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Impacts of Macroeconomic Policies,  
the Environment, Natural Resources,  
and Welfare in Developing Countries

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## 1. Introduction

The purpose of this chapter is to explore relationships between macroeconomic conditions and policies on the one hand, and the environment, natural resources and population welfare in developing and emerging countries on the other. It is a broad and complex topic, and the literature dealing with the relationships between macroeconomic policy, and environmental and resource management and performance so far is small and typically not focused on direct links. Our objective here is to try to sum up some lessons from the literature so far, not the least with the aim to guide future investigations in this area.

An early discussion of relevant issues is found in Munasinghe (1996), in particular the chapter by Mäler and Munasinghe (1996). Broader discussions of the relationships between alternative economic policies, and environmental and resource degradation and management, are provided by Dailami and ul Haque (1998) and Weiss (1995). Dasgupta and Mäler (1996) and Pearce (1996) focus on more specific relationships between macro policies and environmental and resource degradation, with an emphasis on the possible causes of market failure, i.e., the factors that lead to deviation from efficiency.

We will in the following discuss a limited to a small set of issues that are in different ways macroeconomic:

1. Taxes and subsidies, such as those affecting sectors that extract natural resources or strongly influence the environment, and the environmental and resource/welfare effects of these. At a sector level these are often considered microeconomic given their implications for relative prices and allocation efficiency, but given their importance and their link to a country's overall fiscal policy we include them here.
2. Domestic investment, including infrastructure investment affecting costs of resource extraction and environmentally degrading activities, clean-up and other environmental equipment, and the inclination to invest in projects that have long-run versus short-run consequences.
3. Monetary policy, in particular exchange rate and interest rate policy, with focus on exchange rate regime.
4. Issues related to the functioning of the financial sector, including control and regulation of credit and financial markets (hereunder regulation of banks and

other lending institutions), the degree to which foreign direct investment (FDI) and foreign ownership are encouraged and regulated, and the actual flows of funds.

5. The implications of stress situations such as financial crises and disasters with major impact on GDP, employment and balance of payments, and policy responses to crises.

Points 1-2 are largely directed at particular sectors or even firms. Points 3-5 deal more with core macroeconomic policy issues, in combination with financial-markets issues. Our discussion of points 3-4 will be focused more on principles than on empirical detail and verification, as data here are scant.

Our focus forces us to ignore or downplay a number of macroeconomic issues that are potentially important for environmental and resource developments. These include fiscal policy directed at short-run stabilization (hereunder budget deficit policy), for many the very heart of macroeconomics; growth and other long-run issues; as well as issues related to international trade or exports; the latter two topics are however discussed in depth in other chapters of this book. The exclusion of fiscal policy issues is made mainly for brevity and in order to keep the focus of this chapter on financial (including monetary) policy.

We consider a wide set of environmental and natural resource impacts and management issues. Particular attention will however be paid to resource extraction issues, with tropical deforestation and factors causing it as a prime example. There are several reasons for this focus. First, a number of good and relevant studies now exist dealing with mechanisms behind tropical deforestation. Secondly, for many regions of the developing world, deforestation is a key environmental and natural resource problem, at least when viewed from a global perspective. In our view, forest management can also in many countries be considered as a good indicator of more general environmental management practices and principles.

As a basic principle of economics, efficient environmental policy implies that marginal costs and benefits of additional pollution reduction or natural resource improvement be made equal. In most developing countries today, such principles are far from meeting them. Sometime the necessary legal framework does exist, and attempts are made, even by the private sector (as when environmental certification is required), to move in the direction of soundness in environmental

and resource policy. Very often, however, the institutional capacity and incentives imply that little is done to enforce formal regulations.

The broader relationships between macroeconomic activity, environment and natural resource pressure, and population welfare are complicated and will not be analysed in detail here (work that discusses and analyses such issues includes the so-called Kuznets curve literature, see Grossman and Krueger (1995), Shafik (1994), Stern (1998) and Torras and Boyce (1998)). Direct quantitative income effects of environmental and resource availability and quality have been studied in the literature only to a limited extent, and though they can be very significant. Studying 14 cities in Central America, Strand and Walker (2003) found that the average real disposable income of households without current tap water access (who are typically poor) would rise from 62 to 75 % of the average income of households with initial access, if tap water access were provided to all. The supply is greatly affected by macroeconomic policies of types considered here (such as improper subsidies or lack of such, government public goods supply, and macro policies affecting government budgets). Failures in several sectors simultaneously (a typical situation) will compound and magnify the welfare effects identified here.

The concept of a “macro economy” is in itself ambiguous. In standard macroeconomics as taught in universities and practiced by central banks and governments, GDP (or NDP) is taken as the basic measure of macroeconomic activity, and as the basis for analysis. More recently, views of what constitutes macroeconomic analysis has changed in several respects. The introduction of “green national accounting” and related themes (Dasgupta (2001), Dasgupta and Mäler (1996), see also Hamilton and Hassan (this volume)), implies the alternative view that the value of and change in the environment and resources are part of the calculation of national product, on a par with society’s output of more traditional goods and services. It is still unclear how the various effects ought to be embedded into standard macroeconomic policy. Few countries have so far even tried to implement the green GNP concept in the sense of putting numbers to the effects. Secondly, macroeconomic analysis has over time taken a gradually more micro-oriented form, implying that one also may consider sectoral and more partial effects, via the behavior of particular economic agents, in response to

particular macroeconomic instruments. This is the approach we will take in the following.

## **2. Taxes, subsidies and government investment**

Ideally, taxes and subsidies on commodities and economic activities ought to reflect the need for government financing, in combination with the need to address externalities by corrective taxes or subsidies. The current consensus however seems to be that, in many or most developing countries, too many taxes and subsidies work “perversely” in promoting resource extraction and excessive pollution, instead of the opposite (whereby pollution and unwanted extraction are prevented by such policies). As documented by Clements et al (1998), the level of government subsidies follows particular patterns that are not closely related to economic efficiency, but rather to other political and economic factors (such as the size of government and the composition of industry, with particularly high subsidy rates when government and the manufacturing sector are both big).

The concept of a “subsidy” here needs some further clarification. Moor and Calamai (1997) (see also Beers and Moor, table 1.1.) discuss two categories of such subsidies, namely direct on-budget subsidies (government funds are paid out directly to producers or buyers of particular commodities), and more indirect, off-budget subsidies that still normally have budgetary implications for the government. The second category can take many forms such as tax credits or reductions; public provision below cost (including insufficient resource rents for natural resources); capital cost subsidies (preferential loans and debt forgiveness); domestic-oriented market-based subsidies (through price regulation and procurement policies); and trade-oriented market-based subsidies (tariffs and non-tariff barriers). A third and more controversial category implies that a commodity charged a price that covers production cost but is not corrected for possible negative externalities (such as when the pump price of gasoline covers production cost but not road and pollution externalities). In many cases the issue of whether a commodity is “subsidized” or not may then be controversial, since the level of the optimal tax correcting the externality very often is controversial.

Subsidies to, or under-taxation of, environmentally harmful activities has three main implications. First, too little care is taken by economic agents, to improve

the environment and reduce excessive resource use. Perverse resource overuse may even be directly encouraged (such as with subsidies to clear-cutting for ranching purposes in the Brazilian Amazon, and with virtually cost-free limited-time logging concession in East Asia). Secondly, government revenues are reduced, leaving room for fewer highly productive government expenditures. Thirdly, it may have adverse distributional implications as in most cases only the wealthier population groups are able to exploit the subsidies, as with gasoline and electricity subsidies, and even often water subsidies.

Consider first subsidies to activities and goods that have a direct environmental and natural resource nature or have strong impact on the use of the environment and resources. Subsidy schemes of this type can take different forms in different sectors of the economy, and affect different users differently. Production subsidies lead to higher production of the subsidized good, and greater use of inputs into its production. Similarly, consumption subsidies lead to higher consumption of the relevant goods, assuming market clearing and production mainly for a domestic market. Such stimulus can be socially desirable if it corrects a market failure or externality that implies that the activity level is otherwise sub-optimal. Much more typically, however, the subsidy is detrimental to efficiency. Since some of the relevant inputs are environmental and natural resource goods, subsidies lead to overuse and deterioration of these goods.

“Subsidies” can as noted also take the form of underpricing for particular buyers, in cases where markets are not allowed to clear or the good in question is produced or procured by the government. Subsidies of this type will often go hand in hand with rationing of the resources among users, and with a number of further inefficiencies related to under-provision, such as poor maintenance and upkeep of necessary infrastructure, and poor incentives for system expansion. Important examples of such inefficient policies, involving natural resource allocation, can be found in the (urban and rural) water and sanitation sectors of many developing countries, as noted below.

The effects of subsidies on the environment and natural resources depend critically on institutional structure, in particular ownership structure, and on the time horizon of producers. With permanently high prices and secure ownership relationships, it is not always obvious that high producer prices, pushed up by subsidies, need to imply environmental overexploitation; see e.g. Barbier et al

(1995) and Bohn and Deacon (2000). When high prices by contrast are expected to be short lasting, ownership or control relationships insecure, or there is substantial illegal logging, the pressure toward overexploitation is typically much greater; see Amacher, Koskela and Ollikainen (2004a,b).

Beers and Moor (2001) discuss a range of environmental and resource implications of different sectoral subsidy groups, where subsidy is defined as the two first categories discussed above (“subsidies” that are due to a failure to correct for externalities are not included). They focus on 8 economic sectors which all enjoy substantial subsidies worldwide: Agriculture, water, forestry, fisheries, mining, energy, road transport and manufacturing. Table 1 below gives an overview of subsidy levels within these sectors, for both OECD and non-OECD countries, as annual averages for the years 1994-1998. (The table shows that OECD country subsidies are far greater overall than non-OECD ones, and are concentrated in the agriculture and road transport categories).

For the non-OECD group, which is of most interest here, direct subsidies to agriculture are rather limited (the largest single item being implicit subsidy in the form of cheap irrigation water). Instead, massive subsidies to agriculture in rich countries tend to push world market food prices down toward levels that make it difficult for most developing-country producers to compete. The main effect for poor countries, of the massive agricultural subsidies in OECD countries, is to seriously depress production of cash crops (of the types competing with developed-world agriculture). While hardly a favourable situation for the developing world, an effect of these may be to reduce environmental and resource exploitation, at least in the short run. Angelsen and Kaimowitz, in surveying a large number of studies (see Angelsen and Kaimowitz (1999), Kaimowitz and Angelsen (1998)), conclude that lower agricultural prices overall tend to reduce tropical deforestation. The main driving factor behind this conclusion seems to be that the pressure on the frontiers of agricultural expansion in forest-rich regions is thereby reduced.

In the water sector, developing country subsidies take three main forms: as irrigation subsidies (according to Beers and Moor (2001) about half of the total), as general underpricing, and in the form of unsanctioned illegal connections. These subsidies have three main effects. The first, and quantitatively most important, is that following from real subsidization of water-intensive irrigated

agriculture, with zero or near-zero user prices of irrigation water, with often extremely low productivity in irrigated water use (as in Mexico as discussed in Asher (1999)). The second is inefficient water use within households, whereby water is over-used by tap households whose water rates are below government provision costs, and under-used by non-tap households, typically also with very adverse income distribution effects. The third is inefficient provision of water and sewage services by authorities. Utilities then have little incentives to maintain or expand the water and sewage systems (since utility revenue would then typically fall), and often lack even incentives to collect revenue properly (since greater revenue collection might lead to further budget tightening from above). Striking examples of such problems are found in Central American cities; see Strand (2000), Walker et al (1999) and Strand and Walker (2004). The general problem is however ubiquitous, found also in African (Whittington et al (1990) and Asian (Altaf et al (1993)) contexts as well. A related set of problems exist in the irrigation water sector; see e.g. Asher (1999)).

In fisheries, subsidies are largely a developed country problem, except in China which today subsidizes the sector substantially. Subsidies here take both on-budget and off-budget forms; the most important off-sector subsidies are investment subsidies and the private capturing of public resource rents; see Milazzo (1997) for a further discussion. Fishery subsidies are particularly damaging in the long run, in particular when not accompanied by imposed production restraints or quotas, in that they tend to lead to excessive harvesting rates of ocean fish stocks, which are already seriously depleted in many ocean waters. This is a serious global resource problem for the long term, and a possible pollution problem for the short term. China today in particular appears to suffer from these problems, exacerbated by the subsidies from the 1970s on: despite more intensive fishing activity catch rates are only about half of those experienced in the 1950s. The long-run consequence may be to undermine the livelihood of regions currently relying heavily on ocean resources. The short-run effect of subsidies may in some cases be “beneficial” in allowing the maintenance of incomes for local fishermen. Note however again that the overwhelming amount of subsidies are paid out in rich countries. Poor countries’ welfare is then of course further reduced through the reduction in catch rates of their (largely unsubsidized) fisheries.



In forestry, subsidies comprise support policies both within and outside the forest sector. The most common type of support within the forest sector takes the form of inefficient capture of resource rents, mainly through low stumpage fees to logging companies, for the right to harvest timber over a given concession period (see e.g. the examples discussed by Asher (1999), from Cameroon, Costa Rica and Malaysia). Such underpricing is particularly harmful when concession periods are short or possible renewal of current concessions uncertain. Timber companies with concession then have strong incentives to harvest as much as possible within the area and time frame for the concession. Such practices have been and are still widespread, in large regions in particular in South-East Asia and Africa. Beers and Moor (2001) calculate that prices paid by concessionists in most of the country cases studied (such as Indonesia, Russia and a number of African countries) only are in the range 5-25 % of resource rents. In Latin America (notably Brazil) the main problem has rather been a large more direct subsidization of the forestry sector, in particular through investment credits for logging companies, and the payment of direct subsidies for the establishment of cattle ranches on previously forested lands. This has in many cases has a devastating effect on forest lands, and a double negative effect: first, widespread clear-cutting of forest for agricultural expansion; and secondly, little actual use of the forest resources lose (apart from selective exploitation of valuable tree species), as entire forest tracts are simply burned off.

Among the sectors covered by Beers and Moor (2001), the energy sector seems to be the most heavily subsidized sector in the developing world, with overall subsidies estimated at about 160 billion USD annually over the period 1995-1998, as indicated in table 1. Table 2 breaks these subsidies down by more specific energy sector. We see that more than half of the subsidies concern fossil fuel use, where subsidies often is particularly harmful, as fossil fuel use instead ought to be taxed for efficiency and fiscal reasons (as it is in many OECD countries, notably in Europe), see Dixit and Newbery (1984), Newbery (1987) and Gupta and Mahler (1994) for discussions with particular relevance to developed economies. While most subsidies in developed countries here go to production (which spurs output of fossil fuels but not necessarily domestic consumption), in developing countries most subsidies go to consumption, which increases consumption more directly. The most quantitatively important such

subsidies are in the form of lower prices of gasoline and kerosene. Such subsidies are particularly high in many resource-rich (especially petroleum rich) developing countries. A thorough documentation of such phenomena is found in Wunder's (2003) detailed study, focusing on deforestation, of 8 oil-exporting countries (Gabon, Venezuela, Cameroon, Ecuador, Mexico, Nigeria, Indonesia and Papua New Guinea).

In the case of subsidies to fossil fuels, the categories of "subsidy" covered by Beers and Moor (2001) are clearly insufficient to describe the inefficiencies involved. From a social efficiency point of view, a "net subsidy" or "net tax" ought to be calculated relative to a socially optimal tax or subsidy. For fossil fuels this may lead to great differences in optimal subsidy rates, both by fuel type and by location of users. Two important and rather opposite examples may here be mentioned. The first is gasoline consumption, which often involves substantial (congestion, road use, accident and pollution) externalities that by themselves warrant substantial taxes. A further point is that gasoline is over-consumed by wealthier households, making a gasoline tax highly progressive in most developing countries. A zero tax on gasoline is then in reality a significant subsidy. There may here in addition be substantial geographical variation (both across and within countries) in the optimal tax due to differences in magnitudes of externalities and in willingness to pay to avoid these. As argued by e.g. Gupta et al (2002) and Hossain (2003), for kerosene used in households the situation is often the diametrically opposite. Such fuels are consumed by poorer households, typically replacing fuelwood for cooking and heating. Subsidizing kerosene use may then have positive externality effects by leading to less pressure on local forests in the vicinity of concentrations of poorer households, a factor that is particularly significant in Africa.

Another important subsidy category is for electricity users, typically firms or wealthier households. Many of the effects are here similar to those for water, namely inefficient and inequitable use of limited overall electricity supplies, and often suboptimal rates of expansion of new electricity capacity. The latter problem follows because the rate of capacity expansion often is a function of public utility net revenue, which tends to be low when electricity prices are kept artificially low.

**Table 1: Global annual public subsidies by sector, group of countries, 1994-1998, Billion USD.**

Sector	OECD	Non-OECD	Total
Agriculture	335	65	400
Water	15	45	60
Forestry	5	30	35
Fisheries	10	10	20
Mining	25	5	30
Energy	82	162	245
Road transport	200	25	225
Manufacturing	55	Small	55
Total	725	185	1070
% of GDP	3.4	6.3	4.0

Source: Beers and Moor (2001)

**Table 2: Public energy subsidies, 1994-1998 averages, billion USD**

Sub-sector	OECD	Non-OECD	Total
Coal	30	23	53
Oil	19	33	52
Gas	8	38	46
Electricity	(included in fossil fuel subsidies)	48	48
Nuclear	16	Small	16
Renewables	9	Small	9
Total	82	162	245
Per capita (USD)	88	35	44
Share of BNP	0.4	5.5	1.8

Source: Beers and Moor (2001).

A study by the International Energy Agency (1999) attempts to derive potential efficiency gains and reductions in CO<sub>2</sub> emissions, when energy subsidies are removed in selected countries. These figures are given in table 3. These calculations are based on a framework developed by Shah and Larsen (1992) and Larsen (1994), and involves two main steps (see International Energy Agency (1999), pages 86-87). In the first step, overall subsidy rates to energy in the different countries are assessed by calculating “reference prices” for the respective energy goods, i.e., the prices that would have prevailed in the absence of subsidies. The second step uses assessed values of country- and energy-type-

specific demand elasticities, to compute the respective energy demand responses, as well as the Harberger triangle inefficiency measures associated with the subsidies. We see that gains can be substantial, on average CO<sub>2</sub> emissions can be reduced by 16 % in these countries (among which are the two most important emitters in the developing world, China and Russia), and the average potential GDP gain is close to 1 %. One should further note that the IEA study does not consider the further gains that could be reaped, when scarce government funds are freed for other high-value uses when these subsidies are eliminated. (Such costs can however be roughly calculated using a range of values for the marginal cost of public funds)

**Table 3: Calculated efficiency gains and environmental effects of removing subsidies on energy consumption, 1997-1998, selected countries**

Country	Subsidy rate, %	Relative efficiency gain, %	Relative CO <sub>2</sub> reduction, %
Russia	33	1.5	17
China	11	0.4	13
Iran	80	2.2	50
India	14	0.3	14
Venezuela	58	1.2	26
Indonesia	28	0.2	11
Kazakhstan	18	1.0	23
South Africa	6	0.1	8
Average	21	0.7	16
Average, non-OECD			10
Average, world			5

Source: International Energy Agency (1999).

A pending question is what can be done to remove unwanted subsidies, and what factors are responsible for their presence. Beers and Moor (2001) point to two main factors in this context, namely rent-seeking behavior and adjustment costs. The World Development Report 1992 (World Bank 1992), in its analysis of these issues a decade ago, identified a range of perverse subsidies that inflict strong and unnecessary harm on the environment and natural resource base, and at the same time wastes resources in other ways, strongly recommending their removal. In a recent follow-up study, Acharya and Dixon (2002) discuss the

practical possibilities for removing perverse subsidies. They point out that relatively little has so far actually been done in this regard. Main reasons for the inaction are institutional weaknesses in the affected countries, and coalition formation and consolidation among key groups actually benefiting from subsidies. In almost all cases, no matter how perverse or misguided subsidies are, some parties will lose from their removal. Typically, these are parties with considerable political power who are able to exploit the respective institutional weaknesses to their advantage. In some cases efficiency gains have however been made. One example is the extent of petroleum subsidies benefiting the general public, which seems to be dropping in some of the countries.

A main problem in this area for many developing countries is one of undertaxation of activities that are harmful to the environment and to the resource base. Most developing countries do have a formal legal apparatus for dealing with environmental and resource problems. Still, most have no institutional structure permitting the implementation and collection of the appropriate taxes. Hydrocarbon exploitation is an important case in point. Hydrocarbon resources for many countries represent wealth that in many cases naturally has a national ownership, with the potential to provide substantial government revenue. Yet this potential is often not exploited. This may be identified as a subsidy (in the third sense discussed above) of the parties consuming the resources. A prominent case is Russia, where Speck and Martushevich (2002) argue that hydrocarbon exploitation is in this sense seriously undertaxed. The problem is often worsened by, and goes hand in hand with, corruption and excessive government complexity. The scope for corrupt activity and revenue is often magnified by large potential and actual resource rents; in fact this appears to be a main ingredient in the “resource curse” problem to be discussed in section 3 below. Acharya and Dixon (2002) present several examples of cases where a multitude of government ministries and agencies are often in charge of implementing particular laws (as in their concrete examples from Zimbabwe, Botswana and India), typically without much or even any coordination, and often with conflicting interests.

We will finally in this section rather briefly discuss public investments and their interactions with environmental and resource problems. Some public investments clearly put greater burdens on the environment, such as those requiring large increases in aggregate energy consumption (such as the

construction of coal fired power plants or certain heavy manufacturing). Similar effects may be found from direct government investment in or support of agricultural expansion (such as agro-business investments or directed programs for settlement in agricultural frontier regions), and infrastructure investment that lowers the costs of resource extraction, such as the building of roads into forested areas and mining areas. Such investments tend to be high in countries with substantial export income e.g. from resource exports. Wunder (2003) found little direct evidence in the 8 countries that he studied (which are rich both in tropical forest and mineral resources), in favor of increased resource extraction pressure due to agricultural expansion stimulated by the central government. Investments in roads into forested regions however typically lead to large increases in deforestation. In Wunder's study such effects were found for the three Latin American countries included (and similar effects are strong all over Latin America), in addition to Cameroon. Counterexamples were however also found: In Venezuela before 1950, and in Gabon and Cameroon at the oil export peak in 1979-1985, greater road building reduced deforestation pressure, mainly by facilitating migration out of the rural areas and into the cities. These latter cases are however neither typical nor representative.

Certain government investments by contrast tend to reduce overall environmental and resource burdens, e.g. by reducing energy requirements or directly reducing pollution loads. Examples are the instalment of air or water pollution cleaning equipment, sewage treatment plants, and the building of hydroelectric power capacity (as least when such expansion does not in itself have grave environmental consequences).

A key issue is the time frame of government investment projects, whether largely directed toward prevention of long-run problems, or solving short-run ones. This in turn involves at least two issues. First, chronically high interest rates (or high implicit interest rates for investors resulting from widespread credit rationing) tend to bias activities and investments in the direction of short-run solutions, as investment with long-term returns typically become less attractive. These are typical situations for poor countries where credit and other financial markets are poorly developed (see e.g. Munasinghe (1996), chapters 1 and 2; see also our discussion in section 5 below). As is well known, this biases government preferences in the direction of taking short-run instead of long-run positions, thus

putting less priority on environmental and resource consequences far into the future such as deforestation, desertification, species extinction, overfishing, long-term pollution issues, and global warming. Effects should be less serious for shorter-term problems such as reductions in local air and water pollution and current provision of water resources. The other aspect is that interest rates typically correlate with general competitiveness: economies with high resource export value, and high income and export levels, tend to have low real interest rates, not in little part due to good access to international credit. It may then be difficult to isolate effects of interest rates from that of resource wealth, on the environment and resource use. Theoretically, lower interest rates ought to reduce deforestation and resource extraction rates, increasing the attractiveness of immediate resource extraction relative to conservation. They also ought to increase general public concerns for the longer term, which ought to be favourable for the environment.

Under-investment can also be a source of inefficiency in managing the environment and natural resources. One possible such inefficiency, indicated by Asher (1999), is under-capitalization of government-owned companies in resource extracting sectors, notably the petroleum sector, in Latin American countries such as Mexico, Venezuela and Peru. The argument here is that the respective governments were overly concerned with the short-run net revenue flow from resource exploitation, which lead to the companies not getting access to sufficient investment funds to extract optimally from given (opened or as of yet non-opened) resource fields. It is an unusual type of policy failure in this context: too little is extracted, as extracting additionally from the given fields would cause little environmental harm, but could yield considerable additional benefits to the respective countries' governments.

### **3. Monetary policy**

“Monetary policy” will in this context be taken to mean exchange rate and interest rate policies, with a particular focus on the former (what one may denote international monetary policy). In modern economies with high degrees of capital mobility, expansionary or contractionary monetary policy has come to be closely associated with central bank interest rates being set at “low” or “high” levels. In

addition exchange rates and interest rates are closely related. Under perfectly flexible capital markets these two variables are, at least in theory, bound together by an (uncovered) interest rate parity condition whereby the domestic interest rate equals an international (outside) rate corrected for expected exchange rate appreciations or depreciations. “Monetary policy” is typically understood as the use of exchange and interest rate policy for short-term macroeconomic regulation purposes. In our context the issue is whether changes in monetary policy have systematic effects on resource use and on the environment, when considered either at the macroeconomic or sector level.

In most of recent history a majority of developing countries have opted for regimes with “fixed” exchange rates, by officially pegging the home currency to one particular outside currency (for most countries this has been the US dollar). We identify several types of unfavourable economic effects of such policies relevant to natural resource sectors. First, many developing countries have kept this peg at a rate that systematically overvalues the currency, hurting the export sector. Secondly, less foreign capital attracted, as a result of an overvalued currency (which may trigger a fear of future devaluation) may imply less than efficient investment in extraction. An overvalued exchange rate could imply less direct pressure to export the commodity, since the price obtained in the domestic currency is lower than otherwise. Thirdly, trying to cling to unrealistic pegs can have negative overall consequences for the stability of the country’s financial and economic system. Fourthly, low domestic commodity prices through high exchange rates may adversely affect domestic agents’ degree of care for the resource, e.g. through establishment of property rights. Note that while the former two of these arguments are likely to reduce natural resource extraction, notably deforestation (by making resource exports as well as general agricultural expansion less attractive), the two last are likely to increase it. A fifth point is, as Reinhart and Rogoff (2004) have documented, that “fixed” exchange rates have in most developing countries caused the creation of parallel exchange markets, with often extremely different exchange rate levels from those of the official ones. The existence of parallel markets typically dampens the adverse impacts of the (wrongfully) fixed rates, but have the adverse implication of distorting economic activity, between transactions taking place in the official and the parallel market.



A volatile exchange rate may have serious negative implications for resource extraction. A weak rate may lead to strong pressures and incentives to extract in the short run, in anticipation of a strengthening of the future rate (and a reduction in profitability of extraction in domestic currency terms). This pressure is likely to be exacerbated when there is illegal logging or uncertain property relationships, as exposed in recent theoretical work by Amacher, Koskela and Ollikainen (2004a, b), and in empirical studies by Gray (2000).

Most available empirical evidence indicates that the negative effects on deforestation of a high exchange rate dominates, at least in the short run. Pandey and Wheeler (2001) have found that a 10 % devaluation typically increases forest extraction by about 2 %, with greatest effects in Asia. Angelsen and Kaimowitz (1999), surveying more than 100 studies, found that devaluation increases deforestation, mainly via increased agricultural expansion. The effect on logging via timber prices is less clear, but the tendency is to increase deforestation rates. Note here the important distinction, stressed by Wunder (2003), between deforestation and logging. While deforestation in most cases is caused by land clearing for agricultural or other land purposes, logging is typically selective and in most tropical-forest contexts only involves about 10-20 % of the standing biomass, which leaves the main forest, although not necessarily its biodiversity, intact. Wunder concludes that currency appreciation typically reduces pressure on forest resources, for several reasons. One is a reduction in agricultural activity, leading to re-growth of abandoned agricultural land, and to reductions in the amount of new land clearing in forested areas (and thus reduced deforestation); and via reductions in logging for export. He goes so far as to claim that, in the case of logging for export only, the real exchange rate ought to be the only important variable. Empirically, he finds a negative relationship between deforestation and real exchange rates, in all 8 countries in his study. In all these countries the effects were felt both through reduced agricultural expansion (or periodic agricultural contraction coupled with forest regrowth in Venezuela and Gabon), and in reduced logging activity for export. He in fact finds that the real exchange rate, together with national output, account for a full 70-80 % of the country-specific variance in deforestation, over the period of study (for most countries, 1970-1998).

The general relationship between natural resource extraction and exchange rates is however more complex, and can in some cases have an opposite sign. The Cameroon experience in 1986-1994, to be discussed further in section 6 below, is an important case in point. An extremely overvalued exchange rate here caused a depression that forced people back to the countryside, putting pressure on nearby forest areas. A different class of cases is comprised of countries where resources contribute substantially to wealth. High resource extraction rates may then have “Dutch disease” implications, with high domestic spending pressure, loss or relaxation of government control of revenues and expenditures, and appreciated exchange rates. The “resource curse” hypothesis, put forth by Auty (2001), Ross (1999), Sachs and Warner (2001) and Stevens (2003), claims that greater natural resource revenues may even tend to make the respective countries poorer over time as their growth is reduced. While the partial effect of the resulting appreciated exchange rate has a general dampening effect on deforestation as described above, the effect of resource wealth on income can in principle turn this relationship around. Wunder (2003) finds for the Latin American countries in his sample (Ecuador, Mexico and Venezuela), that the appreciated exchange rate following from oil wealth went hand in hand with higher deforestation rates, at least in periods with high income growth. The reason seems to be a rapidly growing domestic demand for forest products, for furniture and construction purposes. In Brazil, 86 % of timber production is demanded domestically and not exported (Smeraldi and Verissimo (1999)), and similar relationships exist in most other Latin American countries. It is then not strange that the real exchange rate is after all far from being the sole dominant factor behind changes in deforestation.

Explanations are found in a nexus of political economy issues. Wunder (2003) points to the lack of central government accountability to political constituencies when most revenues are provided from resource rents and not from local taxes; high degrees of corruption and rent-seeking activity triggered by the resource rents; and reduced labor supply and a less highly educated work force, all contribute to a lack of government control over own resources. Overvalued exchange rates are here clearly is a main factor.

Trying to cling to unrealistic pegs can also increase the risk of financial crises (more about this will be said in sections 5-6 below), with negative consequences even in non-crisis situations. A large literature in international macroeconomics

deals with such issues. “First-generation” theories of exchange rate crises (Krugman (1979)) indicated that an overvalued currency cannot be maintained indefinitely in a rational expectations equilibrium: it tends to trigger an exchange rate crisis which in turn leads to a breakdown of the initial equilibrium. The “second-generation” literature (see Obstfeld (1996)) adds to this by demonstrating that an exchange rate crisis whereby a pegged exchange rate system is attacked and the peg subsequently is abandoned (with possibly devastating consequences for the country subject to attack), can be triggered even in the absence of adverse changes in fundamentals, merely by a shift in expectations among exchange rate market participants.

Importantly here, even when a direct crisis does not occur, lack of credibility of a country’s exchange rate policy can be harmful, e.g. by increasing interest rates beyond levels otherwise prevailing, or forcing central banks to intervene to support their currencies, thus depleting foreign-exchange reserves.

#### **4. The role of financial markets**

The characteristics of a country’s financial markets have implications for how economic fluctuations develop and unfold, and what are their implications for the environment and resources. Key financial markets are the bond market; equity markets; markets for foreign exchange; markets for international and domestic credit; and markets for risk allocation such as derivatives and options markets. We here also include real assets such as corporate takeovers and foreign direct investment (FDI). Openness of these markets involves the degree to which the relevant instruments are traded, within and across countries, the costs involved in such trading, and the range and quality of institutions supporting or hindering the markets. The strength of financial institutions, institutional structure, and market “openness” all impact on the functioning of these markets. The term “openness” is here imprecise. It has formal aspects via the degree of government regulation and formal transactions rules. It also has a real or empirical side through the amounts of international transactions actually taking place, between the country and the rest of the world.

Our aim in this section is, with a couple of exceptions, limited to fundamental effects of financial-sector openness on developing-country environment and

resources, and less to presentation of hard evidence on the issue. Relatively little such evidence is available today, although data do exist on properties of FDI and corporate equity investment, presented below.

Financial market openness has implications for environmental and resource policy in developing and emerging economies in at least two ways. First, financial market openness is likely to create more frequent and deeper crises, as argued below. As we will also document, such crises often lead to increased stress on the environment and resources. Secondly, greater reliance on international financial markets, and an increased range and availability of financial instruments, makes it easier for international investors to take advantage of opportunities to extract resources from developing countries, and thereby exploit the environment and resources in poor host countries to their short-run advantage.

Openness in financial markets creates possibilities for firms and individuals to hedge risk, obtain credit and other funding, and implement international transactions, in ways that are otherwise infeasible, thus potentially leading to large welfare gains. As widely recognized, a high degree of financial openness entails costs resulting e.g. from loss of control and vulnerability to crises. Many economists still hold the view that the gains from openness outstrip any potential losses; see e.g. Obstfeld and Rogoff (1996). Several other leading economists, among them Joseph Stiglitz (see e.g. Stiglitz (2002)) and Paul Krugman (in several newspaper and web columns), are however urging for greater caution in letting market forces go unchecked at least under current international arrangements of financial institutions (or “financial architecture”).

A possible negative effect results from international investments aiming at targets where environmental and resource protection concerns are relatively low, thus possibly adding to the pressure on the environment and resources. This need not be particularly bad if such country policies reflect a real long-run concern for citizen welfare, whereby a (temporary) deterioration in environmental conditions are traded off against higher economic growth made possible by the added investment. Often a lack of environmental and resource control is however more the result of weak or selfish governments that tend to ignore or misrepresent population preferences. In such cases openness can be a bad thing, by adding greatly to global environmental and resource pressure.

A number of features of an economy and its financial sector impact on the degree to which a country is affected by international shocks. General “financial architecture” deals with common rules and institutions for managing the global financial system; see Eichengreen (2002), Stiglitz (2002) and Tirole (2002) for recent elaborations. Another feature is “fundamentals” of the individual country and its financial institutions, namely the degree of diversity of its economy and financial strength of its enterprises; the financial strength of its banks and other financial institutions; the degree and quality of government control, leadership and legislation; and the financial strength of government itself such as the size of its debt and its ability to raise tax revenue. Finally, the degree of imposed controls e.g. on the short-run movement of capital and currency into and out from the country. This issue also has implications for the degree to which e.g. short-run resource extraction opportunities can be exploited by international investors and entrepreneurs, often with little concern for the host country’s environment and resources in the long run (and often with backing from the host country government). These topics will be detailed further in the next section.

The problem of capital market incompleteness is particularly serious for poor households in developing countries, who often do not have access to bank credit or other forms of formal-sector financing, and often do not even have formalized relationships with banks. Such households experience a “worst of both worlds”: the downside of financial-market openness in terms of high volatility of prices and income, and a poor ability to hedge against such volatility. An implication may be increased pressure on natural resources, in particular in times of extreme stress when harvests or external income possibilities fail, something that is confirmed in our empirical cases considered in the next section. This situation creates an increased need, and potentially far bigger role, for effective systems of micro-finance (e.g. of the Grameen Bank type). So far however the total importance of such sources is limited. Morduch (1999) discusses in detail the successes and potentials of micro-finance schemes, and finds that they have had substantial positive impact where they have been implemented so far (in countries such as Bangladesh, Bolivia and Indonesia), and in addition an enormous potential future impact. A main source of this impact is the alternative monitoring mechanisms that reduce lending risks and make it feasible to extend credit to new classes of borrowers. Murdoch argues that such microfinance schemes are

generally not the solution for the very poorest households (at least not in the absence of substantial subsidy), but more for the poor with some minimum amount of resources. Moreover, microfinance schemes have given a new and expanded role for NGOs with their typically greater ability and desire for experimentation and direct problem solution. NGOs are often, more than traditional aid institutions, able and willing to see the direct relationships between environmental and resource degradation and the microsolutions to be sought out to avoid them.

Another important aspect of financial markets in this context is availability of short- and long-term financing for small businesses. This depends on both borrower risk and general availability and price of credit. Tight credit is likely to imply both that many small profitable investment projects are not carried out, and that small agents will have difficulty smoothing consumption in face of cyclical fluctuations. This may have conflicting effects on environment and resource extraction. Clearly, it for one thing depends on what types of investment projects are precluded: whether these contribute to or prevent environmental or resource problems. This can be clarified only in each particular case. A second type of effect is more clear, namely that individuals who are shut off from the credit market will tend to cope with a particularly stressful situation by using whatever resources they have available, hereunder natural resources. This is likely to lead to unwanted and excessive resource extraction during such periods, as also found by Sunderlin et al (2001) in their Indonesian case study of deforestation during the East Asian crisis, and as discussed further below.

Market volatility, representing the degree to which effects of a crisis are propagated to a given economy through financial markets, is a key issue. It is here of some importance to study what types of financial instruments are likely to contribute most to an overall volatile situation. Kaminsky and Reinhart (2002) have considered the degree of co-movement of yields in different types of markets, and find that government bond yields (indicating the possibility of country sovereign debt default) is the asset type that co-varies most across developing countries, followed by equities. Domestic interest rates on credit seem to be least affected by international shocks. This indicates that the market for government bonds is the most internationalised and open (this market also mainly has large institutional investors, who make placements across country borders),

while domestic credit markets are the most “closed” or autonomous (which may also be natural as these are the markets here most directly subject to individual macroeconomic policy; governments may thus want to shelter these markets from impacts of common international fluctuations). The correlation of bond yields might however also indicate that government default risk as perceived by international investors is highly correlated between countries, in particular in times of crisis. Aspects related to the functioning of international credit markets contribute to such a correlation.

The ease with which equity investments can be made in developing countries by international investors (largely from richer countries) is also important. Equity investments take two forms, namely foreign direct investment (FDI) by international corporations, and portfolio investments in equity assets, made by individuals, governments or corporations, and by larger institutional investors. Rich-country FDI in developing countries has a long history (dating back to early colonial times), but has increased rapidly, in leaps and bounds, as a result of capital market liberalization over the last 20 years (with major setbacks during the Latin American crisis in the 1980, and the East Asian crisis in 1997-98). Financial equity investments have grown even more rapidly, exploding in certain parts of the world over the last 15 years (particularly in Latin America), in line with local governments’ increased willingness and pressure to finance their budget deficits through sales of domestic real assets, and the more efficient functioning of local equity markets. Overall, the level of international capital flows from rich to poor and emerging countries increased from 44 billion USD in 1990, to 244 billion in 1996 (and then suffered a setback in 1997-98 before again rising to previous levels by around 2000). Out of this total in 1996, 110 billion was FDI, and 46 billion equity investments (see French (1998)).

Investors’ willingness to invest in a given country depends on various features of the country, including its economic policies and legal regime. In particular, exploitable natural resources, such as mineral ores and petroleum, are obvious FDI targets. Lax environmental and labor laws have traditionally tended to promote FDI, as they lower investors’ operation costs. On the other hand, a transparent legal system, including secure property rights and low corruption levels, also represents important factors for investors. Such features are typically associated with stronger regimes where environmental and labor laws are more

strictly enforced. Firms may thus be viewed to face a tradeoff, between “weak” and “strong” regimes, each with attractive and less attractive features for FDI investors.

When FDI is encouraged by relaxing environmental standards, it likely comes at a cost of environmental and resource degradation. Undoubtedly, much FDI has had such implications. Foreign companies typically have incentives to exploit available resources rapidly (e.g. because their tenure relations may be viewed as less secure), thus often pushing governments to the limits in terms of environmental and resource pressure. Good examples are from the forest sector in many African countries (including Cameroon and Liberia), where foreign companies have been behind more than 80 % of timber extraction and where the loss of valuable timber has been very serious. French (1998) also points out that, from 1991 to 1997, international spending on metals exploration grew by 6 times in Latin America, by four times in East Asia and doubled in Africa, mainly as a result of regimes’ more liberal attitude to FDI.

It is still far from obvious whether higher levels of FDI in developing countries significantly increases the global pressure on the environment and natural resources. The so-called “pollution haven hypothesis”, stating that pollution is “exported” to developing countries as a result of specialization across countries whereby the rich countries avoid environmentally harmful production activities, is not strongly confirmed in the data so far; see also the chapter by Copeland and Gulati in this volume. As Copeland and Gulati document, a number of factors make this issue very complex. First, even if the “pollution haven” hypothesis were true, global pressure may not increase as activity is shifted from rich to poor countries (although particular groups in poor countries may suffer), or more generally as trade is expanded. One may even visualize positive environmental effects for some developing countries when multinationals with cutting-edge technologies and cleaning equipment set up shop there, out competing inefficient and highly polluting domestic firms, although little hard empirical evidence is currently available on this issue. It should also be noted that most FDI today is made by large international corporations with increasing consideration for the environmental and resource implications of their activities. This occurs not mainly because of host government pressure to perform, but instead out of self interest, for various reasons. French (1998) argues that most large multinationals



currently adhere to roughly uniform environmental policies throughout their worldwide operations; see also UNCTAD (1996). This may serve a variety of purposes for the multinationals, such as streamlining their overall management practices, the avoidance of potential lawsuits (that may be filed both by the host countries, or by the corporations' home countries against transgressions overseas), and general image building. Worldwide adherence by many large corporations to the ISO 14000 system or similar certification systems (and the requirement that their suppliers adhere to this system), underlines this trend.

As noted there has recently been a tendency for developing-country governments to sell off government-owned companies and exploration rights to natural resources. Such selling off is typically triggered by short-run financing needs (as typically imposed by creditors) and lead to one-time cash gains for the selling country, in return for foregoing the potential net asset returns in future periods. When the responsibility and accountability of governments are limited, such gains can lead to wasteful initial spending booms (either directly in utilizing the added cash, or in extending credit lines), and to resource management problems further down the line.

## **5. Short-run responses to crises**

We will now look a bit more carefully at cases where a country is hit by an "economic crisis" which causes a substantial reduction in national output, and what then happens to the country's environment and resources. The overall effects of economic crises has become a central issue in the recent economic policy debate following several severe events, notably in East Asia, Russia, Mexico and Argentina. Accumulated output losses have here in all cases been large, up to more than 50 % of current GDP in cumulated value. Typically, a crisis is triggered by a shock, often with an "initial" external component (such as an exogenous negative shock to the trade balance, to import or export prices, or to firms' costs), and/or an (endogenous) domestic component, often in interaction with some particular negative features of the country, including its institutions and financial markets. In many cases the situation leading to a crisis can be described by mechanisms familiar from the celebrated Diamond and Dybwig (1983) framework, where actors in the financial system "panic" and trigger the very

crisis (or at least cause an already started crisis to become more serious). Real impacts of such a scenario are significantly higher (potential or actual) bankruptcy rates for domestic firms, the drying up of credit and finance lines for investors and entrepreneurs, and reductions in investment and output.

Several related adverse components often enter into a crisis. One is capital flight whereby international investors withdraw assets from countries in crisis. There are also internal components resulting from financial instability and liquidity scarcity, whereby domestic funds become severely rationed or overpriced; and a debt component whereby foreign-denominated debt increases in value when the country is forced to devalue its currency. Eichengreen and Hausmann's (1999) "Original Sin Hypothesis" states that countries with weak financial systems or adverse histories for failures, most finance their investments by borrowing abroad. Private sector agents may want to hedge their exposures, especially the ones denominated in foreign currency, but may be unable to do so. Financial markets incompleteness, representing far more serious problems in less developed than in developed countries, are thus accentuated in economic crises.

**Table 4: Subjective ratings of potential factors behind recent international crises affecting developing countries**

Source of distress	Brazil	Indonesia	South Korea	Mexico	Thailand	Russia
Pegged exchange Rate	1	0	0	1	1	1
Current-account Deficit	0	2	3	1	1	3
Fiscal deficit	1	3	3	3	3	1
Financial-sector Weakness	3	1	1	1	1	1
Government short-term debt	1	3	3	1	2	1
Total short-term foreign debt	2	1	1	2	1	1
General governance	2	1	2	2	2	1

Source: Summers (2000).

Explanation of figures: 0=extremely serious, 1=very serious, 2=serious, 3=not serious.

Table 4, taken from Summers (2000) (see also the related discussion in Tirole (2002)), represents principal factors behind the crises in Mexico, 1994, East Asia, 1997, Russia, 1998 and Brazil, 1999. The table shows that initially pegged exchange rates, financial-sector weakness and short-term foreign debt were important, and that pegged exchange rates seemed important in all cases. The table also suggests that exchange rate and “financial” crises (representing the other items in the table were highly related, as in all cases both types of causes figure simultaneously).

A domestic economy “crisis” may have the following components:

- A reduction in GDP below capacity
- A higher firm bankruptcy rate, in particular those with heavy borrowing
- Reduced private consumption
- Higher import and export prices as the exchange rate is devalued; or opposite, real exchange rate revaluation leading to reduced real export prices.
- Increased interest rates and reduced financial flows to (possibly rationing of) prospective investors and borrowers.
- Capital flight from the domestic economy as foreign investors withdraw their financial holdings.

The crisis typically has two main economic effects, namely a general basic reduction in economic activity, and thus GDP, and a reduction in population consumption and welfare.

To understand how the first affects the environment and resource extraction, consider a crisis that is caused mainly by a large initial shock to the domestic economy, such as exogenous falls in prices or quantities of key export goods, or simply poor macroeconomic management, and that triggers a devaluation of the local currency. The immediate (production) effect is then most likely to reduce pressure on the environment and resources, at least to the extent that pressure depends rather directly on economic activity (such as air and water pollution levels). GDP is reduced for two different reasons. First, certain businesses are knocked out directly from the shock (which again is influenced by the bailout strategies followed by the country). The effects of this on the environment will depend heavily on the energy and resource intensities of the businesses mainly affected, in terms of their inputs and outputs. Secondly, there will be a general

reduction in private-sector demand, where the effect is likely to be more general and across the board. Both effects should work to reduce pollution and the extraction of resources that depends directly on economic activity. Note that this process is different from just moving along a given long-run output-environment relationship (or EKC curve; see footnote 1 for references), as technologies, both for production and for pollution control, are already established and will generally not deteriorate over time; thus movement will not be one back along the established EKC curve but rather to a lower level of pollution and resource load. On the other hand, resource extraction for export should increase as the real exchange rate is devalued. Overall, the theoretical effect on deforestation is generally ambiguous.

A second type of crisis is that driven largely by a fall in export prices of one or several important natural resources, as exemplified by the Cameroon crisis in 1986-1994. The pressure on the natural resource then ought to be less than under the first type above, simply because the resource price falls. The main effect should then be that both export volume and price drop. Certain factors may however confound such a pattern. In some cases one may try to compensate for the loss of export revenue by increasing the amount of extraction, thus leaving the overall effect on extraction more or less the same as in the first case. The crisis itself may then create incentives to act more myopically with respect to its natural-resource use. This is probably most relevant when the government itself is directly in charge of natural-resource extraction; or when private extractors are given strong direct incentives to increase it (by the government directly, or indirectly e.g. via higher interest rates or an excessively devalued exchange rate); see e.g. Rauscher (1990) and Barbier and Rauscher (1994) for analyses of such situations. Similar effect on natural resource extraction may follow when the export price fall is sufficiently strong that households are forced back to local subsistence on rural natural resources, with corresponding increases in deforestation rates (as in the Cameroon example). The degree of efficiency or inefficiency of general environmental and resource policy, as dealt with in the Soma and Sterner chapter of this volume, here is very consequential.

A third category is crises driven mainly by a real revaluation of the local exchange rate (as when the country is a member of a currency union with no independent exchange rate policy, and experiences a serious terms-of-trade

worsening). The pressure on resources is then likely to be minor but still perhaps non-negligible as households' immediate needs may increase.

The consumption and welfare effect of crises may have feedback effects on the environment and resources through separate mechanisms, and particularly so in countries where the population relies heavily on natural resources for their livelihoods. Effects are likely to be severe when the consumption reduction largely hits the poor (as when prices of basic foods rise substantially), and the consequences for them can be dramatic in the absence of compensating "coping" mechanisms that would permit a minimum livelihood standard to be met. One coping mechanism is the harvesting of natural resources that otherwise would be preserved. Among natural resources ripe for immediate over-harvesting are forest land and trees close to populated areas, other vegetation that normally have erosion preventing roles, and groundwater supplies known to be scarce. These will often be viewed as reserves that can be run down in times of excessive stress.

Some empirical evidence is available on the relationships between crisis-induced contractions and increases in poverty. Cline (2002), citing in particular the World Development Report 2000-2001 (World Bank (2001)), assesses the poverty elasticity with respect to income at about  $-2$ . On this basis about 40-60 million additional persons were put in poverty as a result of the financial crises in Mexico, Brazil, Argentina, Russia and the Far East over the 1995-2000 period. As documented by Barbier (this volume), in poorer and less developed countries, a large share of the population depends directly on natural resources for their livelihood. Thus, the poorer the country that is hit by a financial crises, and the greater the degree to which poor households' incomes are reduced, the greater should one expect the pressure on natural resources be.

There are also typically government policy responses to a negative shock. This response may in and of itself have environmental and resource implications. Such responses can take many different forms. One possible response is that environmental regulations may be relaxed as more firms are in danger of bankruptcy, if the government's philosophy is that less stringent environmental regulations may help to "save" more firms or make room for further firm establishment. (Such effects may be magnified in cases where the shocks hit several countries at the same time, and some of the countries act to relax their environmental policies; this may provide additional domestic arguments for

policy relaxation, thus increasing environmental loads both directly and indirectly from neighbours.)

For resource-rich countries facing serious liquidity and debt problems, bailouts (or debt forgiveness in various forms) may play a constructive role in preventing excessive natural resource extraction. Theoretical models by Strand (1995, 1997) show that providing unconditional debt forgiveness is likely to do relatively little to prevent excessive resource extraction, on a dollar-by-dollar basis, but is more helpful when it also helps to reduce debtor-country borrowing costs. It is however a much more potent instrument when debt forgiveness can be tied directly to the saving of resources, or when debt is purchased in return for such saving (“debt-for-nature swaps”; see Hansen (1989)).

A controversial issue is whether “bailouts” ought to be used to minimize the consequences of crises. Two main types of bailouts are relevant: first, governments may bail out domestic agents in financial distress; and secondly, international institutions (principally the IMF) may bail out governments in danger of defaulting. Two different views prevail in the literature. Some authors emphasize the negative effects of bailouts on “moral hazard” by leading economic agents to set their “efforts” at sub-optimal levels, or take excessive risks, in anticipation of future bailouts when things go wrong; see e.g. Corsetti, Pesenti and Roubini (1999), Burnside, Eichenbaum and Rebelo (2002) and Mundaca (2002). The second, more positive, view is that bailouts can have favourable consequences once a crisis has already materialised and is unfolding, by softening its effect on the overall economy and avoiding systemic risk; see e.g. Mundaca (2003a, 2003b). Typically the government is severely weakened both by the loss of export and tax revenue, by the direct costs of bailouts, and by the inability to attract foreign investment.

Bailouts can be conditioned on environmental and resource policies implemented in the country that receives funding. This is particularly relevant when the party responsible for the bailout is an outside IFI or a (developed) “donor” country (or group of such countries).

Some countries affected by financial crises may find it advantageous to impose additional financial market regulations or controls, e.g. to prevent an excessive outflow of short-run financial assets placed in the country in the aftermath of a negative shock. (A practical example is the control on outgoing short-run capital

from Malaysia imposed in 1998 as a response to heavy investment withdrawals from that country; which however were lifted in the spring of 1999; see Rogoff (1999).) Such tightening may backfire in the longer run, by triggering retaliatory effects by the international community e.g. in the form of reduced international credit lines, for domestic company borrowing or for overall imports, or greater pressure to immediately repay international debts. Some possible implications of such reactions for environmental and resource extraction may be visualized. One is a cash-strapping effect in the form of reduced public investment. This in turn can take several forms. We may have less instalment of pollution-reducing equipment, leading to more pollution than otherwise. We may also have less investment in industries and enterprises that put direct pressure on the environment and natural resources (and in turn either domestically or foreign financed), thus reducing environmental and resource loads. Finally, the degree of immediate stress on domestic natural resources that can be exported or used domestically as import substitutes (forest resources, easily available petroleum or mineral reserves), may increase. Overall, the picture is complex, and only good case studies can determine the empirical net effects. A couple of such studies will be presented at the end of this section.

Two further issues here need to be discussed. First, to what degree does a country's initial environmental and resource situation make it prone to shocks, and how does this affect the magnitude of a given shock. Secondly, to what degree is the country's environmental and resource situation able to insulate it from the adverse effects of a shock.

We will now go into a more practical discussion of country cases that illustrate the basic principles put forth so far in this section, with emphasis on deforestation issues where the evidence is most ample. Two country cases, both taken from the list of Wunder's (2003) 8 case studies, are particularly illustrative, namely the Cameroon crisis in 1986-1994; and the Indonesia crisis in 1997-1999.

The Cameroon crisis was extremely serious with a drop in GDP by 30 % and a halving of real per-capita incomes. It was triggered by a dramatic terms-of-trade deterioration, by 65 % from 1985 to 1987, combined with a pegging of the local currency to the French Franc (this peg was retained until 1994) and at the same time revaluation of the Franc against the US Dollar by 40 %, and a drop in oil output by a third. A strong over-valuation of the local currency was thus in a large

part to blame for the crisis. From arguments in sections above, the *prima facie* effect of a real exchange rate revaluation ought to be to reduce deforestation pressure as well as extraction of other natural resources, mainly by reducing the incentives for resource exports, but also possibly to reduce incentives for illegal extraction such as timber logging. Other mechanisms were however also at play. Forestry exports did decline substantially during the crisis. But, as documented in separate studies by Mertens et al (2000), Sunderlin and Pokam (2002) and Wunder (2003), the deepness of the crisis forced increased unemployment dramatically in major cities, and forced parts of the population back to the countryside. This in turn caused substantial increased deforestation pressure in areas at the agricultural margin, through agricultural land clearing. In fact, Wunder (2003) argues that the main, often overwhelming, factor behind deforestation is just marginal land clearing for agricultural expansion. Here, this factor far dominated any negative impacts on deforestation, from reduced illegal logging or timber exports.

The Indonesian crisis was almost as deep as that in Cameroon, but far shorter lasting. During 1967-1997, Indonesia's economy increased by an average of 6.5 % annually. In 1998, it contracted by 13.6 %. Taking the long-run growth path as the benchmark, the output drop in 1998 was thus 21 % below capacity, an astonishing one-year drop, and by far the greatest of any of the countries experiencing the 1997-98 East Asian debt crisis. For good or bad, it can be viewed as an interesting natural experiment. One main difference from Cameroon was that the Indonesian currency was devaluated almost immediately, and dropped to a level only about one fourth of its initial value, as an average for the period 1997-99. The crisis was not, as in Cameroon, stretched out as a consequence of an exchange rate imbalance. The Indonesian economy was thus able to recuperate relatively quickly after the crisis. The impact on deforestation was however more direct and dramatic, as documented e.g. by Holmes (2000). First, the dramatic devaluation increased the profitability of both timber and food exports, causing a surge in deforestation, mainly due to increased logging, but also as a result of short-run agricultural expansion. The fall in output, together with the devaluation and resulting inflation, also had the consequence that incomes were dramatically reduced, in particular for the urban populations. A



strong surge of urban-to-rural return migration took place, putting additional pressure on forest lands.

An interesting case study by Sunderlin et al (2001), of small-farmer households in 5 outer island provinces of Indonesia (Riau/Jambi, Lampung, West Kalimantan, East Kalimantan and Central Sulawesi), showed that about 70 % of the household cleared additional forest land over the 1997-99 period. Forest clearing for domestic food consumption increased only slightly over this period. Clearing for cash and export cropping however increased dramatically, in particular in the last part of the period. A reason for this pattern may be that, in the first part of the period, reduced real income forced farmers to care about short-run survival concerns, making it important to sustain consumable food production. As farmers adapted to the more protracted downturn, however, a longer-run view was taken, and more trees were planted for cash crops. The main factor, as argued by Sunderlin et al (2001), was the increased uncertainty caused by the crisis, which triggered a response to attempt to sustain stable long-run incomes. This basic factor was the same as in the Cameroon case. The overall deforestation pressure was however greater in the Indonesian case, since here also the pressure on logging for export increased greatly, something that did not happen in Cameroon (where the real exchange rate appreciated during the crisis).

The bottom line in this section is that a financial and economic crisis can impose severe stress on a country, with serious potential consequences for environmental and resource management. Some of the main factors may be summed up. First, it causes the country to lose grips with its initially established policy regime. Secondly, it leads to stresses (e.g. in the form of increased unsustainable resource use) as households and firms try to cope with the resulting deteriorated situation. There are also countervailing factors, in particular, the reduced economic activity may reduce short-run pollution or extraction for consumption by domestic-market firms. In the examples we have offered, these are however of lesser importance relative to those leading to deterioration.

## **6. Final comments**

We will conclude the discussion with just a few final remarks, that at the same time serve to sum up some of the most important conclusions from our review

above. First, subsidies of non-renewable natural resource use, in particular fossil energy, are typically wasteful and can add pressure to the environment and lead to too rapid resource extraction. Examples of wasteful subsidies are offered, but we also offer examples of ways in which subsidies can be structured such that environmental and resource efficiency and preservation is promoted. Secondly, government investments have the potential to greatly improve the environment and resource use, but also here care must be taken. One particularly sensitive area for investments is road building in previously inaccessible areas, which almost invariably lead to greater pressure to extract resources and convert land to agricultural uses. Thirdly, changes in monetary policies by weakening exchange rates and increasing interest rates can have substantial negative implications for resource use, in particular by promoting short-run exports and illegal extraction when tenure relations are uncertain. Fourthly, increased foreign direct investment resulting from liberalization of capital markets can add environmental and resource pressure, but the evidence here is less clear, in particular as international corporations seem to take their environmental concerns more and more seriously. Fifthly, financial crises very often have negative consequences for environmental and natural resource management, as the worsening (upsetting) effects in most cases seem to outweigh the dampening effects.

As noted in the introduction, this presentation only barely scratches the surface of the basic problem complex. Little systematic is today known, and much needs to be done in the future, in acquiring and assembling such knowledge.

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