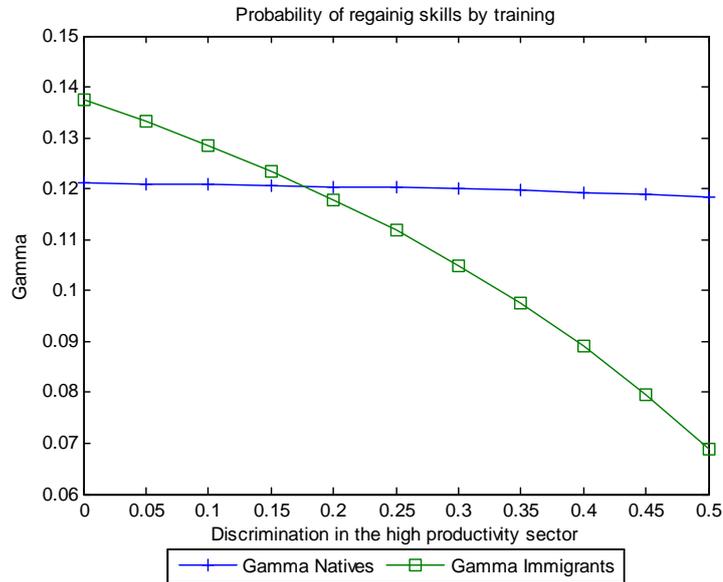
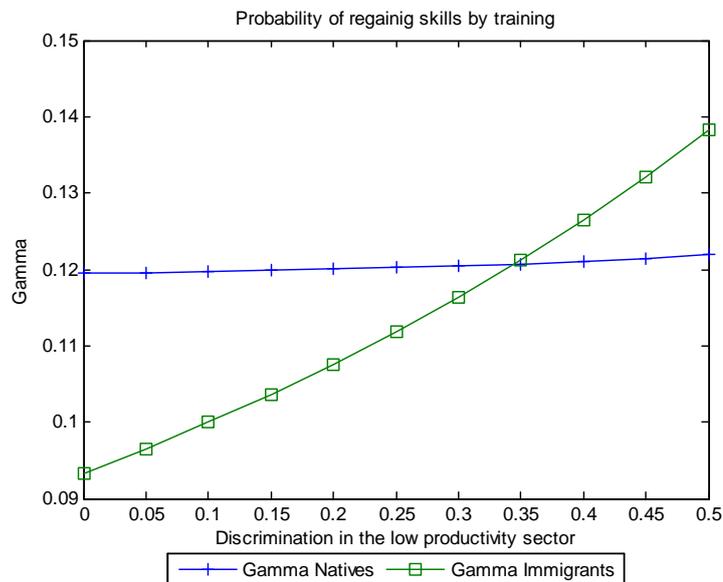


Figure 4: Effect on the probability of regaining skills by training (γ) of an increase in the level of discrimination in the low productivity sector. The level of discrimination in the high productivity sector is assumed to be constant at $d_h = 0.25$.



Chapter 4

Complementary Controls of Corruption *

1 Introduction

At a time when democracy was sweeping the Western Hemisphere, the Fujimori regime managed to maintain a facade of democracy in Peru, while systematically debilitating democratic institutions and the rule of law. The architect of this strategy was Fujimori's intelligence adviser, Vladimiro Montesinos. Corruption rarely sees the light of day, but Montesinos kept meticulous records of his illicit transactions. He demanded signed contracts and receipts and even videotaped bargaining sessions with other corrupt politicians and owners of the nation's major media outlets, so-called "vladivideos".

The independent press was allowed to operate, but investigating print and radio journalists braved severe intimidation, including death threats, surveillance, physical attacks, and arbitrary prosecution. Using their control over the judiciary, government authorities all but eradicated independent television, and most major newspapers, radio, and television were either directly or indirectly controlled by Montesinos by 2000. So complete was Montesinos' domination of the media that he even held

* I am grateful to my supervisor Torsten Persson for his advice, to Nicola Gennaioli, David Strömberg, Anders Olofsgård, Jakob Svensson and participants at the workshop in Political Economy and Development at the CESifo Venice Summer Institute 2005, the 20th Annual Congress of the EEA and the 10th Annual Meeting of the LACEA for helpful comments and to Christina Lönnblad for editorial assistance. Financial support was given by Tore Browaldh's Research Foundation. All remaining errors are mine.

a daily "news meeting" to inform the journalists which stories to feature in their evening broadcasts and the next edition of their papers¹.

McMillan and Zoido (2004) studied the records kept by Montesinos to check which of the democratic checks and balances, opposition parties, the judiciary or a free press, is most critical. The most forceful of all checks and balances on the Peruvian government's power, by Montesinos' revealed preference, was the news media.

Horacio Verbitsky, one of Argentina's leading investigating journalists, provides another example of a government influencing its checks and balances. "In 1990, President Menem increased the membership of the (Argentinean) Supreme Court from 5 to 9 members. He got the resignation of 2 of the biggest members and overnight he appointed 6 out of 9 members of the Supreme Court. This packing of the Supreme Court was the key instrument to control the press during his presidency"².

It is not only in Latin America that governments prefer to have weaker checks and balances. This practice seems to be more common in developing countries, but exists in most parts of the world. How problematic is this? How important is it to have checks and balances by the judiciary, the electoral system and the media? This paper analyses this phenomenon in relation to the problem of corruption.

Corruption is conventionally defined as the abuse of public power for personal gain or the benefit of a group to which one owes allegiance. This problem hits the whole world, but with very different levels of intensity. The average level of corruption is perceived to be substantially lower in rich than in poor countries. Nine developing countries out of ten score less than 5 against a clean score of 10 in the Transparency International Corruption Perceptions Index 2003.

Increasingly, evidence gathered by the World Bank and Transparency International suggests that corruption sands rather than greases the economic machinery of society. Corruption is commonly regarded as one of the most serious obstacles to development. Despite knowing its negative consequences, it seems to be very hard

¹ Fittingly, it was television that finally brought down Fujimori's regime. In September 2000, the independent Canal N cable television station aired a "vladivideo" showing Montesinos bribing an opposition congressman. Fujimori fell in November.

² From a transcript of an interview with Horacio Verbitsky when he was honoured with the Committee to Protect Journalists International Press Freedom Awards in 2001, available at <http://www.cpj.org/awards01/verbitsky.html>.

to curb, which may be due to the fact that developing countries also have other common characteristics. These are, in general, characterized by poor political accountability, both because the probability that corrupt governments are punished is low and because there are informational problems related to government activities. Developing countries have weak institutions less capable of fighting corruption.

The purpose of my paper is to analyse, both analytically and empirically, the interaction of three institutions that provide checks and balances to the government: the media, the judiciary and the electoral system. I define corruption as the rents extracted by the incumbent from tax revenues. The judiciary can remove an incumbent proved to be corrupt from office. Voters are less likely to re-elect the incumbent if he is corrupt and even more so when informed by the media of the extent of the problem.

In the theoretical model, the three institutions are shown to have an effect on the prevalence of corruption. When the judiciary and media are more dependent and the elections are less competitive, corruption flourishes. The three institutions are shown to be complementary; strengthening one increases the marginal effectiveness of the others in the control of corruption.

The empirical analysis uses an unbalanced panel of 135 countries in five or six-year periods to relate an assessment of corruption by the International Country Risk Guide to proxies for the three institutional variables, judiciary and media dependence and non-competitiveness of elections, their interactions and some controls. Then, I test for robustness by using two alternative proxies for the level of perceived corruption, one indicator of Control of Corruption produced by the World Bank and the Corruption Perceptions Index assembled by Transparency International. Due to data availability, these robustness checks are cross-sectional.

The results of the empirical analysis indicate that proxies for the dependence of the judiciary and the media indeed have a positive and statistically significant effect on the level of perceived corruption. A proxy for the non-competitiveness of elections seems to have a positive effect, but this effect does not differ significantly from zero. Most importantly, however, two interaction terms have the predicted negative sign, indicating that the media is complementary with both the judiciary and the electoral system. Importantly, I do not take these results as a test of causality, but rather as a preliminary indication that the predictions of my model are valid.

The rest of the paper is organized as follows. In section 2, I present a theoretical model allowing me to analyse the interaction among elections, media and judiciary. This model combines the media and the judiciary's investigation decision with a simple probabilistic voting model where voters may hold a corrupt incumbent accountable. In the cases where the judiciary investigates and throws out an incumbent, this is always reported in the media and has an impact on the ability of this politician to get back into power. When this is the case, the three institutions reinforce each other in the control of corruption.

Appendices 1 and 2 present two alternative versions of the model in section 2. In appendix 1, the model embeds an investigation game in the simple probabilistic voting model. In this game, it is more favourable for the media to investigate if the judiciary also does so. The three institutions still reinforce each other in the control of corruption. Appendix 2 assumes that voters need the media's report to understand how much utility they derive from public expenditure. Almost all results from the model in the main text go through in this alternative model.

Section 3 describes the data on corruption, the institutional characteristics and controls to be used in the empirical analysis. The econometric estimates in section 4, both the panel data and the cross-sectional estimates, show that more judiciary and media dependence is related to more perceived corruption and that the media is complementary with the judiciary and the electoral system. Section 5 concludes.

Related Research

A vast literature analyses the causes and determinants of corruption; see e.g. Svensson (2005) for a general survey of this literature. I only refer to a few papers of interest for the problem analysed here.

Adserà, Boix and Payne (2003) show that the political control of public officials depends on two factors. First, free and regular elections allow citizens to discipline politicians, i.e. the credible threat of losing office in the next period compels policy-makers to respond to the voters' interests. Second, and equally important, the degree of information of citizens curbs the opportunities politicians may have to engage in political corruption and management.

Besley and Prat (2006) develop a simple model of democratic politics where the actual freedom of the press is endogenous. A key feature of the model is the pos-

sibility that the government can influence the media through threats and promises. This influence is endogenously determined along with re-election rates for politicians and the extent of inefficiency/malfeasance in the political process. In equilibrium, the features of the media market determine the ability of the government to capture the media and control political outcomes.

Finan and Ferraz (2005a) use municipal audit reports from Brazil's randomized anti-corruption program to create a dataset of political corruption and test whether re-election incentives affect the level of rent extraction by incumbent politicians. They find significantly more corruption where the costs of rent-extraction are lower (municipalities without an effective media and or the presence of a judicial representative) and the density of pivotal voters is higher³.

Persson, Tabellini and Trebbi (2003) relate corruption to the different features of the electoral system. Their results suggest that the details of electoral rules have a strong influence on political corruption.

These papers stress the controls imposed by the media, the judiciary and the electoral system on corruption, but they do not study the interaction of these institutions as the current paper does.

2 The Model

2.1 General description

I develop a simple model where three institutions, the media, the judiciary and the electoral system, interact to restrict corruption. An incumbent politician (government) decides how much rents to extract from tax revenues, taking into account the effect on his chances of being thrown out of office, either by the judiciary or by the voters. The incumbent can only be replaced by another politician with similar preferences.

Voters dislike corruption, but they cannot directly observe rent extraction (or they can only do it at too high a cost for an individual citizen). Thus, they need

³ In a companion paper (2005b), they use the same dataset to estimate the effect of the disclosure of local government corruption practices upon the re-election success of incumbent mayors in municipal elections. The disclosure of audit results had a significant impact on the re-election rates of mayors found to be corrupt. This effect is more pronounced in municipalities where radio stations are present.

the media to report how corrupt the incumbent is.

Both the media and the judiciary decide whether to investigate the incumbent, based on their perceived benefits and costs. For simplicity, I will assume that an investigating institution always finds out the level of corruption, that the media reports the level of corruption found, and the judiciary removes the incumbent if he is found to be corrupt⁴. The main cost faced by an institution if it decides to investigate is the fact that the incumbent and his political party could damage it, both economically and by means of violence.

The investigation decision is sequential and the judiciary moves first. If the judiciary decides to investigate, then the cost of investigation for the media drops to zero. This means that the media always investigates if the judiciary has already decided to do so, no matter how dependent it is. In Appendix 1, I present an alternative model where the media and the judiciary decide simultaneously in an investigation subgame. All the results go through in this alternative model.

The judiciary cannot directly use the media's information to start a process against the incumbent; it must make its own investigation to find verifiable evidence that stands in court. If the incumbent is thrown out of power, he is replaced by another politician with similar preferences, but can still run for elections in the following period. This is justified by considering the incumbent as a group of members of a political party sharing the benefit of being in power.

In the model, the incumbent is potentially corrupt, while the media and the judiciary are not. In real life, both the media and the judiciary can be paid by the government to follow its orders. The model could be considered as more realistic by reinterpreting their capture as "higher dependency".

2.2 Timing of events

The timing in the model is as follows:

1. The incumbent chooses the level of corruption.
2. The judiciary chooses whether to investigate or not.

⁴ It is easy to amend the model and make the investigation outcomes probabilistic, thereby obtaining the same results as with certain outcomes.

3. The media chooses whether to investigate or not.
4. Elections are held.

In the following section I study the equilibrium actions at these four stages in reverse order.

2.3 Elections

There is a continuum of citizens of measure 1, indexed by i , all with the same income y . Voters derive utility from the consumption of public goods and a direct disutility from (reported) corruption according to the following utility function

$$u = 2 (B - r)^{\frac{1}{2}} - \beta \hat{r}.$$

Here, $2 (B - r)^{\frac{1}{2}}$ is the benefit from public expenditure, B is tax revenue, r is the level of private rents extracted by the incumbent (the level of corruption), and \hat{r} is the level of corruption reported by the media. β is a positive parameter showing how much informed voters dislike corruption as such, on top of the indirect effect through lower public spending. Since, by assumption, voters cannot directly observe rent extraction, they react directly to media reports.

In this model, the voters are aware of the utility they derive from the public expenditure they enjoy themselves. But they are not able to observe the level of public expenditure other individuals enjoy, so they cannot directly infer the level of corruption from their own utility. In Appendix 2, I show that modifying this assumption, so that the voters need to estimate the level of public expenditure based on the media's reports on corruption, does not substantially change my results.

I assume that voters use a backward-looking strategy to discipline an incumbent who cannot commit to a level of public expenditure. Voters set a reservation utility for reelecting the incumbent. The only reason for not reelecting the incumbent is to punish him *ex post*, and since the opponent has identical preferences, it is (weakly) optimal for the voters to carry out this punishment.

This agency model is here combined with the probabilistic voting model adapted to multidimensional redistribution problems by Lindbeck and Weibull (1987). Voters do not only care about the policies adopted by the incumbent (which determine

the level of corruption), but also about other attributes such as his ideology or personal characteristics. This ideological dimension is a permanent feature which the incumbent cannot affect. It will be referred to as the unpopularity of the incumbent with respect to the opponent.

Voters are characterized by an exogenously given reservation utility \bar{w} , for simplicity set equal to zero. I assume voters to differ in their preference for the incumbent relative to the opponent. The incumbent has an average unpopularity in the population δ , which is uniformly distributed on the support $[-\frac{1}{2}z_V, +\frac{1}{2}z_V]$.

Voter i will reelect the incumbent if

$$u \geq \delta.$$

St stage 1, the incumbent's probability of being thrown out (not re-elected) by the voters is

$$\begin{aligned} P_V &= \Pr\left(\frac{1}{2} + u - \delta < \frac{1}{2}\right) \\ &= \frac{1}{2} - \frac{1}{z_V} \left[2(B-r)^{\frac{1}{2}} - \beta E(\hat{r})\right], \end{aligned} \quad (4.1)$$

where $E(\hat{r})$ is the level of corruption the incumbent expects to be reported by the media.

I will identify parameter z_V with the non-competitiveness of elections. If parameter z_V is high, the average unpopularity of the incumbent in the population has wide support, which means that few voters change their vote when their utility changes. Then, z_V is inversely related to the number of swing voters.

2.4 Media's decision

Given the assumptions of the model, the media looks directly at the benefits and costs of the investigation and propagation of the news. Such costs depend on the decision taken by the judiciary. Consider one unique TV channel as a representative of the media. If the TV channel reports a corruption scandal, it gains reputation, additional viewers and receives more income from (private) advertising. These benefits could be reduced if the media receives less income from government's advertising as a punishment. Investigating corruption has a cost in terms of time and money

invested in the process as well as an additional cost of threatening the incumbent. The incumbent and his political party could damage an investigating media, both economically and by means of violence. I normalize the cost of investigation for the media to zero if the judiciary decides to investigate. If this is the case, the media thus investigates with certainty.

If the judiciary has chosen not to investigate, the media's perceived net benefits are given by ϕ_M and private information, but their distribution is common knowledge. In particular, ϕ_M is uniformly distributed on the support $\left[0, \frac{1}{z_M}\right]$, where z_M is the degree of dependence of the media. A more dependent media thus faces a lower average net benefit of investigation. If the media decides not to investigate, it receives a positive constant benefit F that can be considered as the value of choosing the "safe" alternative or status quo.

If the judiciary has chosen not to investigate, the media obtains ϕ_M if it chooses to investigate and F otherwise, so it will investigate with the following probability:

$$\Pr(\phi_M \geq F) = 1 - F z_M.$$

As stated above, if the judiciary has chosen to investigate, the cost of investigation for the media becomes zero and the media investigates with certainty.

The overall probability that the media investigates is thus

$$P_M = P_J + (1 - F z_M)(1 - P_J),$$

where P_J is the probability that the judiciary investigates corruption.

For future reference, note that the expected level of reported corruption in the incumbent's probability of being thrown out (4.1) is obtained by multiplying the level of corruption by the probability of voters being informed, that is $E(\hat{r}) = P_M r$.

2.5 Judiciary's decision

The judiciary compares the benefits with the costs of investigating, thus conducting a process against the incumbent and throwing him out of office. Throwing the incumbent out of power creates a reputation and, as a consequence, a better career for an investigating judge. The cost of investigation for the judiciary is given by

the time and money invested plus the cost of threatening the incumbent. The difference between the benefits and costs constitutes the net benefit of investigation for the judiciary, ϕ_J . The perceived net benefits of the judiciary are assumed to be private information, but their distribution is common knowledge. In particular, ϕ_J is uniformly distributed on support $\left[0, \frac{1}{z_J}\right]$, where z_J is the degree of dependence of the media. A more dependent judiciary is more likely to have a high cost for threatening the incumbent, so that its average net benefit of investigation is lower. To simplify the algebra, I assume that if the judiciary decides not to investigate, it receives the same positive constant benefit F as the media.

The judiciary obtains ϕ_J if it chooses to investigate and F otherwise, so it will investigate with the following probability:

$$P_J = \Pr(\phi_J \geq F) = 1 - F z_J. \quad (4.2)$$

Not surprisingly, the judiciary is less likely to investigate, the more dependent it is.

Inserting (4.2) into (4.3), we get the probability of the media investigating corruption:

$$\begin{aligned} P_M &= P_J + (1 - F z_M)(1 - P_J) \\ &= (1 - F z_J) + (1 - F z_M) F z_J \\ &= 1 - F^2 z_M z_J. \end{aligned} \quad (4.3)$$

The media's investigation probability is decreasing in the dependence of both the media and the judiciary.

2.6 Equilibrium level of corruption

The incumbent receives utility from the rents he extracts today and from future exogenous benefits R of remaining in power. He can only receive rents today if he is not thrown out by the judiciary, and he can only receive rents tomorrow if he is not thrown out by the voters.

The incumbent then chooses the level of rents (corruption) so as to maximize his expected utility

$$\max_r E(V_I) = (1 - P_J) r + (1 - P_V) R.$$

Taking into account the expressions for P_V , P_J and P_M in (4.1), (4.2) and (4.3), we can solve for the optimal level of corruption

$$r = \left\{ B - \left[\frac{R}{F z_J z_V - \beta R (1 - F^2 z_M z_J)} \right]^2 \right\}$$

Proposition 12 *The level of corruption is increasing in the dependence of the judiciary (z_J), in the dependence of the media (z_M) and in the non-competitiveness of elections (z_V).*

The proof of Proposition 1 follows easily by differentiating the expression for r . Higher dependence of the media or the judiciary reduces the probability that both institutions investigate the incumbent. Less competitive elections make it more likely that the incumbent is re-elected despite being corrupt. As a consequence of these changes, extracting rents becomes less costly for the incumbent and he chooses a higher level of corruption.

The main novelty of the model, however, concerns how these three institutions interact in their control of corruption. Here, the model delivers the following result (also easily derived from differentiation).

Proposition 13 *All the institutions are complementary in the control of corruption; that is, the cross derivatives $\frac{\partial^2 r}{\partial z_J \partial z_M}$, $\frac{\partial^2 r}{\partial z_J \partial z_V}$ and $\frac{\partial^2 r}{\partial z_M \partial z_V}$ are negative.*

It might be easiest to understand the complementarity of the institutional controls if we consider strengthening the institutions. For example, a reform raising the independence of the judiciary (reduces z_J) in itself reduces the level of corruption. But the negative cross derivative, $\frac{\partial^2 r}{\partial z_J \partial z_M} < 0$, also means that a second reform increasing the independence of the media (reducing z_M) would now exercise a stronger negative effect on corruption than with a more dependent judiciary⁵. Strengthening one institution increases the marginal effectiveness of the other two. Stated differently, checks and balances reinforce each other.

As shown in Appendix 1 and 2 this basic complementarity result survives natural variations in the modeling assumptions.

⁵ Note that the timing of the reforms is of no importance for the overall impact on corruption of a given overall change in the three measures of political accountability. The timing only has an impact on the part of the change in corruption that is attributed to each respective measure.

3 Data

The first part of the empirical analysis is performed in a panel data set that covers the period 1982 to 2003. This period is aggregated in four subperiods corresponding to the averages of the following years: 1982-1987, 1988-1992, 1993-1997 and 1998-2003. Only one measure of corruption is available for this entire period. I check the robustness of the correlations in the data using two other measures of corruption. As these other measures are available for a much shorter period, the robustness analysis is cross-sectional on an average of data corresponding to the period 1998-2003.

Tables I to IV provide more detailed summary statistics for all data and pairwise correlations. Tables I and II refer to data used in the panel data analysis, while Tables III and IV refer to data used in the cross-sectional analysis.

3.1 Rents

Due to the nature of corruption, it is impossible to directly observe relative corruption among countries. One then needs to rely on indexes of "perceived" corruption based on survey responses of businessmen and local residents. While such ratings are, by definition, "subjective", different organizations using different techniques derive similar ratings that do not change a great deal between adjacent years.

To set a proxy for r in the model, I use three alternative indexes of perceived corruption: the assessment of corruption by the International Country Risk Guide (ICRG), the Corruption Perceptions Index assembled by Transparency International⁶ and one indicator of "Control of Corruption" produced by the World Bank⁷. The first of these measures is used both in the panel data and the cross-sectional analysis while, as mentioned before, the other two measures can only be used in the cross-sectional analysis due to data availability.

The International Country Risk Guide's (ICRG) assessment of corruption in a wide range of countries between 1982 and 2003 is released by Political Risk Services, a private think tank specializing in international political, financial and economic country-risk assessments. The index is based on the opinion of a pool of country analysts. The index ranges from 0 to 6, with higher scores indicating that: "high

⁶ Available at <http://www.transparency.org/cpi/1999/cpi1999.html>.

⁷ Available at <http://www.worldbank.org/wbi/governance/pubs/govmatters3.html>.

government officials are likely to demand special payments" and "illegal payments are generally expected throughout lower levels of government" in the form of "bribes connected with import and export licenses, exchange controls, tax assessment, policy protection or loans" according to Knack and Keefer (1995).

This is an assessment of corruption within the political system that is mainly concerned with actual or potential corruption in the form of excessive patronage, nepotism, job reservations, 'favour-for-favours', secret party funding, and suspiciously close ties between politics and business. As I model the rents kept by the incumbent, I have rescaled the index to vary between 0 and 1, with higher values denoting more corruption.

The most corrupt countries according to ICRG are Bangladesh in the period 1982-1987 ($r = 1$), Zaire in the period 1988-1992 ($r = 1$) and 1993-1997 ($r = 0.96$) and Niger in the period 1998-2003 ($r = 0.89$). The least corrupt countries are Canada, Denmark, Finland, Iceland, Netherlands and Sweden in the period 1982-1997, all with $r = 0$. The only country with $r = 0$ between 1998 and 2003 is Finland.

The goal of the "Corruption Perceptions Index" (CPI) is to provide data on extensive perceptions of corruption within countries. It constitutes a "poll of polls", computed as the simple average of a number of different surveys assessing each country's performance. The results of these surveys are highly positively correlated, which suggests that they measure some common features of the country in question.

Each year, the CPI combines assessments from at least 14 sources in the past three years to reduce abrupt variations in scoring. Such changes may be due to high-level political scandals that affect perceptions, but they do not reflect actual changes in corruption. All sources generally apply a definition of corruption such as the misuse of public power for private benefits. Originally, the CPI ranges between 10 (highly clean) and 0 (highly corrupt), but I have rescaled it to range from 0 (highly clean) to 1 (highly corrupt). According to the average CPI in the period 1998-2003, the most corrupt country is Bangladesh ($r = 0.9$) and the least corrupt ones are Finland ($r = 0.022$) and Denmark ($r = 0.028$).

The last measure is a governance indicator assembled by Kaufmann, Kray and Mastruzzi in the World Bank Institute (WBI). They present a set of estimates of six dimensions of governance, constructed using an unobserved components model. The governance indicators reflect the statistical compilation of responses on the

quality of governance given by a large number of enterprise, citizen and expert survey respondents in industrial and developing countries, as reported by a number of survey institutes, think tanks, non-governmental organizations, and international organizations. They are measured in units ranging from about -2.5 to 2.5 , with higher values corresponding to better governance outcomes.

"Control of Corruption" (COCORR) measures perceptions of corruption, conventionally defined as the exercise of public power for private gain. This particular aspect of corruption measured by the various sources differs somewhat, ranging from the frequency of "additional payments to get things done" to the effects of corruption on the business environment, to measuring "grand corruption" in the political arena or in the tendency of elite forms to engage in "state capture". Once more, I have rescaled the index to range from 0 (clean) to 1 (corrupt). In my sample, the least corrupt country according to the average COCORR is Finland ($r = 0$) and the most corrupt one is Zaire ($r = 0.8$).

Table IV shows that the three pair-wise correlations among the three indexes for corruption are high, all above 0.80.

3.2 Institutional measures

In my model, the degree of judicial and media dependence determines the probability of corruption being investigated. Each institution is supposed to have a higher average cost of challenging the incumbent the more dependent it is. I try to find proximate empirical measures of such dependency and the non-competitiveness of elections.

3.2.1 Non-competitiveness of elections

In the model, the non-competitiveness of elections (NCE or z_V) gives a measure of the risk for the incumbent of being replaced by his opponent, given the policies adopted. The elections are less competitive when it is difficult for the citizens to participate in the political life of the country and run for political office. If good politicians can participate in the election as opponents, punishing a corrupt incumbent becomes more attractive. I construct a proxy of this variable using data on the competitiveness and openness of executive recruitment and the competitiveness of

political participation from the Polity IV Project⁸.

In the Polity IV Project, there is no "necessary condition" for characterizing a political system as democratic; rather democracy is treated as a variable. The democracy indicator is an additive eleven-point scale (0-10) derived from codings of the competitiveness of political participation, the openness and competitiveness of executive recruitment, and constraints on the chief executive, using the following weights:

1. Competitiveness of Executive Recruitment ($XRCOMP_D$): (3) Election +2; (2) Transitional +1
2. Openness of Executive Recruitment ($XROPEN_D$) only if XRCOMP is Election or Transitional: (3) Dual/election +1; (4) Election +1
3. Constraint on Chief Executive ($XCONST_D$): (7) Executive parity or subordination +4; (6) Intermediate category +3; (5) Substantial limitations +2; (4) Intermediate category +1
4. Competitiveness of Political Participation ($PARCOMP_D$): (5) Competitive +3; (4) Transitional +2; (3) Factional +1

The indicator of autocracy is derived from codings of the competitiveness of political participation, the regulation of participation, the openness and competitiveness of executive recruitment, and constraints on the chief executive using the following weights:

1. Competitiveness of Executive Recruitment ($XRCOMP_A$): (1) Selection +2
2. Openness of Executive Recruitment ($XROPEN_A$) only if XRCOMP is coded Selection: (1) Closed +1; (2) Dual/designation +1
3. Constraints on Chief Executive ($XCONST_A$): (1) Unlimited authority +3; (2) Intermediate category +2; (3) Slight to moderate limitations +1
4. Regulation of participation ($PARREG_A$): (4) Restricted +2; (3) Factional/Restricted +1

⁸ Available at <http://www.cidcm.umd.edu/inscr/polity/index.htm>.

5. Competitiveness of Participation ($PARCOMP_A$): (1) Suppressed +2; (2) Restricted +1

Note that the two scales do not share any common categories. Nonetheless, many polities have mixed authority traits and thus, they can have middling scores on both Autocracy and Democracy scales. The Polity score is computed by subtracting the Autocracy score from the Democracy score and ranges from +10 (strongly democratic) to -10 (strongly autocratic).

My proxy for the non-competitiveness of elections is a measure of Competitiveness and Openness of Executive Recruitment and Competitiveness of Political Participation. It is therefore constructed

$$\begin{aligned} NCE &= (XRCOMP_A + XROPEN_A + PARREG_A + PARCOMP_A) \\ &\quad - (XRCOMP_D + XROPEN_D + PARCOMP)_D \\ &= (AUTOOC - XCONST_A) - (DEMOC - XCONST_D). \end{aligned}$$

The non-competitiveness of elections is equivalent to the difference between $AUTOOC$ and $DEMOC$, after extracting the elements measuring the constraints on the chief executive $XCONST_A$ and $XCONST_B$. These extracted elements will instead be used to create a proxy for the measure of judiciary dependence below.

I have rescaled the variable NCE from 0 (competitive elections) to 1 (non-competitive elections). The average non-competitiveness of elections (for all countries in the sample) is $\overline{NCE} = 0.40$ for the period 1982 to 2003; it decreases monotonically from $\overline{NCE} = 0.54$ in the first period to $\overline{NCE} = 0.31$ in the last one. Elections are very competitive in the OECD region ($\overline{NCE} = 0.003$) and much less competitive in Africa ($\overline{NCE} = 0.64$).

Elections have become more competitive over time in all but 10 countries in the sample. The worst evolution is reported in Gambia, where the NCE increased from 0.15 to 0.75, Azerbaijan (from 0.50 to 0.85), and Zimbabwe (from 0.48 to 0.78). The best evolution is reported in Hungary and Mongolia, where the NCE decreased from 0.85 to 0, Malawi (from 0.95 to 0.15), Romania (from 0.9 to 0.1) and Poland (from 0.85 to 0.05).

The percentage of countries with competitive elections ($NCE = 0$) varies from 20% in the period 1982-1987 to 25% in the period 1998-2003. All OECD countries

have competitive elections in the four periods, except France and Greece. The following are examples of countries with non-competitive elections that are constant in all periods: Qatar, Saudi Arabia, North Korea, United Arab Emirates, and Vietnam, all with $NCE > 0.85$.

3.2.2 Judiciary dependence

I use a measure from the Political Constraint Index (POLCON) Dataset Codebook⁹ to create a proxy for judiciary dependence (JD or z_J in the model). POLCON defines the existence of an independent judiciary by the joint occurrence of a polity score on executive constraints (XCONST) of at least 3 (slight to moderate limitations on the Executive Authority) and, where data is available, an International Country Risk Guide (ICRG) score on Law and Order of at least 4 (a high point total means that there is a strong law and order tradition).

Slight to moderate limitations on the Executive Authority (XCONST=3) implies that there are some real, but limited, restraints on the executive. Evidence of this could be that the legislature initiates some categories of legislation, that the legislature blocks the implementation of executive acts and decrees, that there is an independent judiciary, etc.

The International Country Risk Guide (ICRG) assesses Law and Order separately, with each sub-component comprising zero to three points. The Law sub-component is an assessment of the strength and impartiality of the legal system, while the Order sub-component is an assessment of the popular observance of the law. Thus, a country can enjoy a high rating (3) in terms of its judicial system, but a low rating (1) if it suffers from a very high crime rate or if the law is routinely ignored without effective sanction (for example, widespread illegal strikes).

This measure is binary; in my analysis 0 indicates an independent judiciary and 1 a dependent judiciary. The share of countries with an independent judiciary is 32% in the period 1982-1987, it grows to 55% in the period 1993-1997 and then goes down to 49% in the period 1998-2003. All OECD countries had an independent judiciary in all periods except Greece ($JD = 1$ in all periods but 1993-1997) and Italy ($JD = 1$ in the period 1998-2003). Most countries had an unchanged index of judiciary dependence from 1982 to 2003. The countries whose judiciary was dependent in

⁹ available at <http://www-management.wharton.upenn.edu/henisz/>.

the whole period 1982-1987 and independent in the whole period 1998-2003 include Chile, Egypt, Israel, Jordan, Kuwait, Morocco, Nicaragua, Romania, South Korea, Tanzania, Uganda and Zambia. A few countries moved in the opposite direction, for example Ecuador, Papua New Guinea and Madagascar. Many countries saw their judiciary change the level of independence back and forth during the period.

3.2.3 Media dependence

I will use the annual press freedom survey ratings of Freedom House as a proxy for media dependence (MD or z_M in the model)¹⁰. The level of press freedom in each country is divided into three broad categories: the legal environment, the political environment, and the economic environment. The data comes from correspondents overseas, staff travel, international visitors, findings of human rights and press freedom organizations, specialists in geographic and geopolitical areas, reports of governments and multilateral bodies, and a variety of domestic and international news media¹¹.

Each country is rated in three categories, with the higher number being the least free. A country's total score is based on the total of the three categories: a score of 0-30 places the country in the free-press group, 31-60 in the partly-free, and 61-100 in the not free-press group. I will transform this into a classification of media dependence: "free" corresponds to $MD = 0$, "partly free" to $MD = 0.5$ and "not free" to $MD = 1$. The percentage of countries with an independent media ($MD = 0$) varies from 29% in the period 1992-1997 to 34% in the last period. Hungary and Mali are examples of countries that moved from having a completely dependent media in the whole period 1982-1987 to having a completely independent media in the period 1998-2003, while Gambia's media moved in the opposite direction.

¹⁰ available at <http://www.freedomhouse.org/research/pressurvey.htm>.

¹¹ The legal environment encompasses both an examination of the laws and regulations that could influence media content and the government's inclination to use these laws and legal institutions to restrict the media's ability to operate.

Under the category of political environment, they evaluate the degree of political control over the content of news media, including the intimidation of journalists by the state or other actors, arbitrary detention and imprisonment, violent assaults, and other threats.

The third category examines the economic environment for the media. This includes, among other characteristics, the structure of media ownership; transparency and concentration of ownership and the selective withholding of advertising or subsidies by the state or other actors.

As shown in Tables II and IV, the institutional measures are highly positively correlated with each other in both datasets. Multicollinearity may thus be a problem, particularly as the variables are predicted to affect corruption in the same direction.

3.3 Controls

I control for many characteristics of countries that have been shown to affect corruption in the empirical literature. Developing countries are more affected by corruption than developed ones. To control for poverty, I consider gross domestic product per capita based on purchasing power parities, in US dollars¹². Voters can make better use of the available information when they are more educated. To control for the population's education level, I consider the average gross enrollment ratio in primary and secondary schools¹³. Openness to trade has been shown to be negatively correlated to corruption. I control for openness defined as the sum of imports and exports as a percentage of gross domestic product¹⁴.

In the cross country analysis, I control for the population share with Catholic, Protestant and Muslim religious traditions, as well as the geographic location and the colonial and legal history of a country.

In the panel data estimates, I control for factors that affect corruption but do not vary over time by including country-fixed effects. I also include period-fixed effects to control for factors that potentially affect the perception of corruption in all countries in a given period.

4 Results

4.1 Panel Data

Data on the level of perceived corruption measured by the International Country Risk Guide (ICRG) is available for 135 countries since 1982. The panel of data is unbalanced¹⁵. The institutional variables in which I am interested change very

¹² Source: IMF World Economic Outlook and EconStats.

¹³ Source: UNESCO Institute for Statistics.

¹⁴ Source: The World Bank's World Development Indicators.

¹⁵ 37 of the 540 possible data points are missing for corruption, mainly corresponding to the first three periods of some former Soviet Union countries. The regressions dropping these countries

slowly over time. By considering five- or six-year averages, I observe more variation across periods than I would with annual data¹⁶.

I performed tests for panel-level heteroskedasticity and autocorrelation and found the presence of serial correlation¹⁷. Ignoring serial correlation when it is present results in consistent but inefficient estimates of the regression coefficients and biased standard errors. I attempt to address this problem in two ways. First, I use an Ordinary Least Squares (OLS) regression with robust standard errors, which is valid in the presence of any heteroskedasticity or serial correlation, provided that the number of periods is small relative to the number of countries. Second, I use a Feasible Generalized Least Squares (GLS) regression using a panel-specific AR1 autocorrelation structure.

Table V gives the results of the panel data analysis. Column (1) shows estimates from an OLS regression controlling only for fixed and time effects. All three estimated coefficients for the direct effect of the institutional measures have the expected positive sign. While the coefficient on the proxy for judiciary dependence (*JD*) differs significantly from zero (p-value 0.07), the coefficients on the proxies for media dependence (*MD*) and non-competitiveness of elections (*NCE*) do not. Two interactions (*JD * MD*) and (*MD * NCE*) have the expected negative sign, but only the interaction between judiciary and media dependence has a coefficient that differs significantly from zero (p-value 0.04). The interaction between judiciary dependence and non-competitiveness of elections (*JD * NCE*) has the opposite sign than expected and differs significantly from zero.

Column (2) presents a GLS regression with the same controls as in column (1). The coefficients are more precisely estimated with the same signs as in the OLS

give almost identical results. 18 data points are missing for judiciary dependence, 24 for media dependence and 29 for the non-competitiveness of elections.

¹⁶ Only 28 out of the 135 countries in the sample had no variation in any of the institutional variables during the four periods. Twenty-one of these countries, most of them developed, have an independent judiciary and media and competitive elections. Cuba, Iraq, Libya, North Korea, Qatar, Saudi Arabia and Somalia have dependent judiciary and media and non-competitive elections. All intermediate countries show some variation, mainly in media dependence and non-competitiveness of elections.

¹⁷ I performed an LR test of heteroskedasticity that is based on the fact that iterated GLS with only heteroskedasticity produces maximum-likelihood parameter estimates.

Wooldridge (2002, pp. 282–283) derives a simple test for autocorrelation in panel-data models. Drukker (2003) provides simulation results showing that the test has good size and power properties in reasonably sized samples.

The description of these tests is available at: <http://www.stata.com/support/faqs/stat/panel.html>.

regression with robust standard errors.

The two remaining columns include three time-varying covariates as controls: income, education and openness. In the OLS regression in column (3), all three estimated coefficients for the direct effect of the institutional measures have the expected positive sign. The coefficients on both judiciary and media dependence differ significantly from zero (p-values of 0.03 and 0.05, respectively), but the coefficient on non-competitiveness of elections does not (p-value of 0.25). As previously, the interaction between judiciary dependence and non-competitiveness of elections has the opposite sign than expected, but now it does not differ significantly from zero. The other two interactions have the expected sign, but only the interaction between media dependence and non-competitiveness of elections does now differ significantly from zero (p-value of 0.05).

In the GLS regression of column (4), the coefficients have the same sign as in OLS, the interaction between judiciary and media dependence has the expected negative sign and differs significantly from zero (p-value 0.03) and all relevant p-values increase. Out of the six predicted relationships, in column (4) we find that five have the expected sign and four of them differ significantly from zero. In particular, the direct effect of media dependence and the interactions between media and the other two institutional controls affect corruption as predicted.

Corruption has, on average, been higher in period four (1998-2003) than in the other three periods. With respect to the covariates, income seems to increase corruption, which contradicts previous cross-sectional studies, but is consistent with the predictions of this model, as more income means that the incumbent has more rents to extract. Education and openness of the economy do not affect corruption once the institutional measures, income and fixed and time effects have been controlled for.

I am aware of a potential endogeneity problem in my regressions as the institutional measures and measures of corruption I consider may be related to the same unobserved country characteristics. To the extent that these unobserved characteristics are constant over time, they will be absorbed by the fixed country effects in the panel estimates. Another concern for endogeneity is reverse causality. It seems plausible that governments in more corrupt societies are less likely to allow an independent media and judiciary, as well as open and competitive executive recruitment

and political participation. I have not been able to find any suitable, and time-varying, instruments for my institutional measures, so I cannot make any estimate using instrumental variables. Thus, I take the results of my regressions only as a preliminary indication of the validity of the predictions.

4.2 Cross Sectional Data

To check robustness, I use two alternative proxies for the level of perceived corruption, the Control of Corruption produced by the World Bank and the Corruption Perceptions Index assembled by Transparency International. I run cross-section regressions for average data corresponding to the period 1998-2003, which corresponds to the last period in the panel data regressions. The results are presented in Table VI.

The endogenous variable is a proxy for the level of corruption measured by the International Country Risk Guide (ICRG) in column (1), the indicator of Control of Corruption (CoCorr) in column (2) and the Corruption Perceptions Index (CPI) in column (3). Five of the six relationships have the sign predicted by the theoretical model in all regressions.

Proxies of the dependence of the judiciary and the media and the non-competitiveness of elections have a positive effect on the three alternative measures of the level of perceived corruption. The coefficients on judiciary dependence differ significantly from zero with p-values of 0.03 for ICRG and CoCorr and 0.01 for CPI. The same is true for the coefficients on media dependence, with p-values of 0.01 for ICRG, 0.02 for CoCorr and 0.00 for CPI. The coefficient on non-competitiveness of elections differs significantly from zero only when corruption is measured by the International Country Risk Guide, with a p-value of 0.09.

The interaction between judiciary and media dependence ($JD * MD$) has the expected negative sign in all three columns and differs significantly from zero when corruption is measured by ICRG (p-value 0.06) and CoCorr (p-value 0.02). The same is true for the interaction between media dependence and non-competitiveness of elections ($MD * NCE$) with p-values of 0.09 for ICRG and 0.01 for CoCorr. The interaction between judiciary dependence and non-competitiveness of elections ($JD * NCE$) has, contrary to the predictions of the theory, a positive sign in two of the three regressions, but the coefficients do not differ significantly from zero for

any measure of perceived corruption.

The controls included in these equations come with the expected signs. Income and education seem to decrease perceived corruption, as measured by CoCorr and CPI. Countries with a higher share of Protestant religious tradition and French legal origin have lower perceived corruption in all three regressions.

To get a better feeling of the size of the effects and the estimated complementarity, as an example, the situation in one Latin American country, Argentina, can be compared with that in a Nordic country, Sweden. Institutions are typically weak and corruption high in Latin America, while the opposite is true in Scandinavia. In this example, I will consider the coefficients in column (1) where the perceived corruption is measured by the International Country Risk Guide.

The rescaled ICRG index for Argentina is $r = 0.60$, which corresponds to position 82 out of 135 countries. The judiciary has been considered to be dependent in the last two of the six years in the period, $JD = \frac{2}{6} = 0.33$, the media has been "partly free" during the whole period, $MD = 0.50$ and elections have been quite competitive in the whole period, $NCE = 0.11$.

The situation in Sweden is very different. The index for corruption is rescaled to $r = 0.03$, which corresponds to position 2. The judiciary is independent, the media free and the elections are competitive in the whole period so that $JD = 0$, $MD = 0$ and $NCE = 0$.

Imagine that we could reform the Argentinean institutions to Swedish quality. How large would the effect be according to the empirical results we just obtained? Given its insignificant estimate, I consider the coefficient for the interaction term ($JD * NCE$) to be zero in the following analysis.

Assume that we start by reforming the media. The total effect (direct plus interactions) of having a "free" media is a 9.3% reduction in r (to $r = 0.54$), moving Argentina to position 65 with Ecuador. If we then reform the judiciary, corruption is further reduced by 7.3% ($r = 0.50$), moving Argentina further to position 45 together with Brazil. Finally, reforming the electoral system reduces corruption by 5.5% ($r = 0.48$) to position 40 with Israel.

To understand the complementarity of the media with the other two institutions, we can see what happens if the media is reformed in third place instead of first. Reforming the electoral system first reduces corruption by 1.8% ($r = 0.589$) to

position 79 with Venezuela. Reforming the judiciary brings Argentina to position 80 ($r = 0.591$) with Zambia. Once the judiciary and the electoral system have been reformed, reforming the media has a direct effect of reducing corruption by 19.5% ($r = 0.48$). The effect of reforming the media on corruption more than doubles when the other institutions are stronger.

5 Conclusion

This paper explores the interaction of three institutions that provide checks and balances for corruption: the electoral system, the media and the judiciary.

My theoretical model shows that the three institutions each has an effect on the prevalence of corruption. When the judiciary and media are more dependent and the elections are less competitive, corruption flourishes. The three institutions are also shown to be complementary; strengthening one increases the marginal effectiveness of the others in the control of corruption.

My empirical analysis uses an unbalanced panel of 135 countries in four periods (five or six-years averages) to relate an assessment of corruption by the International Country Risk Guide to proxies for the three institutional variables (judiciary and media dependence and the non-competitiveness of elections), their interactions and some controls. I check for robustness using two alternative proxies for the level of perceived corruption, one indicator of Control of Corruption produced by the World Bank and the Corruption Perceptions Index assembled by Transparency International in a cross-section analysis.

The empirical results indicate that the dependence of the judiciary and the media has a positive effect on the level of perceived corruption, all significantly different from zero, except the coefficients for media dependence in the panel data regressions without covariates. Non-competitiveness of elections seems to have a positive effect, but this effect only differs significantly from zero in one specification.

Most importantly, two interaction terms have the predicted negative sign, indicating that the media is indeed complementary with both the judiciary and the electoral system. The coefficients for these two interaction terms differ significantly from zero in most specifications. The interaction between the judiciary dependence and the non-competitiveness of elections has, contrary to the predictions of the

theory, a positive sign in most specifications.

The results from the panel data analysis seem to be robust to the definition of corruption and to identifying the estimates from the cross-sectional variation in the data. I take the results as a preliminary indication that the predictions of the model are valid.

It thus appears that institutional controls of corruption, especially the media, are important. The complementarity of reforms may be the reason why fighting corruption is so hard and anti-corruption campaigns in many countries have had little or no effect. According to the theory, there exists complementarity among all three controlling institutions. The empirical results seem to indicate that it is mainly the media that complements the other two institutions in the control of corruption. Increasing the independence of the media may be a good start for a reform process seeking to curb corruption.

Bibliography

- [1] Besley T. and A. Prat (2006), "Handcuffs for the Grabbing Hand? Media Capture and Government Accountability", *American Economic Review*, 2006, vol. 96, issue 3, pp. 720-736.
- [2] Boix C, A Adserà and M. Payne (2003), "Are You Being Served? Political Accountability and Quality of Government", *The Journal of Law, Economics and Organization*, Vol. 19, No.2, pp. 445-490.
- [3] Finan F and C Ferraz (2005a), "Reelection Incentives and Political Corruption: Evidence from Brazilian Audit Reports", draft.
- [4] Finan F and C Ferraz (2005b), "Exposing Corrupt Politicians: The Effect of Brazil's Publicly Released Audits on Electoral Outcomes", Institute of Governmental Studies. Paper WP2005-53.
- [5] Henisz W. and B. Zelner, Codebook of the Political Constraint Index (POLCON) Dataset.
- [6] Kaufmann D., A. Kray and M. Mastruzzi (2003), "Governance Matters III: Governance Indicators for 1996-2002", World Bank Policy Research Working Paper 3106.
- [7] Knack, S. and P. Keefer (1995). "Institutions and Economic Performance: Cross-Country Tests using Alternative Institutional Measures", *Economics and Politics*, 7(3), pp. 207-228.
- [8] La Porta, R., F. Lopez-De-Silanes, A. Shleifer and R. Vishny (1999), "The Quality of Government", *The Journal of Law, Economics and Organization*, 15, pp. 222-279.

- [9] Lederman, D., N. Loayza and R R Soares (2005), "Accountability and Corruption, Political Institutions Matter", *Economics and Politics*, Blackwell Publishing, vol. 17, pp. 1-35, 03.
- [10] Lindbeck, A. and J. Weibull. (1987), "Balanced-Budget Redistribution as the Outcome of Political Competition", *Public Choice*, 52, pp. 273-297.
- [11] Marshall M. and K. Jaggers (2002), "Polity IV Project - Political Regime Characteristics and Transitions, 1800-2002".
- [12] McMillan J. and P. Zoido (2004), "How To Subvert Democracy: Montesinos in Peru", *Journal of Economic Perspectives*, American Economic Association, vol. 18(4), pp 69-92, Fall.
- [13] Persson T. and G. Tabellini (2000), *Political Economics Explaining Economic Policy*, MIT Press.
- [14] Persson T., G. Tabellini and F. Trebbi (2003), "Electoral Rules and Corruption", *Journal of the European Economic Association*, 1(4), pp. 958-989.
- [15] Shapiro, C. and H. Varian (1998), *Information Rules: A Strategic Guide to the Network Economy*, Harvard Business School Press, Boston.
- [16] Strömberg, D.(2001), "Mass Media and Public Policy", *European Economic Review*, 45, pp. 652-663.
- [17] Strömberg, D.(2004), "Mass Media Competition, Political Competition, and Public Policy", *Review of Economic Studies*, 71(1), pp. 265-284.
- [18] Svensson, J. (2005), "Eight questions about Corruption", *Journal of Economic Perspectives*, 2005, 19 (5): 19-42.
- [19] The Annual Survey of Press Freedom 2001: *How Free? The Web & The Press*.
- [20] Treisman, D. (2000), "The Causes of Corruption: a Cross-national Study", *Journal of Public Economics*, vol 76, pp. 399-457.
- [21] Wooldridge, J. (2002), *Econometric Analysis of Cross Sections and Panel Data*, MIT Press.

- [22] Olofsgård, A. and Z. Zahran (2007), "Corruption and Political and Economic Reforms: A Structural Breaks Approach", draft.

Appendix 1

In the main text, I have assumed that the investigation decisions by the judiciary and the media are sequential. An alternative would be to let the judiciary and the media choose simultaneously whether to investigate or not. In this appendix, the model embeds an investigation game where it is more favourable for the media to investigate if the judiciary also does so. The three institutions are still shown to reinforce each other in the control of corruption.

Timing

The timing in the alternative model is as follows:

1. The incumbent chooses the level of corruption.
2. An investigation subgame takes place
 - a** The judiciary and the media independently and simultaneously choose whether to investigate. If the media investigates, it finds corruption and reports this to its readers. If the judiciary investigates, it finds corruption and starts a process to throw out the incumbent. The incumbent is then replaced by another politician with similar preferences. If the judiciary and the media make the same choice, the subgame ends here.
 - b** If the uninformed media observes that the judiciary has started a process against the incumbent at stage **a**, it may decide to investigate itself and vice versa. Any investigation at stage **b** has the same consequences as an investigation at stage **a**.
3. Elections are held. If the incumbent loses the election, he is replaced by an opponent with similar preferences.

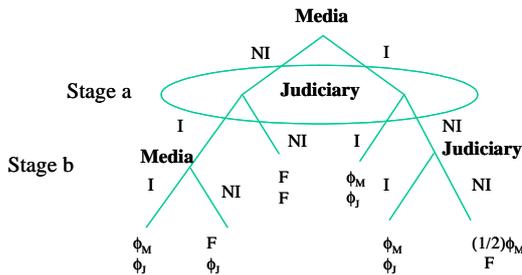
Investigation game

The game at stage 2 is an adaption of a simple technology choice model first formulated by Jean Tirole¹⁸.

I assume that the media benefits more from reporting a corruption scandal that ends with the incumbent being ousted, instead of investigating with certainty when

¹⁸ See Shapiro and Varian (1999).

this is the case. When the judiciary investigates, the media's perceived net benefits are given by ϕ_M . If the judiciary decides not to investigate, the media's net benefits are, for simplicity, reduced to $\frac{1}{2}\phi_M$. As before, the realized level of net benefits of the judiciary is ϕ_J . The same assumptions about ϕ_M and ϕ_J in subsections 2.4 and 2.5 hold here. If an institution decides not to investigate, it receives a positive constant benefit F that can be considered as the value of choosing the "safe" alternative or status quo. The following figure displays the extensive form of the investigation game.



Investigation Game in Extensive Form

At stage **a**, both players simultaneously decide whether to investigate. If they both make the same decision, the game ends. Otherwise, the player that did not investigate gets another chance.

Each player has three possible strategies:

- i** Never investigate
- ii** Wait until stage **b** and investigate only if the other player did investigate at stage **a**
- iii** Investigate at stage **a**.

Note that the judiciary faces the same decision in both stages, so if it chose not to investigate at stage **a**, it will not change its decision at stage **b**. The judiciary obtains ϕ_J if it chooses to investigate and F otherwise, so it will investigate with the following probability:

$$\begin{aligned}
 P_J &= \Pr(\phi_J \geq F) \\
 &= 1 - F z_J.
 \end{aligned}
 \tag{4.4}$$

Once more, the judiciary is less likely to investigate, the more dependent it is.

If the media's net benefits from investigation are very high, if $\frac{\phi_M}{2} \geq F$, the media will choose to investigate at stage **a**. Otherwise, the media will wait until stage **b**. The media will only choose to investigate in this second stage if its net benefit is sufficiently high ($\phi_M \geq F$) and the judiciary investigated at stage **a**.

The overall probability that the media investigates is

$$\begin{aligned}
 P_M &= \Pr\left(\frac{\phi_M}{2} \geq F\right) + P_J \Pr(2F > \phi_M \geq F) \\
 &= [1 - 2Fz_M] + [1 - Fz_J] Fz_M \\
 &= 1 - Fz_M (1 + Fz_J).
 \end{aligned} \tag{4.5}$$

The media's investigation probability is decreasing in the dependence of both the media and the judiciary, but responds more to a change in the own dependence.

Equilibrium level of corruption

As in the main text, the incumbent receives utility from the rents he extracts today and from future exogenous benefits R of remaining in power. He can only receive rents today if he is not thrown out by the judiciary, and he can only receive rents tomorrow if he is not thrown out by the voters. The incumbent chooses the level of rents so as to maximize his expected utility

$$\max_r E(V_I) = (1 - P_J) r + (1 - P_V) R.$$

Taking into account the expressions for P_V , P_J and P_M in (4.1), (4.4) and (4.5), we can solve for the optimal level of corruption

$$r = B - \left\{ \frac{R}{Fz_Jz_V - \beta R [1 - Fz_M (1 + Fz_J)]} \right\}^2.$$

Proposition 1 and 2 in Section 2.6 hold in this alternative model. That is, the level of corruption is increasing in the dependence of the judiciary (z_J), in the dependence of the media (z_M) and in the non-competitiveness of elections (z_V) and all the institutions are complementary in the control of corruption.

I have assumed that the media benefits more from reporting a corruption scandal that ends with the incumbent being ousted; therefore it is less beneficial for

the media to investigate when the judiciary does not. According to evidence documented by journalists in many countries, a common way of punishing journalists that investigate the government is to start a process against them. The government then uses the judiciary as an instrument to punish the media. This punishment is only possible when the judiciary responds to the orders of the government, that is, when the judiciary is dependent on the incumbent. If a dependent judiciary is more likely to punish an investigating media on behalf of the incumbent, the level of dependence of the judiciary directly reduces the net benefits of investigation for the media. It is easy to modify the investigation subgame and check that the predictions of the model still hold.

Appendix 2

In this appendix, I analyse the same setting as in the main text but with a different utility function for the voters. Voters derive utility from the consumption of public goods, but they rely on the information provided by the media to understand how much public expenditure is provided by the government. The voter's utility function is in this appendix assumed to be

$$u = 2 (B - \hat{r})^{\frac{1}{2}},$$

where $2 (B - \hat{r})^{\frac{1}{2}}$ is the perceived benefit from public expenditure, B is tax revenue and \hat{r} is the level of corruption reported by the media.

With this alternative assumption, the incumbent's probability of being thrown out by the voters (not elected) becomes

$$P_V = \frac{1}{2} - \frac{1}{z_V} 2 (B - E(\hat{r}))^{\frac{1}{2}}, \quad (4.6)$$

where $E(\hat{r})$ is the level of corruption the incumbent expects to be reported by the media.

The incumbent then chooses the level of rents (corruption) so as to maximize his expected utility

$$\max_r E(V_I) = (1 - P_J) r + (1 - P_V) R.$$

Taking into account the expressions for P_V , P_J and P_M in (4.6), (4.2) and (4.3), we can solve for the optimal level of corruption

$$r = \left[\frac{B}{(1 - F^2 z_M z_J)} - (1 - F^2 z_M z_J) \left(\frac{R}{F z_J z_V} \right)^2 \right].$$

Proposition 1 in subsection 2.6 holds. The level of corruption is increasing in the dependence of the judiciary (z_J), in the dependence of the media (z_M) and in the non-competitiveness of elections (z_V). The results of this alternative model with respect to the interaction among institutions are presented in the following proposition.

Proposition 14 *The judiciary is complementary in the control of corruption with*

the media and the elections, that is, $\frac{\partial^2 r}{\partial z_J \partial z_M}$ and $\frac{\partial^2 r}{\partial z_J \partial z_V}$ are negative. The third derivative $\frac{\partial^2 r}{\partial z_M \partial z_V}$ is uncertain, so we cannot tell from this model whether the media and the elections are complements or substitutes in the control of corruption.

The proof follows from differentiation. Strengthening the judiciary increases the marginal effectiveness of the other two institutions and vice versa.

Table I Panel Data Description

Variable	Obs	Mean	Std. Dev.	Min.	Max.
Corruption (ICRG)	503	0.46	0.22	0.00	1.00
Judiciary Dependence	522	0.55	0.47	0.00	1.00
Media Dependence	516	0.49	0.40	0.00	1.00
Non-competitiveness of Elections	511	0.40	0.36	0.00	1.00
Income	516	3.63	0.49	2.51	4.74
Education	506	0.80	0.24	0.13	1.33
Openness	481	71.7	43.6	1.4	387.2

Table II Panel Data – Pair-wise correlations

Variable	ICRG	JD	MD	NCE	Y	Ed	Op
Corruption (ICRG)	1.00						
Judiciary Dependence (JD)	0.52	1.00					
	<i>0.00</i>						
Media Dependence (MD)	0.59	0.50	1.00				
	<i>0.00</i>	<i>0.00</i>					
Non-competitiveness of Elections (NCE)	0.54	0.39	0.86	1.00			
	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>				
Income (Y)	-0.69	-0.54	-0.52	-0.38	1.00		
	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>			
Education (Ed)	-0.54	-0.43	-0.48	-0.41	0.62	1.00	
	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>		
Openness (Op)	-0.21	-0.19	-0.17	-0.13	0.21	0.17	1.00
	<i>0.03</i>	<i>0.04</i>	<i>0.06</i>	<i>0.18</i>	<i>0.02</i>	<i>0.07</i>	

p-values for significant pair-wise correlation in italics below coefficient.

Table III Cross Sectional Data Description

Variable	Obs	Mean	Std. Dev.	Min.	Max.
Corruption - ICRG	135	0.53	0.19	0.00	1.00
Corruption-COCORR	134	0.48	0.21	0.00	0.80
Corruption - CPI	124	0.57	0.22	0.02	0.90
Judiciary Dependence	134	0.51	0.47	0.00	1.00
Media Dependence	135	0.47	0.41	0.00	1.00
Non-competitiveness of Elections	130	0.31	0.32	0.00	1.00
Income	129	3.74	0.51	2.74	4.74
Education	128	0.86	0.23	0.22	1.33
Openness	119	75.1	37.7	1.4	213.5

Table IV Cross Sectional Data - Pair-wise correlations

Variable	ICRG	CO CORR	CPI	JD	MD	NCE	Y	Ed	Op
Corruption - ICRG	1.00								
Corruption-COCORR	0.82	1.00							
	0.00								
Corruption - CPI	0.81	0.98	1.00						
	0.00	0.00							
Judiciary Dependence (JD)	0.59	0.63	0.57	1.00					
	0.00	0.00	0.00						
Media Dependence (MD)	0.52	0.61	0.54	0.56	1.00				
	0.00	0.00	0.00	0.00					
Non-competitiveness of Elections (NCE)	0.50	0.45	0.38	0.54	0.87	1.00			
	0.00	0.00	0.00	0.00	0.00				
Income (Y)	-0.59	-0.89	-0.87	-0.53	-0.50	-0.44	1.00		
	0.00	0.00	0.00	0.00	0.00	0.00			
Education (Ed)	-0.46	-0.63	-0.62	-0.46	-0.47	-0.46	0.61	1.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Openness (Op)	-0.17	-0.16	-0.18	-0.21	-0.07	-0.05	0.22	0.21	1.00
	0.00	0.08	0.05	0.00	0.15	0.25	0.00	0.00	

Table V Political Rents and Institutions
Panel estimates

	(1)	(2)	(3)	(4)
	ICRG	ICRG	ICRG	ICRG
Judiciary Dependence (JD)	0.063 * (0.035)	0.067 *** (0.025)	0.070 * (0.037)	0.076 *** (0.025)
Media Dependence (MD)	0.081 (0.066)	0.075 (0.052)	0.110 (0.072)	0.110 ** (0.053)
Non-competitiveness of Elections (NCE)	0.026 (0.082)	0.024 (0.067)	0.105 (0.085)	0.093 (0.071)
JD * MD	-0.147 ** (0.070)	-0.162 *** (0.055)	-0.101 (0.074)	-0.118 ** (0.056)
JD * NCE	0.151 ** (0.072)	0.154 *** (0.059)	0.079 (0.077)	0.088 (0.061)
MD * NCE	-0.065 (0.092)	-0.035 (0.065)	-0.174 * (0.104)	-0.147 ** (0.069)
Covariates	No	No	Yes	Yes
Fixed country and period effects	Yes	Yes	Yes	Yes
Estimation	OLS	GLS	OLS	GLS
Number of countries	135	123	126	113
Observations	486	475	432	419
R-square	0.87		0.88	
Prob>chi2		0.00		0.00

Robust standard errors in parentheses when OLS regression performed.

* significant at 10%; ** significant at 5%; *** significant at 1%

Covariates: income, education and openness.

Additional control variables: country and period fixed effects.

Table VI Political Rents and Institutions
Cross-Sectional estimates

	(1) ICRG	(2) CoCorr	(3) CPI
Judiciary Dependence (JD)	0.142 *** (0.051)	0.140 *** (0.040)	0.155 *** (0.051)
Media Dependence (MD)	0.230 ** (0.088)	0.312 *** (0.068)	0.206 ** (0.082)
Non-competitiveness of Elections (NCE)	0.252 * (0.146)	0.141 (0.089)	0.077 (0.110)
JD * MD	-0.283 ** (0.132)	-0.244 *** (0.078)	-0.099 (0.107)
JD * NCE	0.186 (0.184)	0.181 (0.116)	-0.086 (0.163)
MD * NCE	-0.303 * (0.182)	-0.304 ** (0.133)	-0.160 (0.159)
Number of observations	112	112	105
R-square	0.73	0.90	0.87

Robust standard errors in parentheses: * significant at 10%;
 ** significant at 5%; *** significant at 1%

Control variables: income, education, openness, dummy variable for the
 region of the world, religion, colonial and legal origin.

Chapter 5

Decision making in the ECB's Governing Council - Should minutes and forecasts be published ? *

1 Introduction

The rules of operation of the European System of Central Banks (ESCB) stipulate that "the Community institutions and bodies and the governments of the Member States may not seek to influence the members of the decision-making bodies of the ECB or of the NCBs in the performance of their tasks". Yet, Issing (1999) accepts that even in the absence of published votes, there will be attempts to influence policy-makers. Buiter (1999) goes even further and says that national political authorities and other interested parties will undoubtedly try to put pressure on "their" nationals serving on the ECB Board as well as "their" national central bank governors. The surprise rate cut by the ECB on May 10, 2001 might be an example of such influence. According to *AFX news* (May 10) "Some euro zone finance ministers, led by euro group president Didier Reynders, hinted that they were looking to the ECB for an easing move". Reynders said that the discussions between the ECB and the

* I am very grateful to my supervisors Torsten Persson and Lars Svensson, to Henrik Jensen for very useful comments and Stockholm University and the Wallander Foundation for financial support.

eurogroup "have had an influence on the bank's decision to lower rates".

Buiter (1999) strongly advocates the publication of the minutes from the meetings of the Governing Council and its relevant committees and sub-committees, the individual voting records of Governing Council members and the inflation forecasts. Issing (1999) instead argues against publication in order to defend a "culture of collective responsibility" and not "allow national politicians or interest groups to verify whether any pressure applied individually had the intended result". He argues that "publishing forecasts could be misleading if it leads the public to attach more significance to them than they have in the decision making process". Favero, Freixas, Persson and Wyplosz (2000) monitor the ECB and recommend that individual voting records and minutes focusing on individual differences are not published in order to facilitate the building of a collective reputation, but they consider that summary minutes not attributing individual views would be possible and helpful. They recommend that the Council should publish its internal forecasts on euro-wide inflation and output with appropriate qualifications concerning forecast uncertainty.

The purpose of my paper is to build a model of decision making in the Governing Council of the ECB, where the pressure of the national governments on their representatives affects the decision taken by the Council. Adding uncertainty about either the exact preferences of the Executive Board or its perception of the state of the EMU economy allows me to evaluate one specific aspect of the publication of minutes and forecasts.

Many papers study how the publication of forecasts and votes might influence the private sector, but the fact that publication would affect the pressure of national politicians on their representatives in the Governing Council has not yet been analysed.¹ Dixit (2001) and Dixit and Jensen (2001) analyse the influence from the

¹ Other papers combine uncertainty concerning central bank preferences and asymmetric information about the state of the economy. Cukierman and Metzler (1986) show that deliberately not minimizing errors in the monetary control technology could be welfare improving, since it allows the monetary authorities to make better use of surprise inflation in stabilization policy. This model has been extended by both Faust and Svensson (1998, 1999) in an infinite horizon setting, and Jensen (2000b) and Geraats (2001) in a two-period set-up. Faust and Svensson (1998, 1999) find that transparency is almost always preferred by society, but often not by the central bank which prefers discretion to pursue idiosyncratic output goals. Jensen (2000b) reaches different results than Faust and Svensson (1998); in his model, transparency is good for credibility (reducing inflation expectations) but constrains flexibility in the pursuit of output stabilization. Geraats (2001) identifies transparency with the release of central bank forecasts representing a complete summary of the central bank's (private) information on economic shocks. Transparency leads to

different governments on the ECB, but do not consider the issues of uncertainty and publication. They consider a monetary union where the member governments (multiple principals) act non-cooperatively to offer general state-dependent contracts to the common central bank (common agent). My paper instead considers a model with multiple principals and multiple agents, where each government influences its own NCB. Jensen (2000a) uses the principal-agent approach to monetary policy making in a two-country model, but each country has a separate monetary policy chosen by its own central bank which obtains an incentive contract from its government. He shows that optimal outcomes can be achieved using state-independent quadratic contracts.

Helpman and Persson (2001) develop a multiprincipal – multiagent model to analyse how the contribution of lobbies to lawmakers may influence the contents of legislation. They assume that each lobby group only makes contributions to a single lawmaker. This assumption is more appropriate in the present paper as it is easier for a government to influence its own NCB than that of another country. In Helpman and Persson, one lawmaker is randomly selected by nature to be the agenda-setter while in my paper, an Executive Board Member is always the agenda-setter and is not subject to lobbying by any government.

The economy is represented by a very simple model of monetary policy, with an expectations-augmented short-run Phillips curve, where the ECB can directly choose the inflation rate for the whole EMU area. For simplicity, I will assume that only two countries constitute the EMU which, in turn, implies that the Governing Council is composed by two national central bankers (NCBs) and one Executive Board Member (EBM). I model the decision-making process in the Governing Council using an agenda-setter model where the EBM proposes an inflation rate for the whole EMU area. This is a way of stressing that the EBM seems to have more of a say in the Governing Council's decisions than the NCBs, maybe as a result of some monopoly on information. I consider this assumption to much better reflect reality than the median-voter model. The proposed rate is only implemented if accepted by at

lower inflation and gives the central bank greater flexibility to respond to shocks in the economy. Other papers, such as Cukierman (2000) and Tarkka and Mayes (1999), analyse forecast publication in the context of models which do not assume uncertainty about central bank objectives. An increased transparency could also be attained by publishing the individual voting records of central bankers, as analysed by Gersbach and Hahn (2001a,b) and Sibert (1999).

least one NCB; otherwise a default policy representing the status quo of unchanged interest rates is implemented.

I model the national central bankers in the Governing Council as agents of their respective governments, tied by incentive contracts which can become state dependent only if the forecasts and minutes of the Governing Council's meetings are published. Otherwise, the contracts will be based on the governments' expectations about the EBM's preferences and their perceptions about the state of nature (more specifically, the size of a supply shock) in the whole EMU area. Naturally, these incentive contracts should not be taken literally; they are a way of modelling the fact that the NCB's future career (both reappointment and future employment opportunities) often depends on pleasing the government.

I present both analytical and numerical results and analyse under which circumstances each of these agents will favour publication. Given the chosen parameters, the EBM is always favourable to the publication of both forecasts and minutes, as this allows him to propose his most preferred inflation rate unconstrained in all states of the world. Non publication introduces noise into the incentive contracts faced by the NCBs. When minutes or forecasts are not published, the incentive constraints of both NCBs bind and the EBM must adapt his proposal in some states, which naturally increases his expected loss. The states where the EBM is constrained are typically those where the supply shocks of both countries have different signs; thus, the pivotal government benefits and the other government loses out.

In four simulated cases of ten, the prejudice of not being pivotal in some states more than compensates for the benefit of being pivotal in others, so that both governments agree with the EBM in their preference for publication. In four cases, one government prefers only minutes to be published, while the other government and the EBM still want both minutes and forecasts to be published. In the two remaining cases, both governments prefer that only minutes are published following a boom and both minutes and forecasts published after a recession.

If the group of countries in the EMU is relatively homogeneous, the governments' influence when forecasts are not published does not have any considerable effect on the policies implemented. But the effect of their influence might increase if the group of countries becomes more heterogeneous, as would be the case with an enlargement of the EMU area. As a last exercise, I use the model to see whether the forthcoming

enlargement changes the attitude to publication of the countries currently in the EMU. I assume that the group of countries to be incorporated in the EMU ("new" country) has higher targets for both inflation and employment and faces a supply shock with higher variance.

The government of the "old" country (the group of countries already in the EMU) has the largest influence on the EBM's proposal for both default rates, but with the opposite effect on the proposed rate. The government of the "new" country only appreciates the influence when the European economy is coming out of a boom, as the proposed rate is then higher than π_{EB}^* . The government of the "old" country always benefits from influencing the EBM's decision and thus, it prefers forecasts not to be published. Suppose that the governments of the countries currently in the EMU were to decide on the issue of publication, taking into account that the union could be enlarged in the future. Then, they are likely to favour the publication of minutes but oppose the publication of forecasts in order to increase their influence and reduce their expected losses after enlargement. Heterogeneity exacerbates the conflict of interests and increases the value of the influence on the implemented policy.

Section 2 presents the model under no uncertainty. Uncertainty is added in section 3, while section 4 shows the results of the numerical analysis. Section 5 presents the conclusions of the paper.

2 The Model with No Uncertainty

The model of the economy is a further simplification of what Persson and Tabellini (1999) call a simple positive model of monetary policy. The Government Council of the ECB is assumed to consist of the national central bankers (NCBs) of two countries making up the EMU, and one single Executive Board Member (EBM). As the Governing Council consists of the Governors of the national central banks of the 12 EMU countries plus six members of the Executive Board, this simplification captures the proportion of NCBs and EBMs well.

The demand side of the economy is represented by

$$\pi = m,$$

where π is the common inflation rate and m the money growth rate in the whole EMU area.

The supply side of the model assumes that the nominal wage setting in each country aims at implementing an exogenous real wage growth rate, ω_i . Letting π^e denote rationally expected inflation, nominal wage growth w_i in country i then becomes

$$w_i = \omega_i + \pi^e.$$

Employment in country i satisfies

$$y_i = \gamma_i - (w_i - \pi) + \varepsilon_i,$$

where γ_i is a constant and ε_i a supply shock. Combining the last two equations, we obtain an expectations-augmented, short-run Phillips curve

$$y_i = \theta_i + (\pi - \pi^e) + \varepsilon_i,$$

where $\theta_i \equiv \gamma_i - \omega_i$ can be interpreted as the natural rate of employment in country i .

The timing of events is as follows: (a) the private sector forms expectations π^e , given θ_i , in both countries and given the information available to governments, (b) the values of ε_i in both countries are observed, (c) the Governing Council decides on a money growth rate m , which determines the inflation rate π in the whole EMU area. In this section, the governments have complete information; in the next section, I will introduce uncertainty about the EBM's perception of the shock in the whole EMU area and its exact preferences.

The objective function of the government of country i is a loss function defined over inflation and employment:

$$\widetilde{L}_{Gi} = \frac{1}{2} [(\pi - \widehat{\pi}_{Gi})^2 + \lambda_{Gi} (y_i - \widehat{y}_{Gi})^2] + C_i^h \equiv L_{Gi} + C_i^h.$$

The government of country i wants to stabilize both inflation and employment around some targeted values, $\widehat{\pi}_{Gi}$ and \widehat{y}_{Gi} . λ_{Gi} is the relative weight the government puts on the fluctuations in these two variables. C_i^h is the contribution the government must pay to its NCB when choosing action $h \in \{A, R\}$. Action h can be the

approval (A) or the rejection (R) of the agenda-setter's proposal. In the following, I refer to the first term of the government's loss function as L_{Gi} . The NCB of country i is assumed to be non-benevolent, he only cares about the contributions he receives from his government. This extreme assumption gives governments the maximum possible influence over their representatives' votes. The NCB thus has the following utility function

$$U_{Ni} = C_i^h . \quad (5.1)$$

The contributions need not be taken literally, they could instead represent the fact that the NCB's future career prospects depend on the government being satisfied with his decisions. For simplicity, I will confine myself to globally truthful contribution schedules satisfying

$$C_i^h = [L_{Gi} - K_i^h] , \quad (5.2)$$

where K_i^h is a constant the government sets optimally in order convince the NCB to choose the alternative h it prefers.² These constants provide the NCB with a non-negative expected contribution if he acts according to the government's wishes, so there is no need to add a participation constraint for the NCB. Besides, the constants K_i^h ensure that the government does not pay a larger contribution than needed to induce the NCB to accept the proposal. These schedules completely align the NCB's preferences with the government's preferences.

The objective function of the EBM is assumed to be

$$L_{EB} = \frac{1}{2} [(\pi - \hat{\pi}_{EB})^2 + \lambda_{EB} (y_U - \hat{y}_{EB})^2] ,$$

where y_U is average employment in the EMU area. I assume that the EBM's most preferred rate of employment, \hat{y}_{EB} , always coincides with the natural rate of employment in the EMU area.

The decision process in the Governing Council is assumed to take the form of an agenda-setter model. The EBM is the agenda-setter proposing a policy m to both NCBs. If at least one of them accepts his proposal, then policy m is implemented; otherwise a default policy is implemented. The default policy is given and represents the status quo of unchanged interest rates. It is given because it depends on the

² I assume that the NCB chooses the alternative preferred by the government whenever he is indifferent.

decision taken in the previous period. In a more complete model, the Governing Council would decide whether to move the interest rate up, down or leave it constant. As $\pi = m$ in this very simplified model, I will describe the decision process as if the EBM made direct proposals over inflation rates, instead of money growth or interest rates. Leaving the interest rate untouched in my simple model, where the only shock is a supply shock, would give a default inflation rate higher than $\hat{\pi}_{EB}$ following a recession and lower following a boom.³

If the EBM were allowed to choose policy without any constraint, he would choose an inflation rate according to the standard expression⁴ :

$$\pi_{EB}^* = \frac{1}{1 + \lambda_{EB}} \hat{\pi}_{EB} + \frac{\lambda_{EB}}{1 + \lambda_{EB}} (\pi^e - \varepsilon_U).$$

If the EBM were to propose this rate straightaway for some realizations of the shocks, both NCBs would reject the proposal. The EBM can then adapt his proposal to a rate π^P intermediate between π_{EB}^* and π^d , such that at least one NCB is indifferent between his loss with π^P and his loss with π^d , while the EBM has a lower loss with π^P than with π^d .

The private sector forms its expectations of the inflation rate by computing the probability of being in each state of the world and using these probabilities as weights for the inflation expected to prevail in each state, depending on whether the EBM is constrained. The fact that the EBM proposes a rate π^P that is different than his most preferred rate in some states of the world affects π_{EB}^* in all other states through the endogenous variable π^e .

If the government of country *i* were instead allowed to choose an inflation rate

³ An alternative way of modelling the decision process would be to assume that the governments can first attempt to influence the EBM's proposal and then buy the votes of the different national central bankers; a situation described as "influencing a legislature with an agenda setter – multiple interest groups" in Grossman and Helpman (2001). In that approach, the agenda setter would choose a proposal maximizing a weighted sum of his own expected utility in the voting stage ($-L_{EB}$) and the contributions he obtains from the two governments, while taking into account whether this proposal has a reasonable chance of succeeding. In some states of the world, we could observe the EBM making proposals that are accepted with some probability. This assumption would make it more difficult to obtain unique results and analyse the issue of publication of minutes and forecasts, given the non-linearities in my model.

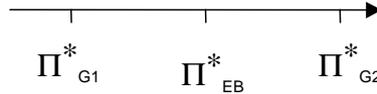
⁴ The EBM minimizes $L_{EB} = \frac{1}{2} \left[(\pi - \hat{\pi}_{EB})^2 + \lambda_{EB} (\pi - \pi^e + \varepsilon_U)^2 \right]$, so that the first-order condition is

$$\pi - \hat{\pi}_{EB} + \lambda_{EB} (\pi - \pi^e + \varepsilon_U) = 0.$$

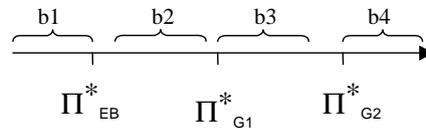
unconstrained, for a given π^e , it would choose

$$\pi_{Gi}^* = \frac{1}{1 + \lambda_{Gi}} \hat{\pi}_{Gi} + \frac{\lambda_{Gi}}{1 + \lambda_{Gi}} (\pi^e - \varepsilon_i).$$

Given the realization of the shocks, the most preferred rates of the two governments and the EBM are often different.



In case (a), represented in Figure 1, the EBM's preferred rate lies in between the most preferred rates of the two governments; no matter where the default rate is, one NCB is always ready to accept the proposal, π_{EB}^* . The location of the default rate determines which NCB accepts the proposal. For example, if $\pi^d < \pi_{EB}^*$, the NCB of country 2 accepts.



In case (b), illustrated in Figure 2, the EBM's proposal depends on the location of the default rate:

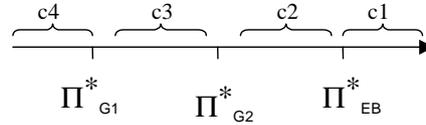
(b1) if $\pi^d \leq \pi_{EB}^*$, then the default alternative is worse for both governments than π_{EB}^* , so that the EBM proposes π_{EB}^* and both NCBs accept the proposal.

(b2) if $\pi_{EB}^* < \pi^d < \pi_{G1}^*$, then both governments will prefer π^d to π_{EB}^* and the EBM can propose no rate that is better for both the NCB of country 1 and the EBM than π^d , so π^d will be implemented.

(b3) if $\pi_{EB}^* < \pi_{G1}^* < \pi^d$ and π^d is sufficiently close to π_{G1}^* so that $L_{G1}(\pi^d, \pi^e, R, \varepsilon_1) + K_1^R < L_{G1}(\pi_{EB}^*, \pi^e, A, \varepsilon_1) + K_1^A$, then the EBM will be able to propose a rate π^P intermediate between π_{EB}^* and π^d that makes government 1 indifferent between π^P and π^d , that is a π^P such that $L_{G1}(\pi^P, \pi^e, A, \varepsilon_1) + K_1^R = L_{G1}(\pi^d, \pi^e, R, \varepsilon_1) + K_1^A$.

(b4) if π^d is very far from π_{EB}^* so that $L_{G1}(\pi_{EB}^*, \pi^e, A, \varepsilon_1) + K_1^R < L_{G1}(\pi^d, \pi^e, R, \varepsilon_1) + K_1^A$

K_1^A , then once more the EBM proposes π_{EB}^* and at least the NCB of country 1 accepts the proposal.



Case (c), illustrated in Figure 3, is the same as case (b), but with opposite signs and country subindexes. These possible outcomes are characteristic of the agenda-setter model associated with Romer and Rosenthal (1978, 1979), a well known way of modelling collective decision making in a committee.

It may be worth noticing that there is no competition among national central bankers. There is no intrinsic benefit from being the pivotal voter, that is, the one accepting the EBM's proposal. The loss of the NCB (and of the respective government) depends on the rate proposed, no matter who accepts the proposal and the NCB cannot do any better by accepting a worse proposal in order to become pivotal.

In cases (b3) and (c3), governments could use strategic delegation, not to compete among themselves, but to compete against the EBM. Strategic delegation to induce more extreme NCB preferences would help the governments obtain a proposal closer to their preferred rates. Both governments could try to induce NCB preferences that make the EBM indifferent between the limit of the acceptance set and the default rate. This would be a way of shifting power from the EBM to the governments. By confining myself to globally truthful contribution schedules, I am ruling out the possibility of such strategic delegation.

The exact proposal, given the expected inflation π^e , can be obtained by solving the EBM's problem when proposing a policy π in a given state of the world,

$$\min_{\pi} L_{EB} = \frac{1}{2} [(\pi - \hat{\pi}_{EB})^2 + \lambda_{EB} (\pi - \pi^e + \varepsilon_U)^2] \quad (5.3)$$

$$s.t. \quad U_{Nj}(\pi, \pi^e, A, \varepsilon_j) - U_{Nj}(\pi^d, \pi^e, R, \varepsilon_j) \geq 0,$$

where j is the NCB that is easiest to convince and $\varepsilon_U = \frac{\varepsilon_1 + \varepsilon_2}{2}$. Substituting (5.2) and (5.1) into (5.3) and changing the direction of the inequality (as utilities and

losses are defined as non-negative values), the EBM's problem becomes

$$\min_{\pi} L_{EB} = \frac{1}{2} [(\pi - \widehat{\pi}_{EB})^2 + \lambda_{EB} (\pi - \pi^e + \varepsilon_U)^2] \quad (5.4)$$

$$s.t. \quad L_{Gj}(\pi, \pi^e, A, \varepsilon_j) - L_{Gj}(\pi^d, \pi^e, R, \varepsilon_j) - K_j \leq 0,$$

where $K_j \equiv K_j^A - K_j^R$ is a given constant. The constraint implies that indirectly, the EBM must make at least one of the governments better off with his proposal than with the default rate. The incentive contract means that the NCB is given an acceptance set of rates around $\pi_{G_i}^*$ by his government, where the length of the interval depends on the default rate, expected inflation, government preferences and the supply shock.

Before making a proposal, the EBM checks if any of the governments is better off with π_{EB}^* than with π^d . Otherwise, he will have to adapt his proposal for it to be accepted by one NCB. The Lagrangean of the problem is:

$$\begin{aligned} \max_{\pi} L_{EB} = & \frac{1}{2} [(\pi - \widehat{\pi}_{EB})^2 + \lambda_{EB} (\pi - \pi^e + \varepsilon_U)^2] + \\ & + \delta \left\{ \begin{array}{l} \frac{1}{2} [(\pi - \widehat{\pi}_{Gj})^2 + \lambda_{Gj} (\pi - \pi^e + \varepsilon_j - \bar{y}_j)^2] - \\ \frac{1}{2} [(\pi^d - \widehat{\pi}_{Gj})^2 + \lambda_{Gj} (\pi^d - \pi^e + \varepsilon_j - \bar{y}_j)^2] - K_j \end{array} \right\}, \end{aligned}$$

where $\bar{y}_j \equiv \hat{y}_j - \theta_j$ is the difference between the most preferred rate of employment and the natural rate of employment in country j . I assume country j 's government to be cheapest to convince and the constraint is binding. The NCB of country j is called pivotal when his incentive constraint is satisfied.

This problem gives the first-order condition:

$$\pi [1 + \lambda_{EB} + \delta (1 + \lambda_{Gj})] = \widehat{\pi}_{EB} + \lambda_{EB} (\pi^e - \varepsilon_U) + \delta \widehat{\pi}_{Gj} + \delta \lambda_{Gj} (\pi^e - \varepsilon_j + \bar{y}_j).$$

The proposed rate π^P , for a given π^e , is

$$\pi^P = \frac{1}{1 + \lambda_{EB} + \delta + \delta \lambda_{Gj}} \left[\begin{array}{l} \widehat{\pi}_{EB} + \delta \widehat{\pi}_{Gj} + \delta \lambda_{Gj} \bar{y}_j + \\ (\lambda_{EB} + \delta \lambda_{Gj}) \pi^e - (\lambda_{EB} \varepsilon_U + \delta \lambda_{Gj} \varepsilon_j) \end{array} \right]. \quad (5.5)$$

Substituting the inflation rate in (5.5) into the constraint $L_{Gj}(\pi^P, \pi^e, A, \varepsilon_j) = L_{Gj}(\pi^d, \pi^e, R, \varepsilon_j) + K_j$, the value of the multiplier δ can be obtained. We can find the conditions under which π^P and π_{EB}^* coincide:

- If the constraint does not bind, so that $\delta = 0$.
- For a given δ and π^e , assuming that the constraint hypothetically binds, they would coincide if the targeted rates of the EBM and government j coincide, so that they have the same inflation objective $\hat{\pi}_{EB} = \hat{\pi}_{Gj}$ and no credibility problem $\bar{y}_j = 0$ and if, at the same time, government j has the same weight on inflation and employment stabilization as the EBM, $\lambda_{Gj} = \lambda_{EB}$, and the same demand for stabilization as the EBM, $\varepsilon_j = \varepsilon_U$.

However, no strict comparison is possible at this point, as π^e is an endogenous variable and the multiplier δ is a non-linear function of all parameters. In a normal Barro-Gordon model, two further steps would be followed to complete the solution: (1) computing expected inflation π^e by taking expectations of π^P and (2) plugging π^e back into the first-order condition to solve for π^P . An analytical solution of the model would then be obtained. As the preset model is not recursive, however, I must instead solve both steps jointly. Because of this simultaneity and the associated non-linearity, multiple equilibria are very difficult to rule out, a priori.⁵ But I have never encountered multiple equilibria in my numerical examples.

3 The Model with Uncertainty

In this section, the governments face two types of uncertainty. First, they may not be certain of the EBM's exact perception of the average shock in the EMU area. Second, they may not be certain of the exact preferences of the EBM, i.e., they may not be certain of the exact value of parameter $\hat{\pi}_{EB}$, the inflation rate targeted by the EBM. Introducing both types of uncertainty in the analysis increases the noise faced by the governments when writing the incentive contract and modifies the interval of rates the NCB is induced to accept. The uncertainty about the EBM's preferences also introduces noise into the private sector's inflation expectations.

I will assume that the first type of uncertainty can be eliminated by the publication of the forecasts of the ECB and the second type by the publication of the minutes of the Governing Council meetings. This is obviously a simplification that

⁵ In this respect, the model reminds me of the escape-clause model of Obstfeld (1997), which stresses multiple equilibria.

tries to capture the fact that publication should help reduce both types of uncertainty. In the literature, the disclosure of central bank forecasts has been called "economic transparency", while the openness about policy objectives, like explicit inflation targets, has been called "political transparency"⁶.

Given the timing of the model, forecasts published in connection with the realization of the shock can be used by the governments in their incentive contracts with their NCBs. But the information is not available and thus, cannot be used by the private sector when forming its inflation expectations. When forecasts are not published, the governments form their expectations about the EBM's perception of the EMU average shock. The private sector expects the error of the governments to equal the average error, namely zero, when forming its inflation expectations. Government i 's estimate of the EBM's perception of the average shock in the EMU area (ε_u^{EB}) is assumed to take the form:

$$E_{Gi}(\varepsilon_U^{EB}) = \frac{\varepsilon_i + \varepsilon_j}{2} + \alpha_i .$$

Even if government i knows the exact value of ε_i and has some estimate of ε_j , it still needs to estimate $E_{Gi}(\varepsilon_U^{EB})$ to figure out which rate the EBM will propose in each state of the world. I will assume that the EBM observes the correct $\varepsilon_U = \frac{\varepsilon_i + \varepsilon_j}{2}$, so that α_i is the error committed by government i when estimating the EBM's perception of the EMU average shock. The errors committed by both governments are uncorrelated and have zero expected value.

The publication of the minutes of the Governing Council meetings over time helps everyone learn about the preferences of the EBM. When minutes are not published, I assume that the private sector in each country shares the government's view of the EBM's targeted inflation and is unaware that it may commit an error, so that this error is incorporated in the private sector's inflation expectations.⁷ The government is thus uncertain about the exact inflation rate targeted by the EBM. I will assume

⁶ These names agree with the classification of transparency proposed by Geraats (2001).

⁷ As a simplification, I assume that the publication of minutes helps the private sector learn about the EBM's preferences which change over time, while they remain ignorant otherwise. This assumption is valid in a transitional phase, but not in the long run as the private sector would learn how to estimate $\hat{\pi}_{EB}$ over time. For example, in Faust and Svensson (1998), the Kalman filter provides the optimal solution to the private sector learning problem.

that government i believes the inflation rate targeted by the EBM to be

$$E_{Gi}(\widehat{\pi}_{EB}) = \widehat{\pi}_{EB} + \beta_i,$$

where β_i is the error government i commits when estimating the EBM's targeted rate. I assume once more that the errors committed by both governments are uncorrelated and have zero expected value.

I also analyse what happens if the errors made by the two governments are perfectly positively correlated, that is, if both governments either overestimate or underestimate ε_U^{EB} or $\widehat{\pi}_{EB}$.

When uncertainty is introduced, government i 's contribution schedule becomes a function of the errors it commits. Through the contribution schedule, each government provides its NCB with an acceptance set based only on the verifiable information available to the government before the meeting.

When neither minutes nor forecasts are published, government i 's estimate of π_{EB}^* , for a given expected inflation, is given by

$$\begin{aligned} E_{Gi}(\pi_{EB}^*) &= \frac{1}{1 + \lambda_{EB}} E_{Gi}(\widehat{\pi}_{EB}) + \frac{\lambda_{EB}}{1 + \lambda_{EB}} (\pi_i^e - E_{Gi}(\varepsilon_U^{EB})) \\ &= \frac{1}{1 + \lambda_{EB}} (\widehat{\pi}_{EB} + \beta_i) + \frac{\lambda_{EB}}{1 + \lambda_{EB}} \left[\pi_i^e - \left(\frac{\varepsilon_i + \varepsilon_j}{2} + \alpha_i \right) \right]. \end{aligned}$$

When only minutes are published, we instead have

$$E_{Gi}(\pi_{EB}^*) = \frac{1}{1 + \lambda_{EB}} \widehat{\pi}_{EB} + \frac{\lambda_{EB}}{1 + \lambda_{EB}} \left[\pi^e - \left(\frac{\varepsilon_i + \varepsilon_j}{2} + \alpha_i \right) \right].$$

And when only forecasts are published,

$$E_{Gi}(\pi_{EB}^*) = \frac{1}{1 + \lambda_{EB}} (\widehat{\pi}_{EB} + \beta_i) + \frac{\lambda_{EB}}{1 + \lambda_{EB}} (\pi_i^e - \varepsilon_U).$$

When $L_{Gj}(E_{Gi}(\pi_{EB}^*), \pi_j^e, A, \varepsilon_j) > L_{Gj}(\pi^d, \pi_j^e, R, \varepsilon_j) + K_j$, both constraints are

binding and the EBM must make a proposal solving the following problem:

$$\max_{\pi} L_{EB} = \frac{1}{2} [(\pi - \hat{\pi}_{EB})^2 + \lambda_{EB} (\pi - \pi^e + \varepsilon_U)^2] + \\ + \gamma \left\{ \begin{array}{l} \frac{1}{2} [(E_{G_i}(\pi) - \hat{\pi}_{G_j})^2 + \lambda_{G_j} (E_{G_i}(\pi) - \pi_j^e + \varepsilon_j - \bar{y}_j)^2] \\ - \frac{1}{2} [(\pi^d - \hat{\pi}_{G_j})^2 + \lambda_{G_j} (\pi^d - \pi_j^e + \varepsilon_j - \bar{y}_j)^2] - K_j \end{array} \right\},$$

where π_j^e is the private sector's expected inflation across all states of the world. The solution to this problem is the proposed rate π^P

$$\pi^P = \frac{1}{1 + \lambda_{EB} + \gamma + \gamma \lambda_{G_j}} \left[\begin{array}{l} \hat{\pi}_{EB} + \gamma \hat{\pi}_{G_j} + \gamma \lambda_{G_j} \bar{y}_j + \\ (\lambda_{EB} + \gamma \lambda_{G_j}) \pi_j^e - (\lambda_{EB} \varepsilon_u + \gamma \lambda_{G_j} \varepsilon_j) \end{array} \right]. \quad (5.6)$$

This proposed rate looks just like (5.5), except for the multiplier being different. The new multiplier γ can be obtained by substituting the inflation rate in (5.6) into the constraint.

The consequences of publication can be seen in a numerical example with specific parameter values and a given realization of shocks and errors presented in Appendix 1. In the example, when either minutes or forecasts are not published, the most preferred rates of all agents and the estimated most preferred rate of the EBM are ordered as follows:

$$\pi_{G_1}^* < E_{G_2}(\pi_{EB}^*) < \pi^d < E_{G_1}(\pi_{EB}^*) < \pi_{G_2}^*.$$

Both governments believe that they prefer the default rate rather than $E_{G_i}(\pi_{EB}^*)$ and determine an acceptance set around $\pi_{G_i}^*$.

When neither forecasts nor minutes are published, the interval of rates the NCBs are induced to accept is all rates such that $L_{G_1} \leq 1536$ for the NCB of country 1 (NCB1) and $L_{G_2} \leq 1032$ for NCB2. In this particular case, the EBM prefers the default rate of 0.015 to all rates in the two intervals, so that he either directly proposes π^d or proposes π_{EB}^* but both NCBs reject this proposal. When only minutes are published, the corresponding intervals are all rates such that $L_{G_1} \leq 2125$ and $L_{G_2} \leq 1525$. The constraints are less binding and the EBM can now satisfy NCB1 by proposing the rate $\pi^P = 0.0063$; an intermediate rate between $\pi_{G_1}^*$ and π_{EB}^* . When only forecasts are published, the intervals are $L_{G_1} \leq 1530$ and $L_{G_2} \leq 1030$ and the EBM once more prefers the default rate to all rates in the two intervals.

When both minutes and forecasts are published, both governments understand that the most preferred rates of all agents are ordered as follows:

$$\pi_{G1}^* < \pi_{EB}^* < \pi^d < \pi_{G2}^*.$$

This corresponds to case (a) in the previous section. Government 1 prefers π_{EB}^* to π^d so the EBM can propose his most preferred rate and NCB1 will accept his proposal.

In the states of the world where the EBM is not unconstrained (those that are interesting for analysing the issue of publication), introducing uncertainty reduces the acceptance interval of both NCBs. This makes it more unlikely that the EBM's most preferred rate is accepted, more often constraining him when he proposes an inflation rate.

Since the constraints faced by the EBM are most binding when minutes and forecasts are unpublished, the governments' influence on the proposed rate is strongest in this regime, while publication reduces their influence. It might thus be considered that publication is bad for governments, since they lose power, but that is not necessarily true. The example in this section dealt with just one possible realization of the shocks and errors. To find out whether publication is good or bad ex ante, it is necessary to consider the full equilibrium decisions and economic outcomes in the different states of the world. This is done by numerical examples in the next section.

4 Numerical Analysis

As explained before, I can only fully describe the voting process and compare the expected losses of all agents in a numerical analysis. I call the set of parameters in the example of the previous section the benchmark case. This symmetric case is a good starting point for the analysis, but it is not realistic. Governments with different preferences or distribution of errors and whose countries have different distributions of supply shocks may have different preferences with respect to publication. So I look at the effect of differences in the parameters by changing them, first one at a time and then simultaneously, trying to analyse the effect of the enlargement of the EMU.

The parameters in the benchmark case are: $\lambda_{EB} = \lambda_{G1} = \lambda_{G2} = 1$; $\hat{\pi}_{EB} = \hat{\pi}_{G1} = \hat{\pi}_{G2} = 0.01$; $\bar{y}_1 = \bar{y}_2 = 0$. The deviations I study are: high λ_{G2} ($\lambda_{G2} = 2$); high λ_{G1} and λ_{G2} ($\lambda_{G1} = \lambda_{G2} = 2$); high $\hat{\pi}_{G2}$ ($\hat{\pi}_{G2} = 0.02$); high $\hat{\pi}_{G1}$ and $\hat{\pi}_{G2}$ ($\hat{\pi}_{G1} = \hat{\pi}_{G2} = 0.02$); high \bar{y}_2 ($\bar{y}_2 = 0.02$) and high \bar{y}_1 and \bar{y}_2 ($\bar{y}_1 = \bar{y}_2 = 0.02$).

With respect to the shocks and errors, I assume that they can either take on a high or a low value, with equal absolute value but different signs. These occur with equal probability, so that their expected value is zero. The supply shock ε_i can take on the values $-e_i$ and $+e_i$, the error government i commits when estimating the EBM's perception of the EMU average shock, α_i , takes on values $-a_i$ and $+a_i$ and the error committed by government i when estimating the EBM's targeted inflation rate, β_i , takes on values $-b_i$ and $+b_i$. In the benchmark and other cases described above, I have assumed that $e_1 = e_2 = 0.06$, $a_1 = a_2 = 0.02$, $b_1 = b_2 = 0.01$. I look at three further cases: low e_2 ($e_2 = 0.03$), low b_2 ($b_2 = 0.0075$) and low a_2 ($a_2 = 0.01$). Initially, I assume the errors committed by both governments to be independent. But I also describe how the results are affected by assuming errors to be perfectly positively correlated. For the supply shocks, I look at five alternative correlation patterns.

When both forecasts and minutes are published, there are four states of the world: four combinations of the two possible supply shocks in each country. When either minutes or forecasts are published, there are 16 states of the world and when neither minutes nor shocks are published, there are 64 states of the world. Table I codifies all possible states of the world, so that I can refer to them in the following tables. Table II shows the probabilities of the different states of the world under the alternative correlation assumptions.

The last parameter that needs to be given a numerical value is the default rate, π^d , supposed to represent the status quo outcome under unchanged policy. I will look at three values: $\pi^d = 1.5\%$ corresponding to a period following a recession (a low default interest rate), $\pi^d = 1\%$, and $\pi^d = 0.5\%$ corresponding to a period following a boom.

I present most results corresponding to the assumption of independent supply shocks, since assuming correlation between the supply shocks does not change the preference ordering of the agents. Table III presents the development of the decision process and the expected losses of all agents for the different correlation assumptions

in the benchmark case. Tables IV to VI present the expected losses of all agents under different publication alternatives and default rates. I show how the voting process is resolved, namely in which cases the EBM is allowed to propose his most preferred rate unrestricted and which NCB is pivotal in the different states of the world.

Table VII summarizes the preferred publication alternatives of all agents corresponding to the different default rates. MF refers to the publication of both minutes and forecasts and M to the publication of minutes only. For all parameter values in the ten cases analysed, the incentive constraints are never binding when both minutes and forecasts are published, so that the EBM can simply propose his most preferred rate in all states of the world. This is not necessarily the case. Had I chosen different parameters, it might have been the case that both incentive constraints bind even when minutes and forecasts are published. It would still be the case, however, that the constraints are more binding and governments have more influence under non publication. The EBM's expected losses are always lowest when the constraints are less binding, so that he will always prefer minutes and forecasts to be published.

The EBM is mostly constrained in states of the world where the supply shocks have different signs in both countries, so that the governments have opposite interests and most often benefit if their own NCB is pivotal but lose otherwise.

When the economy is coming out of a recession or boom, the ten cases analysed can be divided into three groups.

- Both NCBs agree with the publication preferences of the EBM: in the benchmark case, when one or both governments put a high relative weight on the fluctuation of output (high λ_{Gi}) and when one government commits a smaller error when estimating the EBM's inflation target (low β_i), the prejudice of not being pivotal in some states more than compensates for the benefit of being pivotal in some other states, so that both governments agree with the EBM in their preference for publication.
- One NCB agrees with the EBM while the other is opposed to the publication of forecasts: when one government has a higher target for inflation or employment than the other and the EBM (high $\hat{\pi}_{G2}$ and \bar{y}_2), when one country has a smaller

variance of the supply shock (low e_2) and when one government commits a smaller error when estimating the EBM's perception of the EMU average shock (low a_2), the uncertainty benefits one government (the one with a higher target for inflation or employment, a smaller variance in the supply shock and a higher error when estimating the EBM's perception of the EMU average shock) but hurts the other.

- Both NCBs prefer only minutes to be published in the period following a boom (a low default inflation rate corresponding to a high default interest rate) and that both minutes and forecasts are published after a recession: when both governments have a higher target for inflation or employment than the EBM, they have a stronger preference for inflation than the EBM. The stimulation of the economy provided by higher inflation is more valuable following a recession than following a boom. But the NCBs are pivotal in states where they want lower inflation than the EBM following a recession (higher after a boom), so the governments prefer not to influence the proposed rate.

The publication of minutes is always beneficial as it corrects the error committed by the private sector when estimating the EBM's targeted inflation rate. In general, the publication of forecasts makes no difference when the cycle is rapidly changing, that is, when the default rate is very far from the rate targeted by the governments; when the default rate coincides with the most preferred rate of the EBM and when the supply shocks are strongly positively correlated in the EMU area, as all agents then have more aligned interests. When there was neither a recession nor a boom in the previous period, the EBM is most often unconstrained even if only minutes are published, and the three agents agree on their preference for either minutes or both minutes and forecasts to be published.⁸

One might think that both governments have an incentive to make their NCBs attractive as the pivotal agent to get a proposed rate closer to their most preferred rate. Both governments would then compete in accepting rates increasingly closer

⁸ The reason for this is that the EBM is often constrained when supply shocks have different signs in both countries, but in this particular alternative, a zero average EMU supply shock means that $\pi_{EB}^* = \pi^d = 0.01$, so that the governments are indifferent between the default rate and the EBM's most preferred rate. Note, however, that a small change in the EMU average shock and the EBM's most preferred rate, as in the case with low e_2 , means that the EBM is constrained in some states of the world.

to the EBM's most preferred rate. The result of this competition would be that the EBM is never constrained, notwithstanding the level of uncertainty. But this cannot occur, given my assumptions. When each government writes the incentive contract, it is unaware of committing an error with respect to the EBM's preferences and perception of the EMU shock, so it acts as if there were no uncertainty. In this case, there is no benefit from competing to become pivotal as already explained in section 2.

I assume the errors committed by both governments when estimating the EBM's perception of the EMU average shock (α_i) to be perfectly positively correlated in the benchmark case. This does not significantly affect the expected losses of the agents when forecasts are not published. When the errors committed by both governments in estimating the EBM's targeted inflation rate (β_i) are perfectly positively correlated, it hurts the EBM, but there is no significant effect on the governments' expected losses because they win in some states and lose in others.

If the group of countries in the EMU is relatively homogeneous, the governments' influence when forecasts are not published does not have a considerable effect on the implemented policies. But the effect of their influence may increase if the group of countries became more heterogeneous, as would be the case with an enlargement of the EMU area. An interesting application of the model is to ask whether the countries' preferences with respect to publication would change in case the EMU area were enlarged. For this purpose, I identify one country in the model (called "old") with the current EMU area and the other country (called "new") with the group of countries that would be included in an enlarged EMU. For obvious reasons, I assume that the government of the "new" country has a higher target for inflation and a preferred employment rate exceeding the natural rate. Furthermore, the "new" country's supply shock has a higher variance. All three parameter perturbations are included in the second group distinguished above, that is, one NCB agrees with the EBM while the other is in favour of the publication of minutes but opposed to the publication of forecasts. However, as shown before, the effect of a higher variance of the supply shock is opposite to the effect of higher targets for inflation and employment. Thus, the consequence of such an enlargement is not straightforward. Once more, I can only fully describe the voting process and compare the expected losses of all agents in a numerical analysis.

The specific parameter values assumed here are: $\lambda_{EB} = \lambda_{GO} = \lambda_{GN} = 1$; $\hat{\pi}_{EB} = \hat{\pi}_{GO} = 0.01$; $\hat{\pi}_{GN} = 0.03$; $\bar{y}_O = 0$; $\bar{y}_N = 0.02$; $e_O = 0.03$; $e_N = 0.06$; $a_O = a_N = 0.02$ and $b_O = b_N = 0.01$. Table VIII presents the expected losses of all agents under different publication alternatives and default rates and how the voting process is resolved. As was the case before, the EBM is always in favour of publishing both minutes and forecasts as this allows it to propose its more preferred rate in all states of the world and the governments of both countries favour the publication of minutes to correct the error committed by the private sector when estimating the EBM's targeted inflation rate.

The government of the "old" country influences the EBM's proposal most for both default rates, but has the opposite effect on the proposed rate. The government of the "new" country only appreciates the influence when the European economy is coming out of a boom, as the proposed rate is then higher than π_{EB}^* . The government of the "old" country always benefits from influencing the EBM's decision, so it prefers forecasts not to be published.

Suppose that the governments of the countries currently in the EMU were to decide on the issue of publication, taking into account that the union might be enlarged in the future. Then, they are likely to favour the publication of minutes but oppose the publication of forecasts to increase their influence and reduce their expected losses after the enlargement. Heterogeneity exacerbates the conflict of interests and increases the value of the influence on the implemented policies.

5 Conclusions

Despite the stringent rules of operation of the European System of Central Banks (ESCB), governments seem to have some influence in the decisions taken by the Governing Council of the ECB. I have modelled the governments' influence using a multiprincipal-multiagent model, where each national central banker tries to satisfy his own government in order to ensure a better career in the future. This way of modelling the relationship gives the governments considerable influence; before any meeting of the Governing Council, the governments induce their national central banker to accept rates within a certain acceptance set and reject any other proposal.

As a counterweight to this high level of national influence, I assume that the

voting process takes the form of an agenda-setter model, where the Executive Board member proposes a policy (an inflation rate). This voting process gives more power to the agenda-setter who only needs to make one national central banker (called pivotal) indifferent between his proposal and the default rate.

I use this model to analyse the publication of forecasts and minutes of the Governing Council meetings. It has been argued that publication would have a negative effect due to the influence of governments on their national central bankers' votes. In my model, the published information is incorporated in the incentive contracts governments offer to their agents, which actually makes the contracts less binding. This reduces the governments' influence on the proposed rate instead of increasing it and thus benefits the EBM.

In four of the ten parameter constellations that I analyse, one government benefits from the influence and prefers forecasts not to be published, while the other agrees with the EBM. In four cases, both governments agree with the EBM in their preference for the publication of forecasts. Only in two cases do both governments prefer forecasts not to be published. Publication of the minutes further eliminates the error committed by the private sector when estimating the EBM's targeted inflation rate, which is always beneficial for all agents.

Should the minutes of the meetings and forecasts be published? My numerical analysis does not give a definitive answer to the normative question, but it gives some insights into how the decision might be taken. Suppose that the Governing Council itself has to decide on the issue of publication. The decision to be taken should depend on the procedure for making the decision. If the median voter were allowed to decide or the EBM were allowed to make a proposal (as an agenda-setter), the Council would decide in favour of the publication of both forecasts and minutes for most parameter values. If the decision must instead be taken with unanimity, the Council would have a harder time agreeing on the publication of forecasts. The same would be true if the publication had to be decided by a direct agreement among governments and the Executive Board members.

These predictions do not seem to match reality: the Executive Board appears to prefer secrecy and no government seems to be in favour of the publication of minutes. This does not necessarily mean that the previous analysis is incorrect, as I have only studied one specific effect of publication. Publication is likely to

affect financial markets, might make it harder for the Governing Council to build a collective reputation, etc. All these additional effects may explain why minutes and forecasts are not published. The contribution of this paper is to analyse – and maybe refute - one common argument against publication, namely that it would have a negative impact on their national representatives through the influence of governments.

As a last exercise, I use the model to see if the forthcoming enlargement changes the attitude to publication of the countries currently in the EMU. I assume that the group of countries to be incorporated in the EMU has higher targets for both inflation and employment and faces a supply shock with higher variance. The higher level of heterogeneity exacerbates the conflict of interests. The model suggests that the current EMU members may want to withhold the publication of forecasts when taking enlargement with a more heterogeneous group of countries into account.

Bibliography

- [1] Barro, R. and D. Gordon (1983), "A Positive Theory of Monetary Policy in a Natural Rate Model", *Journal of Political Economy*, 91, pp. 589-610.
- [2] Buiter, W. (1999), "Alice in Euroland", *Journal of Common Market Studies*, 37(2), pp. 181-209.
- [3] Cukierman, A. (2000), "Are Contemporary Central Banks Transparent about Economic Models and Objectives and What Difference Does It Make?", for the 16,17/10/2000 Bundesbank Conference on Transparency in Monetary Policy.
- [4] Cukierman, A. and A. Metzler (1986), "A Theory of Ambiguity, Credibility and Inflation under Discretion and Asymmetric Information", *Econometrica*, 54(5), pp. 1099-1128.
- [5] Dixit, A. (2001), Alfred Marshall Lecture "Games of Monetary and Fiscal Interactions in the EMU", *European Economic Review*, 45, pp. 589-613.
- [6] Dixit, A. and H. Jensen (2001), "Equilibrium Contracts for the Central Bank of a Monetary Union", mimeo.
- [7] Faust, J. and L. Svensson (1998), "Transparency and Credibility: Monetary Policy with Unobservable Goals", NBER Working Paper No. 6452.
- [8] Faust, J. and L. Svensson (1999), "The Equilibrium Degree of Transparency and Control in Monetary Policy", NBER Working Paper No. 7152.
- [9] Favero, C., X. Freixas, T. Persson and C. Wyplosz (2000), "One Money, Many Countries - Monitoring the European Central Bank 2" - Center for Economic Policy Research.

- [10] Geraats, P. (2001), "Why Adopt Transparency? The Publication of Central Bank Forecasts", Working Paper N° 41, Working Paper Series - European Central Bank.
- [11] Gersbach, H. and V. Hahn (2001a), "Should the Individual Voting Records of Central Bankers be Published?", Discussion Paper 02/01 Economic Research Centre of the Deutsche Bundesbank.
- [12] Gersbach, H. and V. Hahn (2001b), "Voting Transparency and Conflicting Interests in Central Banks Councils", Discussion Paper 03/01 Economic Research Centre of the Deutsche Bundesbank.
- [13] Grossman, G. and E. Helpman (2001), *Special Interest Politics*, MIT Press.
- [14] Groth, C. (2001), "Committee Decisions and Instrument Smoothing", mimeo.
- [15] Helpman, E. and T. Persson (1998), "Lobbying and Legislative Bargaining", *Advances in Economic Analysis and Policy*, 1, 2001
- [16] Issing, O. (1999), "The Eurosystem: Transparent and Accountable, or Willem in Euroland", *Journal of Common Market Studies*, 37(3), pp. 503-519.
- [17] Jensen, H. (2000a), "Optimal Monetary Policy Cooperation through State-independent Contracts with Targets", *European Economic Review*, 44, pp. 517-539.
- [18] Jensen, H. (2000b), "Optimal Degrees of Transparency in Monetary Policymaking", University of Copenhagen, mimeo.
- [19] Obstfeld, M. (1997), "Destabilizing Effects of Exchange Rate Escape Clauses", *Journal of International Economics*, 43, pp. 61-73.
- [20] Persson, T. and G. Tabellini (1999), "Political Economics and Macroeconomic Policy", in J. Taylor and M. Woodford (eds.), *Handbook of Macroeconomics*, North-Holland, Amsterdam.
- [21] Persson, T. and G. Tabellini (2000), *Political Economics: Explaining Economic Policy*, MIT Press.

- [22] Romer, T. and H. Rosenthal (1978), "Political Resource Allocation, Controlled Agendas and the Status Quo", *Public Choice*, 33(4), pp. 27-43.
- [23] Romer, T. and H. Rosenthal (1979), "Bureaucrats versus Voters: On the Political Economy of Resource Allocation by Direct Democracy", *Quarterly Journal of Economics*, 93, pp. 563-587.
- [24] Sibert, A. (1999), "Monetary Policy Committees: Individual and Collective Reputations", Birkbeck College, mimeo .
- [25] Tarkka, J. and D. Mayes (1999), "The Value of Publishing Official Central Bank Forecasts", Bank of Finland Discussion Paper 22/99.

Appendix

The parameters I will look at are: $\lambda_{EB} = \lambda_{G1} = \lambda_{G2} = 1$; $\hat{\pi}_{EB} = \hat{\pi}_{G1} = \hat{\pi}_{G2} = 0.01$; $\bar{y}_1 = \bar{y}_2 = 0$ and $\pi^d = 0.015$. The realizations of the shocks and errors are: $\varepsilon_1 = 0.06$; $\varepsilon_2 = -0.06$; $\alpha_1 = -0.02$; $\alpha_2 = +0.02$; $\beta_1 = +0.01$ and $\beta_2 = -0.01$.

In this particular case, when neither minutes nor forecasts are published, the expected inflation rates (average of the inflation expectations in all states of the world given β_1 and β_2) are $\pi_1^e = 0.0198$ and $\pi_2^e = 0.00015$. The governments estimate the EBM's most preferred rate as $E_{G1}(\pi_{EB}^*) = 0.0299$ and $E_{G2}(\pi_{EB}^*) = -0.0099$. The expected losses⁹ of the two governments at $E_{Gi}(\pi_{EB}^*)$ are $L_{G1}(E_{G1}(\pi_{EB}^*), A, \varepsilon_1) = 2657$ and $L_{G2}(E_{G2}(\pi_{EB}^*), A, \varepsilon_2) = 2654$. The losses of both governments under the default rate are $L_{G1}(\pi^d, R, \varepsilon_1) = 1536$ and $L_{G2}(\pi^d, R, \varepsilon_2) = 1032$. This means that even for the minimal $K_i = 0$, the EBM cannot propose his most preferred rate unrestricted as $2657 > 1536$ and $2654 > 1032$; he must instead adapt his proposal to such a rate that at least one NCB accepts it.

In this example, the interval of rates that the NCBs are induced to accept are all rates such that $L_{G1}(E_{G1}(\pi), A, \varepsilon_1) \leq 1536$ for NCB1 and all rates such that $L_{G2}(E_{G2}(\pi), A, \varepsilon_2) \leq 1032$ for NCB2. The most preferred rate for government 1 in this particular case is $\pi_{G1}^* = -0.01$, so that the EBM would have to propose a lower rate than $\pi_{EB}^* = 0.01$ to convince NCB1 to accept his proposal. The multiplier turns out to be $\gamma_1 = 0.3278$ and the corresponding proposed rate would be $\pi^P = 0,00258$. This rate is worse for the EBM than the default rate, so the EBM instead proposes $\pi^P = 0.015$.

When only minutes are published, the governments estimate the EBM's most preferred rate as $E_{G1}(\pi_{EB}^*) = 0.02$ and $E_{G2}(\pi_{EB}^*) = 0$. The expected inflation of the private sector in both countries equals 0.01 and the expected losses of the two governments at $E_{Gi}(\pi_{EB}^*)$ are $L_{G1}(E_{G1}(\pi_{EB}^*), A, \varepsilon_1) = 2500$ and $L_{G2}(E_{G2}(\pi_{EB}^*), A, \varepsilon_2) = 2500$. The losses of both governments under the default rate are $L_{G1}(\pi^d, R, \varepsilon_1) = 2125$ and $L_{G2}(\pi^d, R, \varepsilon_2) = 1525$. Even for $K_i = 0$, the EBM cannot propose his most preferred rate unrestricted as $2500 > 2125$. Therefore, he will have to adapt his proposal to a rate in the acceptance set of at least one NCB. The EBM is still constrained when proposing an inflation rate, but the constraints are less binding,

⁹ Losses multiplied by 1000000 to facilitate comparisons.

so that the EBM can propose a rate closer to $\pi_{EB}^* = 0.01$ than before. The EBM can now satisfy NCB1 by proposing the rate $\pi^P = 0.0063$ and the corresponding multiplier is $\gamma_2 = 0.1429$. The publication of minutes reduces the noise in the incentive contracts written by the governments, i.e., makes the acceptance sets of both NCBs wider, which translates into a smaller multiplier.

When only forecasts are published, the endogenous value of the expected inflation in country 1 when β_1 is positive is $\pi_1^e = 0.0195$ and the expected inflation in country 2 when β_2 is negative is $\pi_2^e = 0.0006$, so both governments will estimate the EBM's most expected rate as $E_{G1}(\pi_{EB}^*) = 0.01995$ and $E_{G2}(\pi_{EB}^*) = 0.00007$. The expected losses of the two governments at $E_{Gi}(\pi_{EB}^*)$ are $L_{G1}(E_{G1}(\pi_{EB}^*), A, \varepsilon_1) = 1852$ and $L_{G2}(E_{G2}(\pi_{EB}^*), A, \varepsilon_2) = 1854$. The losses of both governments under the default rate are $L_{G1}(\pi^d, R, \varepsilon_1) = 1536$ and $L_{G2}(\pi^d, R, \varepsilon_2) = 1030$. The EBM is once more constrained and must adapt his proposal to please NCB1. The most preferred rate for government 1 in this particular case is $\pi_{G1}^* = -0.01$, so that the EBM would have to propose a lower rate than $\pi_{EB}^* = 0.01$ to convince NCB1 to accept his proposal. Such a rate is worse for the EBM than the default rate, so the EBM instead proposes $\pi^P = 0.015$.

When both minutes and forecasts are published, both governments estimate the EBM's most preferred rate as $\pi_{EB}^* = 0.01$, since $\pi^e = 0.01$ and $\varepsilon_U = 0$. The private sector's inflation expectation in both countries $E_{Pi}(\pi_{EB}^*)$ also equals 0.01, so that the expected losses of the two governments at π_{EB}^* are $L_{G1}(\pi_{EB}^*, A, \varepsilon_1) = 1800$ and $L_{G2}(\pi_{EB}^*, A, \varepsilon_2) = 1800$. The losses of both governments under the default rate are $L_{G1}(\pi^d, R, \varepsilon_1) = 2125$ and $L_{G2}(\pi^d, R, \varepsilon_2) = 1525$. As $1800 < 0.002125$, the EBM can choose his most preferred rate unrestricted and the NCB1 will accept his proposal.

Table I: Codification of cases

A) No uncertainty (minutes and forecasts published)

	- e1	+ e1
- e2	1	3
+ e2	2	4

B) Uncertainty about the preferences of the EBM (forecasts published)

	-b1, -b2	-b1, +b2	+b1, -b2	+b1, +b2
-e1, -e2	1	2	3	4
-e1, +e2	5	6	7	8
+e1, -e2	9	10	11	12
+e1, +e2	13	14	15	16

C) Uncertainty about the perception of the EMU shock by the EBM (minutes published)

	-a1, -a2	-a1, +a2	+a1, -a2	+a1, +a2
-e1, -e2	1	2	3	4
-e1, +e2	5	6	7	8
+e1, -e2	9	10	11	12
+e1, +e2	13	14	15	16

D) Uncertainty about the preferences and the perception of the EMU shock by the EBM

-e1, -e2	-a1, -a2	-a1, +a2	+a1, -a2	+a1, +a2
-b1, -b2	1	2	3	4
-b1, +b2	5	6	7	8
+b1, -b2	9	10	11	12
+b1, +b2	13	14	15	16
-e1, +e2	-a1, -a2	-a1, +a2	+a1, -a2	+a1, +a2
-b1, -b2	17	18	19	20
-b1, +b2	21	22	23	24
+b1, -b2	25	26	27	28
+b1, +b2	29	30	31	32
+e1, -e2	-a1, -a2	-a1, +a2	+a1, -a2	+a1, +a2
-b1, -b2	33	34	35	36
-b1, +b2	37	38	39	40
+b1, -b2	41	42	43	44
+b1, +b2	45	46	47	48
+e1, +e2	-a1, -a2	-a1, +a2	+a1, -a2	+a1, +a2
-b1, -b2	49	50	51	52
-b1, +b2	53	54	55	56
+b1, -b2	57	58	59	60
+b1, +b2	61	62	63	64

Table II: Probability of shock combinations under different correlation assumptions:

Correlation assumptions	Shock combinations			
	-e1, -e2	-e1, +e2	+e1, -e2	+e1, +e2
Independence	25%	25%	25%	25%
Partial positive correlation	35%	15%	15%	35%
Total positive correlation	50%	0%	0%	50%
Partial negative correlation	15%	35%	35%	15%
Total negative correlation	0%	50%	50%	0%

Table III: Losses of all agents for alternative correlations of the supply shocks - Benchmark case - Default rate $\pi^d = 0.5\%$

Agent	LoG1	LoG2	LoEB	LoG1	LoG2	LoEB
Case	Minutes and Forecasts Published			Minutes Published		
Pivotal NCB	EBM not constrained			NCB1 in state 7, NCB2 in state 10		
Independence	1350	1350	450	1352	1352	452
Partial >0 correlation	1170	1170	630	1171	1171	631
Total >0 corr.	900	900	900	900	900	900
Partial <0 correlation	1530	1530	270	1533	1533	272
Total <0 corr.	1800	1800	0	1804	1804	4
Case	Forecasts Published			Nothing Published		
Pivotal NCB	NCB1 in state 6, NCB2 in state 11			NCB1 in states 23, 34, 44, NCB2 in state 19, 24, 42		
Independence	1402	1402	478	1399	1399	475
Partial >0 correlation	121	1221	657	1219	1219	655
Total >0 corr.	949	949	925	948	948	924
Partial <0 correlation	1583	1583	299	1579	1579	296
Total <0 corr.	1855	1855	31	1850	1850	26

Losses multiplied by 1000000

Table IV: Losses of all agents when the supply shocks are not correlated - Default rate $\pi^d=0.5\%$

Agent	LoG1	LoG2	LoEB	LoG1	LoG2	LoEB
Case	Minutes and Forecasts Published			Minutes Published		
Pivotal NCB	EBM not constrained			Described in footnote 1		
A Benchmark	1350	1350	450	1352	1352	452
B High λ_{G2}	1350	2475	450	1353	2476	452
C High $\lambda_{G1}, \lambda_{G2}$	2475	2475	450	2478	2478	452
D High π_{G2}	1350	1400	450	1352	1397	452
E High π_{G1}, π_{G2}	1400	1400	450	1396	1396	452
F High y_2	1350	1550	450	1357	1539	452
G High y_1, y_2	1550	1550	450	1542	1542	453
H Low e_2	1181	506	281	1189	500	282
I Low b_2	1350	1350	450	1352	1352	452
J Low a_2	1350	1350	450	1337	1365	451
Case	Forecasts Published			Nothing Published		
Pivotal NCB	NCB1 in state 6 in all cases but H, NCB2 in state 11 in all cases.			Described in footnote 2		
A Benchmark	1402	1402	478	1399	1399	475
B High λ_{G2}	1402	2553	478	1399	2549	475
C High $\lambda_{G1}, \lambda_{G2}$	2553	2553	478	2550	475	475
D High π_{G2}	1403	1459	478	1399	1450	475
E High π_{G1}, π_{G2}	1459	1458	478	1449	1449	475
F High y_2	1403	1615	478	1398	1604	475
G High y_1, y_2	1616	1615	478	1616	1612	498
H Low e_2	1236	550	306	1262	551	320
I Low b_2	1383	1399	472	1384	1392	470
J Low a_2	1402	1402	408	1399	1399	475

Footnote 1: NCB1 is pivotal in state 7 in all cases but H and in state 10 in case H. NCB2 is pivotal in state 10 in all cases but H and J and, additionally, it is pivotal in state 16 in case G.
Footnote 2: NCB1 is pivotal in states 23, 34, 44 and NCB2 in states 19, 24, 42 in all cases but case B (where NCB1 is pivotal in states 23, 34, 42, 44 and NCB2 in states 19, 24), case G (NCB1 in states 34, 42, 44, 60 and NCB2 in states 19, 23, 24, 52, 56, 64) and case H (NCB1 in states 19, 23, 42, 58, 62 and NCB2 in states 24, 41, 46, 61). - Losses multiplied by 1000000

Table V: Losses of all agents when the supply shocks are not correlated - Default rate $\pi^d = 1.0\%$

Agent	LoG1	LoG2	LoEB	LoG1	LoG2	LoEB
Case	Minutes and Forecasts Published			Minutes Published		
Pivotal NCB	EBM not constrained			EBM not constrained		
A Benchmark	1350	1350	450	1350	1350	450
B High λ_{G2}	1350	2475	450	1350	2475	450
C High $\lambda_{G1}, \lambda_{G2}$	2475	2475	450	2475	2475	450
D High π_{G2}	1350	1400	450	1350	1400	450
E High π_{G1}, π_{G2}	1400	1400	450	1400	1400	450
F High y_2	1350	1550	450	1350	1550	450
G High y_1, y_2	1550	1550	450	1550	1550	450
H Low e_2	1181	506	281	1172	516	282
I Low b_2	1350	1350	450	1350	1350	450
J Low a_2	1350	1350	450	1350	1350	450
Case	Forecasts Published			Nothing Published		
Pivotal NCB	Described in footnote 1.			Described in footnote 2		
A Benchmark	1398	1398	474	1398	1398	474
B High λ_{G2}	1398	2546	474	1398	2549	474
C High $\lambda_{G1}, \lambda_{G2}$	2547	2547	474	2550	2550	474
D High π_{G2}	1397	1446	474	1397	1447	474
E High π_{G1}, π_{G2}	1446	1446	474	1446	1446	474
F High y_2	1397	1599	474	1417	1582	475
G High y_1, y_2	1606	1603	474	1613	1613	506
H Low e_2	1270	529	313	1248	545	309
I Low b_2	1379	1395	469	1388	1385	469
J Low a_2	1398	1398	474	1435	1361	474

Footnote 1: NCB1 is pivotal in state 6 and NCB2 is pivotal in state 11 in cases A, C and I. NCB1 in states 6 and 11 in case B. NCB2 in states 6 and 11 in cases H and I. NCB1 in state 11 and NCB2 in state 6 in cases D, E, F and G.

Footnote 2: NCB1 is pivotal in states 23, 27, 31, 34 and NCB2 in states 19, 38, 42, 46 in cases A and C. NCB1 in states 23, 27, 31, 34, 38, 42 and NCB2 in states 19, 46 in case B. NCB1 in states 27, 31, 34, 42 and NCB2 in states 19, 23, 38, 46 in case D. NCB1 in states 27, 31, 34, 42, 46 and NCB2 in states 19, 23, 38 in case E. NCB1 in states 31, 34, 42 and NCB2 in states 19, 23, 24, 27, 32 in case F. NCB1 in states 34, 42, 44, 60 and NCB2 in states 19, 23, 24, 52, 56, 64 in case G. NCB1 in states 23, 42 and NCB2 in states 19, 24, 41, 46 in case H. NCB1 in states 27, 31, 34, 38 and NCB2 in states 19, 23, 42, 46 in case I. NCB1 in states 31 - 34 and NCB2 in states 23, 24, 41, 42 in case J. - Losses multiplied by 1000000

Table VI : Losses of all agents when the supply shocks are not correlated - Default rate $\pi^d = 1.5\%$

Agent	LoG1	LoG2	LoEB	LoG1	LoG2	LoEB
Case	Minutes and Forecasts Published			Minutes Published		
Pivotal NCB	EBM not constrained			Described in footnote 1		
A Benchmark	1350	1350	450	1352	1352	452
B High λ_{G2}	1350	2475	450	1353	2476	452
C High $\lambda_{G1}, \lambda_{G2}$	2475	2475	450	2478	2478	452
D High π_{G2}	1350	1400	450	1349	1408	451
E High π_{G1}, π_{G2}	1400	1400	450	1405	1405	451
F High y_2	1350	1550	450	1347	1564	451
G High y_1, y_2	1550	1550	450	1559	1559	451
H Low e_2	1181	506	281	1189	500	282
I Low b_2	1350	1350	450	1352	1352	452
J Low a_2	1350	1350	450	1337	1365	451
Case	Forecasts Published			Nothing Published		
Pivotal NCB	Described in footnote 2			Described in footnote 3		
A Benchmark	1402	1402	478	1399	1399	475
B High λ_{G2}	1402	2553	478	1399	2551	475
C High $\lambda_{G1}, \lambda_{G2}$	2553	2553	478	2550	2550	475
D High π_{G2}	1402	1446	478	1399	1447	475
E High π_{G1}, π_{G2}	1446	1446	478	1447	1447	475
F High y_2	1402	1590	478	1399	1597	475
G High y_1, y_2	1591	1590	478	1600	1599	475
H Low e_2	1237	551	306	1262	551	320
I Low b_2	1383	1399	472	1384	1392	470
J Low a_2	1402	1402	478	1399	1399	475

Footnote 1: NCB1 is pivotal in state 10 in all cases but H, where it is pivotal in state 7. NCB2 is pivotal in state 7 in all cases but H and J.

Footnote 2: NCB1 is pivotal in state 11 in all cases but H, where it is pivotal in state 6. NCB2 is pivotal in state 6 in all cases but H.

Footnote 3: NCB1 is pivotal in states 21, 31, 42 and NCB2 is pivotal in states 23, 41, 46 in all cases but B and H. NCB1 is pivotal in states 21, 23, 31, 42 and NCB2 is pivotal in states 41, 46 in case B. NCB1 is pivotal in states 3, 7, 23, 42, 46 and NCB2 is pivotal in states 4, 19, 24, 41 in case H.

Losses multiplied by 1000000.

Table VII : Most preferred publication alternatives

Case	Default rate $\pi^d = 0.5\%$			Default rate $\pi^d = 1.0\%$			Default rate $\pi^d = 1.5\%$		
	Gov. 1	Gov. 2	EBM	Gov. 1	Gov. 2	EBM	Gov. 1	Gov. 2	EBM
A - Benchmark	MF	MF	MF	MF / M	MF / M	MF / M	MF	MF	MF
B - High λ_{Q2}	MF	MF	MF	MF / M	MF / M	MF / M	MF	MF	MF
C - High λ_{Q1} and λ_{Q2}	MF	MF	MF	MF / M	MF / M	MF / M	MF	MF	MF
D - High π_{Q2}	MF	M	MF	MF / M	MF / M	MF / M	M	MF	MF
E - High π_{Q1} and π_{Q2}	M	M	MF	MF / M	MF / M	MF / M	MF	MF	MF
F - High y_2	MF	M	MF	MF / M	MF / M	MF / M	M	MF	MF
G - High y_1 and y_2	M	M	MF	MF / M	MF / M	MF / M	MF	MF	MF
H - Low e_2	MF	M	MF	M	MF	MF	MF	M	MF
I - Low b_2	MF	MF	MF	MF / M	MF / M	MF / M	MF	MF	MF
J - Low a_2	M	MF	MF	MF / M	MF / M	MF / M	M	MF	MF

Table VIII : Losses of all agents when the supply shocks are not correlated
Enlargement of the EMU

	Minutes & Forecasts Publ.			Minutes Published			Forecasts Published			Nothing Published		
	Old G	New G	EBM	Old G	New G	EBM	Old G	New G	EBM	Old G	New G	EBM
Post recession:	$\pi^d = 1.5\%$			$\pi^d = 1.5\%$			$\pi^d = 1.5\%$			$\pi^d = 1.5\%$		
Pivotal NCB	EBM not constrained			NCB1 pivotal in state 10			NCB1 pivotal in state 11			Described in footnote 1		
Losses	506	1581	281	500	1595	282	549	1645	306	551	1665	320
Post boom:	$\pi^d = 0.5\%$			$\pi^d = 0.5\%$			$\pi^d = 0.5\%$			$\pi^d = 0.5\%$		
Pivotal NCB	EBM not constrained			NCB1 st 16, NCB2 st 8			NCB2 pivotal in state 6			Described in footnote 2		
Losses	506	1581	281	505	1577	282	550	1629	306	553	1665	339

Footnote 1: NCB1 is pivotal in states 2, 4, 34, 42, 44 and NCB2 is pivotal in states 10, 21, 23, 31

Footnote 2: NCB1 is pivotal in states 21, 31, 34, 44, 52, 56, 58, 60, 62, 64 and NCB2 is pivotal in states 18, 20, 22-24, 28, 32, 42, 55, 61, 63.
Losses multiplied by 1000000.