Anonymous market and group ties in international trade

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Abstract

History provides many examples of cohesive groups dispersed over several countries who exploit the ties between their members to gain entry into foreign markets. The phenomenon is well-established empirically and noteworthy because it suggests the importance of informational barriers in international transactions. We present a simple model where output is produced through a joint venture, and agents have complete information domestically but are unable to judge the quality of their match abroad. A minority of individuals, otherwise identical to all others, can exploit complete information in international matches between group members, if they so choose. Group ties increase aggregate trade and income, but hurt the anonymous market because they deprive it disproportionately of the group's more productive members.   © 2002 Elsevier Science B.V. All rights reserved.

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1. Introduction

From the Middle Ages to present days, ethnic groups that are geographically dispersed but cohesive have repeatedly achieved economic prominence. Often but not always as consequence of a diaspora, the members of the group find

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themselves a minority in their host countries, but succeed in exploiting the ties that connect them to other group members abroad, establishing an international network of information and economic ventures. Highly personalized and informal, the ties allow the members of the group to react very quickly to business opportunities developing in any of the countries in which the group has a presence. The group's international success results in economic power in the host countries disproportionate to its minority status and, together with its cultural and often linguistic and religious separation from the majority, breeds resentment and hostility.

The Overseas Chinese, descendants of the Chinese who left the Mainland in the last century and established themselves in the countries surrounding the South China Sea, provide the best-known contemporary example (Lim and Gosling, 1983). Their 'Confucian-capitalism' has been heralded as a model of effective managerial practices in a world of international economic integration (e.g., Redding, 1990). The freedom from the constraints of formal and at times unwieldy procedures, and the ability to spread information within the group rapidly and reliably are identified as the two main clues to their success: ''Chinese entrepreneurs remain in essence arbitrageurs, their widespread dispersion a critical means of identifying prime business opportunities'' (Kotkin, 1992, p. 169). Other groups function in a similar manner, and with similar success. Citing Kotkin again: ''most of Hong Kong's Indian businesses — from the tiny two-man operation to the giant conglomerate — fit the classical mold, with extended families providing the linkages between various national markets'' (p. 219). These modern examples have many historical precursors. Braudel describes the networks of merchants in Europe from the late Middle Ages to the 18th century, the Armenians, the Jews, the Dutch, the Italians: ''The Italian merchant who arrived empty-handed in Lyons needed only a table and a sheet of paper to start work[. . .] [T]his was because he could find on the spot his natural associates and informants, fellow-countrymen who would vouch for him and who were in touch with all the other commercial centres in Europe'' (Braudel, 1982, p. 167).[1] In the recent economic literature, Greif's analyses of cooperation and trust among Maghribi traders in the 11th century are well-known (Greif, 1993, 1994).

Given the success of this mode of operation, it is not surprising to find attempts at replicating it. Consider the role played in international transactions by business groups. Business groups are ''sets of firms that are integrated neither completely nor barely at all'' (Granovetter, 1995), and where the lineages of the members can often be traced back to a founding family or a small number of allied families. Typical mechanisms serving to integrate the firms include mutual stockholdings and frequent meetings of top executives.[2] Recent research (e.g., Belderbos and

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[1]Herlihy (1979–80) provides a detailed and engrossing description of Greek merchants in Odessa in the 19th century, and of the particular fortunes of the Ralli and the Rodocanachi families.

[2]Business groups are common throughout Asia, continental Europe, and Latin America, but are rare to non-existent in Great Britain and the US.

Sleuwaegen, 1998; Dobson and Chia, 1997) has found that business groups that have expanded outside their mother countries play a role similar to coethnic ties in facilitating international transactions, with member firms operating abroad trading intermediate goods (in particular) preferentially with domestic group members. The best documented cases are of Japanese *keiretsu* operating in the United States, Europe and Southeast Asia.

Although these privileged ties are empirically important and well-documented, so far economists have not studied them in formal models of international trade. This paper suggests a first step in such a direction. In particular, we are interested in the interaction between a group whose members have access to preferential information and the rest of the market, where anonymous traders meet and establish economic ventures without full knowledge of their partner's productivity or reliability. We analyze the aggregate volume of trade, the use of ties versus the anonymous market by group members, the value of the ties to the overall economy and to the group, and the consequences of the ties for non-members.

As the examples described above indicate, it is difficult to distinguish whether the ties between group members function primarily as channels of information about potential business deals and business partners, or as channels of trust, overcoming the uncertainties of enforcement in international contracts. Both aspects appear very important. Connections to local agents facilitate entry into foreign unfamiliar markets by providing 'insider knowledge': especially in the case of trade in differentiated products, they permit to verify that local demand for the exported good exists and to target the appropriate market niche; they give access to the correct distribution channels and at times supply the expertise necessary to overcome local bureaucratic hurdles. Chin et al. (1996, p. 498) give an example of how these business contacts worked to promote Korean wig exports to the United States:

> Korean wig importers' contribution to the Korean wig export business was far greater than their numbers. From these immigrant wig importers, South Korea wig manufacturers could obtain information on new styles and market trends. Since [. . .] prominent US hair designers continuously developed innovative styles, South Korea wig manufacturers had to depend entirely on Korean immigrant importers for information on trends in US wig fashion.[3]

At the same time, uncertainty over legal requirements and enforcement across

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[3]Wigs were one of the major items in Korea's initial drive to break into world markets for manufactures in the 1960s and early 1970s (they were her third largest export in 1970, accounting for 11.2% of total exports). More generally, Gould (1994) finds that immigration to the United States increases US bilateral trade with the immigrants' countries of origin and that this 'immigrant-link effect' is stronger for US exports than for US imports, indicating that the effect works primarily through the establishment of business contacts rather than through increased US preferences for goods produced in the country of origin.

national borders remains high, and efforts to shield transactions from such uncertainty add a lot to the complexity and length of international negotiations. Rodrik (2000a) identifies uncertainty in contract enforcement as the main cause of transaction costs in international exchanges, and thus the main culprit of reduced volumes of trade.[4] Indeed all descriptions of coethnic networks emphasize their informality and the importance of personal trust. For example:

> Trusting relationship played a particular role in supporting pre-1949 Chinese merchants, who were developing freedom from Mandarin or official control, and were entering into risky ventures. The trustworthy included kinsmen, people from their old villages in China, clansmen, friends, guild members and those in the same dialect group [. . .] The emphasis on trust lives on today as Chinese family businesses expand and diversify (Granrose and Chua, 1996, p. 204).

The distinction between information and trust, difficult empirically, is also less than clear theoretically — to economists at least, trust is in very large part the rational belief that the information conveyed will be truthful. This paper will describe the model in terms of access to information, but information barriers will be interpreted widely, as affecting both sides of the market and summarizing not only the difficulty of evaluating a product's quality, but also the obstacles that an outsider faces in identifying the appropriate channels through which a product can be marketed.[5] Information problems will be more severe in a world of differentiated products, and it is with these transactions in mind that we have designed our model.

We conceive of trade as a process of matching among distributors and producers (with consumers strictly in the background); a successful match is interpreted as a joint venture between two distributors, two producers, or one distributor and one

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[4] According to legal scholars: ''There is a strong possibility that a judgement given by the courts of a given state should be unenforceable outside the territory of the state'' (David, 1985, p. 17). Private arbitration is indeed dominant in international disputes, and can be read as an imperfect substitute for the enforcement induced by group ties in the examples that motivated this paper (Casella, 1996). If the problem is serious now, it was crucial in the past (e.g., Braudel, 1982 and, for the economist's perspective, Milgom et al., 1990).

[5] The previous literature addressing informational barriers to trade has studied the difficulty faced by an exporter in signaling product quality, and the optimal policy instrument that can help overcome the problem (Grossman and Horn, 1988; Bagwell and Staiger, 1989; Bagwell, 1991), a narrower focus than ours. We do not pursue the distinction between trust and information in this paper, but there are questions closely related to ours for which such a distinction is important. For example, an open issue is the extent to which the services provided by the group can be supplied by private entrepreneurs and sold on the market, or encouraged by government policies. Sociologists in particular have argued that trust, as opposed to information, cannot be traded or produced by formal organizations, and that this limits the extent to which a network can be created artificially where none exists (e.g., Tienda and Raijman (2001), discussing Rauch (2001)).

producer. An agent matching in the domestic market has complete information about others' types, and can approach whichever partner he chooses; in the international market, on the other hand, he is unable to verify ex ante how suitable his partner is, and matching is effectively random.[6] (After the match is concluded, types are revealed, and each partner has the option of rejecting the match and returning to the domestic market.) Incomplete information abroad is a source of inefficiency and reduces the equilibrium volume of trade. Because trade is limited by information, and not only dependent on relative country size, our model provides a plausible response to the overprediction of trade in standard models with differentiated products: no matter how small a country is, relative to the rest of the world, the volume of trade is always bounded below total income.

We then introduce, for a subset of individuals, the preferential information operating through the group: when matching within the group, members benefit from complete information even in their international transactions. The improvement in information is valuable for the economy as a whole, but has systematic distributional implications. Although total trade and GDP rise in each country, the volume of international transactions concluded by non-members falls, causing a decline in their welfare. Non-members suffer from a change in the composition of the anonymous market: even though group members mirror the distribution of types in the economy, it is the most desirable among them who find it advantageous to exploit the group ties. Their exit from the market diminishes the opportunities for successful international partnerships for all others. As commentators have noted about the Overseas Chinese: ''Li Ka-shing calls the boys before he calls the brokers'' (Sender, 1991, p. 31). This type of 'lemon' effect, worsening outcomes for agents excluded from preferential channels of information, has been noticed before in other contexts (e.g., Montgomery, 1991, on personal referrals in the labor market). Here it helps explain the animosity inspired by closely knit groups, even when their only difference relative to the rest of the population is their cohesion, and thus their members' (direct or indirect) knowledge of each other. In addition, those group members who do remain in the market can be — correctly — expected to be less productive; if group members can be identified, discrimination is a possible outcome.

For our purposes, our modeling strategy has two important advantages. First, because the existence and functioning of the ties we have described is well documented empirically, we take complete information within the group as our

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[6]In this respect we have maintained continuity with more traditional models of international trade: Jones (1995) argues that international trade is the study of economies where some markets are integrated and others are not. This assumption may nevertheless seem extreme, and especially inappropriate for large, regionally diverse countries. We feel, however, that it is a justifiable stylization given results such as those of McCallum (1995, p. 616), who found that, controlling for distance and GDP, ''trade between two [Canadian] provinces is more than 20 times larger than trade between a province and a [US] state''.

point of departure. This leads us naturally to investigate economy-wide implications — trade volumes, income levels and distribution, welfare. Our approach is complementary to the study of the transmission of information within the group, a question whose focus has been primarily microeconomic even in analyses that more closely share our interest in information and trade (e.g., Greif, 1993, 1994).[7]

Second, by applying our analysis to groups whose membership is effectively inherited rather than actively pursued, we side-step the question of when and how the provision of information can be organized by market forces. This is an important issue — consultants that help firms to enter a foreign market are becoming increasingly common — and we hope to address it in future research. For now, a simpler approach that takes the group as given is faithful to important empirical examples.

The paper proceeds as follows. Sections 2–4 discuss the model in the absence of group ties; Section 5 studies the equilibrium with group ties, and Section 6 the ties' welfare effects. Section 7 examines possible extensions of the model. Section 8 concludes.

2. The model

We begin by describing and solving our model in the absence of group ties. The world is composed of two countries, each formed by a continuum of types uniformly distributed along a line that extends from -1 to 1. Thus each type i is indexed by his position on the line $z_i \in [-1, 1]$. To be productive, types have to be matched pair-wise in joint ventures. A match between types i and j yields total returns equal to $z_{ij} \equiv |z_i - z_j|$, the distance between the two partners' location on the line — a measure of their diversity and hence, in our set-up, of gains from collaboration.

When an individual chooses to match domestically, he has complete information about all other domestic types, and can approach whomever he chooses. Before matches are concluded, traders compete for the most desirable partners by offering them larger shares of joint returns. In equilibrium this competition determines individual returns from each match.

Traders have also the option of matching internationally, with a partner from the other country who is similarly interested in an international joint venture. For given types, international matches are more productive than domestic matches: total returns are given by hz_{ij}, where h is a parameter larger than 1 capturing sources of gains from trade that are outside our model (comparative advantage,

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[7]Kranton (1996) studies a general equilibrium model where anonymous market transactions or personalized reciprocal exchange are alternative exchange arrangements, only one of which becomes established in the long term. Our own interest is in the stable coexistence and interaction of the two modes of organization.

economies of scale, exchange of technical information). For simplicity, we assume $h \in (1, 2]$. However, individuals are less adept at finding the best match for their product in the international market. To capture this lack of information, we assume that a trader matching abroad cannot recognize ex ante the identity of his partner but has an equal probability of matching with any type: matching among international traders is random.

Once matching has occurred, however, individuals' types are revealed, and traders can return at no cost to the domestic market if their international match is unsatisfactory. Thus an international partnership is accepted only if it yields a higher total return than the sum of what the two partners can obtain in their domestic markets. With the lack of information preventing ex ante bidding for desirable partners, the net gains from trade are then assumed to be shared equally. In other words, the total return from international transactions is divided between the two partners according to the Nash bargaining solution where each trader uses his expected domestic return, if he were to go back, as threat point.

The timing of the model is the following: first, international partnerships are formed among all traders who have entered the international market. Then types are revealed, and traders who accept their assigned foreign partner conclude their transaction, while those who reject their partner return home. Finally, domestic matches are concluded. Since it is always possible to return to the domestic market at no cost, all traders initially attempt the international market.

Our model is an assignment problem in the tradition of Gale and Shapley (1962) and Becker (1973): different traders must match, and they are not all equally well-suited to one another. The equilibrium in the domestic market is equivalent to the complete information solution in assignment models. The equilibrium in the international market then corresponds to the incomplete information solution without resampling.[8] The important point is that individuals' reservation utilities in these latter matches are given by their expectations of domestic returns, i.e., the complete information solution acts as reference against which the international matches, potentially more productive but affected by incomplete information, are evaluated. Thus we need to begin by characterizing individuals' returns if they go back to the domestic market.

3. Domestic returns

In evaluating domestic returns, we face two problems. First, individuals must form expectations about the distribution of types that will be available for

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[8]In this latter case, the canonical assumption in the literature is that all types face the same probability distribution of total match returns, because each individual is identical ex ante (see for example the discussion in Mortensen, 1988). In our model instead different types face different distributions of match returns — they have different positions on the line.

domestic matching. Second, given a distribution of types, we need to characterize what matches will form in equilibrium, and how the match surplus will be divided between the two partners.

Suppose for now that the distribution of types is given, and consider the matching problem when everybody's type is common knowledge. Everything else equal, each type wants to match with someone as distant as possible from his own location. When types are distributed on a line, individuals are then more desirable the closer they are to the edges of the distribution. Bidding for these desirable partners will take place, and matching with them will require renouncing to a larger share of total returns than matching with individuals closer to the middle of the line: a price will emerge for each type, equivalent to the individual return that he will command in equilibrium. Following the literature, we define a set of matches as *stable* if and only if there is no pair of individuals who can abandon their current partners, match among themselves and both be better-off. A partition of the market into pair-wise matches is said to be an equilibrium if and only if all matches are stable. Then we can state:

Proposition 1. *Consider a continuum of types distributed on a line according to some arbitrary distribution $G(z_i)$. Call $\|z_i\|$ type i's distance from the median and z_{ij} the Euclidean distance between types i and j. If the matching of i and j results in total return z_{ij} and each type is free to choose and bid for his matching partner, then in equilibrium type i's return $r(i)$ must equal $\|z_i\|$.*

The proposition, proved in Appendix A, establishes that individual returns in equilibrium are determined uniquely for any distribution of types, given the median of the distribution. Although the total return from a match depends on the distance between the two partners, competition for desirable types has the final effect of equalizing for each individual the payoff from all equilibrium matches: all extra-returns, beyond each type's net contribution to the match, are competed away. The proposition implies that only matches between types on opposite sides of the median can take place in equilibrium, but all such matches (generating total returns equal to $\|z_i\| + \|z_j\|$) are a possibility. Because individual returns are determined uniquely, for our purposes the indeterminacy of the matches is irrelevant.[9]

The result is consistent with the general properties of the assignment problem. As is well known, with complete information competitive bidding for partners yields efficient pairing, and efficient pairing requires positive assortative matching

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[9]The result that competitive bidding brings every individual to indifference over all possible partners on the opposite side of the median is pleasing because it captures sharply our intuitive understanding of the effects of competition. In addition in this model it greatly simplifies the analysis, as we shall see. However it is not robust: it depends on the functional form we have chosen to represent total match returns.

(higher types with higher types) if each type's marginal contribution to total match output is increasing in the partner's type (and conversely in the opposite case).[10] In our case, each type's marginal contribution to total output is independent of the partner's type, as long as the two partners are on opposite sides of the median. Thus, not surprisingly, any match between two types on opposite sides of the median is efficient (and total output is invariant to the specific matches).

If equilibrium returns are given by types' distance from the median, it follows that they are determined uniquely only if the distribution has a unique median, or, in other words, if there is no discrete interval in the neighborhood of the median over which the density of types is zero.[11] In our case, the problem is not trivial because it seems perfectly possible that a discrete mass of traders whose domestic returns would be particularly low might decide always to accept their international option. The corresponding multiplicity of equilibrium returns in the domestic market would needlessly complicate our analysis. A strong but plausible requirement of symmetry is sufficient to rule out this source of indeterminacy: we show in Appendix A that Proposition 1 allows us to establish the following:

Corollary 1. *In any equilibrium in which the distribution of types in the domestic market is symmetrical around zero, if any domestic trade takes place type i's domestic return must equal $|z_i|$, his distance from zero.*

From now on, we concentrate on equilibria where the distribution of types is symmetrical around zero, and therefore we have $\|z_i\| = |z_i|$. Given symmetry, the invariance of domestic returns to the distribution of returning types greatly simplifies the analysis: expected returns in the domestic markets are the threat points used in bargaining in international transactions, and thus expectations over these returns determine the distribution of types who choose to return home. If domestic returns depended on the distribution of returning types, we would have a difficult problem of multiple equilibria.

We conclude this section with two observations. First, notice that because in

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[10]See, for example, Becker (1973, Mortensen (1988), and Sattinger (1993). For a recent analysis that generalizes some of these results, see Legros and Newman (1997).

[11]A simple way of thinking about this case is noticing that any point in the 'gap' of the support could be identified as a median; thus $\|z_i\|$ in the proposition would not be unique, and the measure of the 'gap' in the support would correspond to the measure of the set of possible equilibria. The median is very important in our model because, contrary to most matching problems, partnerships do not take place between two separate groups (men and women, for example, or firms and workers). In these latter cases, efficient pairing pins down relative returns for different types within each group, but an external 'anchor' — typically some measure of reservation utility — is required to determine relative returns between the two groups. In our case, the anchor is provided by the median of the distribution: because a priori any type can always match with the median, it is not possible for all types on one side of the median to earn extra returns over all types on the opposite side. Thus, as long as the median is unique, the multiple equilibria problem that usually plagues the determination of individual returns disappears.

equilibrium $|z_i|$ represents type i's profitability in domestic trade, the arbitrary types space over which an initial distribution is assumed has an immediate empirical counterpart in the different types' opportunities in the domestic market. Second, as our results make clear, matching with complete information does not guarantee high returns. Complete information leads to efficient matching, but the correct returns will not be high for traders who contribute little to a partnership's productivity.

4. Trade

We can now characterize individuals' behavior in the international market. Call $p(i)$ the probability that trader i concludes a successful match abroad, and define the expected volume of trade $E(T)$ as the expected mass of successful international matches for each country:

$$E(T) = \int_{-1}^{1} p(i)\, \mathrm{d}i \tag{1}$$

The match is successful if its total return is higher than the sum of the returns that the two partners can obtain domestically, or $h(|z_i - z_j|) > |z_i| + |z_j|$.[12] If z_i is positive (the opposite case is just the mirror image), a successful match between types i and j requires:

$$h(|z_i - z_j|) \geq z_i + |z_j| \tag{2}$$

or, defining a parameter $\theta \equiv (h-1)/(h+1)$:

$$
\begin{aligned}
z_j &\in [-1, \theta z_i] & \text{if } z_i \geq \theta \\
z_j &\in [-1, \theta z_i] \cup [z_i/\theta, 1] & \text{if } z_i \in [0, \theta).
\end{aligned}
\tag{2$'$}
$$

The parameter θ increases with h and belongs to the interval $(0, 1)$ for all $h > 1$. The closer h is to 1 — the closer the productivity of international and domestic matches — the closer θ is to 0.

Recalling that the distribution of types is uniform, if we define $S(i)$ (illustrated in Fig. 1) as the set of successful partners of i, then:

$$
p(i) = prob(j \in S(i)) =
\begin{cases}
\dfrac{1}{2} + \dfrac{(h-1)z_i}{(h+1)2} & \text{if } z_i \geq \theta \\[2mm]
1 - \dfrac{2h}{h^2 - 1} z_i & \text{if } z_i \in [0, \theta].
\end{cases}
\tag{3}
$$

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[12]With a continuum of types, we can consider the probability of success for each trader as independent of other traders' matches.
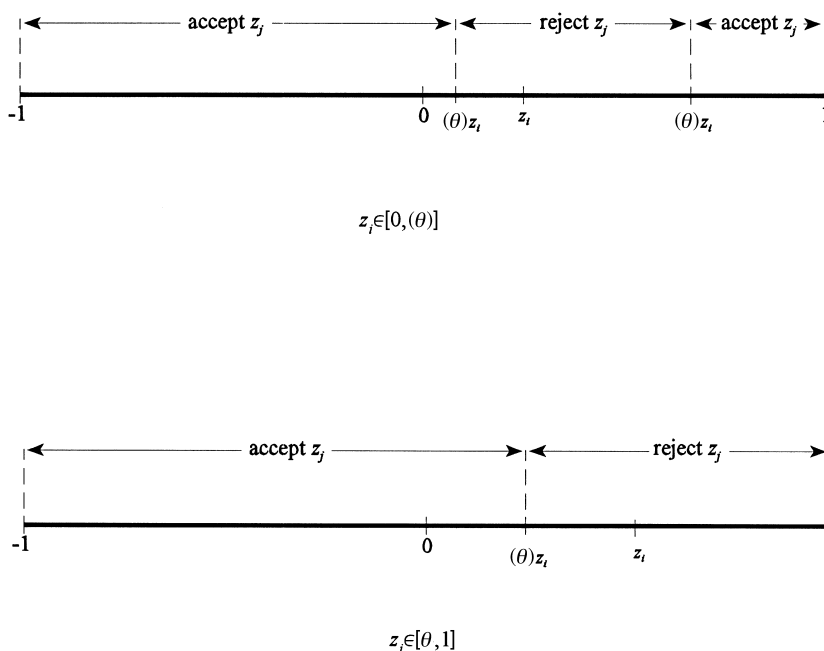
Fig. 1. Determination of $S(i)$.

The probability of concluding a successful match in the international market is not the same for everyone: it is exactly l at $z_i = 0$, reaches a minimum ($p(i) = (h^2 + 1)/(h + 1)^2$) at $z_i = \theta$ and then rises again to $h/(h + 1)$ at $z_i = 1$. As expected, for all types but 0 it is increasing in h. It embodies two different factors: the desirability of any given type, according to his position on the line; and the bargaining power that each type has and that therefore reduces the net return for his partner. The least productive type $z_i = 0$ accepts any international partnership because his domestic alternative yields 0 return. But as an individual's contribution to the match increases — as z_i increases — his domestic opportunities improve and he becomes pickier, rejecting partners that are too close to his own type: it is easy to see from (2′) that the mass of unacceptable partners equals $z_i 4h/(h^2 - 1)$ for all $z_i \in [0, \theta]$, an expression increasing in z_i and reaching a maximum at $z_i = \theta$. In particular, types in this intermediate range increasingly reject partners who have better domestic opportunities than they do and thus higher bargaining power, but are not productive enough to compensate for their extra cost: as z_i reaches θ, only z_j's smaller that z_i are deemed acceptable. This remains true as z_i increases beyond θ, but beyond that point the mass of acceptable partners increases, as z_i's progressively higher productivity and stronger bargaining position make international ventures particularly desirable.

Notice that the non-monotonicity of $p(i)$ requires the higher productivity of international matches: with $h = 1$, the probability of success abroad equals the probability of being matched with a partner on the opposite side of the median, or $1/2$ for every trader. This said, in a world where international transactions are potentially more profitable, the non-monotonicity is an immediate consequence of heterogeneous reservation utilities in the domestic market. Because it is logically so straightforward, we expect it to be robust to most extensions of the original model,[13] and we emphasize it in the following remark:

Remark. For all $h > 1$, the probability of successful matching in the international market is non-monotonic in $|z_i|$ and reaches a minimum at $|z_i| = \theta$.

Substituting (3) in (1) and solving the integral, we obtain the expected volume of trade:

$$E(T) = \frac{2h}{1 + h} \tag{4}$$

If h were equal to 1, i.e., if international and domestic matches were equivalent, the expected volume of international partnerships would be 1, or half of all partnerships; as h increases, $E(T)$ increases but never reaches 2, so that the expected share of all partnership formed by international matches is bound below 1 for all finite h.

If we define the expected value of trade $E(VT)$ in each country as the value accruing to its citizens as result of their international transactions, then:

$$E(VT) = \frac{1}{2} \left[\int_0^1 \left[\int_{-1}^0 h(z_i - z_j) + z_i + z_j \, \mathrm{d}z_j + \int_0^{\theta z_i} (h+1)(z_i - z_j) \, \mathrm{d}z_j \right] \mathrm{d}z_i \right.$$
$$\left. + \int_0^\theta \int_{z_i/\theta}^1 (h-1)(z_j - z_i) \, \mathrm{d}z_j \, \mathrm{d}z_i \right] \tag{5}$$

where the first line reflects the fact that international matches with $z_j \leq \theta z_i$ are successful for all positive z_i's, and the second line accounts for the additional

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[13]For example, we have verified that the non-monotonicity is preserved if we add a fixed cost to going abroad. This leads to self selection in the decision of entering the international market: while low types, with nothing to lose, and high types, who are very desirable everywhere, choose to attempt the international venture, intermediate types around θ prefer to remain at home. It would be tempting to amend the model to study international labor mobility in this spirit. Similarly, the non-monotonicity of $p(i)$ could lead to interesting results if we were to investigate questions of optimal trade policy.

international partnerships of z_i's located between 0 and θ.[14] Solving the integral, we obtain:

$$E(VT) = \frac{2h^2(2+h)}{3(1+h)^2} \tag{6}$$

Again, if h were equal to 1, each trader would have a 50% chance of being successful abroad and earning a return identical to what he would earn at home ($|z_i|$). Thus $EV(T)$ would equal $2 \int_0^1 (z_i/2)\, dz_i = 1/2$, as indeed can be seen from (6). As h increases, both the probability of success and the expected return from an international match rise, and $EV(T)$ increases monotonically.

Finally, we can calculate expected GDP in each country as the total value of all transactions concluded by its citizens. This will differ from (6) because it will include the domestic exchanges concluded by traders whose international matches have proven less productive than their opportunities at home. For each individual i, total expected return equals:

$$Er(i) = 1/4 \left[\int_{-1}^{\theta z_i} h(z_i - z_j) + z_i - |z_j|\, dz_j + 2 \int_{\theta z_i}^{0} z_i\, dz_j \right] \quad \text{if} \quad z_i \geq \theta$$

$$Er(i) = 1/4 \left[\int_{-1}^{\theta z_i} h(z_i - z_j) + z_i - |z_j|\, dz_j + 2 \int_{\theta z_i}^{z_i/\theta} z_i\, dz_j \right.$$

$$\left. + \int_{z_i/\theta}^{1} (h-1)(z_j - z_i)\, dz_j \right] \quad \text{if} \quad z_i \in [0, \theta) \tag{7}$$

Notice that because the probability of matching with any given partner abroad is the same for all types, expected returns must be increasing in $|z_i|$, the domestic fall-back option.

We define expected GDP ($E(GDP)$) as:

$$E(GDP) = \int_{-1}^{1} Er(i)\, di. \tag{8}$$

Solving the integrals in (7) and (8):

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[14]Notice that by symmetry we can focus exclusively on z_i's between 0 and 1, and double their aggregate exchanges. The term $1/2$ outside the integral is equivalent to 2 multiplied by the density ($1/2$) multiplied by each trader's share of net returns in international partnerships ($1/2$).

$$E(GDP) = \frac{2(h^3 - 1)}{3(h^2 - 1)} \tag{9}$$

We know from our preceding observations that if h were equal to 1, $E(GDP)$ would equal $2 \int_0^1 z_i \, dz_i = 1$ and the ratio of trade to GDP ($E(VT)/E(GDP)$) would equal $1/2$. It is now easy to verify from (6) and (9) that, as expected, both expected GDP and the ratio of trade to GDP are increasing in h. However, for any finite h this ratio is always smaller than 1, capturing, as mentioned earlier, the existence of a positive mass of unsuccessful international matches. If agents were able to match with complete information in the foreign as well as in the home market, the return to each agent abroad would equal $h|z_i|$ (see Corollary 2 below) and all international matches would be successful. In our model, on the contrary, informational barriers in international markets create an inefficiency that reduces both trade and, to a lesser extent, GDP.

5. Trade with group ties

We now complete our model by introducing the role of group ties. Suppose that in each country a minority of types of mass m belongs to a specific group. This minority is distributed uniformly along the whole support of the line. To capture the information advantage provided by group ties, we assume that when a minority agent chooses to match internationally within the group, he has complete information about the types of all other group members, and can approach and bid for whomever he chooses.[15] As in all international matches, the total output from this transaction is hz_{ij}, but now, in the presence of complete information within the group, the share that each partner receives is determined in equilibrium by competing offers for desirable partners. Alternatively, each member of the minority group can choose to forego the use of his ties and enter the anonymous international market where matching is random. The choice, however, must be made ex ante: a minority trader knows the type of every group member settled in the foreign country, but must choose whether or not to use the ties before knowing the identity of his potential partner in the anonymous international market. As before, a trader always has the option of renouncing the international partnership, and returning home.

We assume that the minority is distributed uniformly because we want to concentrate exclusively on the informational advantage provided by the group, and thus we want its members to be otherwise identical to non-members. A fortunate implication of this assumption is that we do not need to take a stance on the

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[15]It has been stated of the overseas Chinese in Asia (Ziesemer, 1996, p. 29), ''Every key individual among them knows every other key figure''.

difficult question of whether or not group members can function as middlemen: can they introduce foreign members of the group to any domestic trader? Because the group replicates the distribution of types in the overall economy, foreign members have no incentive to go outside the group, unless they want to benefit from the anonymity of the market.[16]

What is the equilibrium return to a group member matching within the group? Although members benefit from complete information, Proposition 1 does not apply automatically to the new problem because international trade must take place between citizens of the two countries, and thus the set of agents is now divided into two subsets limited to trading with each other. In general this can be a source of indeterminacy in equilibrium returns,[17] but in our set-up restricting the focus to symmetrical equilibria is sufficient to yield an intuitive generalization of Corollary 1. As shown in Appendix A, we can establish:

Corollary 2. *An equilibrium is symmetrical if the distribution of types in all markets is symmetrical around zero, and identical types in the two countries make the same decision with respect to participation in the group. In the symmetrical equilibrium, the return to member i matching within the group must equal $h|z_i|$.*[18]

We can now investigate which members of the minority group will exploit their ties. Suppose first that all members do so. In the anonymous international market, the density of traders in any given interval is reduced. However, because the distribution of group members is uniform and the mass of traders entering the market is reduced by an equal proportion in both countries, the probability of a successful match in the market is unchanged for all types. Thus, if all members use the group, expected returns for non-members continue to be defined by (7) and the probabilities of success by (3). It follows that these equations also define the return in the market to a group member, were he to deviate and abandon the group. Consider a group member at location $z_i = 0$. If he matches through the ties his return is zero (by Corollary 2) because the complete information existing within the group reveals his low productivity. If he enters the anonymous market, his expected return is $Er(0) = (h - 1)/4$ (by Eq. (7)) because his lack of bargaining power makes him an acceptable partner, and he enjoys his share of the gains associated with international trade. Thus he will always prefer the market. We can conclude that there can be no equilibrium where all members choose to match

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[16]We must assume however that non-members cannot take the initiative and effectively nullify the informational barriers by exploiting their link to domestic group members.

[17]See the discussion in Footnote 4.

[18]There is always an equilibrium where the group is inactive (no one matches through it because no one expects anyone else to match through it). We focus instead on equilibria where the existence of the group has some impact.

through the group: there will be self-selection in the use of the group ties. The following proposition, proved in Appendix A, makes this intuition precise:

Proposition 2. *The symmetrical equilibrium with group ties is unique*: *there exists a positive number* $\alpha(h, m)$ *such that all types* $|z_i| < \alpha(h, m)$ *prefer the market, and all types* $|z_i| > \alpha(h, m)$ *prefer the ties.*

The complete information existing within the group attracts the most productive members, while less desirable individuals attempt the anonymous market. Notice that the conclusion holds even though in all cases information is revealed before the match is concluded, and individuals retain the option of returning to the domestic market.

The formal derivation of the interval of minority traders foregoing the group is somewhat involved because the density of types in the market is no longer uniform over the entire support, but is higher in the intervals that include minority traders. It is not difficult to verify that:

$$\text{prob}(z_j \in [s, v]) = \begin{cases} \dfrac{v - s}{2 - m(1 - \alpha)} & \text{in the high density intervals} \\[2ex] \dfrac{(v - s)(2 - m)}{[2 - m(1 - \alpha)]2} & \text{in the low density intervals.} \end{cases} \tag{10}$$

The location of the marginal trader α — the minority trader just indifferent between the group and the market — must satisfy:

$$Er^M(\alpha) = h|\alpha| \tag{11}$$

where the superscript M indicates that the expected market return must now take into account the change in the density of traders. Expected returns in the market can be obtained from Eq. (7), but with probabilities and expected values derived from (10). The procedure is straightforward but cumbersome; we briefly describe how to proceed in Appendix A, but refer the reader to Casella and Rauch (1997) or www.columbia.edu/~ac186/(Appendix B) for detailed derivations and proofs.

The comparative statics properties of α are summarized by the following proposition:

Proposition 3. *The share of members relying on the ties is smaller the higher is the profitability of trade*, *and the smaller is the share of the population that has access to the ties*: $d\alpha/dh > 0$, $d\alpha/dm < 0$ $\forall h \in (1, 2]$.[19]

Consider first the expected return from trading within the group. For a low

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[19]The proof is in Casella and Rauch (1997) or www.columbia.edu/~ac186/(Appendix B).

enough type, the effect of an increase in h must be negligible: whether or not he is involved in a highly productive match his own share of total returns is proportional to his type (the effect of h is linear in z_i). In the market on the other hand, the effect of a higher h is always bound away from zero (the net surplus is divided equally between the two partners of a match). It is clear then that an increase in h must increase the relative attractiveness of the market for types that are sufficiently close to zero. Proposition 3 states that α, the marginal type indifferent between market and group, is always low enough to shift to the market as h increases.

Changes in m, the proportion of the population that belongs to the minority, also affect the choice of market versus group. Because the individuals who choose to forego the ties are those in the proximity of zero, an increase in m implies a higher probability of market matches with lower than average types. The adverse selection problem caused by the presence of the group becomes worse: the relative attractiveness of the market falls and the share of members relying on the ties increases.

6. The welfare effects of group ties

In many countries substantial income differentials exist between ethnic minorities acknowledged to have access to international trading 'societies' and the majority populations.[20] It is also true that most governments run trade promotion organizations with the professed intent to achieve the results we ascribe here to the group.[21] In this section we investigate the welfare effects of the preferential ties on the economy as a whole, and on those traders who have, or have not, access to them. The following proposition provides the general answer.[22]

Proposition 4. *The existence of ties among a minority group increases expected GDP in the economy. It also causes unambiguous distributional effects*:

(*i*) *Expected per capita GDP rises for group members*, *but falls for non-members*.

(*ii*) *All group members who join the market are worse-off than in the absence of ties*; *all group members who use the ties except those near α are better-off. The percentage gain in expected return* (*negative for low enough types*) *is monotonically increasing in $|z_i|$.*

[20]Good examples are ethnic Chinese in Southeast Asia and ethnic Indians in East Africa. Of course these income differentials cannot be attributed entirely to superior international trade opportunities for the minorities, but it appears that these contribute significantly.

[21]The Hong Kong Trade Development Council is widely regarded as one of the most successful examples. According to Keesing (1988, p. 20), ''HKTDC sees its central task as 'matchmaking' between foreign buyers and Hong Kong firms wishing to export''.

[22]The proof is in Casella and Rauch (1997) or www.columbia.edu/~ac186/(Appendix B).

(iii) There exists a value of h ĥ(m) such that for all h < ĥ(m) all non-members are worse off than in the absence of ties; for h ≥ ĥ(m) the highest types are better off. In all cases, the percentage loss in expected return is monotonically declining in $|z_i|$.

Fig. 2 summarizes these findings. Although the existence of group ties is always beneficial to the economy as a whole, there are traders who gain and traders who lose, with the gains concentrated among those who have access to the ties, and the losses concentrated among non-members.

The change in expected per capita income is the result of the change in trade flows caused by the ties. Proposition 4 can be reinterpreted as stating that the existence of a group sharing preferential information abroad increases the ratio of trade over GDP for the group in particular, and for the economy as a whole, but decreases it for those traders who are not members. The injury to market traders is the result of the reliance on the group of the more desirable trading partners.

Not only are distributional effects present between the two sets of agents, but different types within each set also fare differently. The change in the composition of the market brought about by the existence of the group hurts mostly low $|z_i|$ types, because the smaller is the agent's profitability in the domestic market, the larger is his reliance on the international market, and the international market has
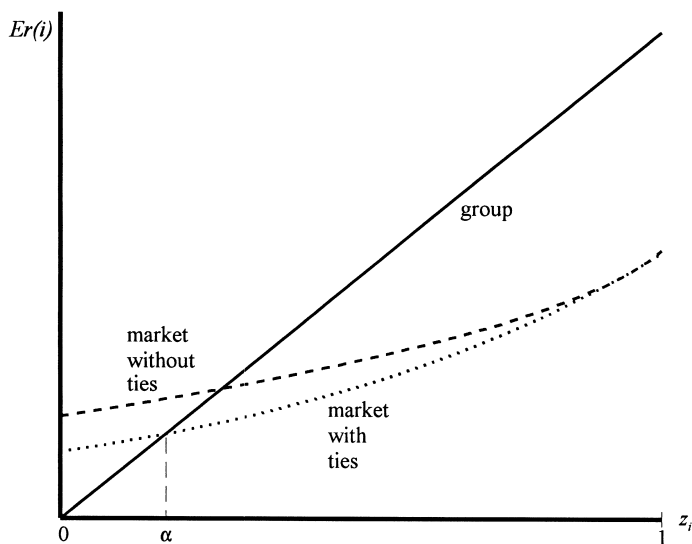

Fig. 2. Expected returns in the presence of group ties.

become more dense exactly in other low types.[23] This is true both among group members and non-members, since low types are led to rely on the market whether or not they have access to the ties.

In summary, our analysis supports the view that coethnic societies, business groups operating across international borders, or institutions devoted to the creation of better information channels in foreign markets are valuable. It stresses, however, that under most circumstances those excluded from these channels or less able to exploit them profitably will be hurt. Since those most hurt are the agents with the poorest domestic opportunities, measures to redress this grievance can be easily rationalized as instruments for redistribution. It is thus not surprising to find de jure or de facto requirements imposing partnerships with ethnic nationals in countries where coethnic societies are important.[24]

What is remarkable is that the distributional effects highlighted by our model stem uniquely from the ability of the minority group to match among themselves with complete information, even when the composition of the group mirrors the composition of the economy as a whole. Traders who do not belong to the group are hurt not because the group as a whole is more productive, but because selective reliance on the group by its members deprives the market of exactly those trading opportunities that would be most valuable. Differential information causes a 'lemon' problem in the anonymous market.

7. Extensions

7.1. Discrimination

The observation at the end of the previous section raises a natural question. Since the lemon problem arises because the market is chosen disproportionately by group members of lower types, would not the other traders refrain from matching with any minority member present in the market? In other words, could this model give rise to statistical discrimination? Answering this question requires allowing for non-random interaction between group members and non-members, and assumptions in this respect are difficult to ground in empirical evidence. Whether agents can distinguish group members from non-members in reality is unclear —

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[23]Notice that if h is large enough, high types benefit from the changed composition of the market. Matches with low types are for them always successful because the latter have such low bargaining power, when h is high the higher probability of concluding an international partnership overcomes the decreased quality (i.e., distance) of the average partnership.

[24]In the case of the Overseas Chinese, we find de jure requirements in Malaysia (Jesudason, 1989) and de facto requirements in Indonesia (Robison, 1986), for example.

while coethnicity or business group membership may be transparent to home country nationals, it may often not be to foreigners: a Thai national may recognize that another Thai businessman is of ethnic Chinese origin, but an Indonesian national (not of ethnic Chinese origin) may not be able to.[25] Encaoua and Jacquemin (1982, p. 26) note that business groups in France ''have no legal existence and are not identified in official censuses. Each subsidiary maintains its legal autonomy and keeps separate accounts''.

If however this distinction is possible, then we can show that an equilibrium with complete segregation can arise: only non-members match in the market. Group members believe (rationally) that they would be shunned if they tried to enter the market, and non-members believe that any member present in the market would be a worse partner than the average non-member.[26] With segregation, non-members fare as in the no-ties equilibrium and the distributional implications can be easily deduced from the previous section (and seen clearly in Fig. 2). Expected per capita income for non-members always rises — relative to no segregation — but the gains fall mostly on the least profitable types located around zero.[27] As for members, per capita income for the group must fall, with all losses concentrated on those types that would prefer to match in the market but are now prevented from doing so. Thus the possibility of discriminating between members and non-members affects almost exclusively the income of low types, whether as objects of discrimination (among group members) or as active subjects (non group members), a result that seems intuitively very plausible.

From an aggregate point of view, the absence of group members from the market is costly. Segregation reduces profitable market matches between very high and very low types, and leads to a decline in trade and in expected GDP for the economy. Once again note that these results arise exclusively from the informational advantage enjoyed by members — it is that factor alone that triggers a series of consequences, possibly culminating in active discrimination.

But it would be misleading to imply that segregation is the unique equilibrium, when group members can be recognized. For example, the following scenario with 'mixed' market partnerships is an equilibrium. A mass of group members close to zero enters the market, gambling that they will be matched with high $|z_i|$'s who are not members. At low h, most fail and return home (the mass of group members in

[26] It is not difficult to find beliefs for non-members that support segregation as a sequential equilibrium. For example, the belief that only members located at $-1/2 + e$ and $1/2 - e$ would enter the market ($e > 0$ but close to zero) supports segregation, since all non-members would then prefer to match only among themselves.

[27] Indeed, if h is high enough, the highest types may be hurt.

the market is much larger than the mass of non-members willing to match with them), but some succeed, justifying the initial gamble. As h increases, the probability of being rationed decreases rapidly. Thus in this equilibrium some mixed partnerships are observed, and the more so the higher is h.

7.2. The trade effects of migration

Often immigrants come to constitute a coethnic society in their host country, facilitating international trade between that country and their country of origin. Indeed, as mentioned in the Introduction, this is one of the most important and well-documented instances of the use of coethnic ties in international trade. Consider an ethnically homogeneous country and suppose that a uniformly distributed subset of its population has migrated to a second country. For simplicity let us also suppose that the two countries are of equal size (post-migration): thus the country of origin is of size 2 and consists of a single ethnic group; the host country has an ethnic minority of size m and a mass of natives of size $(2-m)$. Assume now that when traders from the country of origin are rationed in their attempt to match within the coethnic group, they can match randomly in the anonymous international market. We can then make two preliminary observations. First, since equilibrium returns exploiting the ties are independent of the partner's identity, there is an equilibrium where all traders from the country of origin have the same probability of being rationed when trying to use the ties. It follows, and this is the second observation, that if in the absence of rationing expected returns within the coethnic group are higher than in the market, it is still an equilibrium to (attempt to) use the ties.

It is not difficult to see that in this example the analysis is exactly identical to that presented so far. Consider any interval of the support such that coethnics from that interval prefer to use the ties. In the country of origin it is still the case that a fraction $m/2$ of traders in that interval will be able to match within the coethnic group, and that this fraction will be distributed uniformly; the remaining fraction $(2 - m)/2$, again distributed uniformly, will enter the market. Given the assumption we have maintained throughout the paper that coethnics meeting in the market are unable to rely on the coethnic ties (i.e., do not have complete information) everything follows as in the preceding sections. We can reinterpret the effect of the ties in increasing trade as the trade effect of migration.[28]

This simple case can be easily handled, but should be seen simply as a stepping stone towards a more focused model of trade networks induced by migration. First, the decision to migrate should be endogenous, and in this model the resulting

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[28]The analysis remains unchanged for any example where the masses of coethnics m^1 and m^2 in country 1 and country 2, respectively, are different and $m^1 > m^2$. Note that expected per capita income of coethnics in country 1 is lower than that of coethnics in country 2: the larger is m^1 relative to m^2, the lower is the probability that a group member in country 1 will benefit from the coethnic society.

distribution of migrants will not be uniform. Second, in our example most coethnics in the country of origin are rationed in their attempts to match abroad within the coethnic group. Can group members then introduce them to their non-members compatriots? When the minority masses are equal, the question can be ignored, but a model of migration would have to address it.

8. Conclusions and suggestions for future research

In this paper, we have studied the effect of group ties in a world where entry into foreign markets is hampered by problems of information. We have found that while group ties increase the total volume of trade and aggregate income, they worsen the composition of the anonymous market, and thus reduce trade and per capita income of those individuals who are excluded from, or choose not to exploit, the preferential channel.

Although our results are derived within a very specific model, the intuition behind them seems strong enough to survive relaxing some of our assumptions. For example, in this paper the strength of demand for an individual's variety is equal at home and abroad, but for problems of information (an individual's position on the line is identical in the domestic and international markets). In a more extensive version of this work (Casella and Rauch, 1997), we have verified that our conclusions hold true when traders do not know how their good is placed in the international market (i.e., prior to matching abroad, they do not know their position on the line in the international market), an assumption that seems appropriate in the case of trade between countries with different tastes.

It is clear though that there is room for extending our framework In particular, in order to focus on what is new in our approach we have omitted any role for goods and factors prices. Yet some of the most interesting results of our approach come from the interaction of the matching process we have described with market prices. This is the subject of a companion paper (Rauch and Casella, 1998).

We have already mentioned the possible application of our model to government trade promotion organizations, so widely observed yet so little studied. And the difficult but crucial question of private for-profit provision of information and contacts in international transactions. Other questions suggest themselves: Why are some co-ethnic groups better able to exploit the ties among members than others? What role do formal institutions play, as substitutes or complements of these spontaneous links?[29] More generally, development policy is becoming increasingly concerned with reliable provision of information and enforcement, as essential to the establishment of healthy and open economies.[30] The question of how best to

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[29]For some discussion (and empirical evidence) along these lines in contemporary New York City, see Rauch (2001).

[30]E.g. World Bank (2001/02) and Rodrik (2000b).

structure it is too broad to be tackled in general terms, and will need to be broken down into specific examples. It is our hope that the abstract, simplified but rigorous analysis of group ties in international trade provided by this paper can become a useful part of that larger literature.

Acknowledgements

Appendix A

Proof of Proposition 1. We begin by establishing the following lemma:

Lemma 1. *In equilibrium there can be no set of types of positive measure who match with partners located on the same side of the median.*

Proof of Lemma 1. Suppose this were the case. Then there must be a set of types of equal measure on the opposite side of the median who match among themselves. But then it is always possible to create new partnerships with each member located on a different side of the median such that both partners are better off. Suppose that types j and s, on the same side of the median, were matched with each other. Then the maximum possible return to j is z_{js} when he appropriates the entire return from the partnership, with $z_{js} < \|z_j\|$. Similarly, if i and v, on the opposite side of the median from j and s, match among themselves, i can obtain at most $z_{iv} < \|z_i\|$. By matching among themselves j can earn $\|z_j\|$ and i can earn $\|z_i\|$; each type's return is strictly higher than in the original scenario.

Thus in what follows we will ignore the possibility of equilibrium matches occurring between partners on the same side of the median. We proceed with the proof of Proposition 1.

Suppose first that the the support of the distribution is continuous around the median. Consider types i and j, on opposite sides of the median. They can always match, produce z_{ij} and share it as $\|z_i\|$ to i and $\|z_j\|$ to j. Thus in equilibrium they cannot both earn less. Can at least one of them earn more (for example, can j earn

$\|z_j\| + k$, with $k > 0$)? Only if j matches with w (on the opposite side of the median) who accepts $\|z_w\| - k$ ($\|z_w\| \geq k$). But this can only occur if all types v on w's side of the median are receiving $\|z_v\| - k$. (Suppose that there exists a v who is matched with s and receives $\|z_v\| - d$, $d < k$. Then there exists an $\epsilon > 0$ such that w can undercut v, offer s $\|z_s\| + d + \epsilon$ and be better off.) But all v's receiving $\|z_v\| - k$ cannot occur in equilibrium because any v can then match with a type on the same side of the median, but arbitrarily close to the median and make both better off. Thus, if the support of the distribution is continuous around the median, the return to j must equal $\|z_j\|$ and the return to i $\|z_i\|$.

Suppose now that there exists a discrete interval of length $2A$ in the immediate neighborhood of the median over which the mass of types equals zero. Call $\langle z_i \rangle$ type i's distance from the mid point of the interval. Each type i on one side of the interval earns individual return $\langle z_i \rangle - k$ ($k \geq 0$), and each type j on the opposite side earns $\langle z_j \rangle + k$. Following the logic detailed above, the parameter k must be the same for every type and k must be not larger than A (since underbidding would otherwise be possible), but no profitable deviation exists for all $k \leq A$. Similarly the mirror image of this equilibrium ($k < 0$) is also an equilibrium as long as $k \in [-A, 0]$. We can interpret this multiplicity as arising because any point in the interval can be identified as a median. The choice of a median then determines uniquely the entire distribution of returns.

Proof of Corollary 1. Consider an equilibrium where the distribution of types returning to the domestic market is symmetrical and suppose that in the domestic market all $z_i < 0$ receive $|z_i| - k$ and all $z_i > 0$ $|z_i| + k$ ($k > 0$). By Proposition 1 this can occur only if all types in $[-a, a]$ ($a \geq k$) are absent from the domestic market, i.e., if they are successful with probability 1 in the international market. Consider traders $-a$ and a. Since they have the same probability of matching with any foreign type in the international market, and different expected returns in the domestic market, their probabilities of success cannot be equal. If the probability of success is 1 for $z_i = -a$ and less than 1 for all $z_i < -a$, then it must be less than 1 for $z_i = a$. This establishes the Corollary.

Proof of Corollary 2. Although the two sets of traders restricted to matching with each other are not on opposite sides of the median by assumption (contrary to most standard models), the first part of Proposition 1 remains unchanged: all equilibrium matches must be between individuals on opposite sides of the median. (The argument in Lemma 1 easily generalizes.)

Suppose now that in matching through the group all traders from country 1 located to the left of the median receive $h|z_i| + k$ ($k \geq 0$) when matched with members from country 2 located to the right of the median (k must be the same for all types to prevent underbidding). In any equilibrium where the distribution of

types in the markets (and hence in the group) is symmetrical around the median, it must then be the case that members from country 2 located to the left of the median receive $h|z_i| - k$ when matched with members from country 1. Any k can now be supported without underbidding, but participation in the group requires that all members be better off than in the domestic equilibrium (notice that there is no uncertainty). Thus we require $h|z_i| - k \geq |z_i|$ or $k \leq |z_i|(h-1)$ for any z_i in the group. If $z_i = 0$ is among those who use the ties, k must equal zero. Suppose now that individuals in $[-a, a]$ do not use their group ties. Then in a symmetrical equilibrium a must be the same in both countries, and, for a given type, the expected return from entering the international market is equal in both countries. But if k differs from zero, participation in the group is more advantageous for citizens of country 1 than for citizens of country 2 and the threshold a cannot be the same in both countries. It follows that in any symmetrical equilibrium k must equal zero.

Proof of Proposition 2. Observe first that there is always an equilibrium where no-one uses the group ties (since an individual cannot deviate alone). Let us focus instead on the equilibrium with an active group. We proceed by proving two preliminary results:

(i) *For any $h > 1$, all members using their ties is not an equilibrium.* Suppose that all members use the ties. Then expected returns in the market are unchanged and are given by Eq. (7). Consider $z_i = 0$. His return in the group equals 0 while his expected return in the market equals $(h-1)/4$. Thus $z_i = 0$ would deviate to the market.

(ii) *For any $h > 1$, in any rational expectations equilibrium with an active group, $|z_i| = 1$ prefers to use his ties.* Consider two types, z_i and z_s, such that $z_s > z_i$ and $z_i > 0$. It is not difficult to verify that for any z_j (and $h > 1$), $(r(i,j) - hz_i) > (r(s,j) - hz_s)$, where $r(i,j)$ is the realized return to z_i from matching with z_j in the market, and where we need to consider the four possible cases: $z_j \in S(i), S(s); z_j \in S(i), \not\in S(s); z_j \not\in S(i), \in S(s); z_j \not\in S(i), \not\in S(s)$. Because the inequality holds for any z_j, it must hold in expected values for any distribution of types in the market. Thus if z_i prefers the ties to the market, so does z_s. By symmetry, the argument can be applied to $z_i < 0$; thus more generally if $|z_i|$ prefers the ties to the market, so does $|z_s| > |z_i|$. It follows that if any $|z_i|$ matches within the group, so does $|z_i| = 1$.

We have established that in any equilibrium with an active group: (a) not every member relies on the group; (b) if $|z_i|$ prefers the ties to the market, so does $|z_s| > |z_i|$. Hence there must exist a positive number $\alpha(h, m)$ such that all members in $[0, |\alpha(h, m)|]$ prefer the market, and all members in $(|\alpha(h, m)|, 1]$ prefer the ties. The equilibrium configuration is unique. In Casella and Rauch (1997) or www.columbia.edu/~ac186/(Appendix B) we derive the explicit solution for $\alpha(h, m)$ and show that $\alpha(h, m)$ itself is unique, concluding the proof of the proposition.

Trade with group ties

To account for the different densities, when writing expected returns we will need to divide the support in subintervals. Consider $z_i > 0$. All matches with $z_j \leq \theta z_i$ are successful, and so are all matches with $z_j \geq z_i/\theta$; Call $\theta z_i \equiv \underline{z}_j(i)$, and $z_i/\theta \equiv Z_j(i)$. Depending on z_i, both $\underline{z}_j(i)$ and $Z_j(i)$ can be larger or smaller than α; in addition $Z_j(i)$ could be larger than 1 (if $z_i > \theta$). Thus there are five possible combinations:

1. $\underline{z}_j(i) \leq \alpha$, $Z_j(i) \leq \alpha$;

2. $\underline{z}_j(i) \leq \alpha$, $Z_j(i) \in [\alpha, 1]$;

3. $\underline{z}_j(i) \leq \alpha$, $Z_j(i) > 1$;

4. $\underline{z}_j(i) \in (\alpha, 1]$, $Z_j(i) > 1$;

5. $\underline{z}_j(i) \in (\alpha, 1]$, $Z_j(i) \in [\alpha, 1]$.

Which of these combinations are possible at the same time depends on the relationship between α and θ in equilibrium. There are three different regimes:

(a) $\alpha > \theta$. It is easy to see that if $z_i \in [0, \alpha\theta]$, conditions (1) above apply; if $z_i \in (\alpha\theta, \theta]$ conditions (2), and if $z_i \in (\theta, 1]$ conditions (3). The combinations identified by (4) and (5) are not possible in this regime, because $\underline{z}_j(i) > \alpha$ implies $z_i \theta > \alpha$, which contradicts $\alpha > \theta$ and $z_i < 1$.

(b) $\alpha \in [\theta^2, \theta]$. The condition $Z_j(i) \in [\alpha, 1]$ requires $z_i/\theta < 1$ or $z_i < \theta$, while $\underline{z}_j(i) \in (\alpha, 1]$ requires $z_i > \alpha/\theta$. Together they imply $\theta > \alpha/\theta$, or $\alpha < \theta^2$, impossible in this regime. Thus (5) above is impossible here, and only conditions (1)–(4) are relevant. Respectively: (1) for $z_i \in [0, \alpha\theta]$; (2) for $z_i \in (\alpha\theta, \theta]$; (3) for $z_i \in (\theta, \alpha/\theta]$; (4) for $z_i \in (\alpha/\theta, 1]$.

(c) $\alpha < \theta^2$. The condition $\underline{z}_j(i) \leq \alpha$ requires $z_i \leq \alpha/\theta$, while $Z_j(i) > 1$ requires $z_i > \theta$. Together they imply $\alpha > \theta^2$, impossible in this regime. Thus condition (3) above is impossible here and only conditions (1), (2), (5) and (4) are relevant. Respectively: (1) for $z_i \in [0, \alpha\theta]$; (2) for $z_i \in (\alpha\theta, \alpha/\theta]$; (5) for $z_i \in (\alpha/\theta, \theta]$; (4) for $z_i \in (\theta, 1]$.

Call $Er1^M(i)$ the expected return of i.e., $z_i \in [0, \alpha\theta]$. Divide the support of all potential partners into different intervals, according to two criteria: whether there will be a successful match, and whether the density of the types' distribution is low or high: $[-1, -\alpha]$: low density, successful match; $[-\alpha, 0]$: high density, successful match; $[0, z_i\theta]$: high density, successful match; $[z_i\theta, z_i/\theta]$: high density, unsuccessful match; $[z_i/\theta, \alpha]$: high density, successful match; $[\alpha, 1]$: low density, successful match. Taking into account Eq. (10) and using the notation $d \equiv 2 - m(1 - \alpha)$, we obtain:

$$Er1^M(i) = \frac{(2-m)}{2d} \frac{1}{2} \int_{-1}^{-\alpha} [(h+1)z_i - (h-1)z_j] \, \mathrm{d}z_j$$

$$+ \frac{1}{d} \frac{1}{2} \int_{-\alpha}^{0} [(h+1)z_i - (h-1)z_j] \, \mathrm{d}z_j + \frac{1}{d} \frac{1}{2} \int_{0}^{\theta z_i} (h+1)(z_i - z_j) \, \mathrm{d}z_j$$

$$+ \frac{1}{d} \int_{\theta z_i}^{z_i/\theta} z_i \, \mathrm{d}z_j + \frac{1}{d} \frac{1}{2} \int_{z_i/\theta}^{\alpha} (-h+1)(z_i - z_j) \, \mathrm{d}z_j$$

$$+ \frac{(2-m)}{2d} \frac{1}{2} \int_{\alpha}^{1} (h-1)(z_j - z_i) \, \mathrm{d}z_j. \tag{A.1}$$

The same procedure can be followed for all other possible segments (i.e., $z_i \in [\alpha\theta$, $\min(\theta, \alpha/\theta))$; $z_i \in [\theta, \min(\alpha/\theta, 1)]$; $z_i \in (\max(\alpha/\theta, \theta), 1]$; $z_i \in (\alpha/\theta, \theta]$ when $\alpha < \theta^2$, in regime (c)), yielding all traders' expected returns in the three regimes. All results that follow in the paper can be established by manipulating these expected returns.

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