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ABSTRACT

In-Goup Cooperation in a Hostile Environment: An Economic Perspective on Some Aspects of Jewish Life in (Pre-Modern) Diaspora*

The demographic history of the Jews in the Middle Ages may be characterized by two main phenomena: i) a sharp drop in the number of Jews until the beginning of the modern period, due mainly to conversions; and, ii) early urbanization. Until now, these features have been analyzed as primarily resulting from persecution and restrictions initiated by the political and religious authorities in the host countries. Economic historians have recently proposed an explanation based on mandatory education in the Jewish tradition (Botticini and Eckstein, 2001). We propose a supplementary explanation based on the incentives to switch affiliation and/or location in a dual environment, where potential gains from in-group cooperation for the Jewish minority may well be offset by losses due to intergroup hostility. Our model generates the two results described above (i.e., a decrease in the total number of Jews, and their concentration in urban areas), without having to rely either on discrimination policies or on investment in human capital, as in previous research.

JEL Classification: D64, J15, J61

Keywords: economic history of the Jews, ethnic minorities, cooperation, altruism, hostility

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1. Introduction

The demographic history of the Jews from the Classical period (Roman Empire) to the early modern period can be characterized by two striking features. First, the size of the Jewish population decreased dramatically, from a maximum of about 4.5 million Jews at the beginning of the Christian era, to just over one million in the aftermath of the Renaissance.[1] Second, the residential and occupational distributions of the Jewish population gradually shifted from rural-based activities (farmers) to urban-based ones (merchants, craftsmen), prefiguring an occupational structure that eventually characterized the general population centuries later. Historians have explained these two facts by appealing to "external" factors such as persecutions, expulsions, and discriminatory taxation of the Jews by the rulers of the places where the Jews lived. On many occasions, indeed, Jewish farmers were either denied the right to possess land or were heavily taxed, and access to a long list of professions was drastically limited for Jews, thus limiting their set of obtainable occupations. Regarding location restrictions, it is well known that Jews were expelled from various countries, and, when tolerated, the Jewish population was often confined to specific residential areas – ghettos, mellahs, shtetls, etc. We denote this explanation the "restriction theory."

As pointed out by Botticini and Eckstein (2001), however, this explanation cannot account for the demographic history of the Jews in places where and when such restrictions were absent, and yet similar occupational and residential patterns were observed. This pertains particularly to the Moslem world, where a large majority of the Jewish population was concentrated throughout the Middle Ages and persecution against the Jews, although not absent, was in no way comparable to that inflicted on the European Jewry at the time. In an attempt to explain such changes, Botticini and Eckstein (2001) offered an alternative explanation based on mandatory education in the Jewish tradition. In this paper we offer a supplementary explanation. The essence of our argument is that when society is segmented between groups and group affiliation matters, the very fact that the minority is smaller than the majority may modify the incentive structure faced by individuals in their intragroup dealings, although majority and minority

[1] See Table 1.

members are identical in all respects but group affiliation. Specifically, under certain conditions, the members of the minority may cooperate in their intragroup transactions, while the members of the majority do not. As a result, minority members may benefit from trade more than majority members, and this may, in turn, lead to intergroup hostility that offsets some or all of the gains from in-group cooperation. Based on these benefits and costs, some individual members may find it beneficial to migrate to the city or convert, as we detail below. Thus, in our explanation, it is neither discrimination policies nor differences in education patterns that cause the demographic changes; rather, such changes occur as a result of individual decisions to switch affiliation (to convert) and/or location (to migrate) until individuals' utilities are equalized for each possible choice.

The rest of this paper is organized as follows. In Section 2, we present the various aspects of the demographic history of the Jews we are trying to explain. We also briefly review the current economic literature on the subject, which mainly focuses on the "restriction theory", and summarize Botticini and Eckstein's (2001) theoretical argument based on mandatory education. In Section 3 we build on Rapoport and Weiss (2001 and 2002) to propose a model of endogenous changes in group affiliation and location, where intragroup cooperation and intergroup hostility play a key role. The model is then applied to the issue of Jewish economic life in the Diaspora in Section 4, and generates the two results described above without having to rely either on discrimination policies or on investment in human capital, as in previous research. A brief discussion of the predictions of our model and how these contrast with the other theories is presented in Section 5. Section 6 offers concluding remarks.

2. Background

2.1. Historical evidence

The most striking feature of the pre-modern demographic history of the Jews is the sharp decline in their number during the first millennium of the Jewish Diaspora, that is, roughly, between the 2nd and the 12th centuries A.D. As indicated above, during that period, the total number of Jews decreased dramatically, from approximately 4.5 million

to approximately 1 million.[2] At the same time, the geographic distribution of the Jews also evolved considerably. Following the demise of the Roman Empire, the Christianization of Europe, the repression of Jews in the Byzantine empire, and the Arab expansion, Jews became increasingly concentrated in the Arab-Moslem world during the last centuries of the first millennium C.E. As early as the eight century, more than 90% of the Jewish population was living under Moslem rule.

Using various first and second-hand historical sources, Botticini and Eckstein (2001) summarized what is known about the size and distribution of the Jewish population over that period, part of which we reproduce here as Table 1. The precise numbers are disputable, but the general tendency is clear: while the Jewish population grew rapidly during the last centuries B.C.E. and the first centuries C.E., mainly through conversions to Judaism, the opposite movement was then observed at the end of the classical era and throughout the Middle Ages.

Table 1: Distribution of the Jewish Population (in million)

Region / Period	**Biblical 1000 BCE**	**Classical 1st Century**	**2nd Century**	**6-7th Century**	**Late 12th Century**	**Late 15th Century**
Palestine	1.8	2	1	0.2	0.002	Few
Mesopotamia, Persia		1	1	Many	0.768	Many
North Africa		1	0.5	Some	0.07	Many
Syria, Asia minor		0.2	0.6		0.048	Many
Europe*		0.3 (31)	0.4 (44)	Few (22)	0.156 (49)	0.596 (67)
TOTAL	**1.8**	**4.5**	**3.5**	**1-1.5**	**1.2**	**1.3**

* Terms between brackets denote total European Population (territory of the former USSR excluded).
Sources: Botticini and Eckstein (2001), Table 1, for the Jewish population, and Crouzet (2001, p. 11) for the European population.

[2] As Cecil Roth (1950) acknowledged, "No problem in Jewish history in the Dark and the Middle Ages is more difficult of solution than that of determining with any degree of certainty the number and distribution of the Jewish population at any given time". It should be noted that 4.5 million is not the maximal estimation for the Jewish population at the beginning of the Christian era. For example, Huxley and Haddon (1936) estimated the Jewish population at 4 to 7 million in the Roman Empire alone (about 7% of its population), and Salo Baron (1937) estimated it at 8 million worldwide. See Della Pergola (2002) for a discussion on the numbers.

At the beginning of the Christian era, the Jews were mainly farmers, with only a minority living in cities. This was true not only in Palestine, but also elsewhere in the Middle East, in places such as Egypt, Syria, Persia, and most of all Babylon, where Jewish presence dated back to the first exile in the 8th Century B.C.E. Following the two revolts against Rome in 70 and 135 C.E and the ensuing second exile, many Jews dispersed themselves, voluntarily or not, throughout the Roman Empire and beyond, and settled in urban centers as traders, craftsmen, merchants, moneylenders, etc. For those who migrated to Europe and permanently settled there, the set of occupational and residential possibilities was very limited. The reasons for this are complex. They include institutional factors such as the regime of land ownership rights (and the social statuses attached to it) as well as the quasi-absence of early Jewish rural settlements on the northern shores of the Mediterranean. For those who arrived in Western Europe later, access to agriculture became almost impossible due to the institutional transition towards Feudalism.[3]

The picture for what eventually became the Moslem world is somewhat different. As mentioned above, a Jewish Diaspora had developed in Egypt and in most parts of Mesopotamia long before the Greek and Roman rules over these regions. At the time of the second exile, there were already important Jewish communities established in the main cities, which consequently developed further with the arrival of new waves of Jewish immigrants.[4] However, the majority of the Jews were still making their living from agriculture and lived in rural areas, and this was still the case a couple of centuries later, on the eve of the rise of Islam. From Babylon to northern Africa, a large number of Jewish rural communities were established; some originated from the biblical era, others resulted from the early conversion to Judaism of whole villages, and some were of more recent origin were the result of the later arrivals of new expatriates from the Jewish homeland. For example, Moshe Gil (1992) documents the rural and agricultural

[3] "The Christian feudal patterns that had come to predominate in Europe prevented Jews … from settling on the land" (Ben-Sasson, 1976: 388).

[4] For example, the Jews represented nearly two-fifths of the population of Alexandria in the 2nd Century C.E.

settlement of the Jews in the Arabic Peninsula, which clearly indicates that the Jews indeed tried hard to establish themselves as farmers even under adverse geographical conditions, and succeeded in doing so: "while agricultural pursuits were far from being the province of Arab tribes, the Jews were the farmers *par excellence* in the northern part of the Arabian peninsula, cultivating the land and the oases" (Gil, 1992: 11). These settlements, whose existence is known to us mainly through the Koran, survived until the Hegira and eventually became the first military targets for the Arab expansion. Large Jewish agricultural communities also existed throughout Mesopotamia, as documented, for example, by Ben-Sasson (1976), and in northern Africa, where most Jewish villages resulted from the conversion to Judaism of their native Berber occupants.

We now jump forward a couple of centuries, to the turn of the millennium. At that time, not only had the number of Jews declined sharply, but, also, the Jews were almost totally concentrated in urban areas. This evolution is the opposite of what we observe over the same period for the general population, especially in Europe. For the Jewish population as a whole, the decline in total numbers was accompanied by a gradual concentration within the cities, whereas for the European population, whose size was halved between the 2nd and 7th centuries and then slowly increased until the Black Death of the 14th century, the decline in the economic and demographic importance of cities was continuous until relatively late in the Middle Ages. Whereas the Middle Ages may be seen as times of rurality for the general European population, even for its religious and political elites, in Jewish history, "they were the urban epoch *par excellence*" (Ben-Sasson, 1976: 388).

This demographic evolution of European Jewry would seem to have occurred for obvious reasons: the initial numbers were small, and rural life had never been one of the original distinctive features of European Jews. In the few places where there was an embryo of Jewish rural life, religious restrictions and persecution brought it to a quick end. An interesting case of prolonged Jewish agricultural life within the boundaries of Christendom is provided by the fate of the Jewish population of Byzantine Palestine. While the rural population of Palestine (including Jews, Greeks, Samaritans, and Christians of local origin) remained diverse during most of the Byzantine rule, the end of the period was characterized by increased persecution against the Jews, culminating in

the early 7th century under the reign of Heraclius. The Jewish population then shrunk dramatically as a result of slaughter, forced conversion and emigration; it is only under the more tolerant Moslem rule that the Jewish population started to prosper again, fuelled by return migration from the Diaspora. However, in spite of the fact that some Jewish villages had survived the Byzantine persecutions and the Jews were free to choose their occupations, [5] only a minority opted for agriculture and a majority settled in the cities alongside the Arab masters. Consequently, even after four centuries of Arab domination and relative freedom for the Jews to settle on the land, "the rural population [of Palestine], in the main, was still Christian on the eve of the Crusaders' conquest" (Gil, 1992: 171).

Almost at the same period but on the other edge of the Mediterranean, the same process seems to have developed in Spain. The early Jewish presence there was almost eradicated by the harsh persecution initiated by the Visigoth Kings after they converted to Christianity. Thousands of Jews were forced to adopt the new faith, and remained discriminated against until the Arab conquer of Spain in 711. From then on, the Jewish community prospered in the cities of the Iberian Peninsula, including in the northern cities that were the first to pass under Christian rule again;[6] it is only after the complete Reconquista of Spain and the start of the Inquisition that the picture darkened again for the Jews.

In terms of magnitude and impact on the total numbers, however, the event with the most significant effect on the demographic evolution of the Jewish population occurred in Mesopotamia during the first two centuries of the Arab domination (7th and 8th centuries C.E.). Indeed, this period is characterized by the massive and rapid

[5] This is witnessed, for example, by Gil (1992, p. 225), who indicates that for Palestine "through the Geniza documents, we know that the non-Moslem population maintained the right to own land during all the generations from the time of the conquest until the eleventh century".

[6] This is testified to by many Arabic as well as Christian sources. For example, "from Al-Idrisi, the recently recovered Al-Himyari and other writers, we learn that Granada … had long been called by the Moslems *Igranatat-al-Yahud* (Jewish Granada), not only because of its very large Jewish population, but also because of the Jews' apparently uncontroverted claim to having founded the city … Even in northern Spain, which has long reverted to Christian rule, Al-Idrisi calls Tarragona a *medinat al-Yahud* (Jewish city) … Al-Himyari informs us that Barcelona, the very center of Spanish Christendorm before the reconquest of Toledo in 1085, has 'as many Jews as Christians'. This numerical equality naturally changed in favor of the Christian population during the later periods" (Baron, 1942).

transformation of the rural Jewish population of Mesopotamia into an urban component of the cities of the Caliphate, where the Jews gradually participated in the whole range of possible urban activities. Most of them chose to be self-employed in retail and wholesale trade, and in a wide variety of craftwork activities (silversmith, goldsmith, tanning, silk, glassware, pottery, etc.). According to Ben-Sasson (1976: 388), this process was so quick that "as early as the eight century, agriculture no longer provided a livelihood for most Jews in the Middle East". His explanation is as follows:

> "The new rulers, who were mostly former nomads from the arid lands of Arabia, ruined the agriculture of Babylonia by taxing according to area instead of yield, and by neglecting the irrigation network during the early days of the conquest. The results were impoverishment and the abandonment of villages and rural areas. Furthermore, the *kharaj* (poll-tax) levied on 'infidel' peasants weighed heavily on Jewish farmers. By the end of the eight century, the Jewish population and its economic structure … had become urbanized" (Ben-Sasson, 1976: 393).

Most scholars agree that the Jewish migration to the cities of the Moslem world occurred relatively early, well before the turn of the millennium (Baron, 1937, 1942 and 1975, Deutsch, 1945, Ben-Sasson, 1976, Gil, 1992). Although the attraction exerted by the cities is also acknowledged, the central element in their explanation is the discriminative treatment of Jews with respect to taxation in general, and to taxation of agricultural activities in particular.[7] For the case of European Jewry, the dominant explanation is similar in nature, but differs greatly in degree: the specific taxation that existed in the Moslem world would seem to correspond to the minimal discriminative treatment inflicted on Jews in the European countryside. However, more often than not, Jews were simply denied the right to possess land, or could not profitably do so because of other restrictions (for example, Jews were denied the right to possess slaves in Rome shortly after Christianity became the official religion). All this undoubtedly precluded the Jewish population from remaining in agriculture and deeply affected its demographic

[7] As is apparent from the citation above, Ben-Sasson (1976) also mentions a short-term shock due to the lack of experience in agricultural (and administrative) matters of the new rulers.

structure. Similarly, persecutions, forced conversions and expulsions are generally the main factors proposed for explaining the decrease in the absolute size of the Jewish population. As discussed above, however, over the period covered, the vast majority of Jews (90%) were located in the Moslem world, for which such an explanation is at best incomplete. Even for the Christian countries, it is clear that expulsions, in and of themselves, cannot explain the sharp decrease in the total number of Jews, since their effect is to displace the population but not to reduce its global size.

Other elements frequently mentioned by historians to account for the demographic history of the Jews, either in the Moslem or the Christian world, include the changing attitudes of the Gentiles towards the Jews, and the changes initiated within the Rabbinic circles themselves on issues such as relations to the Gentiles, proselytism, and obligations imposed on current and prospective members of Jewish communities.[8] For example, Ben-Sasson (1976: 386) noted that: "in many lands and in many periods the Jews suffered hostility and humiliation under Moslem rule as well, though to a lesser extreme than in the Christian realms". Baron (1937, 1975) also emphasized that the growing hostility towards the Jews both in Palestine and Persia made them abandon sparse settlements in the countryside in favor of safer urban locations. Also, because of the disorganization of international trade with the end of the Roman rule around the Mediterranean and the general economic decline throughout the medieval period, new urban-based economic opportunities for close-knit communities (such as the Jewish Diasporas) arose, giving them a comparative advantage in international trade and other economic activities characterized by pervasive information imperfections (Greif, 1989, 1993). These two last factors (outside hostility combined with inside gains from cooperation) play a key role in the theory detailed in Section 3 below. Before we turn to that, however, we first review the existing economic approaches to the demographic evolutions just described.

2.2. Economic approaches

[8] See Iannaccone (1992) for an economic rationale for such obligations based on club theory.

From an economic perspective, persecutions of various types, including expulsions, occupational restrictions, discrimination, physical violence, etc., must be regarded as a (sometimes prohibitive) cost imposed on remaining a Jew, and may indeed explain a large fraction of the conversions to Christianity and Islam. To put this differently, one may see persecutions as determinants of the incentive structure faced by individuals when making their decisions in terms of group affiliation, education, occupation, and residential location. Note moreover that these decisions were largely interdependent during the period under consideration.

Standard human capital theory (e.g., Levhari and Weiss, 1974, Brenner and Kiefer, 1981) suggests that members of discriminated-against minorities tend to be relatively highly educated, mobile, and/or self-employed if this provides them with the means of avoiding discrimination. For example, discrimination against minorities has often taken the form of physical expulsion, implying that minorities will tend to invest in mobile assets (human capital) rather than physical assets (land, real estate, factories). As noted by Brenner and Kiefer (1981: 518), "a discriminated-against group which has had physical capital confiscated in the past might tend to take the probability of confiscation of an asset into consideration when making an investment. Further, a group which had been compelled to emigrate from a country might take the portability of an asset into consideration when making an investment in a new country, especially if it continues to face discrimination." Similarly, labor market discrimination may cause minority members to gravitate toward self-employment, which is often associated with higher levels of education (as is the case for merchants, traders, physicians, moneylenders, and others). This "persecution" or "restriction" theory may therefore help explain why Jews were relatively highly educated compared to the rest of the population, highly mobile, and concentrated in the urban areas where educational skills are best rewarded and opportunities for the self-employed are numerous.

To quote Botticini and Eckstein (2001, p. 3), "restrictions on the occupations that Jews were allowed to practice may explain their occupational choice for the later Middle Ages, the early modern and modern era in Europe when these prohibitions were enacted … [but] … cannot explain the occupational choice of Jews in the classical period (in Babylon and in the Roman Empire) and during the Arab expansion in the seventh and

eight centuries when they were free to choose any occupation." In other words, they feel that the explanations given above do not provide a satisfactory explanation for the changes in the size and structure of the Jewish community in areas where and at times when persecution and restrictions were absent.

Because of these limitations of the existing theories, Botticini and Eckstein (2001) proposed a theory based on mandatory education in the Jewish tradition (since the Talmudic period), i.e. on the obligation imposed on each Jew to educate his children. This obligation can be discharged through hiring a teacher, but even then the parents' duty is to remain involved with the teaching. As Carlton and Weiss (2001) explain, this edict increases the education level of both the parents and the children, since the parents who must teach their children must first learn the material, and "(a)s every teacher knows, the best way to learn material is to be required to teach it." So great is the importance placed on teaching children, that Rabbi Yehoshua Ben Gamla (Bava Batra 21a) around the first century B.C.E. instituted education supported by a community tax for all children over the age of 6 or 7. The Talmud tells us that but for the decree by Yehoshua Ben Gamla Torah would have been forgotten from Israel. From this point on, it was decreed that in every town with at least 25 Jewish children, the community is obligated to appoint a teacher (see, for example, the discussion in Shulchan Aruch, 245). In fact, as Carlton and Weiss (2001) surmise, the centrality of educating the young is the reason that free competition was allowed under all circumstances in Torah education, while restrictions on competition existed in almost all other walks of life. Or, as the Talmud states, "jealousy among scholars increases wisdom" (Bava Batra 21a).

This education factor is well recognized in the Jewish history literature. For example, Cecil Roth noted that "to provide and support public instruction … was … recognized as the sacred obligation of the Jewish community, ranking higher in importance than even the maintenance of institutions of divine worship".[9] The Law whereby education is made mandatory has, of course, far-reaching implications. Botticini and Eckstein (2001) try to capture these implications in their model. They suggest that each individual in his adulthood must decide whether to provide his children with education, and whether to migrate to the city and choose an urban occupation (merchant,

[9] C. Roth, *The Jewish Contribution to Civilization*, New York: 1940. Quoted by Deutsch (1945), p. 247.

craftsman) or remain settled in the countryside and work in agriculture as a farmer. Being educated is a necessary condition for being employed in the city, while education is of no value in agriculture. Thus, having educated children increases the familial income in urban activities but not in rural activities. However, as stated above, Jewish Law requires that each Jew provide his children with a given minimal threshold of education, which is mandatory even if they (father and child) work in agriculture. This mean that each Jew is endowed with a minimal level of education financed by his parents. Also, each Jew has the possibility to convert to the dominant religion, thereby avoiding the costs associated with remaining a Jew, including financing his children's education. They then assume that the Jewish population was distributed according to the intensity of its attachment to Judaism, i.e. some were more spiritually attached than others. This level of attachment is interpreted as a discount factor they applied to a dollar of income earned as a non-Jew, with those more strongly connected discounting this income by more. Since education is costly and there is a positive wage differential between urban and rural wages, the incentive structure is such that, ceteris paribus, many Jews will migrate to the city, with many of those remaining in the rural areas converting to Christianity or Islam.

3. The model

As will become apparent from Section 4, the framework we develop in this section generates similar predictions to those in Botticini and Eckstein (2001) with respect to total population and occupational patterns, but with a focus on intragroup cooperation and intergroup hostility. Additional predictions are derived, which allow the formulation of specific testable implications.

In our model, the negative and positive aspects of belonging to a minority are linked in a way that illustrates the common wisdom according to which success by a minority often comes at a price. More precisely, we are interested in showing how a minority group, the Jews in our case, i) may be relatively successful because of its relatively small size, which allows its members to achieve cooperation in their internal dealings, ii) may be affected by potential hostility by a majority precisely because of this relative success, and iii) may see its members rationally choose either to assimilate to the

dominant group and remain in the rural areas or move to urban areas, or settle in cities so as to preserve the quality of their intragroup interactions.

We define hostility as the behavioral implication of envy, i.e., the readiness to sacrifice part of one's wealth in order to inflict pain on others. The envious individual is such that his/her utility is increased when the envied person's income (or wealth, or welfare) is decreased, that is, formally, when $\partial U_i / \partial U_j < 0, i \neq j$ (Becker, 1974). This definition is extremely general and includes various possible types of envy: malice, rancor, resentment, etc. To use a distinction introduced by Rawls (1971), while a rancorous individual is a person who has a distaste for the income of others, the resentful individual has such a distaste (and may thus become hostile) only in given circumstances – when he/she is less successful than someone with similar personal skills and market attributes (the relative deprivation hypothesis).

In our model, two central assumptions are made. First, we accept the theory that it is the resentment type of envy that is the basis for hostile behavior. This interpretation of envy and hostility is strongly supported by evidence from different fields, mainly from the psychology of intergroup relations (Austin and Worchel, 1986), experimental psychology (Grant and Brown, 1995), the sociology of ethnic conflicts (Horowitz, 1985; Gurr, 1993; Williams, 1994), and experimental economics (Falk and Fischbacher, 2001). Second, we do not address the issue of organized hostility, as developed, for example, in Carlton (1995), because we assume hostility to take place in interpersonal relations rather than through collective action initiated by the leadership of the majority.

With these understandings, consider a population of fixed size, bifurcated into two groups: *G* members of a (*G*entile) majority and *J* members of a (*J*ewish) minority. The proportion of the minority in the population is $\pi_J = J/(G+J)$. By definition, $J<G$. Assume that all individuals engage in an identical number of economic transactions per period. Each individual is randomly matched with other players for each transaction, so that a proportion π_i of the transactions consummated by an individual belonging to group i, $i=G,J$ are carried out within the group to which she belongs.[10] Exchanges take

[10] While there would seem to be some justification for assuming that the individual would choose to transact relatively more with people of his own group, we assume randomness for two reasons. First, there is the opposing effect that people in the same group may have similar comparative advantages and thus be

place without recognition costs, i.e., when a transaction is entered into, the individual immediately knows the group affiliation of her trading partner. Each transaction can be carried out through a market mechanism, denoted a non-cooperative interaction, or via a cooperative agreement between the sides. The feasible outcomes portray a non-cooperative one-shot Prisoner's Dilemma game. The payoff matrix for the row player is as presented in Table 1, with $A>B>C>D$ and $2B>A+D$. B is the cooperative, non-market based result, and C is the payoff from interacting via the market.

Table 1: The payoff to the row player for each transaction

	Cooperation	No Cooperation
Cooperation	B	D
No Cooperation	A	C

Without loss of generality, we assume that $D = 0$, and, temporarily, that $C = 1$. A is the gain an individual receives by deviating from a cooperative agreement. This is an increasing function of the size of the *relevant* group (the size of the group as viewed by the individual for *that specific transaction*, as detailed below). This is due to the alleviation of social sanctions when agents get more anonymous, or, in other words, to the increasing incentives to free ride in larger groups. For simplicity, we assume that the ability to free ride depends on the *relative* size of the group in question, so that, for instance the size of the minority is measured by π_J instead of by J.

We now make the following assumption:

Assumption 1: *When an individual in group i, i=J,G, transacts with an individual in the same group, she views the size of the relevant group as* π_i *, but when she deals with someone from the other group, she views the size of the relevant group as the entire population.*

This assumption highlights the fact that only when dealing with someone from the same group is free riding relatively costly (i.e., the payoff from defecting is relatively

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employed in similar occupations. In this case, intragroup trade would be relatively marginal. Second, introducing a bias towards relatively more (or less) intragroup trading would not change the essence of the results.

low), while the cost of free riding is brought to a minimum when dealing with someone from another group.

With these understandings, we conclude that the payoff A is expressed as a function of the relative size of the relevant group. Assuming a linear form, $A_{ij} = B(1+\pi_{ij}), i, j=J,G$, where $\pi_{ij} \equiv \pi_i$ for intragroup transactions, and $\pi_{ij} = 1$ for intergroup transactions. Table 1 can now be rewritten as follows:

Table 2: The payoff matrix for the row player

	C	NC
C	B	0
NC	$B(1+\pi_{ij})$	1

Agents are assumed to be altruistic towards people in their group. More precisely, the individual's utility when dealing with a member of his group is a weighted average of the monetary payoffs of both trading partners, with a weight of $(1-\alpha)$ placed on her own payment, and a weight of α placed on the payment to the other party. As a result of this specification, the payoff table needs to be modified only for intragroup transactions and only in those cells in which players play different actions, i.e., in the off-diagonal cells. We make the ancillary assumption that α <1/3 for analytical convenience (and, in addition it is quite realistic), since, as a result, we rule out the possibility of intragroup cooperation within the majority (as distinct from Rapoport and Weiss, 2002).

We now present the two payoff matrices for intragroup and intergroup transactions in Table 3. Note in Table 3a that for the majority, since they comprise at least 50 percent of the population, and α <1/3, cooperation cannot be an equilibrium.[11] In addition, note from Table 3b that for intergroup transactions, cooperation is also not attainable. Hence, we are left with only the minority group in which there may be cooperation under some circumstances.

[11] Since $(1-\alpha)B(1+\pi) > B \quad \forall(\alpha < 1/3) \cap (\pi > 1/2)$.

Table 3a: The intragroup payoff matrix for the row player with altruism

	C	NC
C	B	$\alpha B(1+\pi_i)$
NC	$(1-\alpha)B(1+\pi_i)$	1

Table 3b: The intergroup payoff matrix for the row player with altruism

	C	NC
C	B	0
NC	2B	1

Finally, we include the hostility externality. The externality shows up as a lessening of the payoff received through a market intergroup transaction, and is expressed through the function $h(\pi_i, B)$, $i = G, J$, with $h'_{\pi_i} > 0$, $h''_{\pi_i} > 0$, $h'_B > 0$, $h''_B > 0$, and $h(0, B) = h(\pi_i, 1) = 0$.[12] This function expresses the idea that an increase in the size of the cooperating group or the benefits its members receive through cooperative agreements leads to a more than proportional increase in the amount of hostility towards that group. The assumption that $h(\pi_i, 1) = 0$ says that in the absence of any *gain* for the minority (B=1), there is no hostility externality, even if there is cooperation. This again highlights the fact that we are discussing hostility caused by the minority's relative success through cooperative efforts, rather than hostility caused by differences in labor market attributes or by non-economic factors.[13]

Since we consider only the "resentment" type of envy and not the "rancor" type of envy, we make the following assumption:

Assumption 2: *An individual is envious of the other group's members if and only if these cooperate in their intragroup dealings while the group to which he or she belongs does not.*

For this to hold true, the hostility externality must kick-in only when one group cooperates and the other does not. We define a dummy variable d_{ij} that equals unity when group j cooperates but group i does not, and zero otherwise. We thus arrive at the final matrix, which

[12] An example of such a function is $h(\pi, B) = [(B-1)\pi]^2$.

[13] For hostility caused by "diversity" and ethnocentrism (i.e., affirmation of identity), see Catton and Hong (1962), who address the following question: "What does ethnocentrism cost, though? If ethnocentrism is functional in promoting social control within the group, is it dysfunctional in relations between groups?" (p. 178) and suggest a positive answer based of their experiments.

refers to intergroup transactions. Note that due to the presence of the hostility externality, the payoffs are no longer symmetric, so we present the entire matrix:[14]

Table 3c: The intergroup payoff matrix in the presence of potential hostility

	C	NC
C	B,B	0,2B
NC	2B,0	$1-d_{ij}h(\pi_i,B)$,1

We add the assumption that $h(\pi_i,B)<1\ \forall \pi_i,B$, so that the market payoff for minority members cannot be negative. Again, this is not a restrictive assumption, since the party upon whom the hostility is inflicted will choose not to interact if this condition does not hold. As can be seen from the Table, cooperation cannot be attained, and the equilibrium payoff from intergroup transactions for the members of the group upon whom the hostility is being inflicted will be given by $1-d_{ij}h(\pi_i,B)$.

Recall that we assumed that $\alpha<1/3$, so there is never cooperation within the majority. We now address the possibility of cooperation within the minority. We assume that when the Pareto superior cooperative outcome is also a Nash equilibrium, cooperation is chosen.[15] In addition, because of the free-rider effect, no individual minority member takes into account the effect of her cooperation in intragroup transactions on the hostility externality. Thus, cooperation will be observed within the minority (see Table 3a) if the payoff when cooperating is higher than the payoff when defecting, i.e. if $B>(1-\alpha)B(1+\pi_J)$. A sufficient condition for cooperation to be a possible (but not unique) equilibrium in transactions within the minority is therefore:

[14] The payoff to the group potentially inflicting the hostility on the other group in the event of a non-cooperative outcome is assumed, for simplicity, to remain equal to 1 in all instances. This differs from the treatment in Rapoport and Weiss (2001), where this payoff is also affected by hostility in two opposing manners. On the one hand, the cooperation within the other group has lowered her utility, and hence sparked a reaction. On the other hand, the damage she has imposed on the other party has increased her utility (for if not, she would not have imposed it). In our setting, details regarding this value are not of consequence.

[15] For sufficiently high levels of altruism, interactions no longer exhibit a Prisoners' Dilemma structure. The possibility of multiple equilibria is ignored; we simply assume the existence of coordination procedures if necessary.

$$\alpha > \frac{\pi_J}{1+\pi_J} \equiv \alpha_J^{\min} . \quad (1)$$

From here it is easy to see that the altruistic threshold required for cooperation to prevail in intragroup transactions is an (less than proportionally) increasing function of the relative size of that group.

Assuming the level of altruism is sufficient to lead to cooperation within the minority, we now examine the effect on income. A minority member's income is a weighted average of the income from cooperative intragroup trades (B from Table 3a) and the income from non-cooperative intergroup trades (1- $h(\pi, B)$ from Table 3c). The average income thus equals

$$I = \pi_J B + (1-\pi_J)(1-h(\pi_J, B)).^{16} \quad (2)$$

Figure 1 illustrates how this average income changes with an increase in the minority size, with the exact shape of the curve depending on the hostility function chosen and on the value of B. Note that the conditions on h guarantee that $\partial I/\partial \pi_J > 0$ when $\pi_J \to 0$, so that the income earned by minority members in the relevant range rises initially (until the minority reaches a size we denote by $\hat{\pi}_J$), and then decreases and becomes lower than unity for a sufficiently large group size (denoted by $\tilde{\pi}_J$, with $1/2 > \tilde{\pi}_J > \hat{\pi}_J > 0$).

[Figure 1 about here]

4. Application to Jewish communities and equilibrium

Beginning from a situation where all Jews were located in rural areas (for clarity), we show how the presence of the hostility externality will lead some Jews to convert to the majority religion (be it Christianity or Islam) in which case their location becomes irrelevant, and others to migrate to urban areas.

Consider an initial situation where there is one urban area with a population of U and a number of villages, with a population of R in each village, and $U>R$.[17] Assume that among the R rural inhabitants of a given village are J Jews ($R>2J$ so that the Jews are in the minority), while there are no Jews among the urbanites. In order to specify which Jews convert, we

[16] Note that the dummy variable no longer appears since it equals 1 when the minority does not cooperate and the majority does.

[17] It is implicit that the total rural population is greater than the urban population (i.e., with n villages, $nR>U$), but this is not central to our argument).

assume that the Jews are uniformly distributed along a scale from 0 to 1, measuring the strength of the individual's link to the religion (as in Botticini and Eckstein, 2001). Thus, those lowest on the scale are the ones most likely to convert. Denoting this scale by ρ, this link manifests itself in how the individual values the income he receives if he converts. Given that the income to a majority member is always 1, a convert with link level ρ will view his income as being 1-ρ.

The income of the rural Jews in the first period, I_0 is given by Equation 2, with $\pi_J=J/R$. We assume that this income is below 1. The possibility of conversion and urbanization is now opened, and Jews in urban areas are assumed to face the same payoff functions as those in rural areas. The resulting new equilibrium will be such that Jews in rural and urban areas will receive the same payoffs. If this payoff is still less than 1, then there will also be some Jews who will convert. Equilibrium will be attained when the incomes of the rural and urban Jews are the same, and this income will also equal the income of the marginal convert. All pre-marginal converts will earn a higher wage. Denote by J_R, J_U and J_C the equilibrium number of rural Jews, urban Jews and converts, respectively. The incomes of the rural Jews, the urban Jews, and the marginal converts, will be, respectively:[18]

$$I_R = \frac{J_R}{R-J_U}B + \left(1-\frac{J_R}{R-J_U}\right)\left(1-h\left(\frac{J_R}{R-J_U},B\right)\right);$$

$$I_U = \frac{J_U}{U+J_U}B + \left(1-\frac{J_U}{U+J_U}\right)\left(1-h\left(\frac{J_U}{U+J_U},B\right)\right); \text{ and}$$

$$I_C = 1-\frac{J_C}{J}.$$

In equilibrium, $I_R=I_U=I_C$.

The equilibrium is depicted in Figure 2. The horizontal axis measures the number of Jews, with the entire population of J Jews being equal to the distance between the two vertical axes. The Jews are organized along this axis according to the strength of their link to Judaism (ρ), with the link getting weaker as one moves to the right. The number of converts will be measured from the right vertical axis, with those most likely to convert having the highest perceived income. The perceived income of the marginal potential convert is thus depicted by the diagonal line from an income of 1 with no conversions to the origin (an income of 0) with everyone converting. The number of individuals remaining in the rural area is measured from

[18] We have assumed that the converts remain in the rural areas, which is in keeping with the evidence. Changing this assumption will not alter the qualitative results, but will lead to slightly more urbanization.

the left vertical axis, with the number of people increasing as one moves to the right, and the number of people moving to cities begins at the right axis, with their number growing as one moves left. The incomes in each of these areas are shown by the I_R and I_U curves. Note that because of the larger population in the urban area, the I_U curve is more spread out.

[Figure 2 about here]

As stated above, the equilibrium is such that the incomes are equal in the rural and urban areas, and also equal to the income of the marginal convert. To find this equilibrium, we must find an income level for which the total number of people adds up to *J*. This is accomplished when the segment marked A equals that marked B. This segment depicts the total number of converts. As seen in the figure, in equilibrium there will be far more Jews in urban areas than in rural areas because of the larger population.

The continuation is inevitable. As the rural communities start to shrink, amenities necessary to support a Jewish life become sparse, and eventually disappear. Thus, for instance, the community becomes unable to support a Rabbi, and at some point even of retaining organized education. As stated above, the rabbinic decree that each community must finance a teacher for children is only applicable if the population warrants it – i.e., if there are at least 25 children of the proper age range in the area. Once this fails, the obligation to teach Torah falls, once again, on the parents, and the time cost to learn the material and teach the children may become prohibitive. At this point, as in Botticini and Eckstein (2001), the parents who cannot manage either convert, thus removing the necessity of providing an education to the children, or move to the cities where these amenities can be found, and where education is more valuable. Once the population in the rural areas continues to fall even a Minyan (quorum for prayers) becomes unavailable, and even those without small children have no choice but to follow their fellow Jews into the cities. Thus, our model can be seen as explaining the start of the process, with the Botticini and Eckstein model being crucial for the continuation.

5. Discussion

While we do not portend to even attempt to give a complete classification of the reasons for Jewish demographic changes throughout history, there are reasons to believe that the explanation presented in this paper is of relevance for some places and periods, and, therefore,

a useful complement to the alternative approaches. For one thing, many of the demographic changes occurred at the beginning of the period considered, while restrictive policies (expulsions, official discrimination, etc.), which could be labeled as "organized hostility", occurred mostly after the 11th century, well after the decline in the size of the Jewish population and while it was already totally urbanized. To quote Baron (1942: 40-41), indeed:

> "One must … bear in mind that, despite the tremendous bloodshed from 1096-1391, we can find no instance of governmentally-instigated pogroms ... As soon as a medieval country was converted into a 'national' state … it began to resent deeply the presence of the only 'alien' minority in its midst. … The growth of religious intolerance … as a rule first manifested itself in undisciplined mob reactions, was then followed by severe anti-Jewish legislation and, finally, culminated in complete exclusion" (Baron, 1942: 40-41).

Furthermore, the Jews were frequently actually protected by the national and/or local rulers, through charters and laws that recognized their economic activity and freedom of religion. However, in many such instances, hostility seems to have developed, and been inflicted, along lines similar to those we suggested. For example, in the case of Western Europe circa 1000, Ben-Sasson notes that:

> "The attitudes of the rulers, who were concerned with public order and to whom the economic and social function of the Jews was important, certainly differed from those of the masses, who were animated by a simplistic Christian zealotry as well as by local animosity towards small groups of successful and wealthy 'infidel' merchants and financier" (Ben-Sasson, 1976: 410).

The same author reports similar evidence of hostility directed against relatively small and successful Jewish communities in Moslem countries as well:

> " Moslems often reacted furiously to the elevation of 'degraded' ones, …, as happened in the Granada riots of 1066, when the whole congregation was killed" (Ben-Sasson, 1976: 405).

Note that the fact that the decline and urbanization of the Jewish population occurred before discrimination became directed from above also lends support to the education theory proposed by Botticini and Eckstein (2001). However, there are some important differences in the predictions of the two models. A first distinction between our model and Botticini and

Eckstein's model is a behavioral distinction: their model predicts that conversions should occur solely in rural areas, while those in urban areas have no particular reason not to remain Jews. By contrast, in our model, there is no distinction – both urban and rural Jews have an incentive to convert. A second important difference is that our approach predicts that the size of the Jewish community will be a function of the degree of hostility, which is in part endogenous (since it depends on income differentials) and in part exogenous and affected by external factors such as religious antagonism. Since we know that religious antagonism was much greater among the Christians than among the Moslems, the implication of our model is that the decrease in the size of the Jewish communities should be greater within the realms of Christianity. We believe these predictions to be in keeping with historical developments. Moreover, taken in conjunction with the traditional approach, the explanation we offer has the advantage of being universal rather than relying on a specific cultural trait. As such, it could also be applied to other ethnic or religious minorities such as the Parsees in India, the Copts in Egypt, the Nestorians in Central Asia, or the Armenian orthodox believers outside of Armenia, groups that have also been the subject of various degrees of hostility, and have displayed residential and occupational patterns similar to those of the Jews.

6. Conclusions

In this paper, we addressed the issue of the demographic history of the Jews from the second exile to the late Middle Ages, that is, roughly, during the first millennium of the Jewish Diaspora. Although the exact number of Jews at various periods and times may be disputable, there seems to be a consensus that there was a sharp decline in the Jewish population over time (at least for the period considered) and early urbanization and specialization in non-agricultural occupations. From an economic perspective, these trends may be seen as resulting from discrimination and persecution initiated by local authorities (the traditional "restriction theory"), as being induced by the Rabbinic obligation imposed on each Jew to educate his children (Botticini and Eckstein, 2001), or as being driven by the incentives for minority members to switch affiliation and/or location when gains from in-group cooperation are balanced with the costs incurred in contacts with a hostile majority, as we advocated here. We believe that these different explanations are complementary rather than exclusive. Since each offers some specific testable implications, a careful examination of the historical evidence for given regions and periods is the ultimate way to further discriminate between them.

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Figure 1

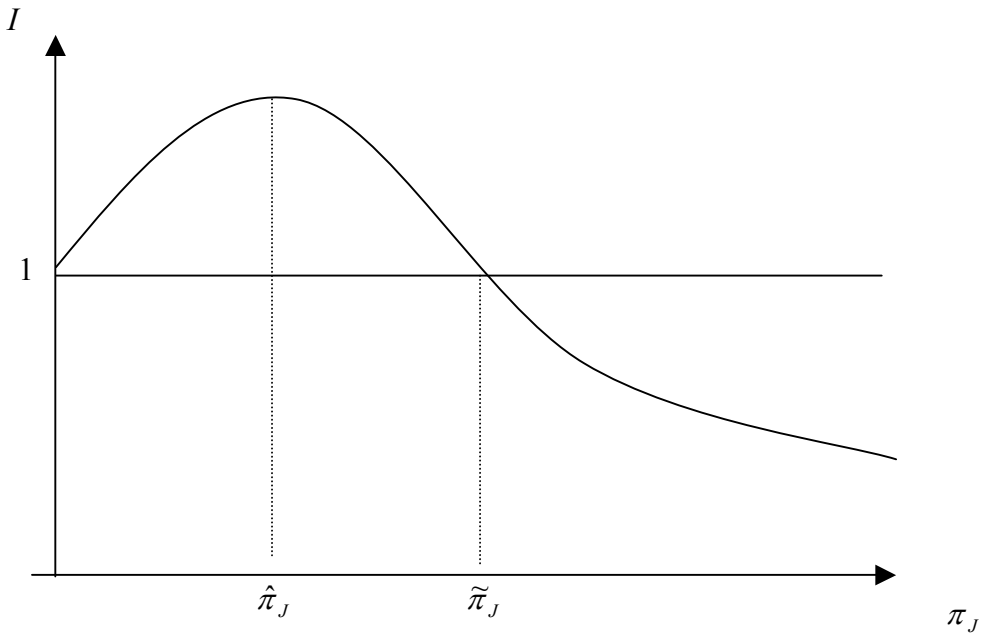
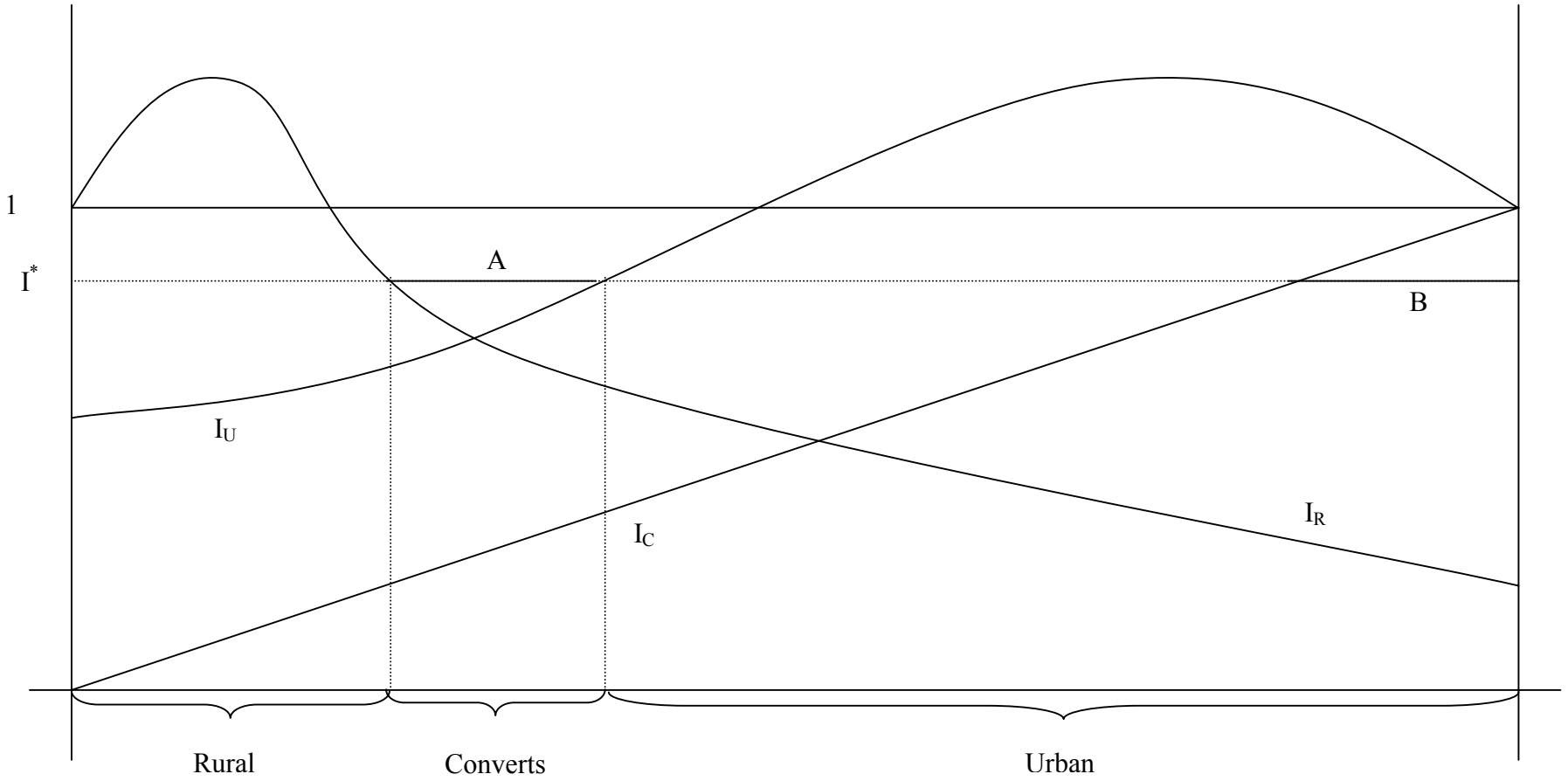


Figure 2



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