Fiscal Revenues and Commitment in Immigration Amnesties☆

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A B S T R A C T

Immigration amnesties aim at reducing the size of the informal sector and identifying employers of undocumented workers. However, potential fiscal gains are also important: tax revenues are crucial in all kinds of amnesties. Nevertheless, over the last thirty years an average of 24% of all applications have been rejected. It remains an open question as to why governments accept this loss of fiscal base. We argue that applying for amnesty is basically self-incrimination, and that immigration-averse governments have an incentive to use applications as a means to identify and expel illegal workers. In equilibrium only applicants with the highest income are granted amnesty, while the poorest immigrants do not apply, and fiscal revenues remain sub-optimal. We show that electoral accountability can solve the commitment problem. However, the large number of rejections suggests that the strict voter-coordination required by this mechanism is hard to obtain in practice. Therefore immigration amnesties seem doomed to inefficiency.

Keywords:
Amnesty
Illegal Immigration
Time Consistency
Incentive Compatibility

1. Introduction

Strict restrictions on legal immigration do not change the inequalities that foster current diasporas. They only drive immigrants into clandestinity and, as a result, masses of irregular workers accumulate in destination countries. These immigrants do not pay income tax, tend to be free riders and fuel the informal economy. Since the ensuing costs grow over time, sooner or later legalization will prove beneficial. Thus authorities increasingly rely on amnesties to legalize irregular workers.[2] Krieger and Minter (2007) show that, especially in Southern Europe, the amnesty is so frequent a phenomenon that it has become the standard practice rather than a sporadic measure (see Table 1).

The need to pull immigrants out of the informal sector and thereby enlarge the tax base is the main reason for announcing an amnesty.[3] We study how efficient amnesties are in these respects. Are they able to make the immigrant come forward? If not, is it possible to improve their efficiency? To what extent are they able to enlarge the tax base?[4] So far, the literature on the subject has

☆ We are grateful to the Editor and the three anonymous referees for their remarks. We acknowledge Antonio Abatemarco for many helpful discussions and observations, and we also thank Gaetano Bloise, Nicola Coniglio and Annamaria Menichini.
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2 Detailed reports on the legalizations occurring over the last 30 years can be found in authors such as Levinson (2005), Krieger and Minter (2007), Baldwin-Edwards and Zampagni (2014).
3 In addition, they are used to raise supplementary funds by charging application fees and other costs, like lump-sum social security payments (see Epstein and Weiss, 2011; Levinson, 2005). Legalizations also provide the authorities with information on the size and the characteristics of the illegal population (Levinson, 2005).
4 Broadly speaking, we contribute to the vast debate on the fiscal consequences of immigration (see Borjas, 1994; Nannestad, 2007; Razin et al., 2002, 2011; Gaston and Rajaguru, 2013).

http://dx.doi.org/10.1016/j.ejpoleco.2015.11.004

Table 1
Approval rates of immigration amnesties.

Country	year	Type of permit	Applicants	Legalized	Approval rate
US	1986	permanent	1.7 million	1.6 million	94%
	1987	permanent	1.3 million	1.1 million	85%
Italy	1995	1 or 2 year	256,000	238,000	93%
	1998	temporary	308,323	193,200	63%
	2002	one year +	700,000	634,728	90%
	2006*	one year +	427,865	259,206	60%
	2009	one year +	295,126	222,182	75%
	2012**	one year +	134,747	84,890	63%
Greece	1998	6 month	370,000	370,000	100%
	1998	1-5 year +	228,000	220,000	96%
	2001	2 year	368,000	228,000	62%
Spain	1985	one year +	44,000	23,000	50%
	1991	3 year	135,395	109,135	80%
	1996	5 year	25,000	21,300	85%
	2000	one year	247,598	153,463	62%
	2005	one year +	691,655	572,961	83%
France	1981	permanent	150,000	130,000	86%
	1997	permanent	150,000	87,000	58%
Portugal	1992	temporary	80,000	38,364	48%
	1996	temporary	35,000	31,000	89%
	2001	1 year	350,000	221,083	63%
Average					**75.5%**

Source: Levinson (2005); Ministero degli Interni, Dipartimento per le Libertà Civili e l'Immigrazione, Rome, Italy; Maas (2006).
Legend: " + " indicates that the permit is renewable. **Provisional data.

proposed various uses to which immigration amnesties can be put, but has not answered these crucial questions. [5] For instance, Karlson and Katz (2003) suggest that illegal immigration followed by a probabilistic amnesty can be used as a tool to select high ability immigrants and get rid of less able ones. Chau (2001) shows that amnesties can be used in an immigration reform in order to incentivize illegal workers to come forward and identify their employers.

Even though all these points deserve attention, in practice the major reason for announcing an amnesty is to enlarge the tax base. It is not difficult to find leading politicians who announce large fiscal benefits from legalizations: in 2005, the Spanish government claimed that the amnesty would boost social security contributions to the tune of 1.5 billion euros,[6] the Italian government was expecting almost 1.6 billion euros from the 2009 amnesty,[7] while in 2013 US president Barack Obama argued that a new immigration amnesty would help to decrease the budget deficit and strengthen the social security system.[8]

However, a look at Table 1 reveals that governments hesitate to legalize all the applicants: data on 21 amnesties over the last 30 years show that the average rejection rate exceeds 24%. Thus, despite the announcement, a large number of candidates are denied legalization. These figures point to a commitment problem. This, in turn, raises two questions: 1) what is the possible source of the commitment problem? 2) what enables governments to default on their announcement?

As regards the former question, we argue that governments cannot commit to legalizing those immigrants who cause net fiscal losses. Immigrants are indeed over-represented among the welfare recipients and the unemployed (Bisin et al., 2011). Thus, even though legalizations have a positive effect on the tax base, they do not necessarily generate a net fiscal gain. In many cases, immigrant minorities do not participate in the labor market and remain unproductive; they exhibit high welfare dependency and impose a fiscal burden on the receiving country (see Azarnert, 2010a, and the references quoted therein). As a consequence, when amnesties entail entitlement to additional welfare benefits they may easily generate net fiscal losses. This is the source of the commitment problem.

Now we turn to the latter question, namely the possibility of governments defaulting on their announcement. In immigration amnesties this issue looks somewhat more subtle than -say- in monetary policy. In fact, once the requirements for legalization are specified, either one meets them, or one does not. These criteria cannot be modified ex post. However, we argue that rejections are made possible by the wide margins of discretion intrinsic to the implementation of the law.[9] In immigration amnesties applicants must show that they meet several eligibility criteria, some of which are are fairly arbitrary and can be manipulated ex post by the authorities.[10]

[5] Perhaps this happens because immigration amnesties look very like tax amnesties. Epstein and Weiss (2011) show that these measures are far from being equivalent. For instance, immigration amnesties do not reveal ways of evading taxes, nor are they useful in targeting potential tax evaders or discouraging applicants from future tax evasion. On the contrary, they encourage further immigration. See Malik and Schwab (1991) and Andreoni (1991) for an analysis of tax amnesties.

[6] See "Spain Stands by Immigrants Amnesty", by Katya Adler, BBC News, 25 May 2005.

[7] This figure was obtained by summing application fees, bureaucratic fees, contributions to social security and income taxes over one year. Source: A. Manganaro "La sanatoria vale subito 450 milioni di euro. Il Ministero dell'Interno si aspetta fino a 750000 istanze di regolarizzazione" Il Sole 24 Ore, 21-08-2009, p.6).

[8] Executive Office of the President (2013): The Economic Benefits of Fixing our Broken Immigration System.

[9] The practice of discretionally implementing the law follows from contractual incompleteness and is known as "prosecutorial discretion". It has existed for hundreds of years in criminal law, but it is employed in all sectors of legislation, including immigration law. In the US, both the Supreme Court and Congress have approved the Department of Homeland Security's authority to decide how the immigration laws should be applied. See Aleinikoff et al. (2011) and Wadhia (2010) for a detailed accout of prosecutorial discretion issues in immigration law.

[10] Levinson (2005) summarizes the main requirements for 23 amnesties in the UK, the US, Spain, Portugal, France, Italy, Belgium, Greece and Luxembourg over the last 30 years. See also Papademetriou et al. (2004); Baldwin-Edwards and Kraler (2009).

Consider, for instance, the requirement to prove continuous presence in the country before a certain date, or the ability to self-support. In practice, officials are free to decide whether to accept the proposed evidence or not, which means that they are ultimately free to deny legalization. However, rejections have worrying consequences for those applicants who receive an expulsion order and face a risk of deportation or job loss.[11] Thus, the uncertainty introduced by discretion has the disastrous effect of breaking the amnesty's credibility.

Our model embodies these features as follows: first, once a stock of illegal immigrants exists, a government can increase the tax base through a general immigration amnesty. However, the amnesty should be as inclusive as possible for the effect on tax revenues to be significant. Then, inasmuch as the marginal tax revenues from the poorest immigrants are negligible, the government has an incentive to expel them after they come forward. We label this behavior "selective time-inconsistency". In the Nash equilibrium the incentive to deviate is rationally anticipated by the immigrants, who apply only if the probability of their legalization in the time-consistent equilibrium is sufficiently high. As a result, many will be rejected, and many will not apply at all.[12] This equilibrium is clearly sub-optimal. We conclude that the commitment problem seriously undermines the success of immigration amnesties. In general, only a minority of the potential recipients have an incentive to apply. In the worst cases, regularization programs can abort and officials are surprised and disappointed at the low turnout. For instance, the Italian government estimated as many as 750,000 regularizations for the 2009 amnesty, but in the end only 295,126 applications were recorded, of which 222,182 were accepted. After this fiasco, the 2012 amnesty performed even worse (see Table 1). Other examples of failed amnesties include the ones announced in Spain in 1985, in Italy in 1986, and in the UK in 1998).[13]

These results underline the possible benefits of a commitment technology. However, implementing the equilibrium under commitment in the case of immigration amnesties is not an easy task. The number of potential applicants changes over time, while governments may go out of office and be replaced by new ones. The repeated game is therefore non-stationary and reputational equilibria are difficult to construct and fragile. Consequently we explore a solution to the commitment problem based on electoral accountability. This approach, though, requires strict coordination on the part of the voters. Unfortunately, legalizations entail sensitive socio-economic issues and their costs and benefits are unevenly distributed among the natives. Thus, we admit that the required coordination is quite unlikely to be forthcoming in practice, and that lack of commitment seems inevitable. Immigration amnesties therefore look doomed to inefficiency.

Finally, since much of the controversy over these policies concerns their incitement to illegal immigration, we extend our model to take into account this effect. We show that our results are qualitatively unaffected, but selective time-inconsistency turns out to be stricter: when immigrants increase after the announcement of an amnesty, the government has an incentive to accept larger groups of richer immigrants and to reject larger groups of poorer ones.

The paper is organised as follows: after the Introduction, Section 2 presents our model, Section 3 discusses the time-consistent equilibrium, Section 4 proposes a commitment technology based on electoral accountability, Section 5 considers the effect of the amnesty on the immigration inflows, and Section 6 summarizes our conclusions. The Appendix A contains the proofs and a comparative statics analysis.

2. The Model

In this Section we present the basic version of our model. In order to preserve simplicity and to better convey the intuition of our results, we defer discussion of two important points -namely the construction of a commitment technology, and the much-debated effect of amnesty on immigration flows- to Sections 4 and 5 respectively.

2.1. The immigrant's problem

Let us consider an exogenously given population of illegal immigrants which is divided up into n groups of workers who earn a real wage $w_i (i = 1, ..., n)$.[14] Wages are ranked so that $w_1 > w_1 > ... w_n$. Each group i includes N_i individuals. We underline the fact that illegal immigrants do not pay income tax, but are subject to the costs of living in clandestinity.[15] We assume that these costs do not depend on personal characteristics, and enter the utility as a fixed cost. Thus, if we normalize to zero the utility of an illegal worker who is detected and deported, we can write the expected utility $E[U_c]$ of a risk-neutral illegal immigrant as follows:

$$E[U_C] = q(w_i - c) + (1-q)b(w_i - c) \quad (i = 1, \dots n) \tag{1}$$

where $q \in (0, 1)$ is the probability of *not* being detected,[16] $b \in [0, 1)$ is the probability of *not* being deported after detection,[17] and $c \in (0, w_n)$ is the cost of clandestinity.

[11] We discuss the consequences of an expulsion decree for the immigrant on page 6.

[12] The focus on dynamic inconsistency distinguishes our analysis from that of Mayr et al. (2011). Haake et al. (2013) consider the control of illegal immigration in a federation as a free rider problem. They propose a revelation mechanism for eliciting the member states' preferences regarding immigration.

[13] See Levinson (2005), and Krieger and Minter (2007).

[14] This real wage reflects a linear technology which uses, for instance, units of human capital as inputs.

[15] Coniglio et al. (2009) formalize the effect of clandestinity as a "skill waste", namely a tax on skills.

[16] Both empirical and theoretical analyses suggest that the value of q is high. See the detailed discussion in Chau (2001) and the references quoted within. See also Hanson and Spilimbergo (2001), and Hillman and Weiss (1999).

[17] We set $0 \leq b < 1$ because, as we discuss in what follows, deportation is not always enforced.

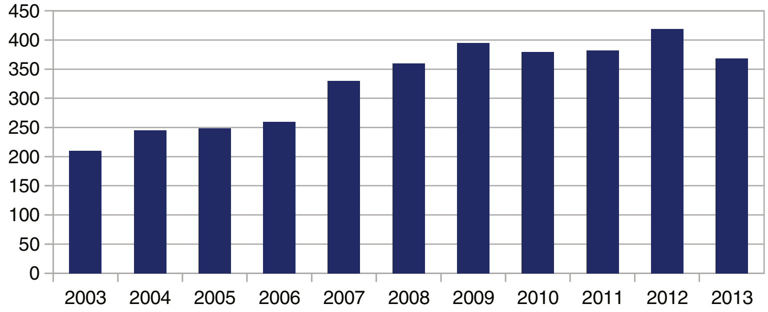

Fig. 1. U.S. Deportations 2003–2013
Source: DHS, Simanski and Snapp (2013)

The cost c in Eq. (1) summarizes different types of cost faced by illegal immigrants. First of all, housing is expensive: renting out a house to undocumented immigrants is punishable in many countries, so either owners demand a premium, or legal migrants abuse their status and sublet to illegal immigrants at higher prices. Second, clandestinity prevents access to many markets and institutions. Financial services, which are crucial to both saving and sending remittances, are often not accessible, and even the most basic deposit accounts can be unattainable. As a consequence, illegal immigrants often rely on informal networks to send cash home and frequently fall prey to loansharks when borrowing. Third, personal mobility is also restricted: an often overlooked penalty for a person's illegal status is that he/she cannot have a driver's license.[18] In addition illegal immigrants, fearful of being identified, have recourse to health assistance only in emergencies. Finally, clandestinity also implies psychic costs, because illegal immigrants live constantly under the threat of arrest and expulsion.

These obstacles do not affect legal immigrants: they are not subject to the cost of clandestinity, but pay a flat tax $0 < t < [(1 - b) + (bc)/w_n]$ on their income.[19] The utility U_L of a legal immigrant is

$$U_L = w_i(1-t). \tag{2}$$

If illegal immigrants were sure of being regularized, the condition to come forward and apply for amnesty would be $U_L \geq E[U_C]$, i.e.[20]

$$w_i(1-t) \geq (w_i-c)(q+b(1-q)). \tag{3}$$

Yet, we know that not all applicants are legalized. Thus, it is crucial to write the utility of a rejected applicant correctly. In order to do so, consider that after he is rejected the immigrant receives an official removal order and must repatriate. If he does not comply, he must be deported. Even though deportation is not always enforced, a removal order creates serious risks for the immigrant. First, the threat of deportation becomes more and more tangible[21]; second, the authorities are supposed to crack down on illegal jobs[22]; third, in order to escape penalties employers could swiftly lay off any immigrant who is under threat of expulsion; fourth, repatriation means that the money spent on crossing the border illegally is totally wasted.[23]

Finally, it must be stressed that, from the theoretical point of view, if just one single applicant is forced to repatriate for any reason, the amnesty's credibility is broken and the threat of deportation becomes effective.

[18] A driver's license can be essential for immigrants working in agriculture and tourism. Access to these licenses has become an important issue in many US states: opponents argue that issuing a license turns an illegal immigrant into a de facto citizen and rewards illegal behavior. However the impossibility of driving entails enormous challenges in finding jobs and earning livelihoods.

[19] The upper bound on t is needed because too high a tax would cancel any incentive to apply for amnesty (see Eqs. (5) and (6) below). Note that the upper bound $(1 - b) + (bc)/w_n$ is smaller than unity since $c < w_n$.

[20] For simplicity we assume that the regularization does not affect w_i. We can depict the effect of the amnesty by introducing a wage $w_i^l > w_i$. In footnote 30, page 10, we briefly argue why this would make the notation heavier without changing our conclusions.

[21] In the US deportations peaked to 419,000 in 2012 (Fig. 1). For the EU the available data report 122,414 deportations in 2008 and 175,797 in 2009. Expulsions from Switzerland and Norway total 5,888 in 2008 and 8,764 in 2009 (Source: European Commission, 2011). In the EU deportations are regulated by Directive 2008/11 of the European Commission. They can be enforced either by the member states or by the Frontex agency. The removal of illegal immigrants in the US is enforced by different agencies of the Department of Homeland Security, namely the US Customs and Border Protection, the US Citizenship and Immigration Services, the US Immigration and Customs Enforcement. The last-named is usually in charge of deportations. For further information on deportations in the US see also "The Great Expulsion: America's Deportation Machine", The Economist, Feb. 6th, 2014.

[22] Papademetriou et al. (2004) and Levinson (2005) confirm that reducing the size of the informal sector is one of the top reasons to legalize.

[23] In most cases crossing the border illegally is quite expensive. (Note that these fees are sunk costs and do not enter c). See Hernandez and Rudolph (2015) for figures on human trafficking in Europe.

These considerations imply that an immigrant whose application is rejected *is worse off than an immigrant who does not apply at all.*[24] As a consequence, immigrants must form expectations on the probability of legalization, and realize that this probability reflects their personal characteristics. In particular, they anticipate that governments will have little incentive to legalize them if their marginal contribution to the fiscal base is negligible. Thus, the individual probability p_i of being regularized will depend on income w_i: the applicant's employment status and his income can be verified.

We can now write the expected utility of applying for amnesty when a share $b \in [0, 1)$ of the rejected applicants are able to keep their jobs even after the expulsion order, while a share $(1 - b)$ must repatriate.

$$E[U_A] = \underbrace{p_i w_i (1-t)}_{regularized} + \underbrace{(1-p_i) b (w_i - c)}_{rejected} \tag{4}$$

The incentive constraint (3) now becomes $E[U_A] \geq E[U_C]$, i.e.

$$p_i w_i (1-t) + (1-p_i) b (w_i - c) \geq (w_i - c)(q + b(1-q)), \tag{5}$$

which yields

$$p_i \geq \overline{p}_i \equiv \frac{q(w_i - c)(1-b)}{w_i(1-t) - b(w_i - c)}. \tag{6}$$

In Eq. (6), $\overline{p}_i$, is the probability that induces the i-group of immigrants to apply. Without loss of generality we assume $\overline{p}_1 \leq 1$. This means that there exists a probability of legalization such that the richest illegal immigrants have an incentive to apply. Since w_1 is the highest wage and since $(\partial \overline{p}_i / \partial w_i) > 0$, this in turn implies that for all groups of immigrants there exists a probability of regularization that will induce them to apply.[25]

Epstein and Weiss (2011) obtain an incentive constraint analogous to Eq. (6) through different reasoning: they argue that authorithies can exploit the amnesty in order to take to court immigrants involved in illegal activities of some sort after they arrive. As a consequence, immigrants trade off the benefits of legalization against the probability of being charged for other violations. This (exogenous) probability generates their incentive constraint. However, in the next Section we determine the probability of legalization as a Nash equilibrium without requiring any violation other than living in clandestinity.[26] The timing of the game is as follows: 1) the government announces an immigration amnesty; 2) immigrants decide whether or not to apply; 3) the government decides whether or not to accept the individual applications. Successful immigrants pay taxes and are regularized; unsuccessful ones receive a removal order, which proves ineffective for a share $b \in (0, 1]$ of them.

2.2. Equilibrium under commitment

Let us consider a government interested in minimizing the population of immigrants and maximizing fiscal revenues. For a given stock of illegal immigrants, the government will face a trade off between increasing the tax base and the costs of legalization. We write the government's objective function as follows:

$$G(p_1, \ldots p_n) = t\sum_{i=1}^{n} w_i p_i L_i - \frac{1}{2}\left[\sum_{i=1}^{n} p_i L_i + b\sum_{i=1}^{n}(1-p_i)L_i + (q - b(1-q))\sum_{i=1}^{n}(N_i - L_i)\right]^2. \tag{7}$$

In Eq. (7), $L_i \leq N_i$ is the immigrants who apply for the amnesty. The term $(t\sum_{i=1}^{n} w_i p_i L_i)$ depicts the fiscal revenues from the amnesty, and the quadratic term in square brackets depicts the cost of the legalization. This cost depends on: the number of legalized immigrants $(\sum_{i=1}^{n} p_i L_i)$; the number of applicants rejected but not deported due to ineffective expulsions $(b\sum_{i=1}^{n}(1-p_i)L_i)$; and the number of immigrants who do not apply for amnesty and stay illegal without being detected and deported $((q - b(1-q))\sum_{i=1}^{n}[N_i - L_i])$.

In our framework all immigrants generate costs: illegal ones free ride and feed the grey economy, whereas legalized ones can increase their consumption of public goods and become entitled to more welfare benefits. In addition, the exponential shape of

[24] The available evidence for immigrants upon whom legal status has not been conferred confirms that they are driven further underground (Cavounidis, 2006; Phillips and Massey, 1999). Interestingly, if re-entering the destination country were easy, the only penalty apart from deportation would be having to search for a new job. Thus both border enforcement and the ability to find a job in the informal economy are relevant to the decision to apply. These remarks imply that the turnout is higher where illegal entry is cheaper and large informal sectors exist.

[25] $\overline{p}_i > 1$ means that there exist some groups of rich illegals who never come forward because for them legalization would be a loss (taxes would be more onerous than the fixed cost). Groups not interested in the amnesty would enter the government's objective function as a fixed term and would only make the algebra more cumbersome.

[26] The fact that infractions committed under clandestinity deter applications is well-known, and amnesties usually provide exoneration for the crimes related to illegal work and residence. For instance, the uncertainty as to the exoneration of such crimes was crucial in deterring applications for the 2009 amnesty in Italy, which ultimately failed (see the reports by Zorzella, 2009; Baldwin-Edwards and Zampagni, 2014). Thus, the argument of Epstein and Weiss (2011) is not relevant in all cases.

the cost term conveniently summarizes not only the economic costs, but also the social tensions and possibly the crime rate that increase rapidly with immigration.[27]

In the equilibrium under commitment, the government maximizes Eq. (7) subject to the immigrants' incentive constraint. This happens because the government is always better off when the incentive constraint holds for any group of immigrants. In order to understand this point intuitively, suppose that the incentive constraint does not hold for some i. In that case, immigrants in group i stay illegal. Those who remain in the underground economy without being detected and deported (namely $N_i(q+(1-q)b)$) only generate costs and do not contribute to the tax base. Instead, if the incentive constraint holds, all immigrants come forward and apply for amnesty. Those who are legalized contribute to the tax base. Those who are not legalized are in part deported. After the amnesty, $N_i(\overline{p}_i+(1-\overline{p}_i)b)$ immigrants of group i are left in the economy, who are fewer than $N_i(q+(1-q)b)$, i.e. the ones left when the incentive constraint does not hold. Thus, the government is unambigously better off when the incentive constraint holds for any i.[28] For this reason, in the equilibrium under commitment we have $L_i = N_i$ for $i = 1 \dots n$, and the term $\sum_{i=1}^{n}(N_i - L_i)$ disappears. Thus, we can rewrite the objective function (7) as

$$G(p_1,\dots p_n) = t\sum_{i=1}^{n} w_i p_i N_i - \frac{1}{2}\left[\sum_{i=1}^{n} p_i N_i + b\sum_{i=1}^{n}(1-p_i)N_i\right]^2. \tag{8}$$

The problem for the government is maximizing Eq. (8) with respect to $(p_1, \dots p_n)$, subject to

$$p_i \in [\overline{p}_i, 1] \ \text{ for any } i. \tag{9}$$

where Eq. (9) is the immigrants' incentive constraint.

We may now proceed to characterize the amnesty under commitment. In the Appendix A, we prove that at most one of the partial derivatives $G_i = \partial G/\partial p_i$ can be zero. Suppose this happens for group $\tilde{\imath}$. In that case, we prove that $G_i > 0$ for any $i < \tilde{\imath}$, and $G_i < 0$ for any $i > \tilde{\imath}$. As a consequence, we observe corner solutions for any $i \neq \tilde{\imath}$. This greatly simplifies the optimization program. We formalize the result in the following Proposition.

Proposition 1. Equilibrium under commitment

Let p_i^* be the equilibrium probability of legalization under commitment. At this equilibrium, there exists a group of immigrants $\tilde{\imath} \in \{1,\dots n\}$ such that each group of immigrants i is assigned the probability of legalization p_i^* as follows: $p_i^* = 1$ for $i < \tilde{\imath}$, $p_i^* = \overline{p}_i$ for $i > \tilde{\imath}$, and $p_i^* \in [\overline{p}_i, 1]$ for $i = \tilde{\imath}$.

Proof. See the Appendix. ■

Since immigrants are ranked with respect to their income w_i, the Proposition can be explained intuitively. The net gain to the government from legalizing a group of immigrants is given by the group's marginal tax contribution minus the marginal cost, as perceived by the government, of legalizing the group. If the richest group produces a strictly positive net gain, the government legalizes it and checks the marginal net gain of legalizing the second richest group. This procedure is iterated and legalization is granted with certainty to all groups that generate a strictly positive marginal net gain. The group $\tilde{\imath}$ that generates zero marginal net gain is legalized with a probability larger or equal to $\overline{p}_{\tilde{\imath}}$.[29] When the marginal net gain from legalizing a group is negative there exists a clear incentive to deny amnesty, but in the equilibrium under commitment the government is subject to constraint (9) and cannot assign a probability of legalization lower than $\overline{p}_i$ for any i. We analyze the optimal deviation for the government in the next Section.

To summarize, under commitment the government legalizes with probability $p_i^* \in [\overline{p}_i, 1]$ all immigrants who generate a non-negative marginal net gain, and legalizes the others with probability $p_i^* = \overline{p}_i$.

Note that two corner solutions are possible. The first one occurs when the marginal net gain from the first (richest) group is negative. In such a case, legalizing any group is a loss[30] and the equilibrium under commitment is $\overline{p}_i$ for all i.

The second corner solution occurs when the marginal net gain from the poorest group is positive. In that case, the marginal net gain from legalizing all groups must be positive[31] and the equilibrium under commitment is simply $p_i^* = 1$ for any i. Interestingly, in this situation the equilibrium under commitment is time-consistent because the government would like to legalize as many immigrants as possible.

However, both corner solutions look very unlikely: the first describes a world in which all illegal immigrants are a burden, the second a world in which all illegal immigrants are a blessing.

In practice, illegal workers are on average poorer than the natives so they tend to be net recipients of welfare benefits. However, there is evidence that net fiscal gains can be positive. For instance, many authors find that the US 1986 Immigration

[27] Piopiunik and Ruhose (2015) and Jaitman and Machin (2013) present contrasting results on the relationship between immigration and crime. Azarnert (2010b) demonstrates that the intensity of the struggle against immigration can be inversely related to the levels of fertility in the host countries.

[28] Note that the condition $N_i\overline{p}_i + (1-\overline{p}_i)b < N_i(q+(1-q)b)$ is a sufficient one, and always holds in the relevant interval of t.

[29] $\tilde{p}_{\tilde{\imath}}$ is obtained by solving $G_{\tilde{\imath}} \geq 0$.

[30] In the proof of prop. 1 we show that if the marginal net gain from group i is negative, then so must it be for groups $i+1, i+2, \dots n$.

[31] In the proof of prop. 1 we show that if the marginal net gain from group i is positive, then so must it be for groups $i-1, i-2, \dots 1$.

Reform and Control Act (IRCA)[32] increased the tax revenues in the medium run.[33] This positive effect on the tax base is mainly driven by the gains in productivity (i. e. higher wages) attainable to legalized immigrants, who are no longer locked in the shadow economy and can take advantage of upward socioeconomic mobility.[34]

Once we have identified the equilibrium under commitment, the next step is to check whether there exists a profitable deviation such that the equilibrium described in Proposition 1 becomes time-inconsistent. It is immediately apparent that there exists an incentive to reject the poorest applicants *ex post*.

2.3. Optimal deviation

The reason for the government's deviation is clear: *ex post*, the government has no incentive to legalize immigrants who generate a negative marginal net gain. Therefore, the poorest immigrants are not granted amnesty.

Proposition 2. Optimal deviation

The optimal deviation for the government is finding a group of immigrants $\check{i} \geq \tilde{i}$ *such that the probabilities of regularization are* $p_i^d = 1$ *for* $i < \check{i}$, $p_i^d = 0$ *for* $i > \check{i}$, *and* $p_i^d \in [0, 1]$.

Proof. See the Appendix. ■

We have explained above why there is an incentive to deviate. Nevertheless, there is a detail we want to point out: since the incentive constraint is irrelevant *ex post*, one would expect that all the immigrants for whom the incentive constraint is binding under commitment would not be granted amnesty in the optimal deviation (i.e. $p_i^d = 0$ for $i > \tilde{i}$). However, things are different: since in the optimal deviation, the government gets rid of the poorest immigrants, the marginal net gain stemming from the richer ones increases, and some groups who were given only the incentive-compatible probability of legalization $\overline{p}_i$ may now achieve regularization with certainty. This is the reason why $\check{i} \geq \tilde{i}$.

3. Time-consistent equilibrium

In a Nash equilibrium, the players have no incentive to deviate. In our game there exist innumerable trivial equilibria. For example, announcing $p_i^* < \overline{p}_i$ for all i is time-consistent, because nobody applies and the government cannot modify the announcement *ex post*. Proposition 2 suggests that the amnesty is credible when legalization is granted only to the immigrants who generate a non-negative net gain to the government. In the following Proposition, we characterize the equilibrium that gives the government the highest gain among all the time-consistent equilibria.

Proposition 3. Optimal time-consistent equilibrium

Let $G_i = \partial G/\partial p_i$ *and let* i^E *be the the largest i such that* $G_{i^E}(1, 1, \ldots p_{i^E}, 0, \ldots 0) \geq 0$. *The optimal time-consistent equilibrium is a vector of probabilities of legalization* $p_1^{**}, p_2^{**}, \ldots p_{i^E}^{**}, \ldots\, p_n^{**}$ *such that* $p_1^{**} = p_2^{**}, = \ldots p_{i^E-1}^{**} = 1; p_{i^E+1}^{**} = p_{i^E+2}^{**} = \ldots p_n^{**} = 0; p_{i^E}^{**} \in [\overline{p}_{i^E}, 1]$.

Proof. See the Appendix ■

Though the Proposition looks very formal, the government still behaves as in Proposition 1. Groups are ranked from the richest to the poorest, and there exists an incentive to legalize only those groups that generate a non-negative marginal net gain to the government. Under the hypothesis that this occurs at least for the richest, the government legalizes the first group, then it proceeds and legalizes all groups that yield a non-negative marginal net gain.

Since in the time-consistent equilibrium, the government is not subject to the immigrants' participation constraint, it will simply deny amnesty to all groups who generate a negative marginal net gain. Regularization for the marginal group i^E can be uncertain because $p_{i^E}^{**} \in [\overline{p}_{i^E}, 1]$.[35] At the equilibrium, incentive compatibility holds for groups $i \leq i^E$ and immigrants in these groups apply.[36] On the other hand, immigrants in groups with $i > i^E$ anticipate that they will not be legalized, thus do not apply and stay

[32] IRCA legalized almost 2.7 millions immigrants in 1986-87 and it is the most studied amnesty ever.

[33] See Steigleder and Sparber (2015) for a recent analysis of the IRCA and a review of the related literature. See also Cobb-Clark and Kossoudji (2000, 2002), Rivera-Batiz (1999), Amuedo-Dorantes et al. (2007), Barcellos (2010), Gang and Yun (2007).

[34] This feature can be easily incorporated into our model by including a wage premium for legalized immigrants. Higher wages from legalization would increase the government's marginal net gain for any group of immigrants. Thus, the number of groups that are legalized with probability $p_i^* \in [\overline{p}_i, 1]$ when legal wages are higher cannot be smaller than the number of groups that are legalized with probability $p_i^* \in [\overline{p}_i, 1]$ when wages are unchanged. This does not alter our results, and we prefer to keep our notation as simple as possible in order to better convey the intuitions of our model. We refer to Casarico et al. (2012) for a model focused on the improved job opportunities available to legalized immigrants. Gains from legalization could also be captured by considering that the cost of clandestinity (including the opportunity costs) is higher for more able immigrants, namely those with higher wages. This would decrease the probability $\overline{p}_i$ especially for the richer groups. In such a case, the amnesty would be particularly attractive for more able immigrants and the applicants would be positively self-selected.

[35] Note that $i^E \leq \tilde{i}$ because in the time-consistent equilibrium the marginal net gain generated by the legalized immigrants is lower than in the optimal deviation. This happens because in the latter case the poorest immigrants apply and are (in part) deported, while in the time-consistent equilibrium they do not apply and stay underground.

[36] This time-consistent equilbrium is indeed a subgame-perfect Nash equilibrium: the announcement takes into account the response of the immigrants to any possible announcement.

illegal. Summarizing, the model suggests that rejections concern immigrants who are neither too rich, nor too poor: the former are legalized with certainty, and the latter do not apply. In practice, observed rejections will concern the poorest group in the self-selected pool of applicants.[37]

This outcome is obviously sub-optimal with respect to the equilibrium under commitment because immigrants in groups with $i > i^E$ stay in the underground economy and generate disutility without contributing to the fiscal base.[38] Thus, with respect to the equilibrium under commitment, in the time-consistent equilibrium the amnesty is unable to make all illegal workers come forward, and fiscal revenues are thereby reduced. Somewhat paradoxically, the lack of commitment harms the poorest immigrants, who would gain most from legalization[39] and would come out even under a low probability of admission were the announcement credible.

In the Appendix A, we prove that the equilibrium outlined in Proposition 3 gives the government the highest attainable payoff among all the time-consistent equilibria. This result is intuitive since these equilibria are trivial. Indeed, any announcement that implies no amnesty at all is credible: for instance, $p_i < \overline{p}_i$ for some i is time-consistent. However setting $p_i < \overline{p}_i$ for $i < i^E$ would cause a loss, because the government's marginal net gain is always positive for $i < i^E$.

The next natural step is explore the existence of a commitment technology able to restore the equilibrium under commitment. Usually this is obtained through reputational mechanisms based on infinitely repeated games, as in Barro and Gordon (1983) or Backus and Driffill (1985). However, introducing such a game into the framework of immigration amnesties looks unreasonable for several reasons. First, the players involved in different amnesties are not identical, because legalized immigrants do not need new amnesties; second, the groups' size changes over time; third, governments go out of office and could be replaced by new ones with possibly different preferences. Under these conditions, it is quite difficult to identify reputational equilibria and, in any case, they would be very fragile. Thus, in the next Section, we adopt an alternative commitment technology and explore the possibility of implementing the equilibrium under commitment through electoral accountability.

4. Electoral accountability and commitment

In this Section, we analyze whether electoral accountability provides us with a feasible commitment technology. Within this framework, inspired by the performance voting models of Barro (1973) and Ferejohn (1986), politicians like being in office ("ego rent") and voters control them by threatening to remove them if they deviate from a specified policy.

Our approach is in the spirit of Aidt and Magris (2006), who develop an infinite-horizon model of capital taxation and political accountability. However, in our case a basic two-period model is sufficient to illustrate the pros and cons of political accountability. Even though finite horizons undermine the possibility of commitment,[40] we know that the electoral discipline enforced by the voters can work as a commitment device when politicians are unable to commit but value reappointment. Thus, electoral accountability can enforce the equilibrium under commitment in a simplified finite horizon framework (see the discussion in Persson and Tabellini, 2000, chapter 4).

In our example, the economy is populated by identical voters who have the same objective function specified in Eq. (7) and the government is made up of one policymaker randomly drawn from the population of voters. In the first period the government takes office in order to implement the amnesty. Each voter announces a rule (the performance standard) indicating, for each amnesty implementation, whether or not he will reappoint the government at the end of the first period. In the second period, if the government is removed another policymaker is drawn from the population. If the government is reappointed, it enjoys the ego rent for another period and then goes out of office. Re-election after the second period is ruled out for the sake of simplicity. This follows constitutional rules that restrict the period of service, as in the US, in France and in Argentina.

4.1. The performance standard

In formal terms, adopting a performance standard means that each voter j provides the government with a vector of probabilities of regularization $p_j^s = (p_{j,1}^s,\dots, p_{j,n}^s)$, and announces a vote function $\theta_j(p^I)$ indicating, for each amnesty implementation $p^I = (p_1^I,\dots, p_n^I)$, whether or not he will support the government.

We restrict our attention to the following vote function:

$$\begin{cases} \theta_j\left(p^I\right) = 1 \quad iff \quad p^I = p_j^s; \\ \theta_j\left(p^I\right) = 0 \quad iff \quad p^I \neq p_j^s. \end{cases} \tag{10}$$

The vote function (10) states that voter j supports the incumbent government if and only if the implemented amnesty coincides with his own performance standard. The government will be re-elected if and only if at least half the standards are satisfied.

[37] Note that the probability $\overline{p}_{i^E}$ is decreasing in c. This happens because c increases the expected returns from legalization, thus in practice we should observe more rejections in countries where c is higher.

[38] The discussion before Proposition 1 on page 9 explains why the government is always better off when all immigrants apply.

[39] The fixed cost of clandestinity is more onerous for the lowest incomes.

[40] For this well-known textbook result see, for instance, Fudenberg and Tirole (1991), chapter 5.

In our benchmark case the voters are identical and adopt the same performance standards, thus we have $p_j^s = p^s$ for all j. This also implies that the vote function $\theta_j(p^I)$ is the same for all j, therefore in what follows we can drop the j index and use a representative voter.

4.2. The government

The government has the sole task of implementing the amnesty for the existing illegal immigrants. Its objective function is the same as that of all the voters (namely Eq. (7)), but, once in office, it enjoys an ego rent $m > 0$. The ego rent is the only difference between a voter and a politician, thus his first-period payoff is simply $(m + G(p_1, \dots p_n))$.

Let now G^K be the voter's payoff in the second period. The policymaker's payoff (thus the payoff in case of re-election) is $(m + G^K)$.

Specifying G^K is quite simple since the government only has to legalize the stock of irregulars residing in the country in period one. As a consequence, G^K is conditioned on the first-period amnesty and can take two values: one corresponding to the implementation of the performance standard in the first period (G^s), and the other corresponding to the deviation from the performance standard (G^d).[41]

We can write the government's expected payoff as

$$E[V] = m + G\left(p^I \middle| p^s\right) + \beta\Big[\underbrace{\theta\left(p^I\right)(m + G^s)}_{reappointment} + \underbrace{\left(1 - \theta\left(p^I\right)\right)G^d}_{removal}\Big]. \tag{11}$$

where $G(p^I|p^s)$ is the payoff of implementing the amnesty p^I for a given performance standard p^s. In case of re-election we have $(p^I = p^s)$, and in case of removal we have $(p^I \neq p^s)$. $\beta \in (0, 1)$ is the intertemporal discount factor of both government and voters.

4.3. The political equilibrium

We define a political equilibrium as a vote function and a policy implementation rule satisfying the following conditions: (i) the government chooses the amnesty that maximizes its payoff given the vote function; (ii) the vote function announced by the representative voter must maximize his payoff given the policy implementation rule of the government.

In order to construct the political equilibrium we consider the government's payoff in case of re-election and in case of removal. Re-election occurs if and only if $p^I = p^s$. In this case, the payoff is

$$V^E = m + G(p^s|p^s) + \beta[m + G^s]. \tag{12}$$

Let now $\hat{p}^d$ be the optimal deviation from a performance standard p^s ($\hat{p}^d$ is defined in the Appendix A). In case of deviation, the government is removed and its payoff is

$$V^{NE} = m + G\left(\hat{p}^d \middle| p^s\right) + \beta G^d. \tag{13}$$

We assume that the government implements the performance standard when V^E weakly dominates V^{NE}, and we identify the critical level of the ego rent m^* that makes $V^E \geq V^{NE}$. This gives

$$m \geq \frac{1}{\beta}\left[G\left(\hat{p}^d \middle| p^s\right) - G(p^s|p^s) + \beta\left(G^d - G^s\right)\right] \equiv m^*(p^s) \tag{14}$$

It follows that the performance standard p^s can be supported as an outcome of a political equilibrium under the domain of inequality (14).

We now define a sustainable performance standard as a vector $p^s = (p_1^s, \dots, p_n^s)$ such that inequality (14) holds. The set of sustainable performance standards associated with m is given by all vectors $p^s = (p_1^s, \dots, p_n^s)$ such that inequality (14) holds. Note that, if $m = 0$, the only sustainable performance standard is the time-consistent equilibrium described in Section 2.3. As m increases, it is possible to sustain a performance standard that departs from the time-consistent equilibrium. In particular, let p^c be the equilibrium under commitment, and suppose that it coincides with the performance standard, namely $p^s = p^c$. Then, the critical level of m that supports the equilibrium under commitment is

$$m^{*c} \equiv \frac{1}{\beta}\left[G\left(\hat{p}^d \middle| p^c\right) - G(p^c|p^c) + \beta\left(G^d - G^s\right)\right]. \tag{15}$$

[41] G^s and G^d also reflect the structure of the immigrant population in the second period.

As m approaches m^{*c}, the set of sustainable performance standards becomes larger, until it includes the equilibrium under commitment. We summarize this result in the following Proposition:

Proposition 4. Electoral accountability and commitment

Electoral accountability can enforce the equilibrium under commitment p^c if and only if the following conditions are satisfied: 1) p^c is the performance standard adopted by the majority; 2) the ego rent of the policymaker is larger than or equal to m^{*c} .

Proof. The proof follows directly from Eq. (14). ■

According to the Proposition, electoral accountability provides us with a commitment technology when the government values re-election and voters can punish it in case of deviation from the equilibrium under commitment.[42] On the part of the government, this requires that the value of the re-election is sufficient to offset its incentive to deviate (see Section 2.3). On the part of the voters, we need them to be able to coordinate not only in announcing the performance standard, but also in removing the non-compliant government. This is not an issue in our example, where voters are identical, but things are quite different under more realistic assumptions. We discuss these points in the next Section.

4.4. Is political accountability implementable?

Accountability requires that politicians value re-election and voters coordinate their strategies. The first requirement is likely to be satisfied: politicians struggle to be re-elected all over the world, and this indicates that they set great store by being reappointed. However, things are different when we look at the voters. In our example, supporting the performance standard is easy because voters are homogeneous. Is it still possible to fulfil such a stringent requirement in a more realistic framework? The answer depends on two issues: 1) the possibility that the threat of removal is effective; 2) the possibility of aggregating a majority on the same performance standard.

With respect to point 1), punishing a government that misbehaves is quite simple, and only requires supporting an alternative candidate at the elections. Nonetheless, since the weight of the individual vote is negligible, if voting is costly for any reason -including opportunity costs- the threat of removal can lack credibility. As regards point 2), things look even worse, because immigration amnesties are always very controversial. First, immigration entails preferences for cultural homogeneity and xenophobic attitudes that vary substantially at the individual level. Second, its costs and benefits are not evenly distributed among the native population. Dropping the simplifying assumption that all voters are identical, and allowing each voter to set a different performance standard, would lead to a very large set of equilibria. This, in turn, would require shaping a theory of equilibrium selection or employing more demanding equilibrium concepts which fall outside the scope of this paper.

In general, when we leave our simple world where the government has a single task and the voters are identical, coordination is problematic and fragile.[43] Even though accountability provides us with a promising avenue for improving the democratic control over elected politicians, voting procedures may easily fail to coordinate heterogeneous voters. These considerations cast serious doubts on the possibility of implementing an efficient immigration amnesty, and contribute to explaining why the rejection rates reported in Table 1 are so high.

5. The announcement effect

In this Section we present a simple extension of our model that takes into account the effect of the amnesty on the inflow of immigrants. The announcement effect is indeed one of the hottest issues in immigration amnesties. The general public and the policymakers are very concerned that amnesties could encourage further illegal immigration. This is one of the main reasons why the debate on immigration amnesties is so heated. In fact, amnesties are often followed by new measures taken to stop illegal entry at the border. In this Section we propose a simple extension of our model that takes this effect into account and shows that our conclusions are qualitatively unaffected.

The simplest way to introduce the announcement effect in our model is by endogenizing the stock of immigrants. We assume that the number of illegal immigrants grows when the amnesty is announced. As a consequence, N_i becomes a continuous function $N_i^E(p_i)$, with $(\partial N_i^E/\partial p_i) > 0$.

To keep it simple we adopt a linear form of $N_i^E(p_i)$, namely

$$N_i^E = N_i(1 + \gamma p_i) \tag{16}$$

[42] It is important to note that immigrants have no voting rights, thus amnesty recipients cannot punish the government in case of deviation from the announcement. However, the natives want to implement the equilibrium under commitment, which Pareto-dominates the time-consistent equilibrium, and remove the government in case of deviation. This, in spite of the discrepancy arising between those who use the vote as a punishment device (the natives) and those who must form expectations about the amnesty (the immigrants), makes the equilibrium under commitment credible to the immigrants too.

[43] See Russo (2011) for a model of voting on immigration policy where heterogeneity in skills and capital endowment invalidates the median voter theorem and requires an alternative equilibrium concept.

where $\gamma > 0$ measures the increase in the stock of immigrants due to the probability of legalization.[44] The *government's objective function* (7) becomes

$$G(p_1,...p_n) = t\sum_{i=1}^{n} w_i p_i L_i - \frac{1}{2}\left[\sum_{i=1}^{n} p_i L_i + b\sum_{i=1}^{n}(1-p_i)L_i + (q-b(1-q))\sum_{i=1}^{n}\underbrace{(N_i^E - L_i)}\right]^2 \tag{17}$$

where the announcement effect works through the underlined term $\sum_{i=1}^{n}(N_i^E - L_i)$.

This extension does not modify our main results. In the Appendix A, we prove that the Nash equilibrium characterized in Proposition 3 is qualitatively unaffected: the government still legalizes with positive probability only the groups that produce a non-negative marginal net gain. The only difference is that the marginal group i^E tends to shift upwards. This happens because the announcement "inflates" all groups. Since the tax base is linear, when the size of a group increases the marginal tax paid by all its members is constant, but their marginal cost increases. As a consequence, in the most propitious case the marginal group i^E stays constant, otherwise it shifts upwards.[45] A large increase in illegal immigration due to the announcement could therefore harm the poorest groups even further.

How important is the announcement effect in practice? Orrenius and Zavodny (2001) address this issue for the IRCA amnesty in the US, which legalized almost 3 million workers in two waves (1986-87). They find that the amnesty did not affect the pattern of illegal immigration to the US, and conjecture that the announcement effect might be secondary because the expected benefits from migrating are huge and the stock of potential immigrants is overwhelming. These considerations suggest that amnesties will not have much effect on the inflow of illegal immigrants.

6. Conclusions

We have developed a model of immigration amnesties that explains a so far overlooked feature, namely why they suffer from a lack of credibility. We then showed that their peculiarities make it quite unlikely that a proper commitment technology will be developed.

However, thanks to the surge in regional conflicts and the persistent wage differentials, the destination countries are facing the greatest migration wave since the Second World War. This is prompting many countries to increase repression, border controls and deportations. In such circumstances, predicting a huge increase in illegal immigration is an easy bet. As a consequence, governments are likely to intensify the use of amnesties in the future.

How will these policies perform in the absence of a commitment technology? High costs of clandestinity foster applications because they reduce the probability of legalization necessary to come forward. On the other hand, a high probability of deportation increases the expected cost of a rejection and promotes clandestinity. Thus, we can expect that amnesties will perform better in countries where the wage premium for the move to the formal sector is substantial. These issues are only marginally explored in the literature, and open interesting avenues for applied research.

Appendix A

Proof of Proposition 1. equilibrium under commitment

Consider the partial derivatives of eq. (8) with respect to p_i:

$$\begin{aligned}
G_1 &= tw_1N_1 - \left[\sum_{i=1}^{n} p_iN_i + b\sum_{i=1}^{n}(1-p_i)N_i\right]N_1(1-b)\\
G_2 &= tw_2N_2 - \left[\sum_{i=1}^{n} p_iN_i + b\sum_{i=1}^{n}(1-p_i)N_i\right]N_2(1-b)\\
&\vdots\\
G_n &= tw_nN_n - \left[\sum_{i=1}^{n} p_iN_i + b\sum_{i=1}^{n}(1-p_i)N_i\right]N_n(1-b)
\end{aligned} \tag{A1}$$

And remember that $w_1 > w_2 > \ldots w_n$.

[44] For simplicity's sake γ is the same for any i. This means that the marginal effect of the announcement is assumed to be homogeneous across all groups. However, since p_i is group-specific the final effect on each group will be *different*. This confirms that our assumption is not restrictive.

[45] See the comparative statics analysis in the Appendix (the effect of N_i).

To prove the Proposition, it is essential to note that at most one derivative G_i can be equal to zero. Suppose for instance $G_1 = 0$ and $G_2 = 0$ simultaneously. Then we have

$$tw_1N_1 - \left[\sum_{i=1}^{n} p_iN_i + b\sum_{i=1}^{n}(1-p_i)N_i\right]N_1(1-b) = 0 \tag{A2}$$

$$tw_2N_2 - \left[\sum_{i=1}^{n} p_iN_i + b\sum_{i=1}^{n}(1-p_i)N_i\right]N_2(1-b) = 0 \tag{A3}$$

Eq. (A2) gives

$$tw_1 = \left[\sum_{i=1}^{n} p_iN_i + b\sum_{i=1}^{n}(1-p_i)N_i\right](1-b)$$

Eq. (A3) gives

$$tw_2 = \left[\sum_{i=1}^{n} p_iN_i + b\sum_{i=1}^{n}(1-p_i)N_i\right](1-b)$$

these two equations imply $w_1 = w_2$ (contradiction).

Now we observe that $G_j = 0$ implies $G_i > 0$ for $i < j$ and $G_i < 0$ for $i > j$

Suppose for example $G_2 = 0$. Then we have

$$tw_2 = \left[\sum_{i=1}^{n} p_iN_i + b\sum_{i=1}^{n}(1-p_i)N_i\right](1-b).$$

By substituting into G_1, we obtain $tw_1N_1 - tw_2N_1 > 0$. By substituting into G_3, we obtain $tw_3N_3 - tw_2N_3 < 0$, and so on.

To grasp how the government finds the optimal p_i^*s, it is useful to begin with the determination of p_n^*, i.e. the probability of legalization given to the poorest immigrants, who produce little fiscal base. If $p_n^* = 1$, it follows that all groups of immigrants must have $p_i = 1$. On the other hand, if the poorest immigrants generate a negative marginal net gain, they can be granted only $\overline{p}_n$. This process is iterated until the government finds a group of immigrants who produce a non decreasing marginal net gain.

Now we show the optimization in detail. Let us consider the derivative G_n evaluated at $(p_1 = p_2 = \ldots p_n = 1)$. If $G_n(1, \ldots 1) \geq 0$, we know that $G_i(1, \ldots 1) > 0$ for any i, and the solution is $(p_1^* = p_2^* = p_n^* = 1)$.

If $G_n(1, \ldots 1) < 0$, we know that p_n^* cannot be smaller than $\overline{p}_n$. Thus we consider $G_n(1, \ldots \overline{p}_n)$.

If $G_n(1, ..\overline{p}_n) < 0$, the solution is $p_n^* = \overline{p}_n$. If $G_n(1, \ldots \overline{p}_n) > 0$ we compute the probability p_n^0 such that the partial derivative G_n evaluated at $(1, 1 \ldots p_n^0)$ is equal to 0. The optimal probability for the nth group will be then $p_n^* = p_n^0$. Once p_n^* is found, we consider $G_{n-1}(1, 1, \ldots p_n^*)$.

If $G_{n-1}(1, 1,..1, p_n^*) \geq 0$ the optimal solution will be $(p_1^* = p_2^* = p_{n-1}^* = 1;\ p_n^*)$ where p_n^* has been found previously.

If $G_{n-1}(1, 1,..1, p_n^*) < 0$ we check $G_{n-1}(1, 1, ..\overline{p}_{n-1}, p_n^*)$.

If $G_{n-1}(1, 1, ..\overline{p}_{n-1}, p_n^*) < 0$ we know that $p_{n-1}^* = \overline{p}_{n-1}$.

If $G_{n-1}(1, 1, ..\overline{p}_{n-1}, p_n^*) > 0$ we compute the probability p_{n-1}^0 such that the partial derivative G_{n-1} evaluated at $(1, 1..\ p_{n-1}^0, p_n^*)$ is equal to 0. The optimal probability for the $(n-1)th$ group will then be $p_{n-1}^* = p_{n-1}^0$. We have now found p_n^* and p_{n-1}^*. We iterate this process until we find the marginal group $\tilde{\imath}$.

Finally we obtain

$$\begin{aligned} &p_i^* = 1 \ \text{ for } \ i < \tilde{i} \\ &p_{\tilde{i}}^* \in [\overline{p}_{\tilde{i}}, 1] \\ &p_i^* = \overline{p}_i \ \text{ for } \ i > \tilde{i}. \end{aligned}$$

Proof of Proposition 2. optimal deviation

The method to prove Proposition 2 reproduces the proof of Proposition 1, but the maximization problem is not subject to the incentive constraint, because immigrants have already applied for the amnesty. As a consequence, when the partial derivative G_i is negative it is now possible to set $p_i^d \leq \overline{p}_i$ or to reject the application $(p_i^d = 0)$.

Consider the derivative G_n evaluated at $(p_1 = p_2 = \ldots p_n = 1)$.

If $G_n(1, 1, \ldots 1) \geq 0$, we know also that $G_i(1, 1, \ldots 1) > 0$ for any $i \neq n$. The solution is $(p_1^d = p_2^d = \ldots p_n^d = 1)$ and $\check{\imath} = n$.

If $G_n(1, 1, \ldots 1) < 0$ we have to consider $G_n(1, 1, \ldots 0)$.

If $G_n(1, 1, \ldots 0) > 0$ we compute p_n^0, i.e. the value of p_n such that $G_n(1, 1, \ldots p_n^0) = 0$ [46]. In this case the solution is ($p_1^d = p_2^d = \ldots p_n - 1^d = 1$; $p_n^d = p_n^0$), and $\check{i} = n$.

If $G_n(1, 1, \ldots 0) < 0$, $p_n^d = 0$ and we iterate the procedure on $G_{n-1}(1, 1, \ldots, 1, 0)$, until we find the marginal group $\check{i}$.

A corollary of this Proposition is that $\check{i} \geq \tilde{i}$. We know that $\tilde{i}$ is the highest i such that $G_{\tilde{i}}(1, 1 \ldots p_{\tilde{i}}^d, \overline{p}_{\tilde{i}+1}, \ldots \overline{p}_n) \geq 0$. When it is possible to deviate, $\check{i}$ is the highest i such that $G_{\check{i}}(1, 1 \ldots p_{\check{i}}^d, 0..0) \geq 0$. Since the marginal net gain G_i generated by the legalization of group i increases as the group $(i + 1)$ is expelled, the marginal group $\check{i}$ in the optimal deviation cannot be lower than $\tilde{i}$.

In other words, when the government deviates it excludes the poorest immigrants from legalization. As a consequence, the marginal net gain of regularizing the richest immigrants is higher, because a share *(1-b)* of all groups $i > \check{i}$ no longer appears in the objective function. Therefore, the marginal group of immigrants cannot be ranked lower than in the equilibrium under commitment.

Proof of Proposition 3. optimal time-consistent equilibrium

In the Nash equilibrium the marginal net gain is given by the partial derivatives G_i

$$\begin{aligned} G_1 &= tw_1L_1 - \left[\sum_{i=1}^n p_iL_i + \ b\sum_{i=1}^n (1-p_i)L_i + (q-b(1-q))\sum_{i=1}^n (N_i-L_i)\right]L_1(1-b) \\ G_2 &= tw_2L_2 - \left[\sum_{i=1}^n p_iL_i + \ b\sum_{i=1}^n (1-p_i)L_i + (q-b(1-q))\sum_{i=1}^n (N_i-L_i)\right]L_2(1-b) \\ &\vdots \\ G_n &= tw_nL_n - \left[\sum_{i=1}^n p_iL_i + \ b\sum_{i=1}^n (1-p_i)L_i + (q-b(1-q))\sum_{i=1}^n (N_i-L_i)\right]L_n(1-b) \end{aligned} \tag{A4}$$

as happens for the proof of Proposition 1, the marginal net gain can be zero at most for a single j, with $G_i > 0$ for $i < j$ and $G_i < 0$ for $i > j$.

In order to find i^E it is sufficient to reproduce the procedure outlined in Proposition 1 and 2.

For $(1, 1\ldots 1, p_{i^E}^{**}, 0, 0\ldots 0)$ to be a Nash equilibrium deviations must not be profitable for the government. This is verified because for any $G_i > 0$ setting $p_i^{**} < 1$ would cause a loss, and for any $G_i < 0$ setting $p_i^{**} > 0$ would also cause a loss. Since $p_{i^E}^{**}$ is found by solving $G_{i^E} \geq 0$, there is no incentive to deviate from $p_{i^E}^{**}$ as well.

It is interesting to remark that $i^E \leq \tilde{i} \leq \check{i}$. We have $i^E \leq \tilde{i}$ because in the time-consistent equilibrium the poorest immigrants do not apply and they reduce the marginal net gain stemming from the richer groups of immigrants.

Proof of Proposition 3. optimality

Consider the time-consistent equilibrium in Proposition. 3, i.e. $(1, 1, \ldots p_{i^E}^{**}, 0, \ldots 0)$ where $p_{i^E}^{**} \in [\overline{p}_{i^E}, 1]$. Note that $p_i > 0$ is not credible for $i > i^E$. It follows that alternative equilibria are vectors of probabilities where $p_i < \overline{p}_i$ for some $i \leq i^E$, because when $p_i < \overline{p}_i$ immigrants do not apply and the government cannot reverse its decision.

Consider now a policy $(1, 1, \ldots p_j^{**}, 1, \ldots 1, p_{i^E}^{**}, 0, \ldots 0)$ with $p_j^{**} < \overline{p}_j$. This policy is time-consistent, but since by construction $G_j(1, 1, \ldots p_j^{**}, 1, \ldots 1, p_{i^E}^{**}, 0, \ldots 0) > 0$, it is dominated by the policy $(1, 1, \ldots 1, p_{i^E}^{**}, 0, \ldots 0)$.

This reasoning holds whenever $p_i^{**} \in [0, \overline{p}_i)$ for an infra-marginal group of immigrants. We conclude that the time-consistent policy outlined in Proposition 3 is dominant.

The optimal deviation in the political equilibrium

Let $p^s = (p_1^s, \ldots, p_n^s)$ be an arbitrary performance standard, and let $p^d = (p_1^d, \ldots, p_n^d)$ be a deviation from it. Note that the equilibrium under commitment takes the form $p_i^* = (1, 1, 1, ..p_{\tilde{i}}^*, \overline{p}_{\tilde{i}+1}, \ldots \overline{p}_n)$, and the optimal deviation from it takes the form $p^d = (1, 1, 1, .., p_{\check{i}}^d, 0, \ldots, 0)$ (see Section 2.3). However, in constructing the optimal deviation from an *arbitrary* performance standard, we must remember that it can take any form, say $p^s = (1, 0, 0, 1, 0 \ldots, 1)$. In other words, an arbitrary p^s may look very different from the equilibria we have studied so far, and identifying the optimal deviation from it requires some work. To this end, let $\Lambda = \{\lambda_1, \ldots, \lambda_m\} \subset \{1, \ldots, n\}$ be the set of all groups of immigrants for whom $p_{\lambda_k} < \overline{p}_{\lambda_k}$ in a performance standard p^s. Since these groups do not apply for amnesty, the government has no incentive to deviate with them. Let now us define the vector $\hat{p}^d = (p_1^d, .., p_{\hat{i}}^d, .., p_n^d)$. This vector contains both elements of Λ and elements out of Λ. The former are such that $p_i^d = p_i^s$ (the government cannot deviate because immigrants in Λ do not apply). The latter are such that $p_i^d = 1$ for $i < \hat{\imath}$, $p_i^d = 0$ for $i > \hat{\imath}$, and $p_{\hat{i}}^d \in [\overline{p}_{\hat{i}}, 1]$, where $\hat{\imath}$ is the largest i such that the marginal net gain $G_{\hat{i}}(p_1^d, .., p_{\hat{i}}^d, .., p_n^d)$ is non-negative. The government cannot be better off by deviating from $\hat{p}^d$: since the marginal net gain G_i is positive for all $i < \hat{\imath}$, granting a probability $p_i^d < 1$ to one of these groups would entail a marginal loss. Likewise,

[46] Note that for any $i \neq n$ the value of p_i^o in the case of the optimal deviation is larger or equal to its value in the equilibrium with commitment, because all arguments p_j^{**} for $j > i$ are now zero.

since the marginal net gain G_i is negative for all $i > \hat{\imath}$, any $p_i^d > 0$ for these groups would reduce the objective function. We conclude that $\hat{p}^d = (p_1^d, .., p_{\hat{i}}^d, .., p_n^d)$ is the optimal deviation.

The announcement effect

We want to prove that the Nash equilibrium can be found with the same procedure used to prove Proposition 3. In order to do so we need to prove that, once again, the marginal net gain can be zero at most for a single j, with $G_i > 0$ for $i < j$ and $G_i < 0$ for $i > j$. When the announcement effect is taken into account the marginal net gain of the government is

$$\begin{aligned} G_1 &= tw_1L_1 - \left[\sum_{i=1}^n p_iL_i + b\sum_{i=1}^n (1-p_i)L_i + Z\sum_{i=1}^n (N_i(1+\gamma p_i)-L_i)\right](L_1(1-b)+\gamma ZN_1)) \\ G_2 &= tw_2L_2 - \left[\sum_{i=1}^n p_iL_i + b\sum_{i=1}^n (1-p_i)L_i + Z\sum_{i=1}^n (N_i(1+\gamma p_i)-L_i)\right](L_2(1-b)+\gamma ZN_2)) \\ &\vdots \\ G_n &= tw_nL_n - \left[\sum_{i=1}^n p_iL_i + b\sum_{i=1}^n (1-p_i)L_i + Z\sum_{i=1}^n (N_i(1+\gamma p_i)-L_i)\right](L_n(1-b)+\gamma ZN_n)) \end{aligned} \tag{A5}$$

where $Z \equiv (q - b(1 - q))$. To proceed we have to assume $N_1 < N_2 < \ldots N_n$, namely that poorer groups are more numerous. This assumption reflects real-world income distributions and is by no means restrictive.

Suppose again $G_1 = 0$ and $G_2 = 0$ simultaneously. This implies

$$\begin{aligned} tw_1L_1 &= \left[\sum_{i=1}^n p_iL_i + b\sum_{i=1}^n (1-p_i)L_i + Z\sum_{i=1}^n (N_i(1+\gamma p_i)-L_i)\right](L_1(1-b)+\gamma ZN_1)) \\ tw_2L_2 &= \left[\sum_{i=1}^n p_iL_i + b\sum_{i=1}^n (1-p_i)L_i + Z\sum_{i=1}^n (N_i(1+\gamma p_i)-L_i)\right](L_2(1-b)+\gamma ZN_2)) \end{aligned} \tag{A6}$$

from the previous equalities we obtain

$$\frac{tw_1L_1}{(L_1(1-b)+\gamma ZN_1)} = \frac{tw_2L_2}{(L_2(1-b)+\gamma ZN_2)}. \tag{A7}$$

We now prove that Eq. (A7) is still contradictory. In fact, $w_1 > w_2$ is equivalent to

$$\frac{tw_1L_1}{L_1(1-b)} > \frac{tw_2L_2}{L_2(1-b)}. \tag{A8}$$

Eq. (A8) can be written

$$\frac{L_1(1-b)}{tw_1L_1} < \frac{L_2(1-b)}{tw_2L_2}$$

by adding γZN_1 to both sides we have

$$\frac{L_1(1-b)+\gamma ZN_1}{tw_1L_1} < \frac{L_2(1-b)+\gamma ZN_1}{tw_2L_2}$$

and by rearranging we obtain

$$\frac{tw_1L_1}{L_1(1-b)+\gamma ZN_1} > \frac{tw_2L_2}{L_2(1-b)+\gamma ZN_1} > \frac{tw_2L_2}{L_2(1-b)+\gamma ZN_2} \tag{A9}$$

that contradicts condition (A7) since $N_2 > N_1$. Thus G_1 and G_2 cannot both be zero.

Consider now what happens when $G_j = 0$. We have

$$\frac{tw_jL_j}{L_j(1-b)+\gamma ZN_j} = \left[\sum_{i=1}^{n} p_iL_i + b\sum_{i=1}^{n}(1-p_i)L_i + Z\sum_{i=1}^{n}(N_i(1+\gamma p_i)-L_i)\right]. \tag{A10}$$

By the same reasoning of Eqs. (A8)-(A9), we obtain

$$\frac{tw_{j+1}L_{j+1}}{L_{j+1}(1-b)+\gamma ZN_{j+1}} < \left[\sum_{i=1}^{n} p_iL_i + b\sum_{i=1}^{n}(1-p_i)L_i + Z\sum_{i=1}^{n}(N_i(1+\gamma p_i)-L_i)\right], \tag{A11}$$

namely

$$G_{j+1} = t_{wj+1}L_{j+1} - \left[\sum_{i=1}^{n} p_iL_i + b\sum_{i=1}^{n}(1-p_i)L_i + Z\sum_{i=1}^{n}(N_i(1+\gamma p_i)-L_i)\right]\left(L_{j+1}(1-b)+\gamma ZN_{j+1}\right) < 0. \tag{A12}$$

By iterating the same procedure we still have $G_i > 0$ for $i < j$ and $G_i < 0$ for $i > j$.

Comparative Statics

The effect of w_i: time-consistent equilibrium

Consider the l^{th} group of immigrants and suppose that w_l increases. This change in w_l may or may not modify the ranking of the w_is. When the ranking is modified, w_l moves to a new position l'. Then, we have either $i^E < l' < l$, or $l' \leq i^E < l$. In the first case the time-consistent policy is unaffected because the marginal group is unchanged. In the second case, the former marginal group shifts one position and there will be a new marginal group $i^{E'} \geq i^E$. When the change in w_l does not modify the ranking of the w_is, the time-consistent equilibrium is affected only if $l = i^E$. In such a case, the wage increase makes it beneficial to legalize more immigrants from group i^E. Thus, the government will increase $p^{**}_{i^E}$ if this probability is smaller than unity.

The effect of w_i: Equilibrium under commitment

Suppose that w_l increases in the equilibrium under commitment. As in the previous case, this wage increase can shift the marginal group of immigrants. When l moves to $l' \leq \tilde{\imath}$, the result is the same as the time-consistent equilibrium, and there will be a new marginal group $\tilde{\imath}' \geq \tilde{\imath}$. However, things are different when $l' > \tilde{\imath}$. To understand what happens, consider the marginal net gain given by the partial derivative

$$G_i = tw_iN_i - \left[\sum_{i}^{n} p_iN_i + b\sum_{i=1}^{n}(1-p_i)N_i\right]N_i(1-b).$$

Since $\partial\overline{p}_i/\partial w_i > 0$, the increase in $\overline{p}_l$ will decrease the marginal net gain produced by *each* group of immigrants through the term $(\sum_i^n p_iN_i + b\sum_{i=1}^n(1-p_i)N_i)$. As a consequence, the marginal net gain $G_{\tilde{\imath}}$ may become negative, and it is not possible to have a new marginal group $\tilde{\imath}'Ni^E$ [47]

The effect of N_i: time-consistent equilibrium

Suppose that there is an increase of N_i for $i = l$ in the time-consistent equilibrium. Then either i^E is unaffected, or it shifts backwards. If $l > i^E$ this happens because the stock of immigrants who stay in clandestinity increases (and reduces the marginal net gain for any i),[48] so the government cannot be better off by legalizing more immigrants. If $l < i^E$ the marginal net gain G_{i^E} cannot be higher, thus the government cannot be better off by legalizing another group of immigrants.

The effect of N_i: equilibrium under commitment

Since an increase in N_i reduces the marginal net gain from all groups, its effect is the same under commitment and in the time-consistent equilibrium: the marginal group $\tilde{\imath}$ cannot shift downwards.[49]

The effect of t: time-consistent equilibrium

Suppose that there is an increase of t. It is immediately clear that $\frac{\partial\overline{p}_i}{\partial t} > 0$. Given our assumption that $\overline{p}_1 \leq 1$, in the time-consistent equilibrium an increase of t matters only if the incentive constraint binds for the marginal group i^E. In fact, $p_i^{**} = 0$ for $i > i^E$ and

[47] Intuitively, a generalized wage growth tends to shift the marginal group of immigrants downwards: suppose that each wi increases by $\delta_i > 0$. Then, G_i increases for any i, and it could be the case that $G_i \geq 0$ for $l > \tilde{\imath}$.

[48] The partial derivative G_i in the time-consistent equilibrium is given by the marginal tax base tw_iL_i and the marginal disutility $[\sum_i^n p_iL_i + b\sum_{i=1}^n(1-p_i)L_i + \sum_{i=1}^n(N_i - L_i)](b(1-q))$ (note that $L_i = 0$ for $i > i^E$).

[49] In the case of a generalized increase of N_i, the partial derivative G_i is reduced for any i, and this tends to shift the marginal group upwards, thus reducing the number of immigrants who are granted amnesty.

$p_i^{**} = 1$ for $i < i^E$. Thus, higher taxes may push the government to increase the number of legalizations when the incentive constraint of the marginal group is binding.

The Effect of t: Equilibrium under commitment

In the equilibrium under commitment $\overline{p}_i$ is binding for any $i > \tilde{\imath}$. After an increase of t, all immigrants in groups $i > \tilde{\imath}$ require a higher probability of admission in order to come forward, thus there will be more legalizations for any i. This affects all the marginal net gains through a positive effect on the fiscal base, and through a negative effect on the stock of immigrants. The net effect is ambiguous, and the marginal group $\tilde{\imath}$ can shift upwards or downwards.

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