THE OFFICIAL LANGUAGE PROBLEM

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Polities and organizations use and require particular languages for official business. The choice of official languages is a vexing issue. Theorists, convinced that a fair language policy cannot be efficient, have despaired of an elegant solution. To investigate this apparent dilemma, I mathematically model the problem of choosing an efficient and fair language policy for a plurilingual polity. The policy designates official languages and taxes the language groups to pay for translation among the official languages. Contrary to prevailing wisdom, this model implies that a fair language policy can be efficient. But what if language groups rationally misrepresent the costs of using a nonnative official language? Even then, the policy maker can discover a fair language policy and, under some conditions, can use a cost-revelation procedure that discovers a fair and *efficient language policy. The results challenge the claim that efficiency and practicality excuse the inferior treatment of language minorities.*

In a world with thousands of languages, the choice of official languages is a natural political issue. When governments, firms, associations, and international organizations designate the languages that they require or permit to be used in official business, interests come into conflict. Those whose languages are not official spend years learning others' languages and may still communicate with difficulty, compete unequally for employment and participation, and suffer from minority or peripheral status.

The issue of official languages has often been described as one that resists peaceful, stable, or satisfying resolution. Possible explanations include the primordial, symbolic, divisive, uncompromisable character of language conflict (Rustow 1970); inherent incompatibilities between linguistic communities (Deutsch 1984; Laponce 1984); the reluctance of linguistic majorities to concede rights to minorities (Sniderman et al. 1989); the power of civil servants to protect their linguistic privileges (Laitin 1989; Mackey 1977); the important material and symbolic consequences of language policies (Weinstein 1983); and the difficulty of predicting these consequences (Fishman 1974, 92–94; Kelman 1971). As an example of this last claim, Laponce (1989) hypothesizes that if a government tries to fortify a language by making it official where it is weak, this act may backfire by drawing speakers away from the language's heartland, threatening the language's very survival. For these or other reasons, the choice of official languages is described in case after case as a frustrating one.[1]

Beyond the foregoing reasons, students of political and sociolinguistic theory may themselves deserve some blame for the recurring eruption of disputes over official languages. Theorists have failed to provide models for optimally resolving this issue. In fact, the theory of official languages echoes with pessimism as to whether any elegant solution could exist. A solution that treats all speakers of all

languages identically is considered impractical. According to Kloss, "three seems to be the maximum number of languages which can be placed on an equal footing as official languages of the nation. The day-to-day affairs of a country's administration and even its legislative proceedings will soon be overtaxed, tangled, and inefficient if transacted in more than three languages" (1966, 7). Some claim it would be unnatural, inefficient, impossible, impractical, and contrary to common sense for governments to provide teachers and textbooks, even throughout elementary school, in all pupils' languages (Avrorin 1975, 205; Deseriev 1977, 259; and Guboglo 1979, 193). Van Dyke says governments have "no other practical choice" but to give different statuses to different languages; the idea "that claims for equal treatment in terms of language need to be balanced off against costs is a principle that all accept" (1976, 5–6). Green (1987), though arguing against any system of official languages that would diminish anyone's welfare, still assents to the officialization of the most powerful groups' languages. De Witte, while insisting that equality under the law would require governments to "use as many languages as are spoken by the target public," says services may be denied in some languages "on the basis of administrative or judicial efficiency. It is clear, for example, that a single user cannot demand an additional official language, but a group consisting of about half the population can legitimately do so" (1989, 97). Mazrui proposes five official "world languages," selected as a compromise among several principles, including "the sheer exigencies of power" (1976, 473–79).

Without a theoretical account of what an ideally democratic language policy would look like, it is no surprise that legislatures, courts, and regulators employ ad hoc numerical, cost, and political criteria when allocating official statuses to languages (Anderson and Silver 1984; Falch 1973). Examples include guarantees of minority-language schools where "a considerable proportion of Polish nationals of other than Polish speech are resident" (Laqueur and Rubin 1979, 154–55), government services in both English and French where there is a "significant demand" (Canada, Commissioner of Official Languages 1989, 34), public notices in the language of any nationality constituting at least 30% of a jurisdiction (Falch 1973, 89–90), emergency telephone operator service in languages spoken by at least 5% of a local population (Rubin 1984, 162), and voting instructions in languages of poorly educated groups constituting at least 5% of a state or local population (42 U.S.C. §1973aa-1a). U.S. Supreme Court justices Burger and Blackmun agreed that eighteen hundred children had a right to recognition of their language by a public school district but said they might reject a similar claim "when, in another case, we are concerned with a very few youngsters, or with just a single child" (*Lau* versus *Nichols* 1974, 572).

Although the intrinsic inelegance of the official language problem is variously described, most theorists appear to have concluded that the choice of official languages involves an inevitable compromise between efficiency and fairness. It is usually claimed that an efficient language policy officializes fewer than all languages and is therefore unfair, while a fair policy officializes everyone's language or an entirely alien language and is therefore inefficient. Efficient neutrality, exemplified in church-state separation and racial nondiscrimination, is held inapplicable to language groups, because governments can simply *ignore* races and religions, but must *use*, and thus *choose*, languages.

A principled solution to the official language problem seems to be further inhibited by the large number of norms that theorists (e.g., Fishman 1973, 63–71; Pool

1976; Thorburn 1971; Vaillancourt 1983; Vikør 1988, 96–138; Woolard 1989) acknowledge in addition to efficiency and fairness. These include authenticity (favoring indigenous languages), uniformity (favoring only one language), diversity (favoring multiple languages), distinctiveness (favoring languages unique to the community), universality (favoring languages known by outsiders), stability (favoring existing language rights and statuses), radicality (using language policy to liberate oppressed groups), definitiveness (avoiding linguistic options), liberty (noncoercion), modernization (favoring languages with developed lexicons and literatures), populism (favoring mass over elite languages), prestige (recognizing already-high-status languages), antibossism (discouraging powerful linguistic intermediaries), and tolerability (avoiding policies that would induce emigration or secession).

A few voices have suggested that efficiency and fairness in a policy on official languages can be reconciled, but their ideas remain to be explored. Among the proposed solutions are voluntarism (Isaev 1977, 21–23, 337–38, 351), compensation (Pool 1987), democratization (O'Barr 1976, 19), and even linguicide—the obliteration of all native languages except a single official language (Atkins 1978). Each of these ideas, even if superficially plausible, is problematic; and no one has yet rigorously defined and analyzed any of them.

The prevailing belief that an efficiency–fairness conflict in official language policy exists and that it justifies evidently unfair policies merits scrutiny. In a world that largely embraces democratic norms, one might expect defenses of unfair policies to be held to a high standard of proof, particularly when, as in this arena, the policies substantially affect the lives of billions of persons. Nevertheless, the case for allowing official language policies to be unfair has been made with the support of only impressionistic arguments.

I plan to show that fairness is compatible with efficiency in a policy on official languages. I present a formal model of the official language problem defining policy alternatives, their consequences, and normative principles that one might wish to satisfy in choosing a language policy. I then prove that there are language policies simultaneously satisfying the fairness and efficiency principles and that procedures exist by which one can discover such policies, even when the affected groups have private information about the policy consequences and are motivated to conceal that information from the policy-making authorities. Finally, I summarize the results, discuss their robustness, and suggest possible elaborations of the model.

Model

What, in essence, is the official language problem? Abstracting from the intricate complexity and variety of practical language politics, I here define the official language problem as a set of language policy choices that have particular consequences and that are subject to particular normative criteria. These choices, consequences, and criteria are expressed in a model consisting of 10 formal assumptions, which I elucidate with accompanying motivations.

ASSUMPTION 1. *A polity is partitioned into two or more groups, each with a positive size and a different native language, drawn from a finite set of languages.*

This assumption reflects the fact that almost all persons can be described as having one native or first language. For simplicity, I assume no one is natively plurilingual. Each group can be understood as the set of citizens sharing some native language, with the group size being proportional to the number of citizens in

it. The assumptions below do not introduce any within-group differences. Accordingly, I shall not analytically disaggregate the groups into individuals in this model.

ASSUMPTION 2. *At least one language is official.*

Each state or other organization generally officializes at least one language, if not de jure then de facto. Assumption 2 allows languages not native to any group in the polity to be official, reflecting the fact that foreign, artificial, classical, and pidgin languages are sometimes given official status. While various kinds and degrees of official status are granted to languages in practice, I simplify by assuming only that every language is either official or not.

ASSUMPTION 3. *For each group whose native language is not official, each official language has a positive adoption price that depends only on the group and the language.*

Typically, persons whose native languages are not official adopt some official language for use in communicating with the rest of the polity. The cost of adopting an official language might consist of time, effort, and money spent in learning the language; deprivations caused by imperfect command of the language; and the loss of prestige arising from the denial of official status to one's native language. All such effects can be viewed as an aggregated price for adopting a particular official language. I assume the adoption price of a particular official language for a particular group doesn't change when any other language is officialized or deofficialized. Thus, the adoption price of official language I for group J is not affected by whether language K, too, is official.

ASSUMPTION 4. *The adoption cost of each group is zero if its native language is official and otherwise is the minimum of the adoption prices of all official languages for the group.*

If a group's own language is official, it typically uses that language and incurs no cost in adapting to an official language. Otherwise, it would be reasonable to expect the group to choose the official language that is least costly for the group.

ASSUMPTION 5. *The translation cost of each group is the product of the group's size and one less than the number of official languages.*

Suppose each group knows and uses only one official language. Suppose, further, there are no superfluous official languages (i.e., official languages that no group uses). Suppose, finally, the polity is participatorily egalitarian: each citizen communicates to the same extent; in terms of assumption 1, the volume of each group's public utterances is proportional to the group's size. Under these conditions, how can all groups understand one another? Each public utterance of any group must be translated into each of the official languages other than the one in which it is uttered. Thus, if o is the number of official languages, each utterance must be translated $o - 1$ times. And what does it cost to translate all the public utterances of a group (its translation cost)? Presumably, the cost is proportional to the volume of those utterances and hence to the group's size, and also proportional to the number of times they are translated ($o - 1$). The cost then equals some constant multiplied by group size and $o - 1$. Assumption 5 adopts a measurement scale that makes this constant 1.

ASSUMPTION 6. *The total cost is the sum of the groups' adoption costs and translation costs.*

For any set of official languages, any group has an adoption cost and a translation cost. The total of all these costs for all

groups is the total cost that a set of official languages imposes on the polity.

ASSUMPTION 7. *The tax schedule is a set of taxes on the groups, the sum of the taxes being equal to the sum of the translation costs.*

Suppose the state performs the translation and does nothing else. Then it might also redistribute wealth by taxing the groups disproportionally to their sizes. Tax rates sometimes in fact differ among language groups. The differences may be by-products of transfers to poorer groups or regions (e.g., in Yugoslavia and Canada) and wealth-based assessments (e.g., in the United Nations) or may reflect an overtly language-based subsidy, such as what the Swiss government pays to the Romansh- and Italian-speaking regions (McRae 1983, 169–72).

ASSUMPTION 8. *The language policy is the set of official languages and the tax schedule. A language regime is a rule producing a language policy. A language regime is* based on *a set of facts if it does not refer to any facts not in the set.*

Both a set of official languages and a tax schedule (which may tax the native speakers of different languages at different rates) can be regarded as ingredients of a language policy. The language policy may be determined by some rule, such as a constitutional provision. Such a rule would be a function: facts (such as the number and sizes of the groups) would be input, and a language policy would be output. I call such a rule a *language regime.*

ASSUMPTION 9. *A language policy is efficient if it minimizes the total cost. A group's burden is the sum of its adoption cost and its tax. A language policy is fair if each group's burden is proportional to the group's size.*

Since this model provides a measure of total social cost, and since assumption 5 guarantees that the total social benefit (communicability) will be constant regardless of the language policy that is chosen, a reasonable notion of efficiency for this model is the minimization of the total cost. As for fairness, any language policy involves an adoption cost and a tax (or subsidy) for each group; I call their sum the group's *burden.* Suppose each group's burden is shared uniformly by its members. Then individualistic fairness would require that each group's burden be proportional to the group's size.

ASSUMPTION 10. *A language regime is objective if it is based on the number of groups, their sizes, and their native languages and semiobjective if based on these and on groups' choices.*

If one wants an efficient and fair language policy, it is reasonable to want a language regime—a rule—that guarantees such a policy. A language regime based on the number of groups, their sizes, and their native languages is especially appealing. The reason is that these facts are relatively easy to measure. Excluded from this set of facts are adoption prices. As discussed after assumption 3, adoption prices may include subjective as well as observable elements. If a language regime measured adoption prices by asking groups to disclose them, the replies might be false. Groups might want to mislead the language regime into officializing their native languages and/or lowering their taxes. This problem is an instance of the general principle that telling the truth is not always rational if a policy that affects the teller is going to be based on the teller's disclosure (see Dasgupta, Hammond, and Maskin 1979; Radner 1986; Rasmusen 1989, 133–36, 172–75). Accordingly, I define a language regime as *objective* if it doesn't require as an input any adoption price. But what if we can't guarantee an

efficient and fair language policy without considering adoption prices? Then we might seek to induce the groups to make choices that will reveal adoption prices. I call a language regime that relies on such choices *semiobjective*. The language regime can use such choices to infer adoption prices, but its inferences may be incorrect.

Results, Proofs, and Discussion

Under the foregoing model, can a language policy be efficient and fair? If so, is there an objective way to produce such a policy? I shall present six results, followed by their proofs and discussions. Readers wishing to skip the proofs can do so without loss of continuity.

RESULT 1. *An efficient language policy always exists.*

Proof. For any polity, each language policy has a total cost. Some language policy's total cost is the smallest. Any language policy with this total cost (at least one must have it) is efficient.

RESULT 2. *A fair language policy always exists.*

Proof. Consider a language policy with all groups' native languages official and each group's tax equal to the group's own translation cost. Assumption 7 requires that the sum of the taxes be the sum of the translation costs, and this is the case for this language policy. Because each group's native language is official, each group's adoption cost is zero. Thus, each group's burden is its tax. By assumption 5, translation costs are proportional to size, so with this policy taxes are proportional to size; thus, burdens are proportional to size. By assumption 9, that makes this policy fair.

Results 1 and 2 are consistent with previous commentaries, which generally imply that a language policy can be efficient or fair. The consensus denies, however, that it can be both efficient and fair.

RESULT 3. *An efficient, fair language policy always exists.*

Proof. We can take any efficient language policy (at least one always exists, by result 1) and make it fair by changing its tax schedule. A changed tax schedule will leave the total cost unchanged, so the new language policy will remain efficient, while now also being fair. For the new tax schedule, I shall identify the groups as group 1, group 2, and so on and shall make o the number of official languages, s_i the size of group i, a_i the adoption cost of group i, t_i the translation cost of group i, and x_i the tax on group i. I shall use s, a, t, and x for the respective whole-polity sums, and we know from assumption 7 that $x = t$. Assumption 5 says that $t_i = (o - 1)s_i$. Summing the equations for all t_i, we get the total translation cost: $t = (o - 1)s$. To make a language policy fair, we must change its tax schedule so each group's burden is proportional to its size. Each group's burden must then bear the same ratio to the total burden as the group's size bears to the total size. By assumption 9, group i's burden is $a_i + x_i$, so

$$\frac{a_i + x_i}{a + x} = \frac{s_i}{s}. \tag{1}$$

Solving equation 1 for x_i, we find that each group's tax is

$$\begin{aligned} x_i &= \frac{a + x}{s} s_i - a_i = \frac{a + t}{s} s_i - a_i \\ &= \frac{a + (o - 1)s}{s} s_i - a_i \\ &= (a/s + o - 1)s_i - a_i. \end{aligned} \tag{2}$$

Efficiency and fairness, as defined here, are compatible because they constrain different things. Efficiency requires minimiz-

ing the total cost, and the total cost depends solely on the set of official languages. Fairness requires proportional burdens, and this can be achieved with an appropriate tax schedule, regardless of the set of official languages.

Result 3 challenges the common claim that efficiency justifies the unequal treatment of different languages' speakers. In this model efficiency is no barrier to fairness. The purported efficiency–fairness conflict results from certain (usually unstated) assumptions. It fails to arise under my assumptions.

For examples of how the model can prescribe an efficient and fair language policy, imagine these "facts" about a polity:

1. each person's lifetime earning potential (which will be the unit of value) is equal;
2. each person spends 1% of a working life using an official language to communicate to the polity;
3. a translator spends the same time translating an utterance as it took to utter;
4. a person whose native language is not official spends 5% of a working life (2 out of 40 years) learning an official language; and
5. its members' learning time constitutes a group's adoption cost.

On these "facts," efficiency would require officializing the largest native language and also any other language natively spoken by more than 20% of the population. If we let l be the native speakers of official languages as a proportion of the population, the fair per capita tax would be $.01o - .05l + .04$ on official language speakers and $.01o - .05l - .01$ on others. The three terms imply that the tax would (1) vary directly with the number of official languages, (2) vary inversely with the fraction of the population not natively speaking an official language, and (3) exactly compensate those who must learn an official language. Official languages and per capita taxes would be insensitive to polity size. Table 1 compares, for several countries, two fair language policies, the efficient one and a plausible but inefficient one, assuming the named "facts." Note that because the taxes are fair, *all* persons—even those whose native languages lose official status—prefer the efficient policy to the inefficient one. The German-speaking Belgians' case in Table 1 will illustrate this principle. Belgium's native German speakers pay a negative tax (receive a subsidy) of 3.61% of their income if only Dutch (A) and French (B) are official but pay a tax of 2.34% of their income if all three languages are official. The difference is 5.95% of their income. But it costs them only 5% of their income to learn Dutch or French. So they prefer the policy that officializes only Dutch and French.

Anyone familiar with any of Table 1's cases will recognize serious complications in the politics of official languages that are ignored in the model and hence in results 1–3. For example, language groups tend to be (as in Belgium) geographically concentrated, making regional officialization policies (as in Belgium) plausible. There are many other complications (such as intergenerational assimilation, variable translation cost rates, and variable participation) that await more elaborate models, as I shall discuss in the conclusion.

In excluding most such complications from this model, I am not diminishing their importance. I exclude them because each is important enough (and probably tricky enough) to deserve a detailed study of its own.

I shall, however, select a single important complication for analysis: cost measurement. I have shown that an efficient and fair language policy exists, but I have not shown that we can find it. One obstacle, mentioned above in my motivation

for assumption 10, is the subjectivity of adoption prices. The language regime described for result 3 is based in part on adoption prices. Suppose we refuse to posit adoption prices, such as those posited by the fourth and fifth "facts" in the last example. Suppose, further, we refuse to assume that groups will sincerely reveal adoption prices when asked. Can we design a language regime that infallibly produces an efficient, fair language policy objectively (i.e., without information about adoption prices)?

RESULT 4. *At least one objective language regime always produces a fair language policy.*

Proof. In proving result 2, I described a language regime that always produces a fair language policy, namely, to make all groups' languages official and make each

Table 1. Alternative Fair Language Policies for Several Countries

Country	Native Speakers by Language (%)	Official Languages	Tax on Speakers[a] (% of Total Income)	Subsidy to Others	Efficient?
Belgium	Dutch (59)	Dutch, French	1.39	3.61	yes
	French (33)	all	2.34	2.66	no
	German (1)				
Canada	English (60)	both	1.76	3.24	yes
	French (24)	English	1.98	3.02	no
India	Bengali (8)				
	Hindi (28)	Hindi	3.60	1.40	yes
	Marāthi (8)	all	6.06	-1.06	no
	Tamil (7)				
	Telugu (8)				
Peru	Quechua (27)	both	1.27	3.73	yes
	Spanish (68)	Spanish	1.60	3.40	no
Philippines	Cebuano (24)				
	Hiligaynon (10)	Cebuano, Pilipino	3.59	1.41	yes
	Ilocano (11)	all	4.53	.47	no
	Pilipino (24)				
South Africa	Afrikaans (16)	Zulu	3.95	1.05	yes
	Xhosa (18)	all	4.24	.76	no
	Zulu (21)				
USSR	Russian (59)	Russian	2.07	2.93	yes
	Ukrainian (13)	all	3.17	1.83	no
	Uzbek (5)				
United States (1990)	English (89)	English	.57	4.43	yes
	Spanish (6)	both	1.29	3.71	no
United States (2080)	English (74)	both	1.27	3.73	yes
	Spanish (21)	English	1.30	3.70	no

Sources: 1990 *Britannica Book of the Year*, pp. 762–67, 774–77; Spencer 1986, 1, 10; Strategy Research Corporation 1987, 176. U.S. forecasts for 2080 assume Hispanics' current language composition and Puerto Rico statehood.

Note: Main assumptions: translation costs 1% of total income per target language; nonnative speakers learn one official language at cost of 5% of total income.

[a]Native speakers of any official language.

group's tax equal to its translation cost. With n groups, group i's tax is then $x_i = t_i = (o - 1)s_i = (n - 1)s_i$. Thus, the language regime is based only on the number of groups (n), their sizes (s_i), and their native languages. By assumption 10, this makes it an objective language regime.

If all the native languages are official, every group's adoption cost is zero, and one can make the language policy fair without ascertaining adoption prices. Result 4 further challenges defenses of unfair language policies. Objectivity, like efficiency, is no bar to fairness in this model.

RESULT 5. *There is no objective language regime that always produces an efficient language policy.*

Proof. Consider a two-group polity with the native languages as the only languages. Let us make L the set of official languages, p_i the adoption price for group i of its nonnative language if its native language is not official, and c the total cost. Then L can be {1}, {2}, or {1, 2}. With {1}, the only cost is an adoption cost, p_2. With {2}, the only cost is an adoption cost, p_1. With {1, 2}, the only cost is the translation cost, $(o - 1)s$, which in this example, with $o = 2$, is s. Thus,

$$c = \begin{cases} p_2 \text{ if } L = \{1\} \\ p_1 \text{ if } L = \{2\} \\ s \text{ if } L = \{1, 2\}. \end{cases} \quad (3)$$

To know that a language policy is efficient in this case requires knowing whether p_2, p_1, or s is smallest. But no objective language regime has access to p_1 or p_2. Thus, no objective language regime can guarantee an efficient language policy in this case or, consequently, in all cases.

An objective language regime may identify some inefficient language policies, but it can't identify all of them. For example, any policy that officializes all the groups' native languages and at least one other language must be inefficient. But policies that officialize only groups' native languages can't be classified as efficient or inefficient without a knowledge of adoption prices.

Under this model's assumptions, it is wrong to claim (as is often done) that having many official languages is necessarily inefficient. As more native languages are made official, translation costs rise but adoption costs fall. If all adoption prices are sufficiently large, it will be efficient to officialize all the groups' native languages. Why, then, do people assert that official multilingualism is inherently inefficient? They may assume that the cost of translation is efficiency-relevant but the cost of language adoption is not. In my model translation is paid for centrally, while language adoption is paid for by the adopters; and in many cases the facts seem to resemble this assumption. The tendency to regard multiple official languages as inefficient may, then, reflect a state-centered neglect of costs incurred by individuals in adapting to language policies.

The search for an objective language regime that reliably produces an efficient and fair language policy has failed. Such a regime can guarantee a fair but not an efficient language policy. I appeal for help, then, to *semi*objective language regimes; and, at least under some conditions, they succeed. In specifying the conditions of success, I shall assume that a semiobjective language regime may force any group, in any sequence, to choose among any set of alternatives and may also *recommend* to any group a principle for making a given choice. I shall further assume that each group follows some *choice strategy*, which determines how the group chooses among any set of alternatives under given conditions. For the sake of analytical simplicity, I now define two special attributes that groups may have. A group is *completely informed* if it knows all relevant facts, including all adoption prices, all previously made

choices, all facts about the language regime, and all facts about each group's choice strategy. A group is *deferentially rational* if its choice strategy is to make a choice that minimizes the group's expected burden and, whenever two or more alternatives would be equally burden-minimizing, to choose among those alternatives according to whatever principle is recommended to the group by the language regime.

RESULT 6. *In a polity with two languages and two completely informed, deferentially rational groups, at least one semiobjective language regime always produces an efficient, fair language policy.*

Proof. My proof has six parts. In part 1, I define a semiobjective language regime that obtains sequential choices from groups. In part 2, I show the language policy that the regime produces, given any sequence of group choices. In parts 3–5, I show the choices that the groups make. In part 6, I show that the language policy is always efficient and fair.

Part 1. The *suspicious own-price-soliciting* (SOPS) language regime is defined by steps A–H:

Choice solicitation

A. The groups are arbitrarily numbered 1 and 2.
B. Group 1 is instructed to choose a positive number, and it is recommended that this number be the adoption price for group 1 of language 2.
C. Next, group 2 is instructed to choose a positive number, and it is recommended that this number be the adoption price for group 2 of language 1.
D. Next, group 2 is instructed to choose the word *one* or *two*, and it is recommended that this word be *one*.
E. Next, if the number chosen by group 1 (step B) is greater than the number chosen by group 2 (step C) and no greater than s, group 1's choice is discarded and group 1 is again instructed to choose a positive number, and it is again recommended that this number be the adoption price for group 1 of language 2.
F. The *primary recommendations* made in steps B, C, and E are supplemented by the *subordinate recommendation* that the group choose the largest of the numbers that it considers.

Policy production

G. A language policy is produced, and it is defined so as to be efficient and fair if the number last chosen by each group is the adoption price for that group of its nonnative language.
H. If step G fails to specify a unique set of official languages, {1} or {2} is officialized in preference to {1, 2}, and if {1} and {2} are tied the word chosen in step D names the official language.

To refer to elements of this language regime, I shall use the following terms: a *claim* is a choice made in step B, C, or E; a claim is *true* if it obeys the primary recommendation; a *disclosure* is a nondiscarded claim; the choice made in step D and the disclosures are *signals*; an *apparent* attribute of the language policy is an attribute that it possesses when both disclosures are true. I shall also make q the initial claim of group 1, r the revised claim (if any) of group 1, d_i the disclosure of group i, c' the apparent total cost, a'_i the apparent adoption cost of group i, and a' the sum of the apparent adoption costs.

Part 2. Given any combination of signals, the SOPS language regime produces an apparently efficient language policy. In other words, the language policy is efficient if both disclosures are true but may or may not be efficient otherwise. Thus, the policy minimizes the apparent total cost c', given by

Table 2. Outcomes in a Two-Language Polity under a Suspicious Own-Price-Soliciting Language Regime

Situation		L	Group	a'_i	a_i	Tax on Group i (x_i)	Group i Burden ($a_i + x_i$)
1.	$\{d_2 < d_1,\ d_2 \leq s\}$ or $\{d_1 = d_2 \leq s,$ *one*$\}$	{1}	1	0	0	$(s_1/s)d_2$	$(s_1/s)d_2$
			2	d_2	p_2	$(-s_1/s)d_2$	$p_2 - (s_1/s)d_2$
2.	$\{d_1 < d_2,\ d_1 \leq s\}$ or $\{d_1 = d_2 \leq s,$ *two*$\}$	{2}	1	d_1	p_1	$(-s_2/s)d_1$	$p_1 - (s_2/s)d_1$
			2	0	0	$(s_2/s)d_1$	$(s_2/s)d_1$
3.	$\{d_1 > s,\ d_2 > s\}$	{1, 2}	1	0	0	s_1	s_1
			2	0	0	s_2	s_2

$$c' = \begin{cases} d_2 \text{ if } L = \{1\} \\ d_1 \text{ if } L = \{2\} \\ s \text{ if } L = \{1, 2\}. \end{cases} \quad (4)$$

Equation 4 is equation 3 with the disclosures substituted for the respective adoption prices. Whichever of $\{d_1, d_2, s\}$ is smallest, the regime makes the corresponding language(s) official. Any ties are broken as described in step H.

The SOPS language regime also produces an apparently fair language policy. Thus, the apparent burdens, $a'_i + x_i$, are proportional to group sizes. Adapting equation 2, we find that the *apparently* fair tax on group i is

$$x_i = (a'/s + o - 1)s_i - a'_i.$$

A complete description of the language policies produced by the SOPS language regime appears in Table 2. It classifies all the possible combinations of signals into three mutually exclusive situations. In each situation, the language regime officializes a different set of languages. For each situation, Table 2 specifies the taxes that will be imposed on the groups. The burdens shown in Table 2 are the true—not apparent—burdens that result from the language policies. These burdens will be used in later parts of the proof.

As an illustration of how Table 2 is derived, consider what happens if group 2's disclosure, d_2, is smaller than group 1's disclosure, d_1, and no greater than s. The language regime then officializes {1} (according to equation 4). The taxes it imposes are determined according to equation 5. For example, the tax on group 2 is derived as follows:

$$\begin{aligned} x_2 &= (d_2/s + 1 - 1)s_2 - d_2 \\ &= (d_2/s)(s - s_1) - d_2 \\ &= d_2 - \frac{s_1}{s} d_2 - d_2 = \frac{-s_1}{s} d_2. \end{aligned}$$

Part 3. If group 1's claim is resolicited, group 1 chooses a revised claim that will minimize group 1's burden. In determining how its revised claim (r, which then becomes d_1) will affect its burden, group 1 is completely informed. Thus, it knows how its burden will depend on d_1, as shown in Table 2.

A complete description of the revised claims made by group 1 appears in Table 3. This table applies under the condition described in step E, namely when $d_2 < q \leq s$. When this condition is met, then, depending on group 2's prior choices, group 1 may be in any of three mutually exclusive positions. For each position, Table 3 specifies group 1's revised claim, together with the situation and burdens resulting from that claim.

It is a straightforward matter to derive r in Table 3 from Table 2. For illustration,

Table 3. Group 1's Revised Claim in a Two-Language Polity under a Suspicious Own-Price-Soliciting Language Regime

Position	r	Situation	Group 1 Burden	Group 2 Burden
I. $p_1 > d_2$ or $\{p_1 = d_2$, *one*$\}$	p_1	1	$(s_1/s)d_2$	$p_2 - (s_1/s)d_2$
II. $\{p_1 \leq d_2$, *two*$\}$	d_2	2	$p_1 - (s_2/s)d_2$	$(s_2/s)d_2$
III. $\{p_1 < d_2$, *one*$\}$	d_2^-	3	$p_1 - (s_2/s)d_2^-$	$(s_2/s)d_2^-$

Note: $^-$ designates a quantity infinitesimally smaller than the quantity to which it is appended.

suppose $d_2 < q \leq s$ and $d_2 < p_1$, and suppose the word is *one*. The former inequality causes group 1's claim to be resolicited. The latter inequality puts group 1 into position I. Table 3 says that group 1's rational revised claim is then true ($r = p_1$), leading to situation 1 and giving group 1 a burden of $(s_1/s)d_2$. Situation 1 emerges from this revised claim because $d_1 = r = p_1 > d_2 < s$, and these inequalities satisfy the definition of situation 1 in Table 2. Now consider why it is rational for group 1 to tell the truth in position I. Suppose group 1 lied by making $p_1 \neq r \geq d_2$. Then situation 1 would still emerge (because the definition of that situation in Table 2 would remain satisfied), and group 1's burden would not change (because it is not a function of r). Now suppose group 1 lied by making $p_1 \neq r < d_2$. Then situation 2 would emerge (because $\{d_1 < d_2, d_1 \leq s\}$ would be satisfied), and group 1's burden would become $p_1 - (s_2/s)d_1$. This burden would be an increase, as shown by

$$p_1 - \frac{s_2}{s} d_1 > d_2 - \frac{s_2}{s} d_1 > d_2 - \frac{s_2}{s} d_2 = (1 - s_2/s)d_2 = \frac{s - s_2}{s} d_2 = \frac{s_1}{s} d_2.$$

Thus, under the conditions of this illustration group 1 minimizes its burden by telling the truth. It would equally minimize its burden by telling some lies; but it is deferentially rational, so when breaking ties, it tells the truth, obeying the primary recommendation in step E. Similar arguments lead to the conclusions of Table 3 about all other possible cases in which group 1's claim is resolicited.

Part 4. Group 2 knows how its burden will depend on the choices it makes. Thus, it knows that if $q > s$ no choices by group 2 can cause group 1's claim to be resolicited, but that if $q \leq s$ group 2 can cause the resolicitation of group 1's claim by making $d_2 < q$. In either case, group 2 can use Tables 2 and 3 to predict the effect of its choices on its own burden. Given this complete information, group 2's choices are shown in Table 4.

The possible initial claims of group 1 can put group 2 into any of the five mutually exclusive cases in Table 4. Since it is not immediately obvious that these cases are exhaustive and mutually exclusive, a more transparent but logically equivalent diagram of the cases is presented in Figure 1. For each case, Table 4 shows group 2's signals, including its disclosure (d_2) and the word it chooses. The table also shows the position into which these signals put group 1 (in Table 3), if relevant, and the situation and burdens that result.

To verify Table 4's predictions, one can use Tables 2 and 3 to determine whether group 2 could obtain a smaller burden by giving any signal other than the predicted one. I shall summarize this verification for

Table 4. Group 2's Signal in a Two-Language Polity under a Suspicious Own-Price-Soliciting Language Regime

Case	d_2	Word	Position	Situation	Group 1 Burden $(a_1 + x_1)$	Group 2 Burden $(a_2 + x_2)$
1. $\{p_1 < q \leq s,\ p_2 > (s_1q + s_2p_1)/s\}$	p_1	*two*	II	2	$(s_1/s)p_1$	$(s_2/s)p_1$
2. $\{p_2 \leq q \leq s,\ p_2 \leq (s_1q + s_2p_1)/s\}$	q	*one*	—	1	$(s_1/s)q$	$p_2 - (s_1/s)q$
3. $p_2 \leq s < q$	s	*one*	—	1	s_1	$p_2 - s_1$
4. $\{q < p_2,\ q \leq s,\ q \leq p_1\}$	p_2	*one*	—	2	$p_1 - (s_2/s)q$	$(s_2/s)q$
5. $\{s < p_2,\ s < q\}$	p_2	*one*	—	3	s_1	s_2

case 1. In case 1, Table 4 predicts that group 2 will choose the word *two* and also that group 2's disclosure will be a lie. Instead of truthfully making $d_2 = p_2$, group 2 will falsely make $d_2 = p_1$. This disclosure must be false, because $p_2 > p_1$, as shown by

$$p_2 > \frac{s_1q + s_2p_1}{s} > \frac{s_1p_1 + s_2p_1}{s}$$
$$= \frac{sp_1}{s} = p_1.$$

When we consider group 2's alternative signals, we find that they all increase group 2's burden, compared with the predicted signals. Suppose group 2 made $d_2 \geq q$. This would directly produce situation 2, and group 2's burden would increase from $(s_2/s)p_1$ to $(s_2/s)q$. Suppose group 2 made $p_1 < d_2 < q$. This would leave group 1 still in position II, but group 2's resulting burden would be $(s_2/s)d_2$, again greater than before. Suppose group 2 made $d_2 < p_1$. This would move group 1 into position I and give group 2 a burden of $p_2 - (s_1/s)d_2$. This would be an increased burden, as shown by

$$p_2 - \frac{s_1}{s} d_2 > p_2 - \frac{s_1}{s} p_1$$
$$> \frac{s_1q + s_2p_1}{s} - \frac{s_1}{s} p_1$$
$$> \frac{s_1p_1 + s_2p_1}{s} - \frac{s_1}{s} p_1$$
$$= p_1 - \frac{s_1}{s} p_1 = (1 - s_1/s)p_1$$
$$= (s_2/s)p_1. \qquad (5)$$

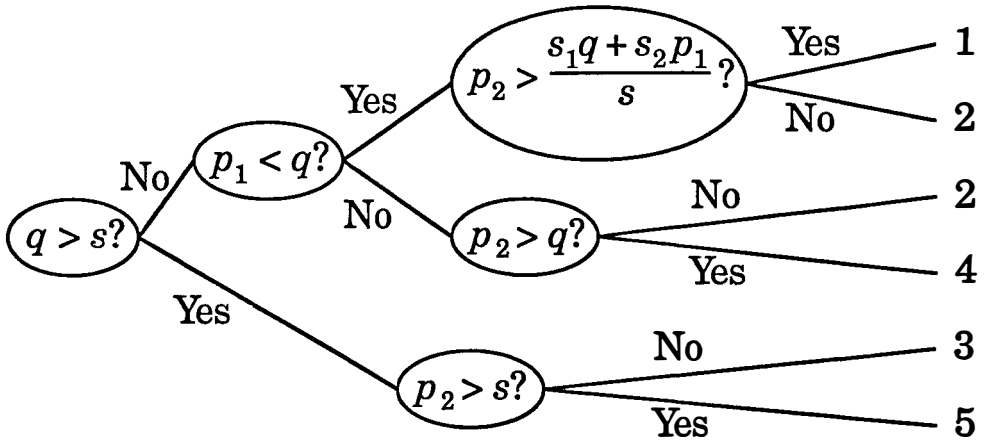
Now suppose group 2 changed *two* to *one* and kept $d_2 = p_1$. This would move group 1 into position I and make group 2's burden $p_2 - (s_1/s)p_1$, which inequality 5 shows would be an increase. Changing *two* to *one* and making $d_2 = q$ would directly produce situation 1 and give group 2 a burden of $p_2 - (s_1/s)q$, which would also be an increase because

$$p_2 - \frac{s_1}{s} q > \frac{s_1q + s_2p_1}{s} - \frac{s_1}{s} q$$
$$= \frac{s_1}{s} q + \frac{s_2}{s} p_1 - \frac{s_1}{s} q = \frac{s_2}{s} p_1.$$

Changing *two* to *one* and making $p_1 < d_2 < q$ would move group 1 into position III and give group 2 a burden of $(s_2/s)d_2$, an obvious increase over $(s_2/s)p_1$. Changing *two* to *one* and changing d_2 in any other way would have the same effects as the corresponding changes of d_2 without changing the word. Thus, every possible pair of signals by group 2 other than $d_2 = p_1$ and the word *two* would increase group 2's burden, making these signals uniquely burden-minimizing. Similar reasoning gives the conclusions of Table 4 for cases 2–5.

Part 5. The initial choice by group 1 anticipates the responses shown in Table

Figure 1. Alternative Representation of Case Definitions in Table 4



4. The relative magnitudes of p_1, p_2, and s can put group 1 into any of the four mutually exclusive states, shown in Table 5, which also shows for each state the choice (q) that group 1 makes and the resulting set of official languages, burdens, and total cost (c).

As in parts 2–4, I shall demonstrate the rationality of the predicted choice for a single example, this one defined by $\{p_2 \leq p_1, p_2 < s\}$. Under these conditions, group 1 is in state A, and Table 5 predicts that group 1's disclosure will be a lie, with $q = p_2$ instead of $q = p_1$. This disclosure puts group 2 into case 2 (in Table 4) and makes group 1's burden $(s_1/s)p_2$. If, instead, group 1 made $q > s$, group 2 would be moved into case 3, and group 1's burden would change to s_1, which would be an increase, since $p_2 < s$. If group 1 made $p_2 < q \leq s$, group 2 would still be in case 2, but group 1's burden would increase to $(s_1/s)q$. Finally, making $q < p_2$ would move group 2 into case 4 and give group 1 a burden of $p_1 - (s_2/s)q$. This would be an increased burden, since

$$p_1 - \frac{s_1}{s} q > p_2 - \frac{s_2}{s} p_2$$

$$= (1 - s_2/s)p_2 = \frac{s_1}{s} p_2.$$

Thus, all of the possible alternatives to the predicted choice would increase the burden on group 1.

Part 6. Through parts 2–5 we know, for any possible set $\{p_1, p_2, s\}$, what choices the groups will make and what policy the language regime will produce. Table 5 shows that the language policy is always efficient and fair. The set of official languages achieves a total cost, c, equal to the smallest of $\{p_1, p_2, s\}$, making the language policy efficient. And in each of the four states the groups' burdens are proportional to their sizes (s_1 and s_2), making the policy fair. The proof is now complete.

At least under some conditions (specifically, when there are two completely informed and deferentially rational groups and two languages) a semiobjective language regime can produce a language policy that is guaranteed to be both efficient and fair. The language regime uses choices by the groups to infer adoption prices and bases its language policy on these inferences.

Table 5. Group 1's Signal in a Two-Language Polity under a Suspicious Own-Price-Soliciting Language Regime

State	q	Case	L	Group 1 Burden $(a_1 + x_1)$	Group 2 Burden $(a_2 + x_2)$	c
A. $\{p_2 \leq p_1, p_2 < s\}$ or $p_1 = p_2 = s$	p_2	2	{1}	$(s_1/s)p_2$	$(s_2/s)p_2$	p_2
B. $s = p_2 < p_1$	p_1	3	{1}	s_1	s_2	p_2
C. $\{p_1 < p_2, p_1 \leq s\}$	p_1	4	{2}	$(s_1/s)p_1$	$(s_2/s)p_1$	p_1
D. $s < p_1, s < p_2\}$	p_1	5	{1,2}	s_1	s_2	s

A semiobjective language regime that achieves efficiency and fairness is valuable because, by assumption, the policy maker can't observe true adoption prices. Superficially, it might seem artificial to deny this information to the policy maker when result 6 assumes the groups know one another's adoption prices. But it would be naive to suppose that mere knowledge of true adoption prices by policy makers would suffice to motivate the adoption of efficient and fair policies. The policy maker may privately know the adoption prices; but because this knowledge is not publicly verifiable, any invocation of any adoption price by the policy maker to justify a language policy could be contested by some group. Conversely, if the policy maker is motivated to benefit some group at some other group's expense and thus knowingly bases the language policy on false adoption prices, no victimized group can demonstrate that the true adoption prices justify a different language policy. My model's assumption of policy maker ignorance, then, can best be interpreted as mistrust in the impartiality of the policy maker. Given this mistrust, I have asked whether rules can be designed that will produce efficient and fair language policies, thereby eliminating the need to rely on the discretion of potentially biased policy makers.

So why not design the simplest possible semiobjective language regime? Why not just ask each group what its adoption price is and trust each group to tell the truth? The answer is that under conditions where a more complex language regime works, such a simple language regime does not work. Although I shall not present the proof here, under the same conditions as defined in result 6, if one simply trusts each group to disclose its own adoption price, the groups are not always truthful, and fairness is not always achieved. Specifically, when the efficient language policy would officialize the native language of group 2 and group 1 is the first one to be asked to disclose its adoption price, it overstates its adoption price (without overstating it so much as to make a different set of official languages appear efficient). Group 2 responds to this lie by telling the truth, because it cannot benefit by lying. The efficient language is officialized; but the taxes are based on the falsely inflated adoption price of group 1, so group 1's per capita burden is smaller than group 2's, making the language policy unfair.

Given this defect in a trusting language regime, one could still rely on it if it were possible to know that the first group to disclose its adoption price is the group with the larger adoption price. In practice, one can plausibly guess that this is true of the larger group. The motivation for this guess is that adoption prices are aggregates of individually incurred costs and are thus proportional to group size, except for any systematic intergroup differences. Further, it seems that minority

members usually learn majority languages more willingly and easily (through exposure) than vice versa, so intergroup differences would tend to support the guess that the larger group's adoption price is larger. In many countries, language groups differ greatly in size. According to Rustow's (1968) compilation the largest native language is at least twice as large as the next-largest in 80% of all countries. Thus, one can hope to inhibit unfairness by soliciting the larger group's disclosure first.

But it is precisely in countries with similarly sized language groups—or with groups whose languages, despite small size, are plausible candidates for official status—where the cost measurement problem is salient and a self-executing rule might be desired. Thus, elegance and practicality both argue for a redesign of the language regime to preserve fairness against false disclosures, without requiring a guess as to the rank order of adoption prices.

As result 6 has shown, an element of suspicion built into the language regime eliminates the advantage that the first-asked group can gain from lying. In effect, it gives group 2 an opportunity to call group 1's bluff when group 1 would otherwise gain an advantage from lying. Knowing that its bluff can be called, group 1 finds it rational not to lie, so its bluff never needs to get called. The SOPS language regime doesn't eliminate all lying but eliminates lying when lying would make the language policy unfair.

The lying that remains under the SOPS language regime actually protects fairness, rather than undermining it. Under this regime, it is rational for group 1 to lie when an efficient language policy would officialize group 1's native language. Group 1 then understates its adoption price. This lie prevents group 2 from gaining an unfair advantage by overstating group 2's adoption price. Group 1's lie keeps group 2 honest. Since language 1 is the one that becomes official, only group 2's (true) disclosure of its adoption price is used in determining the taxes. Therefore, group 1's lie does not mislead the language regime into producing an unfair language policy. A fairness-irrelevant lie by one group induces the other group to disclose a fairness-relevant truth.

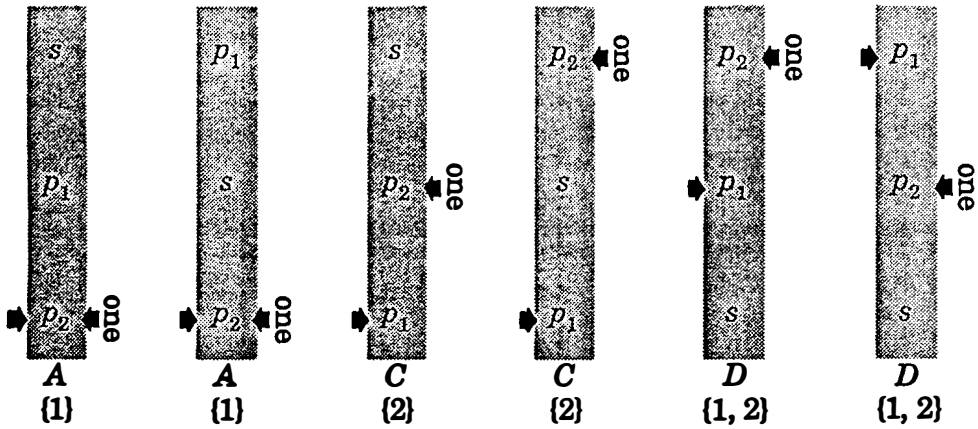
Figure 2 illustrates the groups' responses to the SOPS language regime. Under four out of the six conditions shown, both groups' disclosures are identical to their adoption prices. Under two conditions (in state A), group 1 pretends its adoption price is the same as it knows group 2's to be, so group 2 will have no incentive to pretend its adoption price is larger than it truly is.

Conclusion

My model of a linguistically heterogeneous polity yields reassuring results about the possibility of an efficient and fair language policy. A language policy consisting of a set of official languages and a schedule of taxes on language groups can always be made both efficient (total-cost-minimizing) and fair (individual-burden-equalizing). Furthermore, one can specify a rule that produces a fair (though not efficient) language policy without depending on information about the cost that any choice of official languages would impose on any language group. Finally, if we are willing to let two rational groups give us claims as to the costs they would suffer as a result of official status being denied to their own languages, we can specify a rule that produces an efficient *and* fair language policy. An appropriate revelation procedure can be designed so that any misrepresentation of cost will, rather than preventing an efficient and fair official language policy, actually secure it.

Questions about the robustness of my results are appropriate. One kind of ques-

Figure 2. Signals and Resulting Official Languages in a Two-Language Polity under a Suspicious Own-Price-Soliciting Language Regime



Legend: A = state, {1} = set of official languages, → = group 1 signal, ← = group 2 signals.

Note: p_1, p_2 or s is the true total cost if {2}, {1}, or {1, 2}, respectively, is the set of official languages. The policy maker knows only s. Group i signals a value for p_i. If apparent minimum total costs are tied, the language signaled by group 2 is officialized.

tion is whether the extremity of my assumptions has led to results qualitatively different from those that moderate assumptions would have produced. Most obviously, suppose I had allowed imperfections in the rationality and in the complete information of the language groups. Would result 6 have been fundamentally different? I believe it would have changed only incrementally. Consider state A, as shown in Figure 2. Here, group 1 understates its adoption price, matching the known true adoption price of group 2. Group 2 then truthfully discloses its adoption price. Group 1's language is made official. As a precise empirical prediction, this result is implausible, because of imperfections in information and rationality. If group 1 slightly underestimated group 2's adoption price, group 1 would unknowingly undercut it, and group 2 would then rationally tell the truth and let the language regime make group 2's language the only official language. This could cause group 1 great damage, for its true adoption cost would be p_1 while its compensation would be based on its disclosed price below p_2. What, then, would happen if the model were amended to include reasonable assumptions about uncertainty and miscalculation? Presumably, in state A group 1 would not precisely match its belief about p_2 when it chose a disclosure. Instead, group 1 would allow a margin for error and disclose a price somewhat above p_2, whereupon group 2 would disclose an adoption price between group 1's disclosure and the true p_2. The language regime would still officialize group 1's language. The language policy would still be efficient; and it would be almost fair, only slightly advantaging group 2. Thus, my results appear not unduly sensitive to relaxations in the groups' information and rationality.

Another kind of question is whether I have omitted fundamental aspects of official language politics from this model.

Indeed, I have; and some realistic complications, reflecting known typical features of language politics, deserve inclusion in subsequent models. For example, compensatory differences in tax rates among language groups, used in my model to achieve a fair language policy, would in fact probably lead some native speakers of official languages to attempt to misrepresent their language-group membership. Such misrepresentation has been observed in India, Quebec, and elsewhere; it could be included in a more elaborate model. In addition, official languages, especially when made obligatory media of instruction in schools, can influence intergenerational assimilation. A model that incorporated assimilation would permit one to deal with issues of intergenerational fairness and the value of intergenerational linguistic continuity. Other models could permit defection of groups from the polity or could give citizens a choice whether to learn an official language. The groups could be assumed to have incomplete information about one another's adoption prices. Translation cost could vary depending on the languages. Discounting could be introduced to represent the up-front cost of language learning versus the ongoing cost of translation. New policy norms such as language diversity could be added. Individuals' adoption prices and nonlinguistic policy interests could differ within groups. The official statuses of languages could be permitted to be qualitatively differentiated (e.g., "official," "working") or spatially distributed (e.g., "national," "regional").

While inviting such extensions, I point out that even the present model is complex when compared to those implicit in prior work. The protomodels of official language choice that I have answered here have simply ignored the possibility of nonlinguistic compensation for the inequalities produced by official languages. Theorists addressing the impacts of language policies on population groups have not analyzed the problem of incentives to misrepresent one's costs. Of course, observers of language politics in particular places usually describe trade-offs and deceptions; but we are yet far from making good use of their insights in enriching the general theory of language choice.

Notes

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1. E.g., Andronov 1975; Beer and Jacob 1985; Brass 1974; Coulmas 1985, 113–47; Das Gupta 1970; DeFrancis 1977; Fishman 1986; Haugen 1966; King 1977; Laitin 1977; McRae 1986; Muñiz-Argüelles 1989; Noss 1967; O'Barr and O'Barr 1976; Ostrower 1965; Polomé 1968; Pool 1978; Rabushka and Shepsle 1972; Rubango 1986; Schiffman 1987; Tabory 1980; Tollefson 1986; Weinstein 1990; Whiteley 1974; Wurm 1974; Young 1976, 367–72.

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