‘Remoteness’ and environmental conflicts: some insights from the political ecology and economic geography of copper

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Abstract: This paper describes some historical features of the global economic geography of copper, and explores the conditions underpinning environmental conflicts in this sector, while showing some examples. We found that Europe and Japan are progressively more dependent on imports from developing countries to cover internal copper demand. In contrast, copper production in the USA has considerably increased during recent decades. During the 1990s, there was a boom of Latin American copper exports, led by Chile. We point out that population density, negotiation strategies, environmental performance, distribution of profits and the local notion of social rights are the major steering forces of environmental conflicts in the mining sector. We argue that the location of mines in isolated regions, stricter environmental policies and investments in updating environmental technologies have prevented the emergence of environmental conflicts during the Chilean copper boom.

Keywords: Chile, copper, environmental conflicts, mining, trade and environment.

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1 Introduction

The economic geography of firms' locations has been dominated by the notion of 'proximity'. Studies dealing with the setting and spatial movement of firms traditionally have been focused on the identification of local characteristics, institutional conditions and economic policies that may attract firms and investment to a certain region or place (Bottazzi, 2001; Mariani, 2002). Positive spatial externalities and market closeness are supposed to play an important role as 'centripetal' forces, encouraging agglomeration of firms, and promoting innovation and growth (Acs and Varga, 2002). These externalities include knowledge spillover between private and public agents, as well as transport and labour costs (Lemarié *et al.*, 2000). On the other hand, product differentiation and price competition are considered 'centrifugal' forces, which may push firms far from each other. We could label the study of these centrifugal forces as 'remoteness dynamics', in antagonism to the more common notion of 'proximity dynamics' (Torre and Gilly, 2000). We think that, in some particular sectors, there also exist socio-environmental factors that shouldn't be neglected when analysing the location of firms, and their impacts at the local level. Social conflicts may imply large transaction costs for enterprises. Therefore, particularly in conflict-prone environment-intensive sectors, clashes about the use of natural resources or the distribution of environmental burdens may significantly influence locational decisions, particularly in those enterprises that have the capacity to move internationally, i.e. transnational corporations.

The main objectives of this paper are twofold: (i) to describe some historical features of the global economic geography of copper, particularly trade and production trends in the global South and North; and (ii) explore the conditions underpinning the emergence of environmental conflicts in the copper mining and processing industries, while giving some examples.

The following part of the introductory section intends to draw a tentative theory of environmental conflicts in the mining sector. Section 2 deals with historical data on copper production and trade in different regions of the world, aiming to assess the extent to which there has been an international displacement of copper production and exports from industrialized to developing countries. Section 3 describes some environmental conflicts associated with copper extraction and processing in Peru, Papua New Guinea and Ecuador. The specifics of the Chilean case, the current world leader copper producer

and exporter, are described in Section 4. The article finishes with some concluding remarks.

1.1 Towards a theory of environmental conflicts in the mining sector

Environmental conflicts are disagreements between different groups within society about alternative resource uses or the allocation of environmental hazards or impacts. The occurrence and intensity of environmental conflicts arising from extractive activities depend on a large variety of variables, which makes it hard to arrive at consistent generalizations on the relationship between the scale of the activity and the extent and frequency of conflicts. Mining activities, being among the most environment-intensive sectors, have generated environmental conflicts all around the world (Martinez-Alier, 2001). Conflicts are particularly prone to come out when mining is made through an open pit (Beynon *et al.*, 2000). Akin to nuclear plants, landfills and incinerators, mines are environmentally risky locations, and belong to the generic category of land use usually called 'locally unwanted land uses' (LULUs). On the other hand, endowment with abundant minerals is a source of competitive advantages for nations, and a common means for attracting international capital, particularly in developing countries. During the 1990s, there have been both a substantial increase of foreign investment in the mining sector, and more cases of opposition to mining projects or mines by local groups, often supported by global alliances of activists. Concomitantly with a general trend towards privatization of former state-owned mining enterprises in the developing world, the last decade of the twentieth century also witnessed the consolidation of national and international organizations and networks defending the interest of communities affected by or opposing the settlement of new extractive activities. Currently, there are several examples of such worldwide networks of NGOs. For instance, Oilwatch[1], Mines and Communities[2] and Project Underground[3] are global platforms of activist organizations addressing the negative social and environmental effects of mining and oil extraction activities.

Environmental impacts and risks of copper extraction and processing are concentrated in the first stages of the copper chain (from mining to smelting). For a complete review of the copper chain and its environmental impacts see Graedel *et al.* (2002). Throughout the history of the world copper industry, there have been several cases of harsh social conflicts linked to environmental issues, such as the massacres of peasants in Andalusia, Spain, in 1888, and in San Mateo de Huancor, Peru, in 1934, both triggered by the mining activities of Rio Tinto, or the workers' riot in Tokyo in 1907, against the Fukurawa Corporation (Martinez-Alier, 2002). There are a number of examples showing that local opposition to mining, for environmental reasons, has been by far the most important factor hindering the establishment of new mining in some locations (see the examples of Tambogrande and Intag below). In this sense, social movements against mining activities can be considered part of the 'centripetal' forces influencing locational decisions of

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[1] www.oilwatch.org.ec

[2] http://www.minesandcommunities.org

[3] http://www.moles.org

mining corporations. If the probability of facing strong local resistance is one of the critical factors that managers of mining corporations take into account when assessing the feasibility of new mines, then a sort of 'remoteness' dynamics might be created between world or national regions where communities are more likely to oppose operations of mines and those regions in which such conflicts are less likely to emerge.

Owing to their intrinsic complexity, the occurrence and intensity of ecological distribution conflicts can be hardly predicted. Therefore, any theory aiming to tackle these phenomena is necessarily confined to a descriptive ground. Such a theory would be devoted to identifying broad generalizations in the relationship between some social and environmental factors and the incidence/scale of conflicts. The following is an attempt in that direction. These propositions must be considered as working hypotheses.

Population density: environmental conflicts are likely to come out if the proposed or actual mine is located in a relatively densely populated area. Geographical distance from populated centres has probably played a role in avoiding conflicts in some countries with low population-density regions, where mines tend to be placed in remote areas, such as Australia, Canada, Chile, and to a lesser extent the USA.

Environmental performance: undoubtedly, the scale and concentration of environmental impacts (e.g. pollutant emissions) are decisive factors unleashing environmental protests and conflicts. Both the scale and the technological performance of mining activities determine the extent of environmental burdens. In this sense, the smaller and more technologically updated the mine the less should be the probability of producing pollution that could trigger local resistance. However, a considerable amount of environmental impacts from mining is generated due to accidents (natural events releasing stored and highly pollutant tailings, for instance). Hence, there is an uncertain component of environmental burdens that cannot be entirely accounted for by technological indicators, but rather depends on local perceptions of environmental risks. These perceptions are in part conditioned by previous experience of local communities with mining. 'Stigmatisation' of the mining industry, as for the rest of LULUs, is a common phenomenon. Besides, the perceptions of lay people about environmental risks usually differ from those of experts. This may constitute an additional matter of conflict between different social groups and decision-makers (Garvin, 2001).

Social rights: the notion of 'rights' (e.g. to autonomy, land, etc.) has been shown to be critical in triggering environmental conflicts, even in small and marginal social groups. Owing to its search for remote places, mines are often located in localities populated by indigenous groups (Ali, 2003), which claim ancestral – *de facto* or legal – rights on land. On the other hand, repressive political systems tend to exacerbate the local feeling of exploitation and to worsen the perception of unfair distribution of profits and environmental burdens.

Ownership and distribution of profits: local people are prone to oppose mining operations if they feel that environmental costs are suffered locally, but economic benefits mostly accrue elsewhere, either at the national or international level. Local perceptions on fairness in the distribution of profits and burdens, and on the degree of external imposition of the project – appealing to the 'national interest', for example – are critical components of environmental conflicts in the mining sector. Perceptions on the level of environmental risks may increase if people think that exposure to risky activities is 'imposed' externally (Kasperson, 1992).

Negotiation strategy: bargaining power and negotiation capacity are key factors for harnessing environmental conflicts. The negotiation capacity of the mining company largely depends on the conflict management strategy adopted (for example, openness to dialogue) and on the resources available for compensation. On the other side, the bargaining power of local communities is related to a variety of issues, including the political framework (e.g. degree of enforcement of democratic rules), level of organization, access to resources for mobilization and profitability of local alternative economic activities to mining. In addition, mutual distrust between groups is a factor that may hamper the resolution of the conflict through negotiation.

Income: while poorer communities tend to be more affected by undesirable land uses, the degree of opposition to LULUs – contrary to common propositions – is not weaker in communities with low socio-economic status (Bohon and Humphrey, 2000). Even in remote and poor areas, strong resistance to mining has been reported (Muradian *et al.*, 2003). However, richer and more empowered communities are more able to put into practice effective mechanisms to prevent LULUs. Thus, opposition to environmentally risky facilities is becoming universal across different social sectors and world regions, but the capacity of communities to actually stop, hinder or transform them might vary greatly according to their income.

As stated before, the relationship between these factors and the role they play in environmental conflicts in the mining sector is not straightforward. Although some broad hypotheses can be proposed, universal generalizations on this issue are not reachable. We are not going to elaborate here on the above propositions. Instead, we will focus on what kinds of factor have played a role in unleashing or preventing environmental conflicts associated with copper mining or processing. We will come back to this in Section 3, where we will describe some cases of severe environmental conflicts between transnational copper corporations and local populations in developing countries. In Section 4, we will explore the role of the above factors in explaining why Chile did not experience an escalation of environmental conflicts equivalent to its copper boom during the 1990s.

2 The macro-geography of copper production and trade

This section presents some figures about copper trade and production in different regions of the world, particularly in the USA, Western Europe and Japan, obtained from different data sources. We focus our analysis only in these countries owing to data constraints. The main objective of this section is to assess how the geography of copper production and trade has changed across time, particularly between industrialized and developing regions of the world economy. A general trend towards displacing copper production and trade to developing areas may be also indicating that environmental burdens and conflicts associated with this industry are being displaced. Figure 1 shows that copper production increased considerably from the 1980s to the 1990s in the USA, whilst it only slightly changed in Western Europe and decreased to almost zero in Japan. These trends are different in the case of semi-processed copper production. Figure 1 also reveals that, for the last years of the analysis, the amount of semi-processed copper produced is almost the

same in the USA as in Europe, and several times larger in these regions than in Japan, where it changed only slightly.

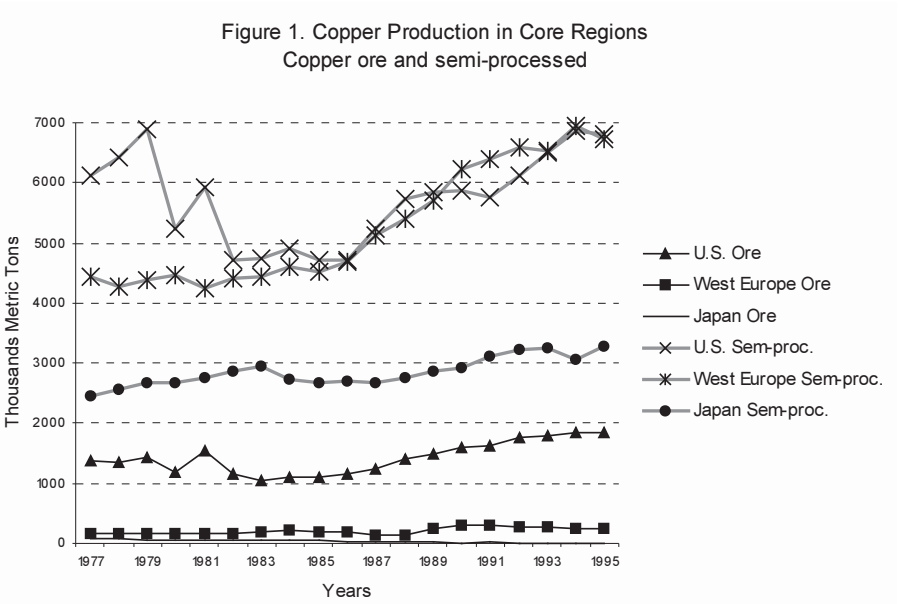

Figure 1 Copper production in core regions: copper ore and semi-processed copper (source: *UN Industrial Statistics Yearbook*, various issues).

Figure 2 shows that, compared with Europe and the USA, Japan is a much greater importer of copper ore from developing countries. In this country, as well as in Western Europe, the amount of copper ore imported from developing countries has increased significantly in the period of analysis. In contrast, imports from developing countries have remained at very low levels in the USA. Figure 2 also shows that Western Europe's imports of semi-processed copper from developing countries have increased considerably, while the same kind of import has changed in a lesser extent in the USA and Japan.

Figure 3 shows the European Union's imports of copper from Africa, Latin America, and the industrialized countries. It also reveals that during the 1990s there was a boom of Latin American copper exports to the EU, while EU imports from Africa dropped noticeably. In the same period, there was also a sustained decline in European copper imports from industrialized countries. In contrast, EU copper exports to industrialized countries rose substantially during the 1990s, whereas exports to Latin America and Africa remained stable (see Figure 3).

These figures shed some interesting light on the global geography of copper production and trade. From them we can state that the Japanese and European demand for copper from developing countries increased considerably during recent decades. Latin America, particularly Chile, has a rising importance as a copper provider to the world economy, especially to the EU. The USA is still a huge producer of copper, which makes it considerably less dependent on imports from developing countries in comparison with Japan and Europe. As shown before, in relation to copper ore production and trade, the USA shows a very different trend to Japan and Europe (see Figures 1 and 2). Copper ore

production in the USA has increased continuously since the beginning of the 1980s. However, this trend has not been accompanied by a rising number of mines. In fact, of the 26 significant mines producing copper in 1975, seven were shut down by 1995. In that year, 97% of copper output in the USA came from mines that had been in operation for 20 years or more. Rising output, concomitant with a falling number of mines, was possibly due a noticeable increase of productivity and falling labour inputs and wages from the 1980s onward.

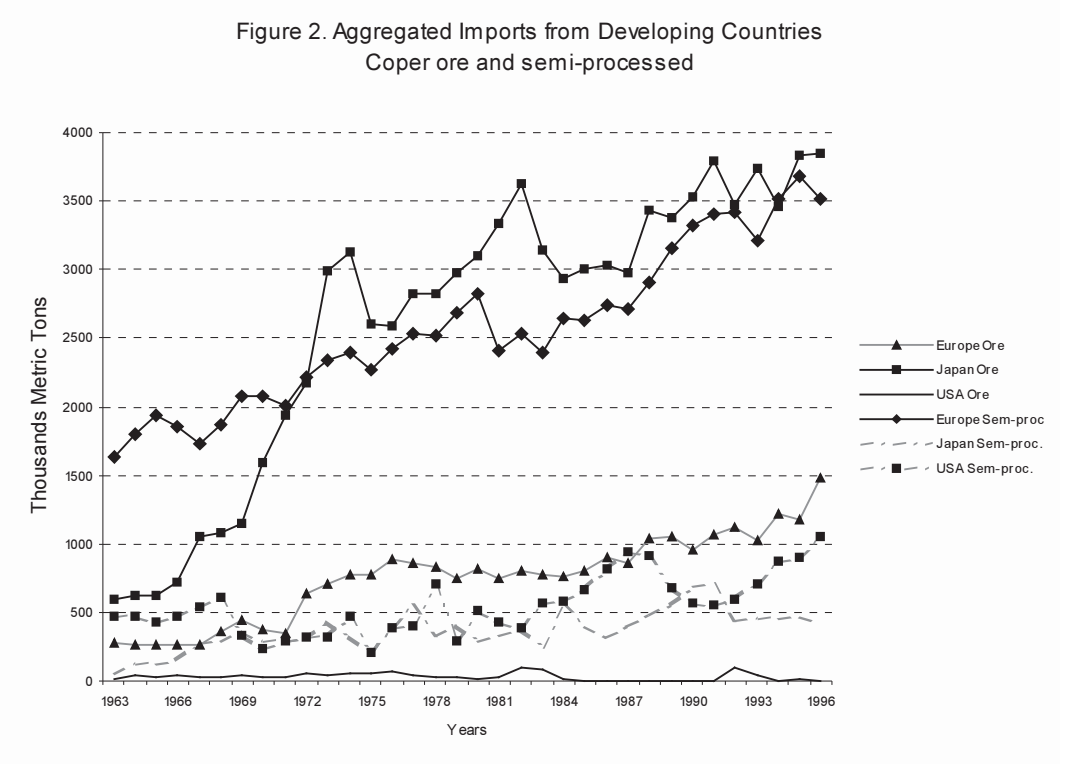

Figure 2 Aggregated imports from developing countries: copper ore and semi-processed copper (source: *World Trade Annual*, various issues. European data are aggregates of France, Germany, The Netherlands, Spain, Sweden, Denmark, UK and Ireland).

These transformations faced strong opposition from some trade unions. In 1983, there were two major strikes in American copper mines, one against Phelps Dodge in Arizona and the other in the White Pine Mine, Michigan. The latter mine remained closed for two years owing to this labour conflict (Tilton and Landsberg, 1997). Growing copper ore production in the USA (which is still the second largest world producer) reveals that the displacement of copper extraction towards developing countries is not clear-cut, though American transnational corporations were the main foreign investors during the copper boom in Chile. Nevertheless, the trend towards increasing flows of copper imports from developing countries is evident in the case of Japan and Western Europe. Historically, this represents a major change in the pattern of world copper production because, during the nineteenth century and beginning of the twentieth century, the greater part of the world's supply was coming from mines in Britain, Germany, Russia and Japan (Mupimpila and van der Grijp, 1999; Schmitz, 2000). Like the USA, Chile also experienced an incredible

boost of productivity in copper mining during the 1990s (Garcia *et al.*, 2001). However, in contrast to the USA, the copper boom during this period was accompanied by the opening of several new mines.

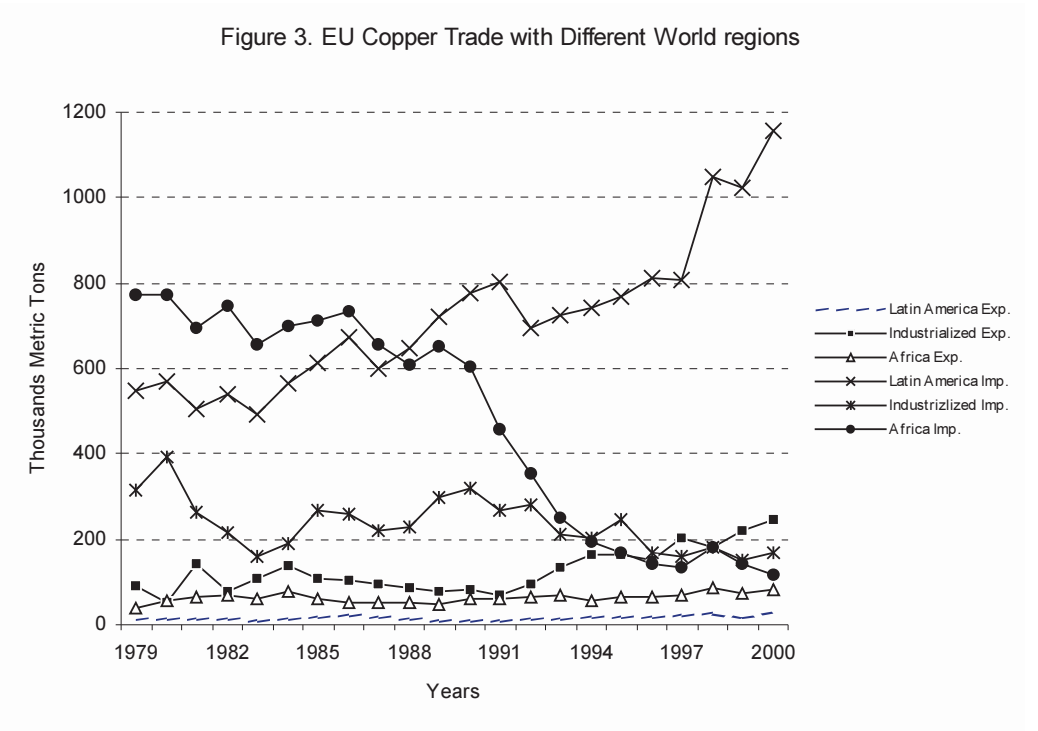

Figure 3 EU copper trade with different world regions (source: EUROSTAT, Intra and Extra EU trade CD-ROM).

3 Environmental conflicts and copper mining and refining

This section describes some recent examples of social conflicts associated with copper mining in different regions of the world.

3.1 Peru

Mining in Peru was long dominated by the Cerro de Pasco Copper Corporation. Indeed, the new national organization CONACAMI, which coordinates communities affected by mining, was born at the end of the 1990s from conflicts between the community of Vicco and the new mining companies in Cerro de Pasco. However, in the 1960s the extraction of copper had moved southward, towards Cuajone and Toquepala. These are large open-pit mines near Ilo, an extension of the rich deposits of Chuquicamata and other mines in northern Chile. Copper ores are now obtained by open-cast mining in southern Peru, with the associated problem of sulfur dioxide emissions from the smelters. The Southern Peru Copper Corporation (SPCC) owned by Asarco and Newmont Gold (and later on by Grupo

Mexico) subjected the city of Ilo in southern Peru, of 60 000 inhabitants in the late 1990s, to water and air pollution for thirty years. The smelter was built in 1969, 15 km north of Ilo, it emitted daily almost two thousand tons of sulfur dioxide, while tailings and slag were discharged without treatment on land, and also in the ocean where, it was claimed, 'several kilometres of coastline are totally black' (Diaz Palacios, 1988; Balvin *et al.*, 1995). The Southern Peru Copper Corporation is among the ten top copper producers in the world, and it was then Peru's major single exporter. More recently, local NGOs and European environmentalists have intervened in this long 'urban' conflict. During the 1990s, two international appeals to courts have been made. The local authorities presented a successful complaint in 1992 to the (unofficial) International Water Tribunal in the Netherlands obtaining its moral support. A class-action suit was initiated at the District Court for the Southern District of Texas, Corpus Christi Division, in 1995 (*New York Times*, 12 December 1995) but was dismissed after the Peruvian state asked for the case to be brought back to Peru. The plaintiffs, on behalf of people from Ilo, complained that the pollution from sulfur dioxide had not appreciably decreased in recent years, despite the construction of a sulfuric acid plant (which recovers SO_2). The federal court judge decided on 22 January 1996 against admitting the case into the USA judicial system on grounds of *forum non conveniens.* In 1997, the smelter emitted as much as 424 000 metric tons of sulfur dioxide, which exceeded the combined annual emissions of SO_2 of Sweden, Norway, the Netherlands, Finland and Denmark (Boon *et al.*, 2001). In 1997, SPCC signed an agreement with the government committing to carry out a two-stage programme to improve air quality by 2006. However, it revised that programme in 2001, proposing to the ministry that it would be completed by 2004 in a single stage. The ministry accepted that proposal but SPCC asked, in 2002, to return to the original plan (fully complete the modernization plan by 2006). In 2003, the government gave Southern three months to give proof of selecting new environmentally friendly technology, and SPCC finally said that it would meet the deadline.

This case exemplifies very well the role of both environmental performance and population density in unleashing environmental conflicts. The Ilo smelter was located near the city because copper was shipped through its port. This immediacy generated serious health threats to the city's population. The geographical proximity to the city was aggravated by the fact that the environmental performance of the smelter was clearly the result of using outdated technology, as well as of following environmental standards much lower than those applied in industrialized countries. Technological updating arrived due to considerable governmental pressure and after several decades of incredibly high levels of pollution that seriously affected surrounding populations. In this case, the mining corporation adopted a conflict management strategy focused not on dialogue, but on resistance to local opposition, and delaying of technological investment, which was permitted by legal considerations.

One of the most recent and prominent mining conflicts in Peru took place in Tambo Grande, a small town of some 16 000 inhabitants in the northern province of Piura. The open pit mining project, designed by a relatively small Canadian corporation (Manhattan Minerals Corp.) involves relocating most of the town's residents. During the first years of exploitation, the deposit is planned to be a gold and silver mine. Afterwards, copper would be the major mineral extracted, during at least 10 years. Since the beginning, the project has faced local opposition, led by a grassroots organization. The conflict witnessed a violent turning point on 27 and 28 February 2001, when a massive

demonstration took place in the town. Some 5000 local residents stormed the company's offices, burning machinery and destroying models of houses for relocating people. In May 2001, a forum for dialogue was established between the mining corporation, the Ministry of Energy and Mines, the Archbishop of the Diocese of Piura and the Front of Defense (the local opposing grassroots organization). Dialogue did not last long, because the Front pointed out that a compromise solution was not possible. They opposed any mining that involved dismantling part of Tambo Grande. On October 2001, dialogue was re-launched, mediated by the Defensoría del Pueblo (an Ombudsman reporting to the National Congress). This attempt at negotiation failed again. On 2 June 2002, opposition groups organized a 'referendum' (consulta popular) at the level of the Tambo Grande district. The 'referendum' was not legally binding, but the local government supported it. It was funded mainly by Oxfam UK. Voters against the project were about 94%. Abstention was around 31% of the total number of the 36 000 eligible voters in the district (*El Correo de Piura*, 3 June 2002). Later, in 2002, the leader of the opposing group won the municipal elections in Tambo Grande, which confirmed a very strong local opposition to the mining project. At the time of writing, after four years of conflicts and hundreds of thousands dollars spent by the mining company, it seems that the project is not going to be developed. This case reveals again the importance of population density and proximity to a residential centre in unleashing environmental conflicts in the mining sector. Despite the fact that the company undertook a negotiation strategy with the local population since the beginning of the operations, dialogue did not prosper, in part due to high levels of local opposition to relocation of houses. Perceptions on the distribution of profits and environmental burdens and risks – potentially affecting the main source of local income, agriculture – also played a crucial role on generating opposition.

3.2 Ecuador

In the late 1990s, in the region of Intag (Cotacachi, province of Imbabura) in northern Ecuador, Mitsubishi was defeated by a local non-governmental organization, Decoin, with help from Ecuadorian and international groups, in its plans to start mining for copper. The idea was to relocate one hundred families to make way for open pit mining, bringing in thousands of miners in order to extract a large reserve of copper. This is a fragile area of cloud forest and agriculture, with a mestizo population. A Mitsubishi subsidiary, Bishi Metals, started in the early 1990s some preliminary work in Intag. After many meetings with the authorities, on 12 May 1997 a large gathering of members of affected communities resorted to direct action. Most of the company's goods were inventoried and removed from the area (and later given back to the company), and the remaining equipment was burnt with no damage to persons. The government of Ecuador reacted by bringing a court case for terrorism (a rare event in Ecuador) against two community leaders and the leader of Decoin, but the case was dismissed by the courts one year later. Attempts at the time to bring in CODELCO to mine (the Chilean national copper company) were also defeated, when Accion Ecologica (a NGO from Quito) sent one activist to downtown Santiago to demonstrate with support from Chilean environmentalists on the occasion of a state visit of the president of Ecuador, and she was arrested. The publicity convinced CODELCO to withdraw.

This case is very similar to Tambo Grande in the sense that the main factor driving opposition was the plan for relocation. Even though Intag is a village with a low population density, the intention of 'forced' relocation generated enough local hostility to

trigger a conflict. In this case, as in Tambo Grande, good organizational skills of the grassroots organization and a partnership with urban NGOs seem to have determined, to a large extent, the result of the clash.

3.3 Indonesia

In Irian Jaya, Indonesia, near the town of Timika, Freeport McMoRan has being operating the world's largest gold mine and the third largest copper mine. Two kilometres from there, Freeport recently opened a new pit. The combination of the two sites is planned to become the world's single biggest mining operation. During the more than 30 years of operation of Freeport in West Papua, water pollution in the Ajkwa river (from tailings dumping) and violations of human rights have been the major complaints from local population. Historically, the company is reported to have not adopted any remarkable policy of commitment or royalty distribution to the local community. In 1977, in the initial stages of operation, some Amungme – indigenous group wishing independence from Indonesia and in whose territory the mines are located – rebelled, and destroyed the slurry pipeline carrying copper concentrate to the coast. Reprisals by the Indonesian army were notorious. On 31 May 1995, 11 villagers from Hoea near Timika were gunned down by army members assigned to guard the mines. In both 1996 and 1997, riots in Timika were sparked off by confrontations between Freeport and military personnel and local people. A number of people were killed in each incident, and Freeport's vehicles, equipment and laboratories were smashed by angry crowds. Complaints against Freeport McMoRan have led to a couple of class-action suits in American courts, without concrete outcomes owing to jurisdiction uncertainties.

Freeport has undertaken environmental and social programmes intended to lessen opposition. It has published an annual report entitled *Working Toward Sustainable Development* since 2001, which includes the company's commitment and performance with regard to social relations and environmental issues. However, the company is facing difficulties in improving its image. Its mines in Irian Jaya are probably the most prominent recent case of environmental and social conflicts associated with copper mining. The main driving forces of local discontent towards mining in Irian Jaya seem to be (i) the scale of the impacts, related to the huge size of the mining activity itself and (ii) the local political context, which was conditioned by the local independence movement and the repressive Suharto dictatorship.

Political and 'land' rights, particularly among minority groups, have been frequently involved in mining conflicts. The secessionist war at the end of the 1980s in Bouganville island, against Papua New Guinea, was also triggered by a conflict related to the social and environmental effects of a large-scale copper mine (Connell, 1997). Even though the population density in the villages surrounding the Freeport's mines in Irian Jaya is relatively low, the 'minority' condition of the Amungme (intensifying the sense of exploitation and unfairness), the local repressive context and the great scale of the impacts were sufficient to unleash the clash between the local population, the state and the company.

4 The Chilean copper boom

In the previous section we dealt with the driving forces of environmental conflicts in copper mining. The following is an attempt to address the reverse concern, that is, which conditions prevent the appearance of environmental conflicts in a context that apparently should produce them.

4.1 The copper boom, 1983–2003

Current Chilean annual copper production is twice that of 1994, four times bigger than 20 years ago, and ten times larger that the average during 1950s (see Figure 4). Owing to this boom, Chile has become the main copper producer and exporter of the world, overtaking its historical competitors (USA, Canada, Zambia) and surpassing the production of other countries that have also experienced a considerable expansion of copper production during the past decade, such as Indonesia and Australia. The Chilean copper boom was partially the product of a good performance of the traditional mines of CODELCO, the state-owned mining enterprise. However, new and huge private mining projects, carried out by transnational mining corporations, accounted for the bulk of the production boost. The decisive factor of this spectacular process of transformation has been the new institutional arrangement built from 1974, by the military dictatorship, which offered facilities and guarantees to the transnational mining corporations wishing to operate in the country. Surprisingly, the neo-liberal Pinochet government (1973–1989), which privatized hundreds of state-owned enterprises, kept CODELCO as a public asset. From 1974 to 1984, foreign investment in the mining sector accounted for about 43% of total direct foreign investment. From 1985 to 2001, accumulated foreign investment in the mining sector reached 13 700 million US dollars. Most of these investments (61.4%) came from the USA and Canada. During the period 1974–2001, the mining sector was the main recipient of foreign investment in Chile, with a share of 33% of accumulated foreign investment. Since the second half of the 1990s, private enterprises have surpassed state-owned corporations in the production of copper (see Figure 5). In 1998, the 17 largest mining companies operating in the country, both public and private, constituted a lobby chamber called the ‘Mining Council’, which has been crucial for the redefinition of policies in the sector.

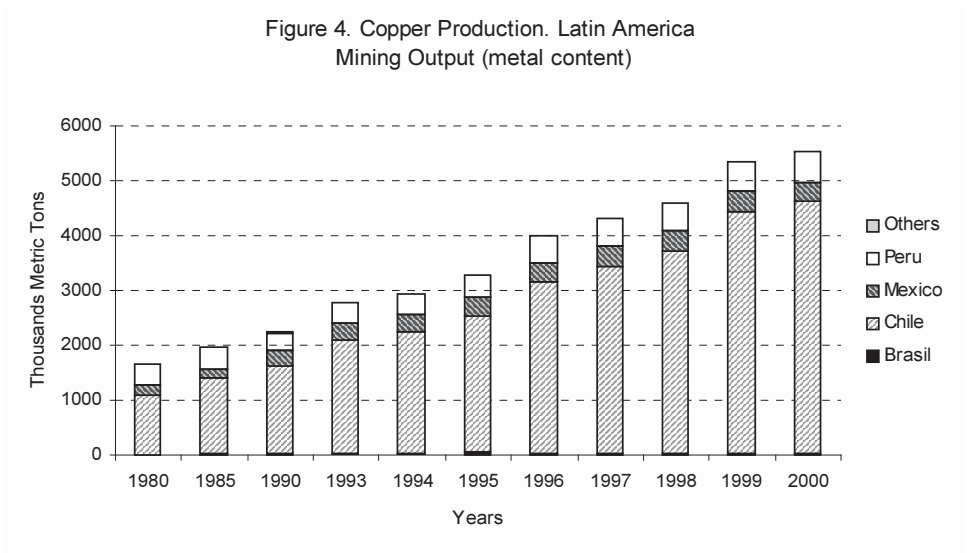

Figure 4 Copper production. Latin America mining output (metal content) (source: ECLAC, *Annual Statistical Yearbook 2002*).

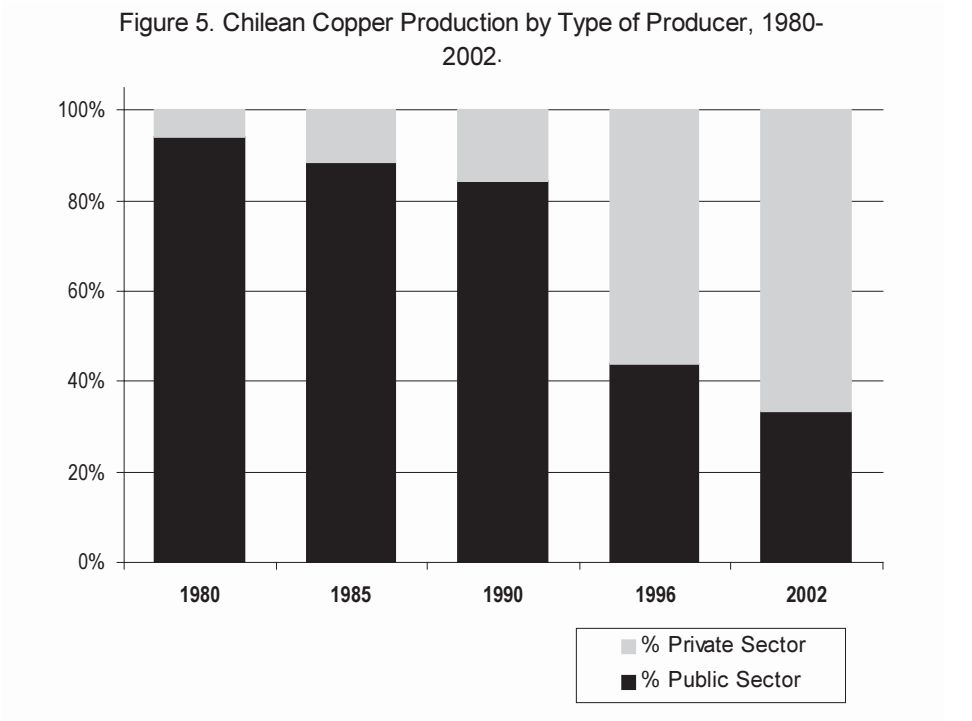

Figure 5 Chilean copper production by type of producer, 1980–2002 (source: COCHILCO, 2003; Vera, 1994).

4.2 Copper boom and environmental impacts

The copper boom has not been accompanied by an equivalent rise of environmental impacts (measured as aggregated emissions to the air or water). We argue that there are at least three reasons for this. First, unlike 20 years ago, not all of the copper extracted currently in Chile is completely processed, thus the expansion of emissions from refining (concentration, smelting and refining) has not been directly proportional to the increase of the extracting activities. Figure 6 shows that the proportion of copper ore to total copper production has considerably increased. Besides, a larger ratio of refined copper is nowadays produced by means of electro-winning, which is the best available smelting technology in terms of pollution. Second, the expansion cycle of copper has coincided with a trend in the world metals mining industry oriented towards the development of more efficient and cleaner technologies, which have been introduced in Chile by the same foreign companies. For example, from 1980 to 2000, the percentage of SO_2 emissions captured in Chilean smelting plants has changed from almost zero to practically 80%, owing to technological improvements (Tilton, 2001). Lastly, the copper boom has been accompanied by new environmental policies, stimulated by democratic governments, which have established a regulatory framework for mining activities and have started to control its processes by applying sanctions when it has been necessary. In 1990, a national commission for the environment (CONAMA) was created. Two years later, a law project on 'General Framework on the Environment' was submitted to Congress, and finally approved in March 1994. In 1997 the 'Code of Evaluation of Environmental Impact' was issued, completing the environmental normative system for the mining industry. All these technological and institutional changes have prevented the explosive development of mining activities in Chile from leading to ecological catastrophe.

Figure 6. Chilean Copper Produccion by Type of Product, 1980-2003.
(Thousands metric tons of copper content)

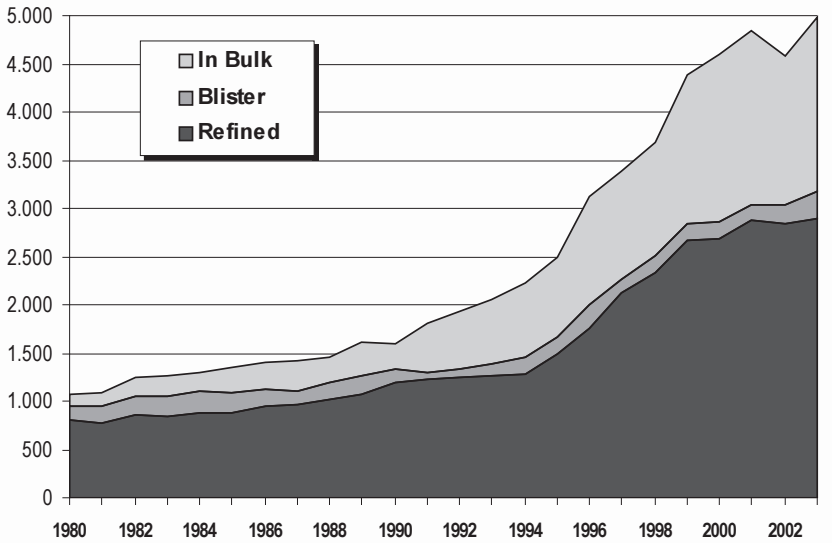

Figure 6 Chilean copper production by type of product, 1980–2003 (thousands of metric tons of copper content) (source: COCHILCO, 1997 and 2003).

There have been several examples showing that the actions of the state or state-owned companies have favoured environmental improvements in the copper sector. For instance, in 1987, civil organizations from the city 'Chañaral' set a court action against the division 'El Salvador' from CODELCO, which had been disposing tailings from copper mining into the Salado river. The court resolved in favour of the local organizations and forced the enterprise to solve the problem of tailings disposal. In 1995, CODELCO published its environmental policy, and set out some environmental objectives based on ISO rules, which led to the control of smelting gases and to the construction of tailings deposits. ENAMI, a state-owned smelting company, has had a similar evolution to CODELCO. In 1990, after Chile started to be ruled by democratic governments, the company recognized that it had caused pollution in the past, set up a system to reduce 30% of SO_2 emissions, and launched a plan of pollution mitigation. Paipote Smelting, also a public smelting company, followed a similar pathway. The government also took measures against some mining enterprises that had not followed the environmental law. For instance, in May 1991, the government ordered Chagres Smelting to reduce the concentration of SO_2 in its emissions because pollution was causing losses to neighbouring farmers. Another example is the shutting down, in February 1993, of a mine belonging to Compañía Explotadora de Minas, owing to environmental risk considerations. The mine was located in a wildlife-protected area.

Nevertheless, despite these improvements, national environmental agencies are still politically weak – CONAMA, the higher environmental authority, has not yet the status of a ministry – and the environmental performance of the mining sector is sometimes below

international standards. For instance, since 1999 the Chuquicamata smelting company has been unable to reduce emissions to the levels agreed with the government (Figure 7). Moreover, some environmental issues of mining are not yet clearly regulated, such as access to resources (water or soil) or management of long-term impacts, such as remediation of accumulated pollution or landscape restoration. Intending to fill this legal gap, voluntary agreements, called 'agreements of clean production', between the government, mining companies and some technical bodies, have been created. These agreements – from which civil associations or the potentially affected communities are excluded – aim 'to minimize pollution and to increase the competitiveness of companies'. In November 2000, the 'agreement of clean production for large mining industry sector' was signed, by the government and the companies affiliated to the Mining Council.

Figure 7. Emissions of SO2 by Chuquicamata's smelting, 1993-2003
(Thousands metric tons by year)

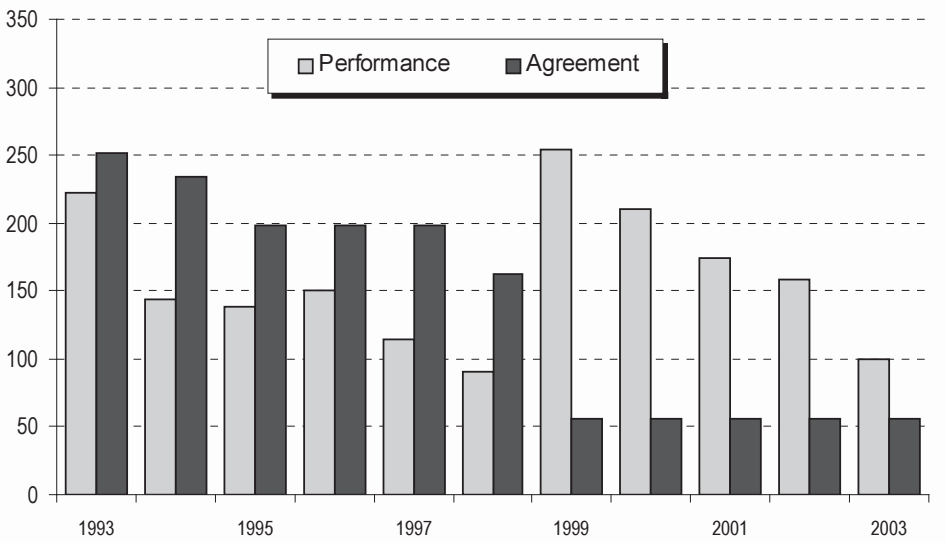

Figure 7 Emissions of SO_2 from smelting at Chuquicamata, 1993–2003 (thousands of metric tons by year) (source: CODELCO, 2000 and 2002).

Environmental accidents related to copper mining have not disappeared from Chile. For example, the copper mine El Alba (which was opened using the slogan 'this mine does not pollute') suffered a sulfuric acid spill from the lixiviation plant, polluting the Loa river. In August 1999, a tailings spill from the concentration plant of Cobrex SA polluted the Lautaro dam, near Copiapó. The same company has polluted several times, with tailings, the Elqui river. The mining company Los Pelambres was fined 12 000 US dollars after a spill of concentrated copper, caused by a leak in the transportation pipe. The mining company Portezuelo, operating a lixiviation plant near to Illapel, was investigated and sanctioned following illegal disposal of liquid waste to water deposits from April to July 2002. In November 2002, the smelting company Altonorte was fined 18 000 US dollars for surpassing the allowed amount of SO_2 emissions. In October 2003, one of the tailing

deposits of the mine Cerro Negro, from a medium-sized and old company, suffered a break, with the consequent spillage of 50 thousand tons of tailings that contaminated the water streams of Guayacán, an agrarian locality.

Environmental accidents also occurred in the public mining sector. In August 1998, there was a spill of concentrated copper in the Andean Division of CODELCO, which polluted the White River. In June 2000, the same division suffered a spill of 5280 cubic metres of tailings into the El Maitén stream. At the beginning of 1998, there was a spill (which lasted 14 days) in El Teniente mine, which released one thousand metric tons of concentrated copper to the Coya River. In August 2001, the same division suffered a spill of 26 000 litres of sulfuric acid to the same river. In February 2002, a spill of sulfuric acid caused the intoxication of 33 workers in CODELCO. In November 2002, on two occasions, pipe breakages caused the spillage of tailings in the Chuquicamata division, producing a pool 3 km long which, according to the company, 'did not provoke any ecological damage'.

4.3 Copper boom and environmental conflicts

In spite of the previously described environmental modernization of the state and copper mining companies, there have been indeed some recent cases of environmental conflicts associated with copper mining in Chile. The following are the most outstanding.

- Transportation of sulfuric acid from the smelting plant of the El Teniente (CODELCO) to the San Antonio harbour (1997–1998). Opposition of surrounding communities forced the company to build a pipe, instead of the system of transportation by trucks that was originally planned (which was considered too risky by local civil organizations).
- Copper concentration plant in Los Vilos (1996–1998). The mining project Los Pelambres planned to build a plant. It faced local opposition by the community of fishermen, who were concerned about potential pollution. An agreement of cooperation was signed between the mining company and the fishermen community. The latter turned down resistance towards the project (Mayorga, 2000).
- Dam of tailings of the mining enterprise Los Pelambres (2000–2002). This mining company planned to expand its tailings dam (which filled up earlier than planned). This project faced strong opposition by communities potentially affected.
- Dump leaching in Andacollo (1997–2002). The mining company Carmen de Andacollo, a subsidiary of the Canadian Aur Resources Inc., uses sulfuric acid in the treatment of piled-up copper mineral. The plant is about 200 m from the town of Chepiquilla, whose inhabitants have reported dispersion and filtration of toxic substances. They have set an international court action against the Chilean environmental authority for allowing the functioning of the plant using this risky method (Corvalán, 1999).
- Mining harbour Caleta Coloso (1990–1997). The mining company La Escondida (BHP Billiton) built a plant for drying and shipping copper mineral in this coastal locality. Local dwellers and fishermen complained about dust and water pollution caused by the plant. The enterprise agreed to change the system and avoid environmental problems (Padilla, 2000).

- Tailings dam of the mining enterprise Las Juntas in Ovalle (2000–2001). This company used a faulty system of tailings disposal, which produced several spills. Local farmers complained to the government, which finally decided to shut down the dam. Some time later the company declared its bankruptcy and abandoned the place without implementing any abatement of accumulated pollution.

These – relatively speaking – 'minor' conflicts (compared with those we have described before) reveal that, even though social contests due to copper mining or processing activities have not been absent in Chile, there has been not a direct correlation between the scale of the activity (measured as the weight of copper production) and the magnitude or frequency of environmental conflicts. The following are the main reasons we have identified for explaining this fact. First – which is probably the major explanation – most copper mining activities in Chile are developed in isolated and thinly populated regions. Environmental conflicts have thus been concentrated near smelting or refining plants. Second, the environmental legislation intends to prevent large, evident and permanent environmental impacts (as there were in the past). As we have described before, considerable environmental impacts have occurred in sporadic and accidental events, which are hardly predictable and unlikely to generate a permanent opposition movement. Finally, there is a factor related to the distribution of power. In the 'mining regions' of the country, there are practically no social actors able to exercise a counterweight to mining interests. Most groups affected by the mining activities come from marginal sectors, such as small farmers, modest fishermen or the poor inhabitants of the surrounding settlements to mines or smelters. These groups often lack enough empowerment for consolidating protests. Moreover, many mining enterprises (private and public) have introduced systematic policies of 'cooperation' with nearby communities, which has likely reduced the probability of social clashes (due to, in part, a better local perception on the distribution of benefits).

5 Concluding remarks

This article has dealt with some aspects of the economic geography and political ecology of copper. We have shown that Europe and Japan are progressively more dependent on imports from developing countries to cover internal copper demand. Historically, this implies a major change in the geographical pattern of global copper production, because Europe was once the leading copper producer in the world. The trend is different in the USA, whose copper production has considerably increased in recent decades; however, improvements in productivity have meant that rising production has not been accompanied by an increasing number of mines in the country, and this has probably prevented environmental conflicts. In Chile, the pathway has been different, because the 'copper boom' has taken place concomitantly with the operation of new mines. However, there has not been an equivalent climb in the number or intensity of environmental conflicts (although they have not disappeared entirely). We have argued that this is, in part, explained by the location of mines in isolated regions, stricter environmental policies and investments in updating environmental technologies.

We think that local social movements and conflicts can play a significant role as 'centrifugal' forces in environment-intensive sectors, such as mining. We have described several environmental conflicts related to copper mining or processing. In some of them,

local resistance has decisively affected the locational decision of mining facilities. The cases of Intag, Ecuador, and Tambo Grande, Peru, seem to disclose that mining companies are likely to face very strong local opposition when their activities involve displacing local dwellers. The case of Irian Jaya and Bouganville Island shows that the scale of the activity (environmental burdens) and the local notion of social rights are also critical factors triggering environmental conflicts. The case of Ilo reveals that some conflicts might be lessened by means of investment in technological updating. Population density also plays a major role in unleashing environmental conflicts. The particular geography of some regions, such as Chile, the USA or Australia, where there are plenty of isolated locations where mining does not compete directly with alternative economic activities, allows mining companies to stay away from social clashes. The Chilean case has also shown that the institutional framework for conflict resolution may influence considerably the emergence, extent and resolution of conflicts.

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