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ABSTRACT

Unilingual versus Bilingual Education System: A Political Economy Analysis*

We define an economy composed of two language groups. Value is created through bilateral trade between individuals who can speak the same language. The value of trade increases in each participant's level of education. We compare a bilingual education system, under which the individuals who take education become bilingual, with a unilingual system, under which the individuals attending school end up speaking the language of the politically dominating group only. Bilingualism is socially optimal when education levels are centralized. In the decentralized equilibrium, individuals (i) vote over education systems anticipating the future levels of education (ii) independently and simultaneously choose whether or not to take education. We show that in the unilingual system the returns to education for each member of the dominated group positively depend on the number of members of the same group attending school (a 'bandwagon' effect). Instead, under bilingualism, decisions to take education are negatively correlated across groups (a 'duplication' effect). For this reason, the equilibrium education levels may be higher under unilingualism, and there may be unanimity for unilingualism. We find that language conflict, whenever it arises, consists in a situation in which uniligualism is supported by the dominant group, while bilingualism is defended by the dominated group. We characterize also the conditions under which unanimity for bilingualism arises. The predictions of the model are shown to be compatible with the almost unanimous choice of a bilingual Finnish-Swedish education system in Finland (1919-22) and the choice of a unilingual French-language system in France (1789-94).

JEL Classification: I20 and J15
Keywords: education, language policies, minorities and skills

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1 Introduction

In multilingual countries, language policies are a key determinant of the development or the decline of languages. As stressed by historians of language (see among others, Hagège, 1996) one crucial component behind language shift in populations over generations is the choice of the language(s) of instruction in school. In other terms, languages which are not given the status of medium of instruction in school tend to be replaced by the language used in school. France and Finland provide two interesting case studies. In late 18th century France, around two thirds of the French did not speak French (Grégoire, 1794).[1] The unilingual French-speaking education system set up during the 19th century (among other factors) has lead to a wide language shift in France, as languages other than French are now spoken by around 5 percent of the population (Encyclopaedia Britannica, 2002). By contrast, the bilingual Finnish-Swedish education system set-up in Finland after its independence in 1917 has been one of the factors explaining the relative good shape of Swedish in contemporary Finland. Indeed, the native Swedish-speaking population has declined to a much lesser extent in relative terms (from 11 percent of the total population in 1920 to 5.9 percent in 2000), and has remained almost constant in absolute numbers (314,000 native Swedish-speakers in 1920 and 293,000 in 2000).[2] The objective of this paper is to understand the *political economy* of the choice in a multilingual country between a unilingual education system and one in which more than one language is used as medium of instruction.

Our economy consists of a continuum of individuals belonging to two language groups initially unable to communicate. Value is created through bilateral trade between individuals who can speak the same language. Conditional on speaking the same language, the match surplus increases in each participant's level of education. The education system can be organised in two different ways. Under a bilingual system, individuals who choose to attend school learn the language of the other group and keep their own language. In contrast, under a unilingual system, the language of the politically "dominating" group (the m-group) is the unique medium of instruction, and thus the "dominated" group (the n-group) members who attend school lose their own language. The personal cost of taking education is assumed constant across the population and independent of the education system.

We first show that the bilingual system is socially optimal when education levels are centralised, i.e. when a benevolent planner can choose the education level of each individ-

[1] The other languages spoken were Occitan, Alsacian, Franconian, Basque, Breton, Catalan, Flemish, Franco-provençal, and Corsican.

[2] Data for 1920 are from McRae (1997) and for 2000 from the Encyclopaedia Britannica (2003). According to the Research Centre of Wales (1998), in 1995 the number of Finns using Swedish in their everyday life would be around 600,000 out of 5 million.

ual. This result is not surprising since under our assumptions bilingualism is technologically superior to unilingualism, in the sense that the agents get access (at a zero additional cost) to a larger set of potential partners if they speak both languages.

We then consider the following game. First, anticipating the future levels of education, the educational system is chosen so as to maximise the expected utility of the group(s) in power. Second, the individuals independently and simultaneously choose whether or not to take education. We consider symmetric Nash equilibria in which all members of each group randomise between education and staying unskilled with the same probability.

An essential feature of the model is that individual decisions of taking education generate externalities, as the payoff associated to attending school depends on the skill level and the languages spoken by the potential partners.

Under unilingualism, the ms never choose to take education[3], since education does not enlarge their set of trading partners. Indeed, any agent attending education will end up speaking the language of the ms, and thus the ms can avoid paying the cost of education. In addition, the returns to education for each member of the n-group positively depend on the number of ns who attend school: each time that an n takes education, she forgets her initial language, and thus the other members of the group can keep her as a potential partner only if they choose to attend school themselves (a "bandwagon" effect). If the cost of education is very low (high) and/or the m-group is sufficiently small (large), all (none of) the ns take education. For intermediate values of these two parameters, both equilibria co-exist.

Under bilingualism, the bandwagon effect is absent, since nobody loses her own language when attending school. In contrast, this system is characterised by *negative* externalities in the decisions to take education across groups: any member of one group who chooses to attend school becomes bilingual and thus becomes an additional partner for the members of the other group who do not attend school (a "duplication" effect), reducing the incentives for education. The negative nature of the externalities explains why multiple equilibria, when they arise, are characterised by all the members of one group and none of the other taking education. When the equilibrium is unique, the only group which undertakes education (if any) is the smallest group.

Concerning the choices of both groups between the two education systems, the model delivers three interesting results. First, our model predicts that the ns never support unilingualism in a situation in which the ms favour bilingualism. In other words, the only type of language conflict that arises as an equilibrium outcome is one in which the ms push for a unilingual system in its own language, while the ns support bilingualism. The intuition goes as follows: when education is very expensive, the ms never take education under any

[3] Unless we are in the trivial case in which the improvement in productivity associated to taking education is itself higher than the cost of education.

system, while the ns may take education only under bilingualism due to the bandwagon effect. Then, the ms support unilingualism because they can benefit from the other group's education, and the ns prefer a system in which they can avoid taking education. This is an interesting result since it does not rely on any direct utility enjoyed from speaking one's own language. A second important result is that despite the technological advantage assumed here for bilingualism, unanimity for unilingualism is an equilibrium outcome in some cases. The intuition comes from the different nature of the externalities: as externalities are positive under unilingualism, the equilibrium education levels may end up being higher in a unilingual system, and both groups may prefer this system if education is not too expensive.[4] On the contrary[5], there is unanimity for bilingualism if education is cheap and the size of the m-group is sufficiently large. Remember that the ms never get educated under unilingualism, while they may attend school in a bilingual system. Then, the ns prefer a bilingual system, since they can avoid paying the cost of education, and, as the m-group is big, a large proportion of potential partners get skilled. The ms also prefer a bilingual system: if education is cheap, bearing the cost of education is compensated by the fact that meeting another m is much more likely than meeting an n.[6]

Next, we address the issue of failure in political decision-making, i.e. we study under which circumstances the political decision process leads to the adoption of the 'wrong' type of education system. For this purpose, we define a new optimality benchmark, corresponding to the socially optimal education system with *decentralised* educational choices. We show that political failure may arise when the ns are the ruling group in the political process (bilingualism chosen too often) and when the ms are the ruling group but constitute a minority (unilingualism chosen too often).

The theoretical part of the paper is completed with an analysis of compulsory education. More precisely, we study whether agents can alleviate the undereducation outcome resulting from coordinational failures by choosing to introduce compulsory education. We show that compulsory education is chosen as a solution to undereducation only in a part of the parameter space where this problem arises.

Finally, we show that the predictions of the model for the Finnish and the French case are compatible with the observed outcomes. In Finland (1919-1922), the Swedish-speaking

[4]More precisely, the presence of the bandwagon effect leads to positive amounts of education in the unilingual system, while under bilingualism nobody gets educated. If education is not too expensive, the ns prefer to pay the cost of education rather than remain uneducated and are able to trade with a relatively small number of partners.

[5]In addition to these situations, in some cases the agents are indifferent between the two systems, and for some zones of the parameter space the choice between uniligualism and bilingualism is indeterminate for some individuals, i.e., some of the equilibria under unilingualism are preferred to their bilingual counterpart, while others are dominated.

[6]Unanimity for bilingualism arises also in situations in which the ms do not get educated under either system, and the education level of the ns is higher under bilingualism.

group was small (11.6% of the population in 1910), and the bilingual Finnish-Swedish education system was approved by an overwhelming majority[7], with the entire support of the Swedish-speaking side and a very large support of the Finnish-speaking group. As seen above, our model predicts that unanimity for bilingualism can be reached if the size of the m-group (here, the Finnish-speaking) is sufficiently large. In France (1789-1794), the French-speaking group was small (around one third of the population) and it seems reasonable to assume that the cost of education was high. A unilingual French-speaking system was chosen when power was under the control of the *montagnards*, radical jacobins revolutionaries with the support of the Parisian *sans-culottes* (see Furet, 1988), so the ms favoured unilingualism. The position of the non-French speaking groups needs further analysis: while a series of federalist rebellions took place in 1793 in the main non-French speaking towns (Bordeaux, Lyon, Marseilles, and Toulouse), it is unclear to what extent language was an important issue. Our model predicts that when the m-group is sufficiently small and the cost of education sufficiently high, either there is unanimity for bilingualism or a language conflict in which the ms support unilingualism.

Other papers in the literature have modelled language and/or language acquisition. Church and King (1993) shows in a game-theoretic setting that the individual decisions of language acquisition can be inefficient. Laitin (1994) uses also game theory to study why state-induced coordination on a national language is difficult to achieve in multilingual countries. John and Yi (2001) develops a dynamic setting to provide an explanation of the factors leading to a decline or a development of different languages.[8] Our novel contribution to the literature is the modelling of the specific role of schooling, together with the analysis of the political economy of the decisions concerning education systems.

2 The model

Consider a country inhabited by a continuum of citizens, normalised to unity. In the country there are two *language groups*, m and n, of sizes $M \in (0,1)$ and $N = 1 - M$, respectively. Initially, the ms speak $m$ish and the ns $n$ish. ms and ns are unable to communicate unless they learn to speak a common language.

A fraction μ_m (μ_n) of the ms (ns) take education and become *skilled*. The rest remain *unskilled*. μ_m and μ_n are endogenously determined.

Value is created through bilateral trade between individuals. Each citizen is matched exactly once with every other citizen. Two unskilled who meet and trade gain one unit of surplus each. If one is skilled and the other unskilled, surplus increases to $1 + \sigma$ for each.

[7] see Eduskunta-Riksdag (1920).

[8] Other papers studying language are Lazear (1999) and Saint-Paul (2001).

A match between two skilled creates a surplus of $1 + 2\sigma$ for each.[9] Trade occurs if and only if the two potential trading partners are able to communicate, i.e. speak a common language. If they cannot communicate, there is no trade and each obtains zero surplus.

Returns to education are two-fold. Taking education implies becoming skilled, which increases the value of trade as described above for all agents with which a skilled person trades, hence there are positive *skill externalities* in education. Schooling also involves language training, the type depending on educational system. This paper compares a *unilingual* to a *bilingual* educational system. The personal cost c of taking education is assumed constant across the population and independent of the educational system.

2.1 The unilingual education system

Under the unilingual system, $m$ish[10] is the unique language of instruction. The ms who attend school become skilled and keep their initial language. The ns who take education become skilled, learn $m$ish and *lose their initial language*. Indeed, as shown by historians (see e.g. Hagège, 1996, for the case of France) one crucial factor behind language shift in populations over generations is the choice of the language(s) of instruction in school. In other terms, languages which are not given the status of medium of instruction in primary school tend to be replaced by the language used in school.

The expected utility of taking education under a unilingual system, given expected education shares $\boldsymbol{\mu} = (\mu_n, \mu_m)$ is:[11]

$$U^{uni}(\boldsymbol{\mu}) = M[(1 + 2\sigma)\mu_m + (1 + \sigma)(1 - \mu_m)] + N(1 + 2\sigma)\mu_n - c. \tag{1}$$

Becoming educated means having $m$ish as sole language and a high skill level. The skilled trade with all the ms, the value of which is given by the first term in brackets. The first part is the value of trading with the skilled, the second part the value of trading with the unskilled. The skilled trade also with those of the ns who have taken education. The value of this trade is given by the second term in brackets. From this is to be subtracted the cost of education. Each skilled individual unambigously benefits from anyone else taking education. There are two reasons. First, increasing the skill level of one agent enhances the value of trade for all trading partners through the skill externality. Second, the ms and skilled ns benefit from additional ns taking education through an expansion of their

[9] This means that the "return to skill", the value added of increasing the skill level of one of the trading partners, is constant and given by σ.

[10] The assignment of the dominant role to the m group is arbitrary and without loss of generality. So far we have said nothing about the relative sizes of the two groups or the amount of skilled belonging to each. Nor have we described the political process by which the educational system is chosen.

[11] There is no need to make a distinction between ns and ms who take education since they speak same language and have identical skill levels subsequent to becoming educated.

set of trading partners, a positive *communication externality*.[12]

An unskilled n trades only with other unskilled ns. Hence, the expected utility for an n of staying unskilled is

$$\underline{U}_n^{uni}(\boldsymbol{\mu}) = N(1-\mu_n) \tag{2}$$

under the unilingual system. The unskilled n lose from others taking education. This is an example of a negative communication externality, as those who become educated no longer are able to trade with the remaining unskilled ns.

An unskilled m improves also her situation when other agents take education: while she trades with exactly the same people, some of the matches become more productive:

$$\underline{U}_m^{uni}(\boldsymbol{\mu}) = M[(1+\sigma)\mu_m + (1-\mu_m)] + N(1+\sigma)\mu_n. \tag{3}$$

2.2 The bilingual education system

Under the bilingual system, all those who take education become bilingual, hence able to communicate with the entire population. Consequently, the skilled trade with everybody.

The expected utility of taking education under a bilingual system given expected education shares $\boldsymbol{\mu} = (\mu_m, \mu_n)$ is:

$$\begin{aligned} U^{bi}(\boldsymbol{\mu}) = M[(1+2\sigma)\mu_m + (1+\sigma)(1-\mu_m)] + \\ N[(1+2\sigma)\mu_n + (1+\sigma)(1-\mu_n)] - c. \end{aligned} \tag{4}$$

The first term in brackets is the value of trading with the ms and the second term the value of trading with the ns. As was the case under the unilingual system, anyone who has taken education benefits from all other doing so. This time the benefit is entirely due to the skill externality, as the educated are able to trade with everybody independently of her language background.

The expected utility of staying unskilled under the same conditions for anyone belonging to the n masses is:

$$\underline{U}_n^{bi}(\boldsymbol{\mu}) = M(1+\sigma)\mu_m + N[(1+\sigma)\mu_n + (1-\mu_n)]. \tag{5}$$

The difference between this expression and (2), which identifies the value of being uneducated under the unilingual system, is that bilingualism enables the unskilled ns to maintain trading relations with all other ns and are now able to trade with the skilled ms. The negative communication externality that arises under the unilingual system is removed under the bilingual system.

[12] It is possible to view a language as a network defining the set of trading partners. With this terminology, the communication externality would be the equivalent of a network externality. Everybody belonging to the network benefits (loses) from additional people joining (leaving) the network.

The expected utility of the unskilled ms under a bilingual system is the same that in the unilingual case, as the unskilled ms communicate with and trade only with those who know how to speak $m$ish. Hence,

$$\underline{U}_m^{bi}(\boldsymbol{\mu}) = M[(1+\sigma)\mu_m + (1-\mu_m)] + N(1+\sigma)\mu_n. \tag{6}$$

2.3 Equilibrium

The timing is as follows. First, anticipating the future levels of education, the educational system is chosen so as to maximise the expected utility of the group(s) in power. Second, the population independently and simultaneously choose whether or not to take education. We consider without loss of generality symmetric Nash Equilibria in which all members of each group randomise between education and staying unskilled with the same probability.

3 Equilibrium education levels

3.1 The unilingual education system

By subtracting (2) from (1), we obtain the individual n's net benefit of taking education under a unilingual system:

$$\triangle U_n^{uni}(\boldsymbol{\mu}) = [M\mu_m + N\mu_n](1+\sigma) + M(1-\mu_m) - N(1-\mu_n) + [M+N\mu_n]\sigma - c. \tag{7}$$

We can distinguish between three effects. First, there is a *communication effect* which alters the set of trading partners. Under the unilingual system, the communication effect can further be broken into three separate parts. By taking education, the skilled n is now able to trade with the skilled ms and the other skilled ns. That effect is captured by the first term. Further, she is able to trade with the unskilled ms, the effect of which is captured by the second term. Unfortunately, the skilled n can no longer trade with the unskilled ns, which is captured by the third term. Education increases the value of trade through increased skills. This *skill effect* is the fourth term. It is given by the marginal value of education σ times the fraction of people with which the skilled n trades, the ms and the other skilled ns in this case. Finally, there is a cost effect represented by the last term.

Equation (7) displays an important feature which turns out to be crucial to the understanding of the preferences over education system of two language groups. An increase in the number of ns that take education reinforces both the communication and the skill effect, as more people speak $m$ish and less people speak $n$ish. Thus, the educational choice of an n generally depends on the educational choice of her peers. The incentive for taking education is strong if many other ns take education. There is much less point in taking education if the other ns choose to remain unskilled.

The net benefit

$$\triangle U_m^{uni}(\boldsymbol{\mu}) = [M + N\mu_n]\sigma - c \tag{8}$$

of becoming skilled for a member of the m masses is obtained by subtracting (3) from (1). Here, only the skill and cost effects show up, since the ms do not learn to speak $n$ish and the set of trading partners does not change.

The *bandwagon* or *snowball* effect in educational choice of the ns sometimes gives rise to multiple equilibria. In addition to the possibility of two extreme equilibria in which either all or none of the n masses take education, there may exist a mixed equilibrium.[13] However, as the incentive for taking education is positively correlated across groups:

Proposition 1 *Under the unilingual education system, equilibrium education levels are positively correlated across language groups in the following sense: in the cases with multiple equilibria high (low) education levels among the ns are coupled with high (low) education levels among the ms.*

Proof. Let $\mathbf{z}^{uni} = (z_n^{uni}, z_m^{uni})$ and $\mathbf{y}^{uni} = (y_n^{uni}, y_m^{uni})$ be two distinct equilibria of the game. We need to establish that $z_n^{uni} > y_n^{uni}$ and $y_m^{uni} > z_m^{uni}$ cannot simultaneously hold. Suppose they do. $y_m^{uni} > z_m^{uni} \geq 0 \Rightarrow \triangle U_m^{uni}(\mathbf{y}^{uni}) \geq 0$. $\partial \triangle U_m^{uni}(\boldsymbol{\mu})/\partial \mu_n > 0 \Rightarrow \triangle U_m^{uni}(\mathbf{z}^{uni}) > \triangle U_m^{uni}(\mathbf{y}^{uni})$ for $z_n^{uni} > y_n^{uni}$. Hence, $z_n^{uni} > y_n^{uni}$ and $y_m^{uni} > z_m^{uni} \Rightarrow \triangle U_m^{uni}(\mathbf{z}^{uni}) > 0$ and thus $z_m^{uni} = 1$, which contradicts $y_m^{uni} > z_m^{uni}$. ■

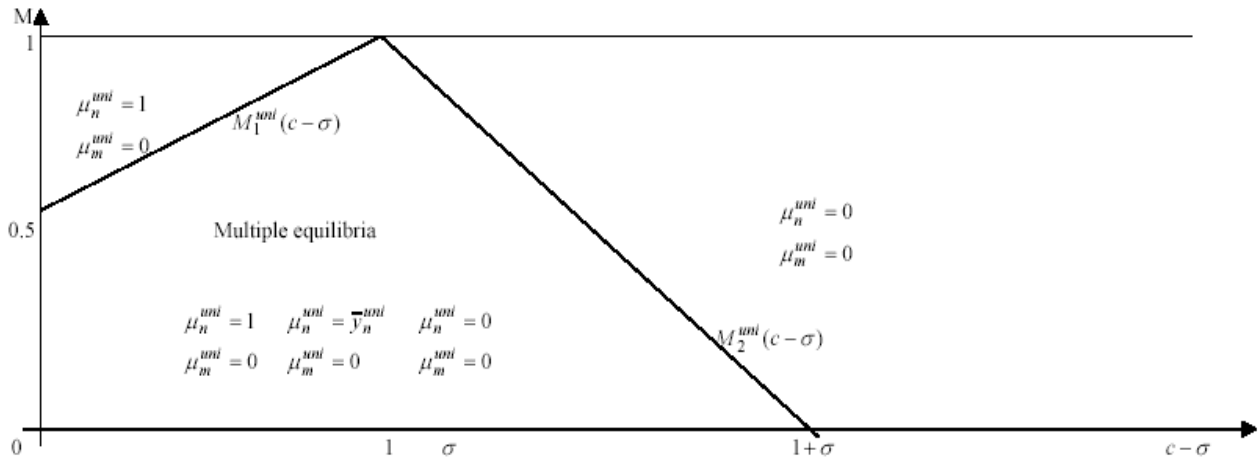

Fig. 1: Equilibrium education levels under the unilingual system

Let us consider in more detail the types of possible equilibria that can potentially arise. Figure 1 characterises the set of equilibria in $(c - \sigma, M)$ space for the $c > \sigma$ case. The

[13] This unstable equilibrium is sometimes referred to as a *tipping* equilibrium, a term coined by Schelling (1978).

reason for considering this subspace will become apparent when we turn to the political analysis in the next stage.[14] Moreover, we restrict attention here to the $\sigma > 1$ case, that is, when the marginal benefit of increasing the skill level is larger than the marginal benefit created when two unskilled meet and trade. At this stage this is purely for expositional purposes.

The first thing to notice is that the ms never take education under the unilingual system whenever $c > \sigma$. As there is no communication effect at play for this language group, the educational choice depends entirely on the magnitude of the skill effect. If $c > \sigma$, the skill effect is never sufficiently strong to induce the ms to take education, even if all the ns should choose to take education.

For the ns, educational choice hinges crucially on the relative sizes of the two language groups and potentially on the choices of the other ns. If N is small, or equivalently, M is large, it does not matter what the other ns do. By taking education, the set of trading partners is significantly expanded and so the communication and skill effects are both strong. Hence, if the number of ms exceeds some lower threshold M_1^{uni}, all ns take education, and $(1, 0)$ is the unique equilibrium. Conversely, if the number of ns is suffiently large, the bandwagon effect in education becomes important. Suppose only a few ns take education. In this case the skill effect and communication effects are weak, hence it is unprofitable to take education. If, on the other hand, a large proportion of the ns take education, the skill and communication effects are strong, hence it becomes very profitable to take education. There are multiple equilibria. As education becomes increasingly expensive, the externalities becomes increasingly important for educational choice. When education is very expensive ($c > 1 + \sigma$), positive education levels can be sustained if and only if the externality in education is very strong, i.e. the size of the m group drops below an upper threshold M_2^{uni}. Eventually, education becomes so expensive ($c > 1 + 2\sigma$) that nobody can afford to take education.

3.2 The bilingual education system

Subtract (5) from (4) to get

$$\triangle U_n^{bi}(\boldsymbol{\mu}) = M(1 - \mu_m) + \sigma - c, \tag{9}$$

the net benefit of taking education for the unskilled n under the bilingual system. The first term is the communication effect. By taking education, the n expands her set of trading partners to include the unskilled ms. The skill effect is simply equal to σ since the skilled trade with the whole population and there are "constant returns to skill". The cost of

[14] When $c < \sigma$, a plethora of subcases arise. The interested reader could consult the appendix for a full characterisation of the equilibria.

education is given by c. Everything is symmetric for the ms. Hence, the net benefit for an m of becoming educated is

$$\triangle U_m^{bi}(\boldsymbol{\mu}) = N(1-\mu_n) + \sigma - c. \tag{10}$$

As opposed to the situation under the unilingual system, the education level in the population now has a negative effect on the individual incentive for taking education. When more people of the other group become educated and learn to speak a person's native language, it becomes less important for that person to learn the other language. Education weakens the communication effect of education, which we shall label a *duplication effect*. When it comes to trading opportunities, there is no point in both groups speaking both languages.

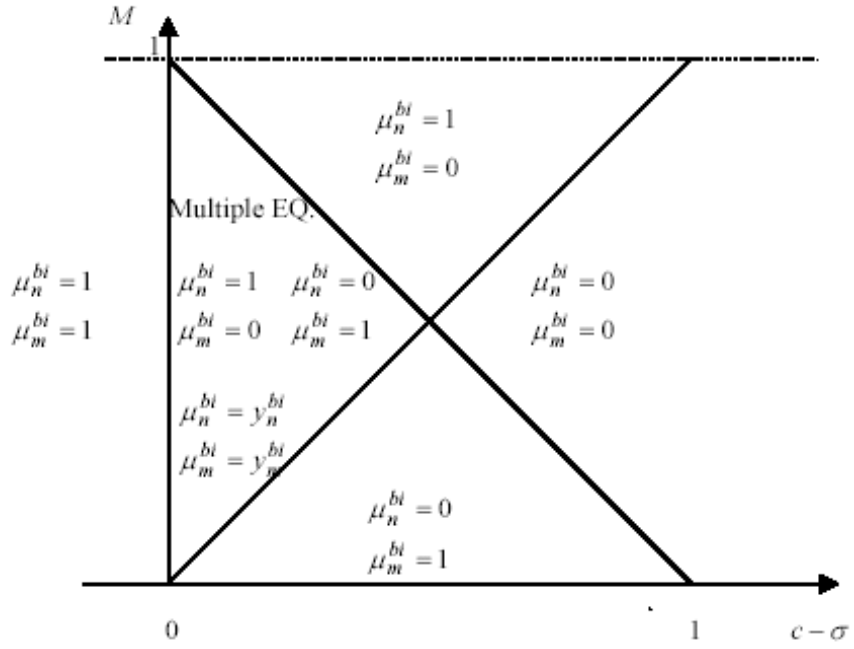

Fig. 2: Equilibrium education levels under the bilingual system

The equilibrium levels of education are depicted in Figure 2 above. Suppose all members of one group take education, so that the duplication effect completely eradicates all communication effects. In this case the incentive for taking education depends entirely on the skill effect σ relative to the cost c of education. If $c < \sigma$, the skill effect alone is sufficient to induce people to take education, hence the unique equilibrium education levels are $(1, 1)$ in this case.

If $c > \sigma$, the skill effect provides insufficient incentives for becoming skilled, hence the communication effect comes into play. The communication effect is stronger for the smaller than the larger group since the set of trading partners subsequent to becoming skilled is expanded more for the former than the latter group under a bilingual system.

Consequently, the smaller group has a stronger incentive for taking education than the larger group, all other things equal. If education is quite cheap ($c < 0.5+\sigma$) and the groups do not differ too much in size, it may be one group or the other that takes education in equilibrium. It is also possible that a positive fraction of the members in each group takes education.[15] If the groups differ at lot in size, however, the positive communication effect is never sufficient to render education profitable for the largest group. Hence, if the cost of education is sufficiently small and one group is very small compared to the other, there is a unique equilibrium in which the smallest group becomes educated and the largest does not.

The importance of relative group size becomes even more pronounced when the cost of taking education is quite large. As the cost of education increases ($c > 0.5 + \sigma$), a stronger and stronger communication effect is required so as to maintain the incentives for becoming educated, i.e. only when groups vary a lot in size will one of them find it beneficial to take education. If the groups are quite equal in size, the communication effect is insufficient for both groups, hence they both remain unskilled. Finally, when the cost of education becomes too large, ($c > 1 + \sigma$), no one will ever choose to take education under the bilingual system.

We end this section by stating and proving a proposition regarding a feature of the bilingual system which should be obvious from inspection of Fig. 2:

Proposition 2 *Under the bilingual education system, equilibrium education levels are negatively correlated across language groups in the following sense: for the cases with multiple equilibria, high (low) education levels among the ns are coupled with low (high) education levels among the ms.*

Proof. Consider $\mathbf{z}^{bi} = (z_n^{bi}, z_m^{bi})$ and $\mathbf{y}^{bi} = (y_n^{bi}, y_m^{bi})$ two distinct equilibria of the game. $z_n^{bi} > y_n^{bi}$ and $z_m^{bi} > y_m^{bi}$ cannot simultaneously hold. Suppose they do. $y_m^{bi} < z_m^{bi} \leq 1 \Rightarrow \triangle U_m^{bi}(\mathbf{y}^{bi}) \leq 0$. $\partial \triangle U_m^{bi}(\boldsymbol{\mu})/\partial \mu_n = -N \Rightarrow \triangle U_m^{bi}(\mathbf{z}^{bi}) < \triangle U_m^{bi}(\mathbf{y}^{bi})$ for $z_n^{bi} > y_n^{bi}$. Hence, $z_n^{bi} > y_n^{bi}$ and $z_m^{bi} > y_m^{bi} \Rightarrow \triangle U_m^{bi}(\mathbf{z}^{bi}) < 0$ and thus $z_m^{bi} = 0$, which contradicts $y_m^{bi} < z_m^{bi}$. ■

4 Welfare

This section considers the welfare properties of the unilingual and bilingual education systems. Define expected welfare under educational system $s \in \{uni, bi\}$ by

$$W^s(\boldsymbol{\mu}) = M[\mu_m U^s(\boldsymbol{\mu}) + (1 - \mu_m)\underline{U}_m^s(\boldsymbol{\mu})] + N[\mu_n U^s(\boldsymbol{\mu}) + (1 - \mu_n)\underline{U}_n^s(\boldsymbol{\mu})].$$

[15] As was the case under the unilingual system, any interior equilibrium that arises under the bilingual system is unstable.

As a first step, keep education levels exogenously fixed at $\boldsymbol{\mu} = (\mu_n, \mu_m)$ and compare utility under the two systems, group by group. Subtract (1) from (4) to obtain the net benefit of the skilled of having a bilingual education system, all other things held equal:

$$U^{bi}(\boldsymbol{\mu}) - U^{uni}(\boldsymbol{\mu}) = N(1+\sigma)(1-\mu_n) \geq 0. \tag{11}$$

The skilled now benefit from being able to trade with the unskilled masses from the n group. Subtract (2) from (5) to obtain the net benefit of the unskilled ns of switching from a unilingual to a bilingual system, all other things held equal:

$$\underline{U}_n^{bi}(\boldsymbol{\mu}) - \underline{U}_n^{uni}(\boldsymbol{\mu}) = [M\mu_m + N\mu_n](1+\sigma) \geq 0. \tag{12}$$

This group benefits a lot because the set of trading partners expands to include the skilled of both language groups. The ms are indifferent between the two education systems, all other things held equal, as their set of trading partners is unaffected by a change in education system:

$$\underline{U}_m^{bi}(\boldsymbol{\mu}) - \underline{U}_m^{uni}(\boldsymbol{\mu}) = 0 \tag{13}$$

Of course, education levels are not exogenously given, hence we cannot on the background of the above comparisons conclude that the bilingual is superior to the unilingual system from a welfare point of view. We need to adjust for education levels.

4.1 Full centralisation system

Suppose there exists a benevolent social planner who is able to select the level of education that maximises welfare under each system.

Proposition 3 *Under full centralisation, the bilingual system yields higher expected welfare than the unilingual system. The welfare maximising education levels* (x_n, x_m) *are (i)* $(1,1)$ *if* $c < 2\sigma$*; (ii)* $(1,0)$ *if* $c \in (2\sigma, 2(1+\sigma))$ *and* $M > \max\{1/2; c/2 - \sigma\}$*; (iii)* $(0,1)$ *if* $c \in (2\sigma, 2(1+\sigma))$ *and* $N > \max\{1/2; c/2 - \sigma\}$ *and (iv)* $(0,0)$ *if* $c > 1 + 2\sigma$, $M, N < \min\{1; c/2 - \sigma\}$.

Proof. The bilingual system outperforms the unilingual system: Write $\mathbf{x}^s = (x_n^s, x_m^s)$ welfare maximising education levels under s. (11)-(13) non-negative yield $W^{bi}(\mathbf{x}^{uni}) \geq W^{uni}(\mathbf{x}^{uni})$. By optimality of $\mathbf{x}^{bi}$ under the bilingual system, we have $W^{bi}(\mathbf{x}^{bi}) \geq W^{bi}(\mathbf{x}^{uni})$. Adding the two inequalities produces $W^{bi}(\mathbf{x}^{bi}) \geq W^{uni}(\mathbf{x}^{uni})$.

Socially optimal education levels: By differentiating (4)-(6) with respect to μ_m and μ_n and plugging in (4)-(6), it is easily verified that (subscripts denote partial derivatives throughout):

$$\begin{array}{l} W_{\mu_m}^{bi}(\boldsymbol{\mu}) = M(2N(1-\mu_n) + 2\sigma - c) \\ W_{\mu_n}^{bi}(\boldsymbol{\mu}) = N(2M(1-\mu_m) + 2\sigma - c) \end{array}.$$

(i) follows directly from $W^{bi}_{\mu_m} \geq M(2\sigma - c)$ and $W^{bi}_{\mu_n} \geq N(2\sigma - c)$. (iv) follows from $W^{bi}_{\mu_m} \leq 2M(N + \sigma - c/2)$ and $W^{bi}_{\mu_n} \leq 2N(M + \sigma - c/2)$ and the fact that $M < c/2 - \sigma$ and $N = 1 - M < c/2 - \sigma$ can simultaneously hold if and only if $c > 1 + 2\sigma$. We finally prove (ii). The proof of (iii) follows from a symmetric argument and is omitted. Note first that $M < 1$ and $M > c/2 - \sigma$ can simultaneously hold if and only if $c < 2(1 + \sigma)$, hence the upper limit on c. Let $N(1 - \widetilde{\mu}_n) = M(1 - \widetilde{\mu}_m) = c/2 - \sigma$. In the relevant parameter space, $W^{bi}_{\mu_m}(\widetilde{\mu}_n, \widetilde{\mu}_m) = W^{bi}_{\mu_n}(\widetilde{\mu}_n, \widetilde{\mu}_m) = 0$, $W^{bi}_{\mu_m}(\boldsymbol{\mu}) < 0$ for all $\mu_n > \widetilde{\mu}_n$, $W^{bi}_{\mu_n}(\mu_n, 0) > 0$, $W^{bi}_{\mu_m}(\boldsymbol{\mu}) > 0$ for all $\mu_n < \widetilde{\mu}_n$ and $W^{bi}_{\mu_n}(\mu_n, 1) < 0$, hence there are at most three candidates for a social optimum: $(1, 0)$, $(0, 1)$ and $(\widetilde{\mu}_n, \widetilde{\mu}_m)$. $W^{bi}(1, 0) - W^{bi}(0, 1) = 2(M - 0.5)(c - 2\sigma)$ and $W^{bi}(1, 0) - W^{bi}(\widetilde{\mu}_n, \widetilde{\mu}_m) = (M - 0.5 + \sigma)(c - 2\sigma)$ imply $W^{bi}(1, 0) > W^{bi}(0, 1)$ and $W^{bi}(1, 0) > W^{bi}(\widetilde{\mu}_n, \widetilde{\mu}_m)$ in the relevant parameter space. ■

The central planner would always choose a bilingual system if able to fully control eductional levels of the population. It is not hard to understand why. For given education levels, more people communicate, hence trade, under a bilingual than a unilingual system. As welfare is increasing in trade everything else equal, it immediately follows that the bilingual is better than the unilingual system. The proposition also describes optimal education levels. The expressions look complicated at first, but really are quite intuitive. The welfare optimising education levels under the bilingual system are drawn in Figure 3 below.

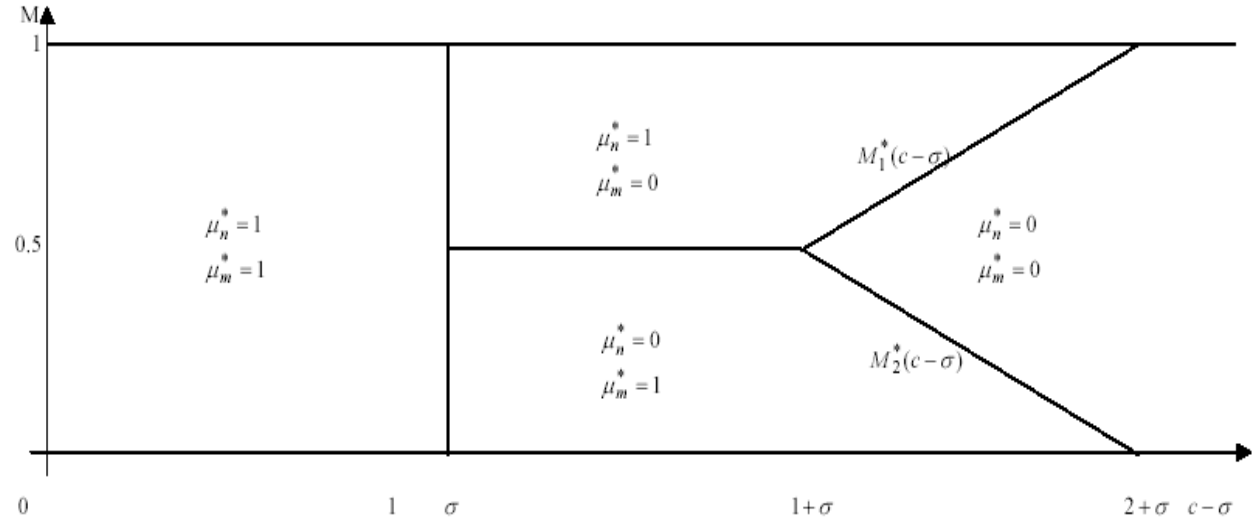

Fig. 3: Optimal education levels

Education levels are decreasing in the cost of taking education. When education is cheap, it is socially optimal for the whole population to become educated. An increase in the cost of becoming skilled beyond a certain point ($c > 2\sigma$) renders suboptimal that everybody takes education. However, to maximise the total value of education it is im-

portant that communication is hurt to the lowest possible extent. Full communication is preserved if all the members of one group get educated, and the cheapest way of attaining this is by having the members of the *smallest* group attending school. This is illustrated in Fig. 3, where the ns are the ones who become educated when the ms are sufficiently large in number ($M > \max\{0.5, M_1^*\}$) and the ms become educated when the ms are sufficently small in number ($M < \max\{0.5, M_2^*\}$). When education is very costly, and the groups are sufficiently equal in size, it is too costly for society to achieve communication, hence no group gets educated. This is the area in Fig. 1 for which $c > 1 + \sigma$ and $M \in (M_2^*, M_1^*)$.

4.2 Decentralised educational choice

In reality, of course, no central planner can perfectly control the amount of effort students put into their studies, even in a system with mandatory education. To capture this degree of freedom, consider therefore a fully decentralised education system in which the choice whether to become educated or not is fully delegated to the individuals. Let $\mathbf{y}^{bi}$ and $\mathbf{y}^{uni}$ be the equilibrium levels of education under this decentralised education system. It is still the case that $W^{bi}(\mathbf{y}^{uni}) \geq W^{uni}(\mathbf{y}^{uni})$, but it is no longer necessarily true that $W^{bi}(\mathbf{y}^{bi}) \geq W^{bi}(\mathbf{y}^{uni})$, hence the welfare implications are unclear and contingent upon equilibrium education levels.

As previously shown, multiple equilibria sometimes arise. In models with multiple equilibria, model predictions generally depend on the equilibria that are under consideration. We focus on results that hold for all comparisons of *stable* equilibria. For example (formal definitions are given in the appendix), a group weakly prefers the bilingual to the unilingual system if the members are never worse off in any stable bilingual equilibrium than any stable unilingual equilibrium and strictly better off in at least one stable bilingual equilibrium than in all stable unilingual equilibria. Some of our results depend on the exclusion of the interior unstable equilibria, but many do not. In the subsequent analysis, we discuss the matter of equilibrium selection whenever relevant.

Figure 4 characterises the optimal decentralised education system for $\sigma > 1$. Whenever $c < \sigma$, the decentralised bilingual system generates the optimal amount of education for both groups and, consequently, is the socially optimal one. As the cost of taking education increases above σ, education systems may fail to create sufficient incentives for taking education. When education is not too expensive, society prefers the majority group to become educated. When the ms are in majority, this leads to the adoption of a bilingual system as this is the only one that produces any incentives for that group to take education.

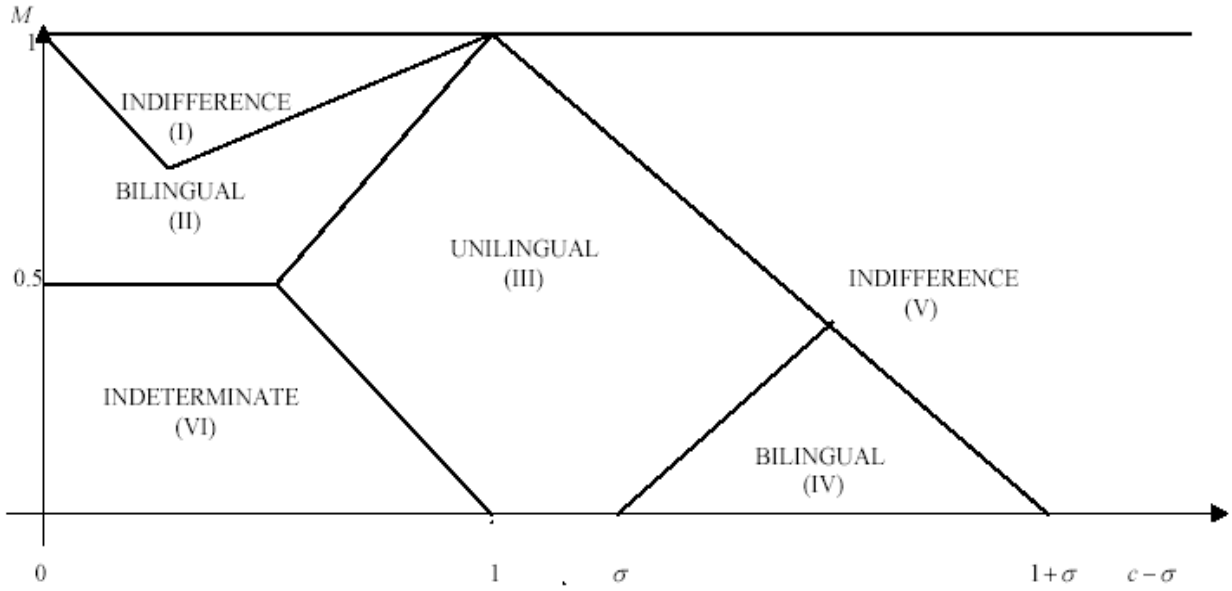

Fig.4: optimal decentralised education system

The figure vividly demonstrates how the bilingual system may cease to be the optimal one once educational choice becomes decentralised. When the cost of taking education is sufficiently high and the differences in group size rather small, the bilingual system fails to produce sufficient incentives for taking education. The communication effects simply are not strong enough. Under the unilingual system, on the other hand, the bandwagon effect is strong enough to sustain positive education levels, even if education is costly. As communication and skills are maximised under the unilingual system, in this case it is the socially optimal of the two.

This is not to say that the bandwagon effect is always beneficial to society. When the ns are in a large majority and education very expensive, the bandwagon effect may trap the majority groups in inefficiently high education levels. To overcome the communication barrier, it is always the smallest and not the largest group that should be educated. In this case education is so costly that it is worse for society to have the wrong group than no one at all to become skilled. In order to avoid this fate, it is better to implement a bilingual system.

5 The choice of education system

When the cost of education is very low, all members of the population are better off if everybody else takes education, even if it means oneself having to take education. One way of guaranteeing that education levels are maximized when the cost of taking education is small, is to vote for a bilingual system.

Proposition 4 *If $c < \sigma$, all groups prefer the bilingual to the unilingual system.*

Proof. For $c < \sigma$, $(1,1)$ is the unique equilibrium under the bilingual system, as shown in the appendix. $U^{bi}(1,1) = U^{uni}(1,1) = 1 + 2\sigma - c$. To complete the proof, we show that all groups prefer the $(1,1)$ equilibrium to any other equilibrium under the unilingual system whenever $c < \sigma$. Compare $(1,1)$ under a unilingual system to an arbitrary equilibrium $\mathbf{y}^{uni} = (y_n^{uni}, y_m^{uni}) \neq (1,1)$. All those who would remain skilled under an alternative equilibrium prefer the $(1,1)$ equilibrium:

$$U^{uni}(1,1) - U^{uni}(\mathbf{y}^{uni}) = M(1 - y_m^{uni})\sigma + N(1 - y_n^{uni})(1 + 2\sigma) > 0.$$

All those who would be unskilled under an alternative equilibrium prefer the $(1,1)$ equilibrium, too:

$$U^{uni}(1,1) - \underline{U}_n^{uni}(\mathbf{y}^{uni}) = 1 - N(1 - y_n^{uni}) + 2\sigma - c > 0.$$

$$U^{uni}(1,1) - \underline{U}_m^{uni}(\mathbf{y}^{uni}) = N(1 - y_n^{uni})(1 + \sigma) + M(1 - y_m^{uni})\sigma + \sigma - c > 0. \blacksquare$$

Figures 5 and 6 characterise the preferences of the ms and ns, respectively, regarding education system for $c > \sigma$. This is the case for which duplication effects start playing a role for educational choice under the bilingual system. In region I, the ms are so dominating in size relative to the cost of education, that the bandwagon effect in education is too weak to carry any weight in the educational choice of the ns under the unilingual system. Instead, the skill and communication effects are sufficently strong to lead all ns to take education under both systems. The skill effect is too weak under the unilingual and the communication effect too weak under the bilingual to generate sufficient incentives for the ms to take education under any of the systems. In equilibrium, therefore, all end up speaking $m$ish and only the ns being skilled, no matter which system is chosen. Hence, the ms and ns are both indifferent between the two systems in region I.

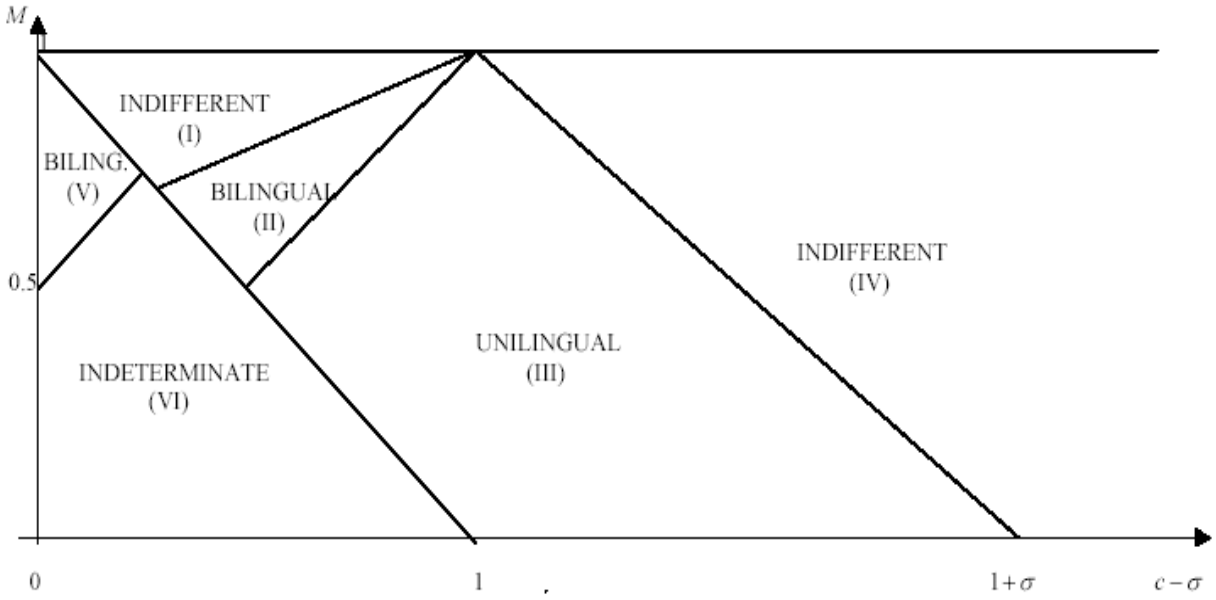

Fig. 5: the *m*'s choice of education system

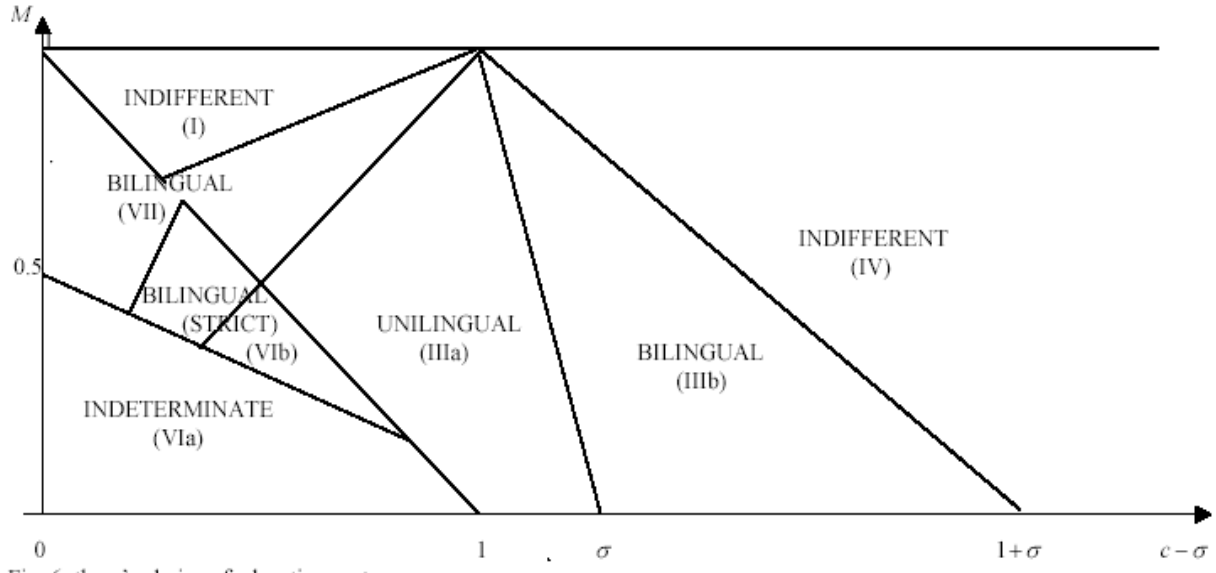

Fig. 6: the *n*'s choice of education system

Region II is much like region I, except now the ns have become sufficient in number relative to the cost of education, for bandwagon effects to become key in shaping the incentives for taking education under the unilingual system. The ms still do not take education under either system, hence opt for the system that maximises the equilibrium amount of education among the ns. By selecting the bilingual system they avoid the risk of the ns being trapped in a low education equilibrium, while maintaining the incentive for the ns to become educated under the bilingual system through the strong communication

effect. The ns are the ones who have to carry the cost of education under both systems. However, trading with the ms is so important that they want to avoid ending up in a low education equilibrium. Hence, the ns too opt for a bilingual equilibrium.

In region III, the size of the n group has increased even further relative to the cost of taking education. Now, either the cost of taking education is too high, or the language groups too equal in size to generate a significant communication effect for any of the groups under the bilingual system. Thus equilibrium education levels are zero for both groups under the bilingual system. Under the unilingual system the bandwagon effect is strong enough to sustain positive education levels under the unilingual system. Hence, the ms go for that system. For the ns, on the other hand, things are not so simple. When the cost of taking education is not so high (Region IIIa), the high education equilibrium is still better than the low education equilibrium, hence the ns prefer the unilingual system, too.[16] When the costs increase even further (Region IIIb), the ns change opinion and prefer the bilingual system instead.

In region IV, the cost of taking eduction has become so large that equilibrium education cannot be sustained for any group under any system. Under the unilingual system, education is either too expensive, or the bandwagon effect on communication too weak to sustain positive education levels. Hence, equilibrium education levels are zero for both groups under both systems hene everybody is indifferent as to the choice of education system.

In region V education is so cheap and the size of the m group so large that both groups would prefer the ms to become educated under a bilingual system - even the ms themselves, owing to the strong skill externality. Under the unilingual system, the wrong group for sure is provided with the incentives for taking education. Hence, both groups prefer the bilingual system.

In region VI, the ns are in sufficient size and the cost of education sufficiently low to generate a sufficient incentive for the ms to take education under the bilingual system, given that the ns do not take education. Now, however, the ms would prefer the other group to bear the cost of education. All the ns becoming skilled is an equilibrium in the unilingual case - which tends to pull in favour of a unilingual equilibrium. However, owing to the bandwagon effect, it is also an equilibrium that nobody at all takes education, in which case the ms would prefer the bilingual system, after all. As we cannot say anything about which of the two stable unilingual equilibria is more likely, the preferences of the ms are indeterminate in this final case. This is not to say that the preferences of the ns necessarily are indeterminate. In the regions (VIa-c), the ms are in sufficient number that the ns opt

[16] This result is not robust to the inclusion of interior equilibria. The ns are better off under the zero education bilingual than the interior unilingual equilibrium. Intuitively, equilibrium education levels are insufficient to cover the cost of education for each individual. Hence, if we include interior equilibria into the comparison, the preferences of the ns become indeterminate in this area.

for a bilingual system so as to generate incentives for the m for taking education.[17] If the ns are in majority, however, and education is cheap (region VId) they would prefer to be skilled themselves than the others to be skilled, which in turn is preferred to no one taking education at all. Hence, in this range the preferences of the ns are indeterminate.

Having, determined the preferences of the two groups regarding educational system, we need to compare how well they match across the two groups to see whether political digression ever arises. Figure 7 is a blend of Figures 5 and 6.

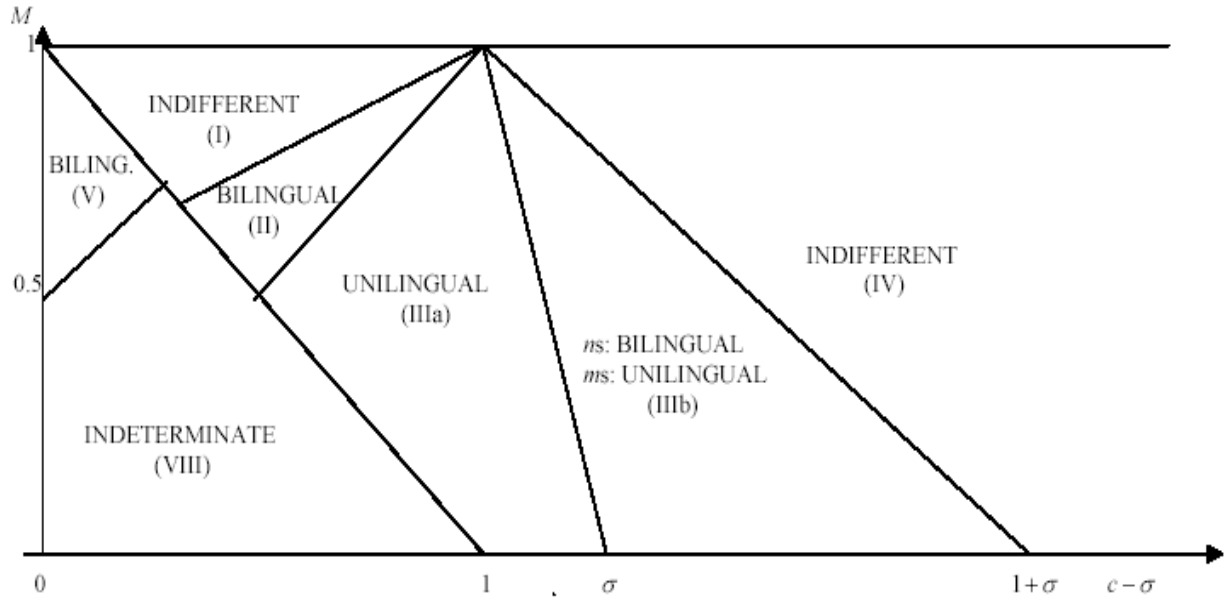

Fig. 7: choice of education system

Perhaps a bit surprisingly, there is sometimes unanimity for the unilingual system, i.e. the ns are perfectly willing to give up their own language and the ms perfectly happy to accommodate their wishes. Unanimity for the unilingual system occurs in cases in which the cost of taking education is sufficently high and the groups sufficiently equal in size to render the communication effect insufficient to generate incentives for taking education under the bilingual system, but where the n group is sufficiently large to generate a strong bandwagon effect and thereby potentially positive education levels under a unilingual system. As education in this case is not too expensive, it is better to take education and trade with other skilled ns than to save on the cost of education and trade only with unskilled ns, which would be the guaranteed outcome under the bilingual system. Of course, if the ns prefer the unilingual to the bilingual system, so do the ms, as the ms do not even have to bear the cost of education, but nevertheless benefit from increased trade with the ns.

[17] Region VIb becomes indeterminate for the case of the ns if we include interior equilibria. In that case the ns would be better off under the $(1,0)$ unilingual equilibrium than the mixed bilingual equilibrium, which in turn is preferred to the no-education unilingual equilibrium.

The observation that the ms always prefer the unilingual system if the ns do so, has the implication that the situation will never occur in which the ns propagate in favour of a unilingual system and the ms argue for a unilingual system. The only political tension possible is the situation in which the dominating (m) group wants to implement its own language in a unilingual system whereas the dominated (n) group opts for a bilingual system. This happens in situations similar to the one above, namely when equilibrium levels are zero in the bilingual system, but the bandwagon effect sufficient to generate a potential for positive education levels under the unilingual system. The ms go for a unilingual system, owing to the possibility of catching the ns in a high education equilibrium, whereas the the ns go for a bilingual system, precisely in order to prevent the same thing from happening. The diffence bewteen this and the unanimity case is that the cost of education now is so high that the ns are better off staying unskilled and trading with other unskilled ns only than to take the cost of education and trade with the other skilled ns and the ms.

In addition to the possibilities above, there are cases in which both groups agree on a bilingual system. This exclusively happens when the ms are in majority and the cost of education low. In this case it is important for both groups to generate strong incentives for the ms for taking education. This can only be achieved in a bilingual system.

We next turn to an examination of the welfare properties of political decision-making. This is done by comparing the outcomes of the political process (Fig. 7) to the socially optimal education system with decentralised educational choice (Fig. 4). In particular, we address the issue of political failure. Which, if any, are the circumstances under which the political decision-process leads to the adaption of the wrong education system?

For a substantial part of the parameter space for which welfare rankings can be made, there is unanimous agreement on the socially optimal education system, i.e., both groups benefit from introducing the socially optimal system. This happens in particular when education is not particularly expensive.

When discourse arises, it is not necessarily so that the system preferred by the majority is the socially optimal one. If the ms happen to be in majority, the socially optimal system is always chosen. When the ns are in majority, on the other hand, they tend to select the bilingual system in circumstances under which the unilinual system would actually be better. They do so in order to avoid being caught in a, to them, unfavourable high-education situation. If we interpret majority rule to be democracy, we conclude that democracy leads to bilingualism being chosen too often, with too low education levels as the unevitable result.

Consider instead the merits of minority rule. If the ns are the minority rulers, they choose the socially sub-optimal bilingual system too often, for the same reason as before. On the contrary, if the dominating m group is the minority ruler, the socially optimal rule is chosen, unless the ms are in very small number, in which case the unilingual system is

adopted despite the bilingual system being the optimal one. The ms go for the unilingual system hoping to be able to catch the ns in a socially sub-optimal equilibrium with too much education on part of the ns.

Note finally that indeterminacy in the political model not necessarily is a political failure. For a large part of the parameter space for which the different groups have no clear preferences, it is also true that the different systems cannot be welfare ranked, either. The problem lies in the externalities that follow as a result of decentralised educational choice.

6 Compulsory education

So far we have assumed educational choice to be fully decentralised to individuals. Considering the fact that decentralised education systems tend to create either too weak incentives, or incentives for the wrong group to become educated, it is pertinent to ask whether these problems can in any way be alleviated.

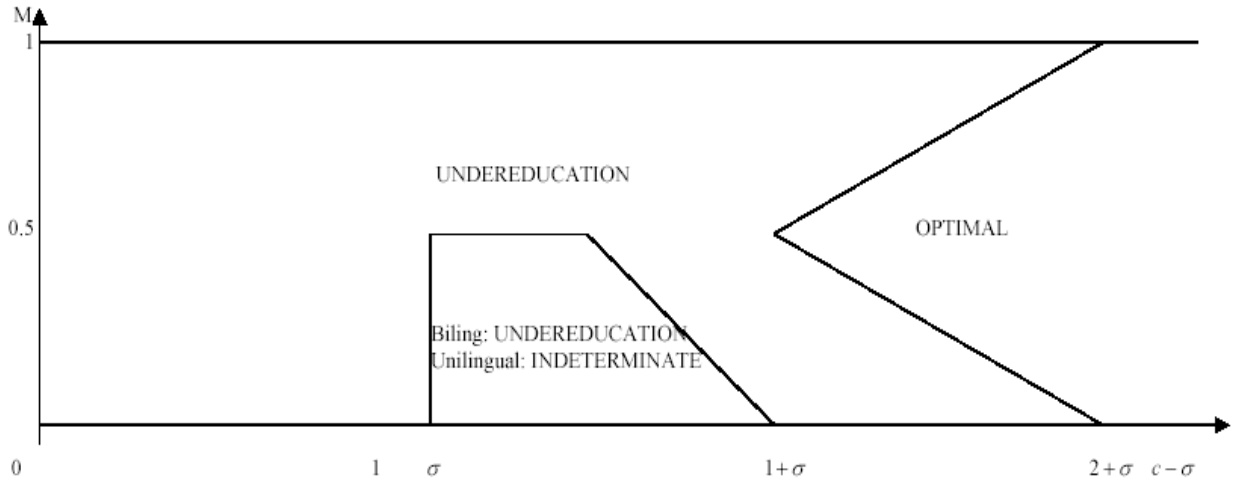

Fig.8: Efficiency of decentralised education choices

Fig. 8, which is a blend of Fig. 7 and Fig. 3, shows that decentralised education choice leads in many cases to undereducation with respect to the optimal education levels. One potential remedy is of course compulsory education. In this way everybody coordinates on the highest education level by default. However, no more than the type of education system is exogenous, is compulsory education exogenous. One therefore needs to study costs and benefits on the different language groups of introducing a compulsory education system in order to assess its relevance.

The model does not allow to distinguish between compulsory unilingual and compulsory bilingual systems. Under each system everybody learns to speak at least one common language, $m$ish, perfectly, and everybody attains a high skill level. Hence, the expected utility

of being in a compulsory education system is identical for all members of society and independent of education system. This is not to suggest that the differences between unilingual and bilingual systems vanish completely once compulsory education is introduced. It is impossible to monitor student input perfectly. The incentives for studying may therefore vary with education system, much in the way that was described in the previous sections, even in a setting with mandatory education. However, it is certainly true that the skill and language levels of somebody who went to school and did not worked especially hard at it, nevertheless are likely to be larger than those of someone did not attain school at all. Hence, we believe that the introduction of a compulsory education leads to a convergence of the two language systems. The case studied here, with full convergence, is the upper bound to what can be achieved by introducing mandatory education.

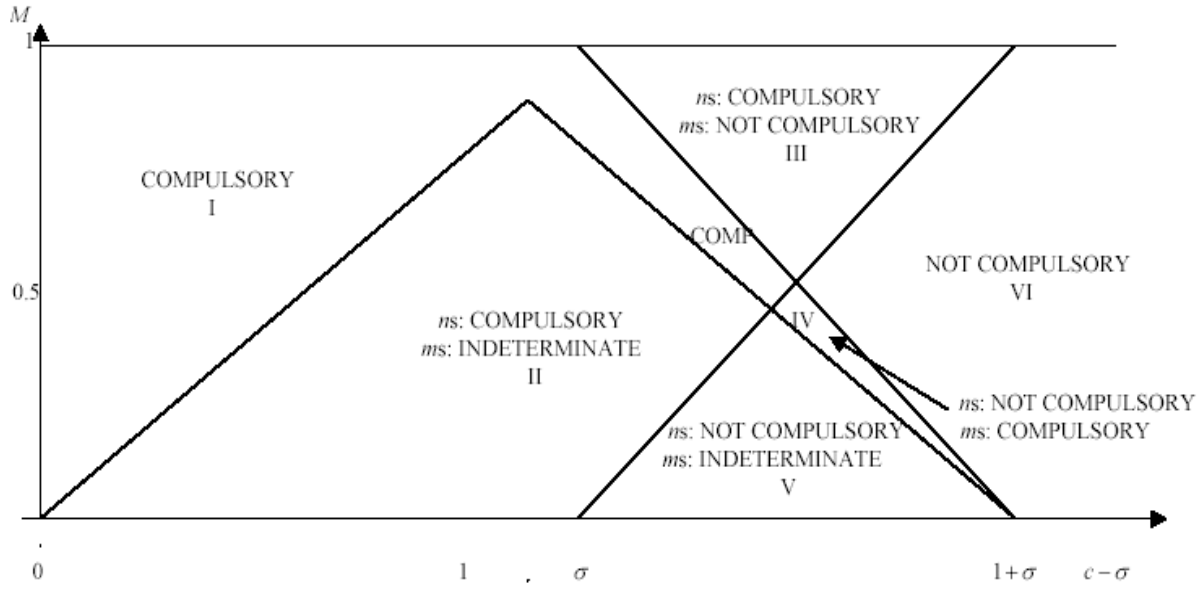

Fig. 9: Compulsory education

Figure 9 is a graphical representation of the preferences of the two language groups regarding the choice between a decentralised unilingual, decentralised bilingual or a compulsory education system. The first thing to notice is the existence of unanimity for introducing compulsory education for low enough costs of education, while for very high costs none of the groups favour such a choice. The second general feature is that the ns tend to favour a compulsory system much more frequently than the ms, since in the unilingual system the ms never invest in education, implying that the ns have to bear the cost of education if they want to increase their set of trading partners.

More specifically, in region (I) there is unanimity for compulsory education, although the reasons for which the two language groups favour it, vary accross the region. As stated above, the ns tend to prefer compulsory education to a decentralised unilingual system

because the profitability of their investment in education rises if the ms take education, which is never the case under a unilingual system. When comparing compulsory education with a decentralised bilingual set-up, this argument still applies in some cases, while in those zones of region (I) in which $(\mu_n^{bi}, \mu_m^{bi}) = (0, 1)$, the force driving the ns preference for compulsory education is its ability to increase the education level for the ns themselves. The ms may prefer compulsory education to a decentralised unilingual system for two reasons. On the one hand, under a compulsory system, all the ns take education, while in the decentralised unilingual system this is not necessarily true, thus improving the set of trading partners and the productivity of the matches for the ms. On the other, a compulsory system raises the value of education for each m by insuring that all the members of this group get educated. This effect is determinant when the ms constitute a large share of the population, and explains why the shouthern border of the (I) region is upward sloping: as the cost of education goes up, the ms are willing to give up a unilingual decentralised system only for increasingly higher sizes of the m group. If the m group is not big enough (region II), the ms prefer the unilingual $(1, 0)$ equilibrium to a compulsory system. In the eastern peninsula of region (I), nobody takes education neither under the unilingual nor under the bilingual system, and compulsory education is leads to a better outcome for both groups. To the north of that region (in area III), the number of ns is smaller, and the ms prefer the $(0, 0)$ decentralised equilibrium, since taking education broadens only to a small extent their set of partners. For the same reason, the ns do not favour compulsory education in regions IV and V. Finally, in region VI both types of agents agree on rejecting compulsory education as being too expensive an option.

Comparing Fig. 9 with Fig. 3, it appears that endogenous compulsory education solves the undereducation problem only in some parts of the parameter space (region I).

7 Case Studies

7.1 Finland: establishment of the current linguistic organisation (1919-1922)

Due to its historical links to the Kingdom of Sweden (see appendix for more details), Finland had an important Swedish-speaking group when it became independent from Russia at the end of 1917. The linguistic organisation of Finland was set up in the Constitution of 1919 and a series of language laws, the most important being approved in 1922.

Characteristics of the groups: as the possibility of a Swedish unilingual system was not defended by any group, the Swedish-speakers are the "dominated group" (the n-group) in the terminology of our model. In 1920, the Swedish-speaking population constituted 11

per cent, so $M = 0.89$.[18]

Setting of the Rules and Characteristics of the System: The elections of March 1919 determined the Parliament that was to establish the linguistic organisation of Finland through the Constitution (17 July 1919) and the Language Act of 1922. Table 1 presents the results of the election, together with the electoral basis of the different parties, and their position in the linguistic debate. The Social Democrats won the elections (38 % of the votes, 80 deputies over 200), with support both from the Finnish-speaking and Swedish-speaking electorate and defended bilingualism.[19] The Finnish-speaking Agrarian party (42 seats) "offered serious opposition to constitutional guarantees to bilingualism" (Mc Rae, 1997, p. 60). The conservative National Coalition Partly drawing support mainly from Finnish-speakers "shared the Swedish party's concerns for a strong executive and were prepared to make concessions on language"(p. 60). Most of the members of another dominantly Finnish-speaking party, the National Progressive Party (liberal, 26 seats) were also favourable to bilingualism. The Swedish-speaking electorate was mainly represented by the Swedish People Party (Svenska folkpartiet, SFP) founded in 1906, with 22 seats [see Jackson (1938), p. 107]. This party pushed for bilingualism with explicit constitutional and legal guarantees for Swedish-speakers.[20]

Political Party	**Seats**	**Electoral basis**	**Choices**	**Model Prediction**
Social Democrats	80	FI-SWE	BI	BI
Agrarians	42	FI	UNI-BI	BI
National Coalition (conservatives)	28	FI	BI	BI
National Progressive Party (liberals)	26	FI	mostly BI	BI
Swedish People Party	22	SWE	BI	BI

Table 1: Finland (1919-1922): Observations and Predictions of the Model

The linguistic clauses of the Constitution (July 1919) were approved with a very wide consensus (173 'yes' to 23 'no', 165 'yes' to 22 'no', 183 'yes' to 10 'no'and 183 'yes' to 7 'no'[21]). McRae (1997) stresses that, "in the constitution-making process (...) as a result of political skills, bargaining power and persistence of Swedish speaking leaders, there was wide acceptance through much of the preparatory work that in language matters Finnish

[18] See McRae (1997), p.84.

[19] see McRae, p.60 and 67. Among the Social Democrat MPs, three of them were Swedish-speakers in 1919 (p. 236).

[20] In order to compensate their minority status derived from the existence of a unicameral Parliament, the SFP created through a community-wide unofficial election in May 1919 a new organisation, the Swedish Assembly of Finland (Svenska Finlands Folkting) aimed at defending the interests of the Swedish-speakers [McRae (1997), p. 60].

[21] see Eduskunta-Riksdag (1920), pp. 1028-30.

and Swedish were continue to be recognised -as previously- on a basis of legal equality. Interparty differences developed mainly around the application of this principle" (p.219-20)[22].The Constitution recognises Finnish and Swedish as national languages on an equal basis. The State had to provide for the "cultural and economic needs [of the two language groups] according to identical principles" (art. 14, cited in McRae, p. 60). The Language Act of 1922 establishes that the use of each language in administration and in the courts of law depends on the linguistic composition of the administrative district. Municipalities are declared either unilingual or bilingual.[23] Concerning the educational system, each municipality, independently from its official languages, has to organise schools in the minority language (Swedish or Finnish) when a minimum number of parents ask for them.[24] The linguistic arrangement has been quite stable, as stressed by McRae (p. 229): "the post-independence system of language regulation survived in most of its essential features, in spite of the strong upsurge of Finnish nationalism and longer-run demographic changes. Since the later 1930s, no major political party has taken a stand against the language laws, though interparty disagreements have arisen over approaches to their application and a few populist politicians have launched isolated attacks upon them (...) The real strength of Finland's language legislation seems to lie in its durability, its acceptance by both major language groups, and in an absence of concerted action against it".

The choice of a bilingual system with unanimity when $M = 0.89$ is compatible with the predictions of the model for the areas V and II in Fig. 7.

Swedish-speakers represented in 2000 5.7 % of the total population (293,000 people, Encyclopaedia Britannica, 2003). Among these individuals, it is estimated (see Research Centre of Wales, 1998) that virtually all of them have (excluded those living in the island of Åland) some knowledge of Finnish and one third are bilingual Swedish-Finnish. Additionnally, a part of the Finnish speakers use Swedish, and the number of Finnish citizens using Swedish in their everyday life would be close to 600,000 people.

[22] An important reason for which this wide consensus was possible is according to McRae that "the Swedish speakers [resisted] strongly the notion that their group was in any sense a national minority of the type envisaged by the minorities treaties of the League of Nations. Their goal was a full-scale equal partnership" (p. 220). Two other reasons are that the Swedish speakers had fought against the attachment of the Swedish-speaking Finnish island of Åland to Sweden (p.63) and that Finland was seeking diplomatic recognition and League of Nations membership (p. 65).

[23] A bilingual municipality is one in which the speakers of the minority language exceed 8 per cent of the population or more than 3,000 individuals. The government determines the language status of each municipality every ten years according to the results of the population census. A bilingual municipality is declared monolingual when, according to the census, the minority language does not exceed 6 per cent of the population. However, the bilingual status of a municipality can be maintained on request of the municipal administration.[see Svenska Finlands Folting (2001)].

[24] Currently, the condition is the existence of 18 pupils (Research Centre of Wales, 1998).

7.2 France: foundations of French-unilingualism during the Revolution (1789-1794)

Historically, French (or one of its different dialects) was only spoken in most of the northern half of the territories corresponding to contemporary France. Four other roman languages were spoken: occitan (southern half of contemporary France), Francoprovençal (around Lyon and in the Savoie region), Catalan (south-east) and Corsican. Additionally, five other non-roman languages were spoken: three of them were germanic (Alsacian and Franconian, in the north-east and Flemish, in the north), one celtic (Breton, in the western part of Brittanny), and one non indoeuropean (Basque, south-west) (see appendix for more details).

Setting of the Rules (1789-1794): As stressed by Hagège (1996), the linguistic policy became quickly an important issue of the political choices of the Revolution started in 1789. Until 1793, no policy of imposition of French was chosen during the Revolution, and actually the translation of the decrees of the Parliament (Constituante) was decided in june 1790, although this measure was rarely applied [see Alcouffe and Brummert, 1985 and Bell, 1995][25]. However, a report by Talleyrand established already in 1791 that: "The primary schools will put an end to a strange inequality: the language of the Constitution and the laws will be taught to everybody; and this mass of corrupted dialects, last remainings of feudalism, will be forced to disappear" (cited in Hagège, 1996, p. 75). Another report, this time by Condorcet, establishes that latin should not be used for teaching in primary schools. The policy of the newly born Republic (september 1792) with respect to "regional languages" changes after the execution of Louis XVI in january 1793. The newly elected Parliament (Convention) controlled by the *montagnards* (radical revolutionaries) makes war to an international coalition (Austria, Prussia, England and Spain), faces an interior Royalist and Catholic insurrection in Vendée (from march 1793) and, after marginalising the parliamentary minority (girondins, moderate federalist republicans) tackles new insurrections by Royalists or Girondins in Bordeaux, Lyon, Marseilles, Toulouse, and Brittany among others [see Furet (1988)]. According to Hagège (1996), this provincial insurrection is a very important element for explaining the future linguistic policy since the *montagnards* see in it the proof that the ideas of the "counter-revolution" (royalists, catholics, and girondins) are very often conveyed through languages other than French.[26]

[25] Alcouffe and Brummert (1985) show that during the period 1790-end of 1792, the National Assembly treated several times the issue of the budget to be allocated to the translation of the constitution in Occitan. According to Bell (1995), "In the provinces (...) local authorities, notables and the expanding network of the Jacobin clubs combined to sponsor what can fairly be called a minor Renaissance of the French regional tongues in 1790-1792 (...) Clubs in non-French speaking areas, while generally deliberating in French themselves, commonly organized public sessions at which members would orally translate new laws and newspapers into the local language".

[26] According the Bell (1995), the linguistic policy against regional languages is especially motivated by

In september 1793, the "Terreur" policy is instaured as a means to fight the ennemies. In this context (8 Pluviôse an II-January 27,1794), the *montagnard* deputy Barère[27] delivers a speach to the Convention on the linguistic issues: "federalism and superstition speak Breton, emigration and hatred of the Republic speak German, counterrevolution speaks Italian and fanatism speaks Basque. Let us break these instruments of injury and error (...) the monarchy had reasons to look like a tower of Babel ; in a democracy, leaving the citizens ignorant of the national language (...) is a betrayal of the fatherland (...) French will become the universal language, since it is the language of the People. Up till then, since it had the honour to be useful for/ used for the Declaration of Human Rights, it must become the language of all the French (...) For a free people, the language has to be one and the same for everybody" (cited by Hagège (1996), p. 83-84). The same day, a decree was issued stating that French teachers should be sent to those regions where these languages denounced by Barère were spoken. In 1790, Grégoire[28] had started a study on the linguistic situation in France. In prairial an II (June 1794) he read the conclusions of his enquiry in the Convention. The title of the report was "On the necessity and means of annihilating the patois[29], and universalising the use of the French language". The conclusion of his report is that French should be the unique national language: "Everything we said leads us to the conclusion that, in order to extirpate the prejudices, develop all the truths, the talents, the vertues, merge all the citizens in the national mass, simplify the political mechanisms, we need identity of language" (Grégoire, 1794, p. 9). His arguments for the imposition of French as a unique national language were based on the necessity to expand the ideas of the revolution accross France and fight the counter-revolutionaries[30], the costs of keeping many languages[31], and the need to promote social mobility and to fight backwardness.[32]

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the objective of controlling the Catholic Church. In 1790, the Parliament approved the "Civil Constitution of the Clergy", which aimed at transforming clerics into civil servants under the control of the State. Each priest had to take an oath of loyalty to the new regime or face dismissal. Many priests refused. Bell shows that the publications in occitan (which treated in a majority of cases about the Civil Constitution) where in that particular period concentrated in cities where a majority of the priest did not accept the Civil Constitution (Toulouse) rather than in others in which this was not the case (Marseilles).

[27] A member of the Comité de Salut Public.

[28] A constitutional bishop, who defended the civil rights for the Jews and the abolition of slavery.

[29] The term "patois" refers to all the languages and dialects in France, except French: the dialects of French itself, the other existing languages, and their corresponding dialects.

[30] "Those who were in the Occidental Pyrenees in october 1792 were writing to us that among the Basques, sweet and brave people, a big number of individuals were prone to fanatism, because their language was an obstacle to the propagation of the Lights. The same thing has happened in other départements, where a series of criminals based the success of their anti-revolutionary machinations on the ignorance of our language" [Grégoire (1794), p. 5]

[31] "Would you solve this ignorance [of French] by translations? then you would multiply the expenses" (p. 6)

[32] "All the members of the sovereign are admissible in all the positions (...) if these positions are occupied by men who cannot express themselves and write correctly in the national language, will the rights of the

As the possibility of a unilingual system in a language other than French was not defended by any group, the non-French speakers are the "dominated group". In the end of the 18th century, the non–French speakers constituted according to Grégoire (1794) roughly 66 % of the total population, so $M = 0.34$.[33] It seems safe to argue that the French-speaking group (the m-group) favoured unilingualism. This was the case of the *montagnards* and probably also of the Parisian sans-culottes who supported them (see Furet, 1988). The position of the ns is less clear. While the federalist rebellions took place in cities in which French was not the main language (Bordaux, Lyon, Marseilles, and Toulouse), it is difficult to assess to which extent language was an important issue in these movements. For $M = 0.34$, both unanimity for unilingualism and a linguistic conflict in which the ms favour unilingualism and the ns bilingualism are compatible with the predictions of the model [respectively regions (IIIa) and (IIIb)].

Characteristics of the System:

In July 1794 (thermidor an II), one week before the fall of Robespierre, an important linguistic decree is issued by the Convention: article 1 establishes that no public document can be written in any language which is not French, and article 2 establishes that no private document can be registered officially if it is not written in French. Article 3 institutes prison penalties of six months and the loss of their job for those civil servants or public officers which would write any document in some language other than French in the exercise of their functions [see CIRAL (2001) or Hagège (1996)]. The regimes that followed the Republic prolounged this policy of primacy of French. In 1859, the *Cour de Cassation* (High Court) condemned the use of Corsican in all private and public documents in Corsica, and the same policy was applied to Italian in 1861 after the county of Nice became part of France or in Alsace after 1918. The main instrument through which this linguistic policy was implemented was the schooling system. In 1881, the laws proposed by Jules Ferry made primary education compulsory and created a system of free public primary schools. As stressed by Hagège (1996), this "system did not attribute any role to regional languages" (p. 124). Moreover, and till the 1960s, the pupils who spoke some regional language during the classes where punished for that [see CIRAL (2001)].

There are no complete official data concerning the use of regional languages in contem-

citizens be guaranteed by texts improperly written, with unprecise ideas and, in one word, the sympthoms of ignorance?" (p. 4) "it is mainly the ignorance of the national tongue that keeps so many individuals away from truth : however, if do not put them into direct communication with the men and the books, the cumulated errors, rooted for centuries, will be undefeatable. In order to improve agriculture and all the branches of the rural economy, so backward in our country, the knowledge of the national language is indispensable" (p.6).

[33] "We can state without exageration that at least six million French, mainly in the countryside, ignore the national language; that an equal number of individuals is more or less unable to have a prolonged conversation in it; that the number of those who speak it does not exceed three million; and probably the number of those who write it correctly is even smaller" (Grégoire, 1794, p. 3)

porary France. According the Encyclopaedia Britannica (2003), around 5 per cent of the French population uses a "regional language". The French Ministry of Education estimates that 152,600 students (out of 12 million) received teaching of some regional language in 2000-2001 [see Le Monde (2002)]. A series of bilingual schools have been recently developed in Basque (6,000 students in 2002), Breton and Occitan (see appendix for more details).

8 Conclusion

While many countries are multilingual or have been constituted historically by different language groups, language diversity has not always lead to language conflict between the groups when coming to decide the language policy in education, nor has it been always the case that both groups have defended a unilingual or a bilingual system. A possible way of understanding this variety of situations is to assume that agents get some utility from speaking their own language and that compromise over language issues may be reached through transfers among groups. Here we take a different stand on the issue, and we do not assume that language enters the utility function. Rather, we explain the choices between unilingualism and bilingualism as the outcome of strategic interactions in the decisions to take education, in which the main parameters are the relative sizes of the groups and the cost of education.

We endogenously find that language conflict, whenever it arises, consists in a situation in which unilingualism is supported by the group which speaks the 'dominant' language, while bilingualism is defended by the group who speaks the 'weak' language. We show that unanimity for unilingualism is a possible outcome in our model, even if we attribute a technological advantage to bilingualism over unilingualism. This is due to the fact that there is a positive externality between education decisions in the unilingual system, while the externality is negative under bilingualism. We also characterise the situations in which we expect each of the three possible outcomes (language conflict, unanimity for unilingualism, and unanimity for bilingualism) to be empirically observed, and show that the predictions of the model are compatible with the language policies decided in Finland (1919-1922) and France (1789-1794).

As an extension, we plan to quantitatively test one empirical prediction of our model, namely that when the "dominating" group constitutes less than half of the population, unanimity for bilingualism shall not be observed.

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9 Appendix

Let $\pi = (n, m, \sigma, c)$ be a vector of parameters, Γ_π^s the (finite) set of equilibria under education system $s = bi, uni$ and $\gamma_\pi^s \in \Gamma_\pi^s$ a specific equilibrium. Let $u_m^s(\gamma_\pi^s)$ be the indirect utility of a member of the m group attains under the education system s given that γ_π^s is played. Write $\underline{u}_{m\pi}^s = \min\{u_m^s(\gamma_\pi^s)|\gamma_\pi^s \in \Gamma_\pi^s\}$ and $\overline{u}_{m\pi}^s = \max\{u_m^s(\gamma_\pi^s)|\gamma_\pi^s \in \Gamma_\pi^s\}$, the minimum respective maximum indirect utility that is attainable. We shall say that a member of the m group strictly prefers the bilingual system at π ($bi \succ_m uni$ at π) if $\underline{u}_{m\pi}^{bi} > \overline{u}_{m\pi}^{uni}$, weakly prefers the bilingual system at π ($bi \succsim_m uni$ at π) if $\underline{u}_{m\pi}^{bi} \geq \overline{u}_{m\pi}^{uni}$ and $u_m^{bi}(\gamma_\pi^{bi}) > u_m^{uni}(\gamma_\pi^{uni})$ for at least one configuration $(\gamma_\pi^{bi}, \gamma_\pi^{uni})$ of equilibria and is indifferent between the two at π ($bi \sim_m uni$ at π) if the equilibria under both systems are unique and $u_m^{bi}(\gamma_\pi^{bi}) = u_m^{uni}(\gamma_\pi^{uni})$. A member of the m group prefers the bilingual system if he either weakly or strictly prefers the bilingual system. If either $bi \succ_m uni$, $bi \succsim_m uni$ or $bi \sim_m uni$ at π, there exists a preference ordering for the m group at π. These definitions are extended to the other groups and to other comparisons in the obvious way.

9.1 Equilibrium education levels

9.1.1 The unilingual system

There are at most nine possible types of equilibria, as depicted in the table below.

the ns \ the ms	maximum level	interior	minimum level
maximum level	CE(I): $(1,1)$	PIE(II): $(1,\underline{y}_m^{uni})$	CE(III): $(1,0)$
interior	PIE(I): $(\underline{y}_n^{uni},1)$	FIE: (y_n^{uni},y_m^{uni})	PIE(IV): $(\overline{y}_n^{uni},0)$
no education	CE(II): $(0,1)$	PIE(III): $(0,\overline{y}_m^{uni})$	CE(IV): $(0,0)$

Two of the nine are degenerate. The Partially Interior Equilibriua PIE (II) and PIE(III) arise only if $c=\sigma$ and $c=M\sigma$, respectively. This leaves us with seven candidates, the Fully Interior Equilibrium FIE, two Partially Interior Equilibriua PIE (I) and PIE(IV) and the four Corner Equilibria CE (I)-(IV). Below, we describe the necessary and sufficient conditions for each of these to exist.

FIE $(y_n^{uni},y_m^{uni})=(1-\frac{\sigma-c}{(1-M)\sigma},1-\frac{(2+\sigma)c-\sigma}{M\sigma^2})$:

$$y_m^{uni}\in[0,1]\Leftrightarrow c\in[\frac{\sigma}{2+\sigma},\frac{(1+M\sigma)\sigma}{2+\sigma}],$$

$$y_n^{uni}\in[0,1]\Leftrightarrow c\in[M\sigma,\sigma].$$

PIE (I) $(\underline{y}_n^{uni},1)=(1-\frac{1+2\sigma-c}{2N(1+\sigma)},1)$:

$$\underline{y}_n^{uni}\in[0,1]\Leftrightarrow c\in[1+2\sigma-2N(1+\sigma),1+2\sigma],$$

$$\triangle U_m^{uni}(\underline{y}_n^{uni},1)\geq 0\Leftrightarrow c\leq\frac{\sigma}{2+\sigma}.$$

PIE (IV) $(\overline{y}_n^{uni},0)=(1-\frac{1+2\sigma-c-M\sigma}{2N(1+\sigma)},0)$:

$$\overline{y}_n^{uni}\in[0,1]\Leftrightarrow c\in[(2+\sigma)M-1,1+2\sigma-M\sigma],$$

$$\triangle U_m^{uni}(\overline{y}_n^{uni},0)\leq 0\Leftrightarrow c\geq\frac{(1+M\sigma)\sigma}{(2+\sigma)}.$$

CE (I) $(1,1)$:

$$\triangle U_n^{uni}(1,1)\geq 0\Leftrightarrow c\leq 1+2\sigma,$$

$$\triangle U_m^{uni}(1,1)\geq 0\Leftrightarrow c\leq\sigma.$$

CE (II) $(0,1)$:

$$\triangle U_n^{uni}(0,1)\leq 0\Leftrightarrow c\geq 1+2\sigma-2N(1+\sigma),$$

$$\triangle U_m^{uni}(0,1)\geq 0\Leftrightarrow c\leq M\sigma.$$

CE (III) $(1,0)$:

$$\triangle U_n^{uni}(1,0)\geq 0\Leftrightarrow c\leq 1+2\sigma-M\sigma,$$

$$\triangle U_m^{uni}(1,0) \leq 0 \Leftrightarrow c \geq \sigma.$$

CE (IV) $(0,0)$:

$$\triangle U_n^{uni}(0,0) \leq 0 \Leftrightarrow c \geq (2+\sigma)M - 1,$$

$$\triangle U_m^{uni}(0,0) \leq 0 \Leftrightarrow c \geq M\sigma.$$

Next, we derive the equilibrium configurations which arise for $c > \sigma$. Note first that FIE, PIE (I), CE (I) and CE (II) arise only if $c \leq \sigma$. Hence, the only possible equilibrium candidates for $c > \sigma$ are PIE (IV), CE (III) and CE (IV). By rewriting the conditions above, we obtain the following necessary and sufficient conditions for existence of the three respective equilibria, given $c > \sigma$:

PIE (IV):

$$M \leq M_2^{uni}(c-\sigma) = \frac{1+\sigma-(c-\sigma)}{\sigma} \text{ and } M \leq M_1^{uni}(c-\sigma) = \frac{1+\sigma+(c-\sigma)}{2+\sigma},$$

CE (III) :

$$M \leq M_2^{uni}(c-\sigma),$$

CE (IV):

$$M \leq M_1^{uni}(c-\sigma),$$

The equilbrium configurations are depicted in Figure 1.

9.1.2 The bilingual system

As was the case under the unilingual system, there are at most nine possible types of equilibria under the bilingual system:

the ns \ the ms	maximum level	interior	minimum level
maximum level	CE(I): $(1,1)$	PIE(II): $(1, \underline{y}_m^{bi})$	CE(III): $(1,0)$
interior	PIE(I): $(\underline{y}_n^{bi}, 1)$	FIE: (y_n^{bi}, y_m^{bi})	PIE(IV): $(\overline{y}_n^{bi}, 0)$
no education	CE(II): $(0,1)$	PIE(III): $(0, \overline{y}_m^{bi})$	CE(IV): $(0,0)$

The four Partially Interior Equilibria are all degenerate. PIE (I) and PIE (II) arise if and only if $c = \sigma$, PIE (III) arises only if $c = N+\sigma$ and PIE (IV) only if $c = M+\sigma$. This leaves us with five candidates, the Fully Interior Equilibrium FIE and the four Corner Equilibria CE (I)-(IV). Below, we describe the necessary and sufficient conditions for each of these to exist.

FIE $(y_n^{bi}, y_m^{bi}) = (1 - \frac{c-\sigma}{N}, 1 - \frac{c-\sigma}{M})$:

$$y_m^{bi} \in [0,1] \Leftrightarrow c \in [\sigma, M+\sigma],$$

$$y_n^{uni} \in [0,1] \Leftrightarrow c \in [\sigma, N+\sigma].$$

CE (I) $(1,1)$:

$$\triangle U_n^{bi}(1,1) \geq 0 \text{ and } \triangle U_m^{bi}(1,1) \geq 0 \Leftrightarrow c \leq \sigma.$$

CE (II) $(0,1)$:

$$\triangle U_n^{uni}(0,1) \leq 0 \Leftrightarrow c \geq \sigma,$$

$$\triangle U_m^{uni}(0,1) \geq 0 \Leftrightarrow c \leq N + \sigma.$$

CE (III) $(1,0)$:

$$\triangle U_n^{uni}(1,0) \geq 0 \Leftrightarrow c \leq M + \sigma,$$

$$\triangle U_m^{uni}(1,0) \leq 0 \Leftrightarrow c \geq \sigma.$$

CE (IV) $(0,0)$:

$$\triangle U_n^{uni}(0,0) \leq 0 \Leftrightarrow c \geq M + \sigma,$$

$$\triangle U_m^{uni}(0,0) \leq 0 \Leftrightarrow c \geq N + \sigma.$$

The equilbrium configurations are depicted in Figure 2.

9.2 Welfare

This section derives the socially optimal welfare system under decentralised education choice. We constrain attention to the $c > \sigma$ case, as the bilingual system generates optimal education levels and maximum communication for $c < \sigma$, hence is the optimal one in that case. Moreover, we compare only stable equilibria. We need first calculate the indirect utility of the two groups in the two systems given the different possible equilibria.

The unilingual system:

$$u_n(1,0) = 1 + 2\sigma - M\sigma - c,\ u_m(1,0) = 1 + N\sigma,$$

$$u_n^{uni}(\overline{y}_n^{uni}, 0) = \frac{1 + 2\sigma - M\sigma - c}{2(1+\sigma)},\ u_m^{uni}(\overline{y}_n^{uni}, 0) = \frac{1 + c - M\sigma}{2},$$

$$u_n(0,0) = N,\ u_m(0,0) = M.$$

The bilingual system:

$$u_n(1,0) = 1 + 2\sigma - M\sigma - c,\ u_m(1,0) = 1 + N\sigma,$$

$$u_n^{bi}(0,1) = 1 + M\sigma,\ u_m^{bi}(0,1) = 1 + M\sigma - (c - \sigma),$$

$$u^{bi}(y_n^{bi}, y_m^{bi}) = 1 + \sigma - (1 + 2\sigma)(c - \sigma),$$

$$u_n(0,0) = N,\ u_m(0,0) = M.$$

Superscript on indirect utility, used to identify education system, is dropped in the $(1,0)$ and $(0,0)$ equilibria as they generate identical utility under both systems. Suberscript on

indirect utility, used to identify language group, is dropped in the (y_n^{bi}, y_m^{bi}) equilibrium as all individuals obtain identical indirect utility. Expected welfare in equilibrium $\boldsymbol{\mu}^s = (\mu_n^s, \mu_m^s)$ under system $s \in \{bi, uni\}$ is defined by

$$W^s(\boldsymbol{\mu}^s) = Mu_m^s(\boldsymbol{\mu}^s) + Nu_n^s(\boldsymbol{\mu}^s).$$

First, we rank the equilibria under the unilingual system.

$$W^{uni}(1,0) - W^{uni}(0,0) = N(2M + \sigma - (c - \sigma))$$

implies

$$W^{uni}(1,0) \geq W^{uni}(0,0) \Longleftrightarrow M \geq M^*(c-\sigma) = \frac{(c-\sigma)-\sigma}{2}$$

Consider next the ranking of the equilibria under the bilingual system:

$$W^{bi}(0,1) - W^{bi}(0,0) = M[\sigma + N + N - (c - \sigma)] > 0,$$

$$W^{bi}(1,0) - W^{bi}(0,1) = 2(c - 2\sigma)(M - 0.5).$$

Noting that $W^{bi}(1,0) = W^{uni}(1,0)$, it is now possible to rank the two education systems in terms of expected welfare. Figure 4 shows the ranking of the two systems for the $\sigma > 1$ case.

Region (I): $\Gamma^{bi} = \Gamma^{uni} = (1,0)$ implies that welfare is the same under the two systems.

Region (II): $\Gamma^{bi} = (1,0)$ or $\{(1,0);(0,1);(y_n^{bi}, y_m^{bi})\}$ and $\Gamma^{uni} = \{(1,0);(\overline{y}_n^{uni}, 0);(0,0)\}$ or $(1,0)$. $c < 2\sigma$, $M > 0.5$ and $M > M^*$ imply $W^{bi}(0,1) > W^{bi}(1,0) = W^{uni}(1,0) > W^{uni}(0,0)$. Hence, the bilingual system is socially optimal.

Region (III): $\Gamma^{bi} = (0,0)$ and $\Gamma^{uni} = \{(1,0);(\overline{y}_n^{uni}, 0);(0,0)\}$. $M > M^*$ implies $W^{uni}(1,0) > W^{uni}(0,0) = W^{bi}(0,0)$. Hence, the unilingual system is socially optimal.

Region (IV): $\Gamma^{bi} = (0,0)$ and $\Gamma^{uni} = \{(1,0);(\overline{y}_n^{uni}, 0);(0,0)\}$. $M < M^*$ implies $W^{uni}(1,0) < W^{uni}(0,0) = W^{bi}(0,0)$. Hence, the bilingual system is socially optimal.

Region (V): $\Gamma^{bi} = \Gamma^{uni} = (0,0)$ and $W^{bi}(0,0) = W^{uni}(0,0) = N^2 + M^2$ imply that welfare is he same under the two systems.

Region (VI): $\Gamma^{bi} = (0,1)$ or $\{(1,0);(0,1);(y_n^{bi}, y_m^{bi})\}$ and $\Gamma^{uni} = \{(1,0);(\overline{y}_n^{uni}, 0);(0,0)\}$. $c < 2\sigma$, $M < 0.5$ and $M > M^*$ imply $W^{uni}(1,0) = W^{bi}(1,0) > W^{bi}(0,1) > W^{bi}(0,0) = W^{uni}(0,0)$. Hence, the welfare implications are indeterminate.

9.3 The choice of education system

We consider here the $c > \sigma$ case. For $c > \sigma$, there are three potential equilibria, $(1,0)$, $(\overline{y}_n^{uni}, 0)$ and $(0,0)$, under the unilingual system and four potential equilibria, $(1,0)$, $(0,1)$, (y_n^{bi}, y_m^{bi}) and $(0,0)$, under the bilingual system.

9.3.1 The ms' preferred system

In order to rank the two systems, we first need to rank the equilibria under the different systems.

$$u_m(1,0) - u_m^{uni}(\overline{y}_n^{uni}, 0) = \frac{(M_2^{uni} - M)\sigma}{2} \geq 0$$

and

$$u_m^{uni}(\overline{y}_n^{uni}, 0) - u_m(0,0) = \frac{(M_1^{uni} - M)(2+\sigma)}{2} \geq 0$$

imply that the ms prefer the unilingual equilibrium that maximizes education levels of the ns.

$$u_m^{bi}(0,1) - u_m(1,0) = (2M-1)\sigma - (c-\sigma)$$

and

$$u_m^{bi}(y_n^{bi}, y_m^{bi}) - u_m(1,0) = M\sigma - (1+2\sigma)(c-\sigma)$$

imply that the ms are better of taking at least a fraction of the education themselves than leaving it all to the ns under the bilingual system if and only if

$$M \geq M_1^{bi}(c-\sigma) = \max\{\frac{(c-\sigma)+\sigma}{2\sigma}; \frac{(1+2\sigma)(c-\sigma)}{\sigma}\}.$$

Consider Figure 5.

Region (I): $\Gamma^{bi} = \Gamma^{uni} = (1,0) \Rightarrow bi \sim_m uni$.

Region (II): $\Gamma^{bi} = (1,0)$, $\Gamma^{uni} = \{(1,0); (\overline{y}_n^{uni}, 0); (0,0)\}$. $u_m(1,0) = \overline{u}_m^{uni} \Rightarrow bi \succeq_m uni$.

Region (III): $\Gamma^{bi} = (0,0)$, $\Gamma^{uni} = \{(1,0); (\overline{y}_n^{uni}, 0); (0,0)\}$. $\underline{u}_m^{uni} = u_m(0,0) \Rightarrow uni \succeq_m bi$.

Region (IV): $\Gamma^{bi} = \Gamma^{uni} = (0,0) \Rightarrow bi \sim_m uni$.

Region (V): $(M \geq M_1^{bi})$: $\Gamma^{bi} = \{(1,0); (0,1); (y_n^{bi}, y_m^{bi})\}$, $\Gamma^{uni} = \{(1,0); (\overline{y}_n^{uni}, 0); (0,0)\}$ or $(1,0)$. $\underline{u}_m^{bi} = u_m(1,0) = \overline{u}_m^{uni} \Rightarrow bi \succeq_m uni$.

Region (VI): $(M < M_1^{bi})$: $\Gamma^{bi} = \{(1,0); (0,1); (y_n^{bi}, y_m^{bi})\}$ or $(0,1)$, $\Gamma^{uni} = \{(1,0); (\overline{y}_n^{uni}, 0); (0,0)\}$. $u_m(1,0) > u_m^{bi}(0,1) > u_m(0,0)$ render preferences indeterminate.

9.3.2 The ns' preferred system

$$u_n(1,0) - u_n^{uni}(\overline{y}_n^{uni}, 0) = \frac{(M_2^{uni} - M)(1+2\sigma)\sigma}{2(1+\sigma)} \geq 0$$

and

$$u_n(0,0) - u_n^{uni}(\overline{y}_n^{uni}, 0) = \frac{(M_1^{uni} - M)(2+\sigma)}{2(1+\sigma)} \geq 0$$

imply that the ns prefer either the no-education equilibrium or the one in which all the ns take education to the mixed equilibrium under the unilingual system. Note further that

$$u_n(1,0) \geq u_n(0,0) \Leftrightarrow \begin{cases} M \leq M_3^{uni}(c-\sigma) = \frac{\sigma-(c-\sigma)}{\sigma-1} \text{ for } \sigma > 1 \\ M \geq M_3^{uni}(c-\sigma) \text{ for } \sigma < 1 \end{cases},$$

$$u_n^{bi}(0,1) \geq u_n(1,0) \Leftrightarrow M \geq M_2^{bi}(c-\sigma) = \frac{\sigma-(c-\sigma)}{2\sigma}$$

and

$$u_n(1,0) \geq u_n^{bi}(y_n^{bi}, y_m^{bi}) \Leftrightarrow M \leq M_3^{bi}(c-\sigma) = 2(c-\sigma).$$

Consider Figure 6.

Region (I): $\Gamma^{bi} = \Gamma^{uni} = (1,0) \Rightarrow bi \sim_n uni$.

Region (II): $\Gamma^{bi} = (1,0)$, $\Gamma^{uni} = \{(1,0); (\overline{y}_n^{uni}, 0); (0,0)\}$. $u_n(1,0) = \overline{u}_n^{uni} \Rightarrow bi \succeq_n uni$.

Region (IIIa) ($M < M_3^{uni}$): $\Gamma^{bi} = (0,0)$, $\Gamma^{uni} = \{(1,0); (\overline{y}_n^{uni}, 0); (0,0)\}$. $u_n(1,0) > u_n(0,0) > u_n^{uni}(\overline{y}_n^{uni}, 0)$ render preferences indeterminate if all equilibria are considered, but $uni \succeq_n bi$ if merely stable equilibria are compared.

Region (IIIb) ($M > M_3^{uni}$): $\Gamma^{bi} = (0,0)$, $\Gamma^{uni} = \{(1,0); (\overline{y}_n^{uni}, 0); (0,0)\}$. $u_n(0,0) = \overline{u}_n^{uni} \Rightarrow bi \succeq_n uni$.

Region (IV): $\Gamma^{bi} = \Gamma^{uni} = (0,0) \Rightarrow bi \sim_n uni$.

Region (V): ($M > \max\{M_2^{bi}; M_3^{bi}\}$: $\Gamma^{bi} = \{(1,0); (0,1); (y_n^{bi}, y_m^{bi})\}$, $\Gamma^{uni} = \{(1,0); (\overline{y}_n^{uni}, 0); (0,0)\}$ or $(1,0)$. $\underline{u}_n^{bi} = u_n(1,0) = \overline{u}_n^{uni} \Rightarrow bi \succeq_n uni$.

Region (VIa): ($M < M_3^{bi}$, $M > M_2^{bi}$): $\Gamma^{bi} = \{(1,0); (0,1); (y_n^{bi}, y_m^{bi})\}$, $\Gamma^{uni} = \{(1,0); (\overline{y}_n^{uni}, 0); (0,0)\}$ $u_n^{bi}(0,1) > u_n(1,0) = \overline{u}_n^{uni} > u_n^{bi}(y_n^{bi}, y_m^{bi})$ render preferences indeterminate unless attention is restricted to stable equilibria, in which case $bi \succeq_n uni$.

Region (VIb): ($M > M_2^{bi}$): $\Gamma^{bi} = (0,1)$, $\Gamma^{uni} = \{(1,0); (\overline{y}_n^{uni}, 0); (0,0)\}$. $u_n^{bi}(0,1) > u_n(1,0) = \overline{u}_n^{uni} \Rightarrow bi \succ_n uni$.

Region (VIc): ($M < M_2^{bi}$): $\Gamma^{bi} = \{(1,0); (0,1); (y_n^{bi}, y_m^{bi})\}$ or $(0,1)$, $\Gamma^{uni} = \{(1,0); (\overline{y}_n^{uni}, 0); (0,0)\}$. $u_n(1,0) > u_n^{bi}(0,1) > u_n(0,0)$ render preferences indeterminate.

9.4 Compulsory education

Indirect utility under compulsory education is equal to $u^c = 1 + 2\sigma - c$. Consider first the preferences of the ns.

$$u^c - u_n(1,0) = M\sigma > 0,$$

$$u^c - u_n^{uni}(\overline{y}_n^{uni}, 0) = \frac{(1+2\sigma-c)(1+2\sigma)+M\sigma}{2(1+\sigma)} > 0,$$

$$u^c \geq u_n(0,0) \Leftrightarrow M \geq M_1^c(c-\sigma) = (c-\sigma) - \sigma,$$

$$u^c - u^{bi}(y_n^{bi}, y_m^{bi}) = 2\sigma(c-\sigma) > 0,$$

$$u^c \geq u_n^{bi}(0,1) \Leftrightarrow M \leq M_2^c(c-\sigma) = 1 - \frac{(c-\sigma)}{\sigma}.$$

Whenever $\sigma > 1$, it is always the case that $u^c > u_n^{bi}(0,1)$ whenever $(0,1)$ belongs to the bilingual equilibrium set. This is so because $(0,1)$ is a bilingual equilibrium only if $M \leq 1-(c-\sigma) < M_2^c(c-\sigma)$. hence, the ns always prefer the compulsory to the bilingual education

system whenever positive education levels can be sustained in equilibrium. Consider next the preferences of the ms.

$$u^c \geq u_m(1,0) \Leftrightarrow M \geq M_3^c(c-\sigma) = \frac{(c-\sigma)}{\sigma},$$

$$u^c \geq u_m^{uni}(\overline{y}_n^{uni},0) \Leftrightarrow M \geq M_4^c(c-\sigma) = \frac{3(c-\sigma)-(1+\sigma)}{\sigma},$$

$$u^c \geq u_m(0,0) \Leftrightarrow M \leq M_5^c(c-\sigma) = 1+\sigma-(c-\sigma),$$

$$u^c - u_m^{bi}(0,1) = N\sigma > 0$$

Consider Figure 8.

Region (Ia): $M > M_1^c \Rightarrow comp \succ_n bi$ and $comp \succ_n uni$, $M < M_2^{uni} < M_5^c$ and $M > M_3^c > M_4^c \Rightarrow comp \succ_n uni$ and $comp \succ_n uni$.

Region (Ib): $M > M_1^c \Rightarrow comp \succ_n bi$ and $\Rightarrow comp \succ_n uni$, $M > M_2^{uni}$ and $M < M_5^c \Rightarrow comp \succ_m uni$ since $\Gamma^{bi} = \Gamma^{uni} = (1,0)$ and $u^c > u_m(0,0)$.

Region (II): $M > M_1^c \Rightarrow comp \succ_n bi$ and $\Rightarrow comp \succ_n uni$. $\Gamma^{uni} = \{(1,0);(\overline{y}_n^{uni},0);(0,0)\}$, $M < M_3^c$ and $M < M_5^c \Rightarrow u_m(1,0) > u^c > u_m(0,0)$, which taken together render the preferences of the ms indeterminate.

Region (III): $M > M_1^c \Rightarrow comp \succ_n bi$ and $\Rightarrow comp \succ_n uni$. $M > M_5^c > M_2^{uni} \Rightarrow \Gamma^{uni} = \Gamma^{bi} = (0,0)$ and $u^c < u_m(0,0)$. Hence, $uni \sim_m bi \succ_n comp$.

Region (IV): $\Gamma^{bi} = \Gamma^{uni} = (0,0)$, $M < M_1^c$ and $M < M_5^c \Rightarrow bi \sim_n uni \succ_n comp$ and $comp \succ_m bi \sim_m uni$.

Region (V): $\Gamma^{bi} = (0,0)$, $\Gamma^{uni} = \{(1,0);(\overline{y}_n^{uni},0);(0,0)\}$, $M > M_3^{uni}$ and $M < M_1^c$. $u_n(0,0) = \overline{u}_n^{uni} > u^c \Rightarrow bi \succeq_n uni$ and $bi \succ_n comp$. $M < M_3^c$ and $M < M_2^{uni} < M_5^c \Rightarrow u_m(1,0) > u^c > u_m(0,0)$, which renders the preferences of the ms indeterminate.

Region (VI): $\Gamma^{bi} = \Gamma^{uni} = (0,0)$, $M < M_1^c$ and $M > M_5^c \Rightarrow bi \sim_n uni \succ_n comp$ and $bi \sim_m uni \succ_m comp$.

9.5 Case studies: historical background

9.5.1 Finland

Finland has been linked or part of the Swedish Crown from the 13th century till 1809, where it became a Grand Duchy within the Tsarist Empire[34]. According to Singleton (1998), Swedish became the language of government and administration during the first half of the 17th century and was still so when the so-called "Finnish national awekening

[34] According to McRae (1997, p. 29), Finland had a substantial degree of internal autonomy inside the Russian Empire until the "Russification" policies started in the 1890s.

movement " started to develop in the 19th century[35]. This movement was aimed both at the creation of new institutions independent from the Russian rule and the promotion of the Finnish language, and was rarely characterised by proposals of creating a unilingual Finnish-speaking Finland. Actually, an important part of the Swedish speaking elites participated actively to this movement[36]. In 1847, a decree "required a satisfactory' knowledge of Finnish for elementary school teachers" [McRae (1997), p. 35]. In 1863, the liberal Tsar Alexander II signed a decree prepared by the Finnish Senate which by Swedish would remain the official language but Finnish would be on a 'footing of complete equality with Swedish in all matters which directly concerned the Finnish-speaking part of the population'. Documents in Finnish would be freely accepted in courts and administrative offices" [McRae (1997), p. 34-5]. Other language decrees were approved in the following years[37], but as stressed byMcRae (1997) "all these language enactments were in the form of executive decrees of the Senate, without the participation of the Diet. The first language law in the proper sense would come only after independence" (p. 37). In addition to that, the proportion and number of secondary schools in Finnish increased from one third of the 3,500 grammar schools in 1880 to two thirds of 8,600 schools in 1900 [Singleton (1998)]. After the October revolution in Russia and the Brest-Litovsk settlement, the Finnish Parliament (Eduskunta) declared the independence of Finland on December 1917. This was followed by a short civil war (January-May 1918) in which the so-called "Civil Guards" (whites) sustained by Germany defeated the "Red Guards", backed by Soviet Russia.

9.5.2 France

In the 15th century, French was already the language spoken at the Court of the King of France, but most of the texts issued by the Parliaments outside the francophone zone were written in the corresponding "regional" language or in latin.(Hagège,, 1996). Under François I, the Edict of Villers-Côtterets (1539) imposed French over Latin and the other languages in the courts of law and for the official judicial documents (e.g. in testaments, registers or sentences). Most of teaching for the popular classes consisted in catechism,

[35] During the first half of the 17th century, "Swedish began to replace Finnish in the governing circles of Finland. Oral Finnish was still used in dealings with the peasantry, by parish priests amongst their flocks (...) but Swedish became the language of the higher courts and the administration(...) in 1649, Swedish replaced Finnish as the language of instruction in grammarschools, alongside classical Latin and Greek" (Singleton, 1998, p.41-42). In the 1770s Finnish was recognised for use in the deliberations of the Diet (Parliament) and started to appear in banknotes, but Swedish remains the language of the "skilled".

[36] "Paradoxically, most of the historians and poets who contributed to the growing sense of Finnish national pride used their mother-tongue, Swedish -which was also the official language of the Grand Duchy" (Singleton, 1998, p. 70) and "most of the early leaders to promote the Finnish language found it easier to use Swedish" (p. 79).

[37] In particular, a language decree equalised in 1902 the status of Finnish and Swedish, but "its impact was overshadowed by the language edict of 1900, which attempted to impose Russian as the ordinary language of the upper levels of government" [McRae (1997), p.50].

and was done in the local dialect or language, or in latin. The Protestants, though, started to use French (rather than the regional languages or latin) earlier than the Catholics (Le Roy Ladurie, 2001).