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From Dutch Disease to Deforestation - A Macroeconomic Link? A case study from Equador

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Abstract

In the literature about macroeconomics and deforestation, it is often supposed that strong foreign exchange outflows (e.g. debt service) increase deforestation, as higher poverty augments frontier migration and natural resources are squeezed to generate export revenues. This paper analyses the opposite phenomenon, i.e. the deforestation impact of substantial foreign exchange inflows, which is analysed in the "Dutch Disease" macroeconomics literature. This framework is applied to Ecuador, which from 1974 to 1982 faced a foreign exchange boom from oil exports and foreign borrowing, and then compared to the somewhat scattered data on Ecuadorean deforestation. The results do not support the initial hypothesis of 'more foreign exchange - less deforestation'; it is more likely that deforestation increased during the boom. Oil production facilitated new colonization; road construction programmes heavily spurred deforestation; soaring budgets of development agencies facilitated cattle expansion. Factors that worked in the opposite direction (such as higher rural-urban migration, competitiveness loss in land-extensive agriculture, and more money available for forest conservation) were insufficient to reverse the picture. As an overall conclusion, the Ecuadorean case reveals a complexity of links from macroeconomics to sectoral growth and deforestation, in particular because of the catalytical role of economic policies: With the Ecuadorean state's explicit strategy of infrastructural and agricultural expansion financed by oil revenues, the boom could not possibly lead to reduced deforestation. This implies that no easy conclusions can be drawn from the external and macroeconomic framework to deforestation: Much depends on the specific sectoral structure and on domestic policy responses.

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1 Introduction

Within the study field of deforestation processes in the tropics, growing attention has recently been given to the links from the macro economy to changing land use patterns and derived pressures on forests. A principal rationale for this new emphasis is that the macro economy is supposed to provide "underlying factors" in the explanation of deforestation. Such factors may be determining the more direct forest destruction by e.g. loggers, fuelwood collectors and agricultural smallholders that can be observed in the field.

This view has been advocated with particular vigour among conservationist organizations. As an example, the World

Conservation Union (IUCN) and the World Wide Fund For Nature (WWF) state in their recent joint forest policy book, "Forests for Life", that "...the real causes of forest destruction can occur far away from the forest itself. Key issues include: current consumption levels, international debt and structural adjustment, pressure for trade and development" (WWF & IUCN 1996:12).In political and strategic terms, a confirmation of this link would mean that the struggle against forest loss should be partly shifted from local deforestation agents to the national and international sphere, where the underlying macroeconomic impacts originate.

The purpose of this paper is to investigate the relation between macroeconomics and forest loss for one particular developing country, Ecuador. Ecuador has faced high deforestation rates compared to other South American countries. At the same time, Ecuador experienced an oil export boom in the 1970s, coupled with heavy international borrowing. The fate of primary commodity exporters facing a boom in their foreign exchange receipts has come to be analysed in the extensive "Dutch Disease" literature; the term was born in a description of negative side-effects of the Netherlands' natural gas boom in the 1960s and 1970s.

As in most of Latin America, the roaring 1970s were followed by a period of economic depression in Ecuador during the 1980s. As a case study, the country thus provides a good opportunity to juxtapose a changing macroeconomic framework with trends in deforestation. While the traditional literature on macro economy and deforestation focuses on the austerity scenario (foreign exchange outflows, debt servicing and structural adjustment programmes), the Dutch Disease emphasizes the reverse situation of plentiful foreign exchange inflows.

Our main research question is: Has the Dutch-Disease type of macroeconomic adjustment had a reducing impact on deforestation, compared to the periods before and after the export boom? The reason for expecting this pattern would be two-fold: First, foreign exchange inflows are expected to discourage other export- and trade-related activities that relate to deforestation (e.g. agroexports and timber extraction), i.e. sectoral adjustment. Second, to the extent that boom incomes trickle down to rural producers, poverty is alleviated, thus reducing a commonly accepted push factor of deforestation.

Related research questions would be: Did the Dutch Disease country (here: Ecuador) experience less deforestation during the boom than a comparable country unaffected by the boom (i.e. a comparative approach)? or: Does the boom-and-bust pattern of a Dutch Disease country in the long run produce more deforestation than in a comparable country with stable export revenues (i. e. focusing on the long-run impact of primary commodity export fluctuations)? Here, we will limit ourselves to the question of temporal adjustment in one country, and leave the two additional questions unanswered. We will also focus on the boom situation in the 1970s and early 1980s, and when necessary make comparisons to the situations before and after this period.

The structure of the paper is the following: We begin in section 2 by reviewing the literature on the macroeconomic linkages to deforestation, which is closely related to the Dutch Disease framework. In section 3, we present the economic theory and terminology of the Dutch Disease, and outline its variants and its empirical relevance to different types of natural resource booms. Section 4 deals with the Ecuadorean version of the Dutch Disease; the macroeconomic adjustment to the Ecuadorean oil boom has only been analysed by few authors in this context. In section 5, we then turn to the core of our hypothesis: the relation between Dutch Disease and deforestation in Ecuador. First, the very scattered deforestation evidence is reviewed, then proceeding to a comparison with the different macroeconomic adjustment effects. The concluding section 6 gives a resume and discussion of the main findings.

The most important conclusion of the present paper is that the Ecuadorean case did not behave as may be expected from the conservationist-macroeconomics link perspective; deforestation during the boom was at least as high, and maybe even accelerating, compared to the periods before and after. This was due to a number of circumstances that related particularly to the policy package that accompanied the boom and its impact on sectoral distribution. A series of partial effects is outlined. Some of these reduced deforestation while others accelerated it. Their respective strengths are analysed.

The complexity of this adjustment should be interpreted as a call for cautiousness addressed to those who seek to draw direct conclusions from the external macro economic context about the fate of forests and forest-dwelling people. Although the macro economy may provide important background variables, it would seem that, in the present case, the national development strategies (including the distribution of oil incomes), combined with the more traditional micro framework (forest tenure, land use dynamics, population densities, asset inequalities, etc.) are the main determinants of Ecuadorean deforestation.

The paper is a case study within a comparative research project on this new topic, carried out together with William Sunderlin and David Kaimowitz from the Centre for International Forestry Research (CIFOR) in Bogor, Indonesia. Contact to the CIFOR team was made during my March 1997 visit to Bogor. The paper has benefited from the methodological discussion with the CIFOR team. It also draws on my earlier work on the Dutch Disease in Colombia (Ph.D. thesis) and on deforestation in Ecuador (three-year assignment to the IUCN Regional Office in Quito). I am grateful to Phil Raikes and Marie Bille for comments on earlier versions of this paper. The usual disclaimer applies.

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2 Deforestation and Macroeconomics

There are basically three methods of analysing macroeconomic impacts and testing hypotheses regarding deforestation, each of which having its own advantages and disadvantages.

First, national time series analysis would be the most natural way of investigating the link, but inadequate data availability normally limits its use; second, cross-country data sets provide a broader empirical base, but also show considerable inter-country deforestation differences that remain unexplained by the applied models; and third, economy-wide models may be best at describing complex and counteracting processes, but they are highly sensitive to specific theoretical assumptions, and are mainly designed to analyse policy tools in a comparative-static framework.

Among the different macroeconomic change factors, various scholars have chosen to focus on foreign debt and its environmental impact: Deforestation would thus in part be a by-product of the LDC debt crisis since the 1980s, and add another dimension to the complexity of global North-South relations. Consequently, an intuitive, although seldom empirically confirmed policy conclusion is that debt relief to developing countries is *per se* good for the environment (e.g. Miller 1991).

In terms of cross-country studies, Kahn & McDonald (1995) conclude, from their modelling and econometric analysis of the 1981-85 debt and deforestation in 68 tropical LDCs, that debt service has had a significant deforestation impact. The explanation is that debt service requirements would raise marginalization and poverty-led deforestation, and force highly indebted countries to adapt myopic strategies for higher logging exports and accelerate agricultural export expansion ("resource mining"), both leading to higher deforestation.

However, a similar cross-country statistical test by Capistrano & Kiker (1995), with data for 45 developing countries over the 1967-85 period, leads to the opposite conclusion: Debt service was generally an insignificant explanatory variable, except for the 1972-75 period where it had a negative sign, i.e. higher debt service would actually lead to less deforestation. This counter-intuitive result is explained by the high availability of new international credit during this sub-period, which would alleviate deforestation pressures in spite of higher debt service payments. The conflicting results are coupled with a number of severe methodological shortcomings in both studies. [In both articles, a measure of net capital inflow would be a more relevant indicator for the impact on deforestation, e.g. vis-a-vis the results for 1972-75. Capistrano & Kiker (1995) use the industrially logged forest area as a proxy for deforestation. This is bound to be highly inaccurate for many countries where agricultural conversion, rather than logging, is the main deforestation motive. It amounts to a tautology to say that "[t]here was a high correlation between industrial logging and deforestation..." (ibid:23) when the latter is measured by the industrially logged area. Capistrano & Kiker (1995) also fail to apply a consistent deforestation model over their 4 sub-periods. In Kahn & McDonald (1995), the link between macro economy and deforestoration seems to be poorly described in their "behavioural model", based on a rather arbitrary distinction between "productive" and "unproductive" sectors.]

Rudel & Roper (1997) analyse debt impacts in the context of a 67-country data set with two sub-periods, the 1970s and 1980s. Foreign debt per capita is found to have a significant deforestation impact in all the regressions, within broader explanatory models of tropical deforestation. In particular, debt is confirmed as a push factor of deforestation in countries with smaller, fragmented forests. However, it should be noted that, due to scepticism towards FAO deforestation data, the dependent variable has been dichotomized in this study ("high" vs. "low" deforestation), which implies a considerable loss of information.

It seems clear that the debt-deforestation link depends not only on data variations, but also on the model specification. In terms of simple correlation coefficients, Angelsen & Culas (1996:15-7) fail to find any significant relationship between the two variables, both at the global level and for sub-samples divided according to income levels or time periods. It seems fair to say that cross-country econometric studies may indicate a conditional positive relationship, but they do not provide us with consolidated facts about the relation between debt and deforestation.

At the national time series level, a debt crisis may have impacts that are highly variable from country to country. In Brazil for example, it seems to be widely acknowledged that the debt crisis curbed deforestation in the 1980s, by reducing the availability of public finance for road building and settlement programmes in the Amazon (Young 1995:19). This is an example of a partial curbing impact of debt and debt servicing on deforestation.

Among the limited number of detailed country case studies, e.g. the WWF com parative study on Thailand, Ivory Coast and Mexico during the 1980s, it also proved impossible to find a clear debt-deforestation relationship (Reed 1992:143-6). As an example, Ivory Coast had at that time the highest deforestation rate in the world, but this could not be linked to its large foreign indebtness. Rather, as in the two other cases, the pattern of forest loss was associated with national development patterns and strategies that were embarked upon in the 1970s. That is to say, the root causes of deforestation were already at work before a high foreign debt had been accumulated and serviced under the soaring real interest rates of the 1980s.

Finally, a third method of analysis is to apply economy-wide models of the Computable General Equilibrium (CGE) type, which allow for a quantification ofcomplex relationships and multi-sectoral spill-over effects. [See Amelung & Wiebelt (1991) for a methodological introduction to CGE deforestation analysis. Examples of applied models are Persson & Munasinghe (1995), Thiele (1994) and Wiebelt (1995).] Wiebelt (1995) e.g. develops this framework for the analysis of deforestation in the Brazilian Amazon region, considering 11 productive sectors, three geographical regions, and a variety of production inputs. While many analysts look at fiscal adjustment as a result of the debt crisis, the sequential line of causation in Wiebelt's model is the reverse: Fiscal imbalances and "domestic economic mismanagement" overheat demand and cause the accumulation of external debt in the first place. Debt service requirements then call for currency devaluations to stimulate primary exports (e.g. land-extensive agricultural export crops) which promote deforestation. In this sense, domestic fiscal policies rather than external debt constitute the prime cause of forest loss; reestablishing domestic fiscal balance is a policy condition for fighting deforestation.

In general, the evidence on the connection between debt and deforestation is thus mixed. Some cross-country studies claim to confirm the relation, but signs and statistical significance of elasticity parameters change with different model specifications. Both country studies and economy-wide models indicate that debt may not be the root cause of forest loss. As Angelsen & Culas (1996:19) rightly conclude that "...the link between debt and deforestation rates is tenuous".

This could indicate that the macroeconomic linkage is dubious in general; however, it could also mean that, rather than the basic external debt context, the accompanying macroeconomic policy is what matters most for the deforestation outcome. Thus, a prospective deforestation impact would be to put the blame, not on the debt crisis *per se*, but on the way this crisis is managed. Consequently, another branch of the literature deals with structural adjustment programmes (SAPs) and their impact on deforestation and other environmental indicators. [Different aspects of this literature are reviewed by Young & Bishop (1995), Shafik (1994), Coady (1995) and Angelsen & Culas (1996).] The first generation of SAPs in the 1980s were often designed under pressure, or at least a firm influence, from the Bretton Woods institutions - IMF and the World Bank, and typically included unpopular measures such as drastic currency devaluation, foreign trade liberalization, and reduction of public sector deficits by heavy cuts in public spending.

A general conclusion of the WWF country case studies on Thailand, Ivory Coast and Mexico is that structural adjustment may have had both positive and negative impacts on the environment, so that no unanimous environmental impact of the SAPs can be outlined (Reed 1992). With specific respect to deforestation, conclusions are also mixed. SAPs may lead to the expansion of land-extensive export crops, e.g. through the incentives provided by currency devaluation. At the same time, governmentbudgets for the implementation and control of existing forest laws and monitoring of protected areas may be reduced drastically, which may stimulate local level forest degradation and conversion.

On the other hand, sectoral SAP adjustments in the forestry sector (longer concession periods, increased stumpage prices) may make forestry operations more sustainable (Bishop & Young 1995:11/2); the same is true for the restrictive impact of government austerity on new road construction and other land-extensive mega-projects, e.g. hydroelectrical dams. The SAP-inherent elimination of the policy bias against agriculture may allow farmers to diversify production towards more intensive, high-value crops, which would tend to work towards a reduction in deforestation.

Perhaps the empirically best sustained impact of the SAPs is poverty-led migration to the agricultural frontier, causing increased deforestation as in the case of the Philippines (Cruz & Repetto 1992:6). In particular, increased marginalization is likely to induce a higher pressure on open-access common pool resources, such as state forests (Coady 1995). However, a detailed study of Kaimowitz, Thiele & Pacheco (1995) does not confirm this frontier migration effect for the case of the Bolivian SAP; rather, an increase in logging activities and in agricultural conversion for soybean exports is found. This underlines the complexity and geographic variability of the links between macroeconomic adjustment and deforestation.

In methodological terms, it is a difficult task to define the counterfactual baseline of "no SAP", i.e. what would have happened in the absence of structural adjustment programmes: Many LDCs would have had to adjust somehow to an increasing debt burden, fiscal imbalances, and an external environment of rapid trade liberalization. What would have been the realistic alternatives to compare with?

The impacts of structural adjustment policies on deforestation are quite country-specific and with mixed signs - both positive and negative. As pointed out by Reid (1992), this neither means that SAPs are environmentally neutral, nor that their environmental dimension should be ignored. Rather, the inclusion of environmental concerns can help to make SAPs more efficient in both environmental and economic terms.

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3 The Dutch Disease [This section draws on the theoretical overview in Wunder (1992:part 1).]

A topic closely related to the debt/SAP vs. deforestation debate is the "Dutch Disease" - a synonym for booming foreign exchange inflows and their impact on domestic absorption, hence analysing the reverse situation of debt crisis, SAPs andnet foreign exchange outflows. While an extensive economic literature exists on the macroeconomic impacts, there seem to have been no studies hitherto on prospective environmental adjustments linked to the Dutch Disease macroeconomics.

By the end of the 1970s, the great economic impacts of rising energy prices on oil-importing industrialized countries had begun to foster a parallel interest in the fate of oil-exporting economies: What was their likely adjustment to the significant oil price hike, and to correspondent windfall gains and foreign exchange inflows?

The term "Dutch Disease" was put forward by the journal, The Economist (1977), claiming that Dutch natural gas exports had triggered an overvalued currency, excessive government spending, loss of Dutch competitiveness, and eventually a sustained process of Dutch deindustrialization. In general, what should have been the lucky day of energy-exporting countries in the 1970s - the receipt of a large once-and-for-all economic rent, was turned into a "disease", or at least "a very mixed blessing" (Amuzegar 1982). A vast theoretical literature evolved, with applications for primary commodity export booms (oil, beverages, minerals, etc.), both in the developed world (UK, Norway, Australia), for traditional capital-exporting oil exporters (e.g. the Gulf countries), [See e. g. Halbl ützel (1981), Alam (1982) and Amuzegar (1982).] for high-absorbing developing countries with booming enclaves (e.g. Indonesia, Nigeria, Colombia), [Comparative case studies are provided by Gelb et al. (1988) and Neary & van Wijnbergen (1986).] and even for natural resource boom cases from economic history (such as Australian mining and the inflow of precious metals from Latin America into 16th century Spain). [See Maddock & McLean (1984) on Australia, and Forsyth & Nicholas (1983) on Spain.]

In fact, it takes rather restrictive assumptions to make the Dutch Disease a true "disease", in the sense of actually making a country worse off after experiencing a natural resource boom. [See Wunder (1992:part 1) for a review and discussion of the Dutch Disease literature.] The Dutch Disease basically tells a story of sectoral reallocation in an open economy facing a foreign exchange transfer. The core model [Corden (1982), Corden & Neary (1982).] consists of three sectors: The first is the booming (B) sector that generates a windfall foreign exchange profit, e.g. because of rising oil prices, generating higher national income and spending. This rise in aggregate demand causes a higher price for non-tradable goods (NT) - private and public services, construction goods, etc. - which cannot be imported from abroad. However, rising demand for goods from the non-booming tradable sector (T goods - agriculture and/or industry) is satisfied by anincrease in imports - the price of these T goods is strictly world-market determined (the "law of one price") - and thus fixed.

The net outcome of the Dutch Disease income rise is thus a relative price shift in favour of non-tradables, which under the "law of one price" is equivalent to a real appreciation of the domestic exchange rate (a decline in competitiveness). In equilibrium, this "spending effect" of the boom causes a reallocation of production factors from the (trade-exposed) T to the (sheltered) NT sector. [Additional assumptions here are ex ante and ex post equilibrium (e.g. no unemployment) and only one production factor (e.g. labour) is fully mobile. Each of these assumptions can be relaxed, producing more complicated modelling results.]

Things can get more complicated when the booming (B) sector is not a pure transfer-producing enclave, but attracts production factors from both the T and the NT sector (e.g. workers employed in the booming mining sector), the so-called "resource movement effect". In this case, the contraction in the T sector is more severe and, in theory, the aggregate impact on the NT sector becomes indeterminate. However, the empirical evidence shows that spending effects tend to dominate, causing an overall expansion in the NT sector.

Second, 'cost effects' have to be taken into account when both labour and capital are sectorally mobile, with different factor intensities and endogenous factor remuneration, or when output goods are also used as inputs. The latter is especially important in developing countries where industrial imports (machinery and equipment) may account for the lion share of total imports. These are made cheaper by the boom currency revaluation, which strongly favours industrial investments (see Wunder 1992 on Colombia).

A third qualification occurs when the trade boom - e.g. a sudden oil or coffee price hike - is clearly perceived as temporary by all producer country agents. In this case of a purely temporary boom, and economic agents with perfect foresight, the rational "spending effect" response would be to save most of the boom revenues, rather than to consume them. Under LDC capital controls, increased savings would raise domestic investments, which in the NT sector would tend to induce a "construction boom". [This line of theory is entitled "the new macroeconomics of external shocks" - see e.g. Bevan, Collier & Gunning (1989).] However, this theory of rational expectations is only relevant when the boom is undoubtedly temporary, and this temporariness is clearly perceived by the main economic agents - a premise that is seldom satisfied in an LDC framework. [In the case of e.g. the Colombian coffee boom in the mid 1970s, coffee producers augmented both their coffee plantation areas ("resource movements") and their current consumption (the conventional "spending effect"), in spite of the apparent temporary character of the boom (see Wunder 1992:part II, and Echavarr ía 1987).] The "core model" predictions of a rising real exchange rate, and an NT sector (service, construction) expansion at the cost of a T sector (industry, agriculture) decline, is thus the best point of departure for empirical Dutch Disease analysis.

It is remarkable that the Dutch Disease model has only been applied to natural resource exporters: for example, there is no equivalent "Japanese" or "German" disease related to industrial export expansion. The reason is that international prices of industrial goods tend to follow a much more stable pattern than primary commodities, causing a gradual, stable price pattern, rather than boom-and-bust fluctuations.

Two main things can turn a welfare-improving foreign exchange inflow into a true disease-like scenario of falling incomes, both of which originate in the political economy sphere. First, natural resource richness may cause government employment and investments to over-expand under the rent-seeking pressure of the private sector, which is looking for opportunities to lay hands on publicly accruing boom revenues. In the case of some high-absorbing oil exporters in the 1970s like Nigeria, Mexico and Venezuela, countries also took advantage of their easy access to international capital markets to borrow against their oil incomes, thus further exacerbating their public spending spree. This over-emphasis on public sector spending amplifies inflationary spending effects, shifts resources excessively towards services etc., and crowds out industry and agriculture that lose their competitiveness.

Second, the Dutch Disease adjustment from boom to bust, i.e. on the downward cycle of fluctuating export prices and revenues, is often found to be asymmetrical. Prices of NT goods tend to be sticky downwards, inflation rates persist after the boom, and governments are politically reluctant to devalue their currency and to cut government spending. This means that the economy does not adjust back to its pre-boom equilibrium, but continues celebrating "the good old days" of foreign exchange inflows, thus further discouraging T sector production. This policy bias causes post-boom losses in foreign exchange and national income.

In what sense would we expect the Dutch Disease to have an impact on deforestation? The expected link does bare a similarity to the foreign debt *cum* deforestation debate, and to the discussion of the environmental impacts of structural adjustment.

First, the Dutch Disease boom produces a relative price shift that discourages T sector production. If the T sector is dominated by primary commodities and produces tree-using (timber) or land-extensive (agricultural) products, we would *ceteris paribus* expect T sector contraction to be associated with declining deforestation.

Second, if foreign exchange inflows trickle down to rural producers, poverty-led expulsion to the agricultural frontier deforestation would be curbed, as held by the 'impoverishment' theories of deforestation (e.g. Eckholm 1976, Brundtland Commission 1987:28) that enjoy considerable popularity on the Ecuadorean conservation scene. The Dutch Disease would thus potentially be a cure - or at least a calmative- for the loss of forest cover.

However, as we will see below, the aggregate outcome in the Ecuadorean case is dependent on a number of additional factors: the deforestation impact of the booming B sector itself, changes in factor remunerations induced by the boom and, first and foremost, the government policies and development strategies that accompanied both the boom and the subsequent post-boom downward adjustment.

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4 The Ecuadorean Dutch Disease

Ecuador emerged as a new oil exporter in the beginning of the 1970s, due to the significant oil exploration and production efforts in the country's Amazon region (*el Oriente*). However, due to conflicts between foreign oil companies and the Ecuadorean state over royalties and concessions, oil production drastically fell short of projections. From a production of less than 1 million barrels in 1971, oil production grew to 76.2 mill. in 1973, but then actually dropped to 58.8 million barrels in 1975, and maintained more or less the 1973 level during 1978-82 (Gelb & Marshall-Silva 1988:176). It was not before the 1982-86 period that Ecuadorean crude oil export doubled in quantity, simultaneously with the sharp drop in oil prices - first in 1983, and even sharper in 1986 (IMF 1991:342/3).

First, in terms of oil-generated foreign exchange inflows, the country took little advantage of the first oil price hike in 1973/74, because of its low production levels. The situation was more favourable for the second price boom in 1979/80, although it never reached an oil richness in the 1970s of the magnitude of established oil exporters, such as Venezuela or the Gulf countries.

Second, unlike traditional oil exporters, Ecuador's bonanza was not a pure price boom, but also a (continuous) quantity boom: From a pre-1973 export base dominated entirely by agricultural products, such as bananas and coffee (with a 1970 export share of 65% and 27%, respectively - IMF 1991:342), oil in the 1970s came to constitute the dominant export commodity and has remained so ever since, with an export share of 40-60% during the 1980/90s.

Third, because oil was a new sector, and because of the more difficult extraction conditions in the *Oriente* compared e.g. to the Gulf countries, it was necessary to undertake sizeable investments in the oil sector, corresponding to between 10% and15% of total public investment during the 1974-81 period (Gelb & Marshall-Silva 1988:184). This means that, unlike many of the established oil exporters, the Ecuadorean B sector was not a pure windfall-generating export enclave, but did in fact compete for additional production factors with other productive sectors: In Dutch Disease terms, there was not only a "spending effect", but also a "resource movement effect" of the oil boom. [Yet, it goes without saying that the other dimension of the boom, foreign borrowing (see below), as a pure financial transfer generated no resource movement, but only spending effects.]

In this sense, the Ecuadorean oil boom was not purely temporary, but the switch to oil richness had permanent features of structural change, compared to the situation in the beginning of the 1970s. As oil prices and export quantity followed opposite trends, the oil boom was prolonged into the beginning of the 1980s. These permanent changes also mean that the "construction boom theory" of Bevan et al. (1989), designed for temporary trade shocks, is hardly relevant for the Ecuadorean case.

However, the Ecuadorean Dutch Disease is not only about oil export receipts. Like many other oil exporters, the country used its new creditworthiness and the easy access to international capital markets in the mid-1970s for external borrowing. In the period from 1977 to 1981, Ecuador indulged in a short but intense borrowing period: Long-term loans jumped from 159.8 mill. US$ in 1976 to 633.2 mill. US$ in 1977. For comparison, crude petroleum export revenues for the same year were only 478.2 mill. US$. In 1981, long-term loans had soared to 1,275 mill. US$, but with the Mexican crisis in 1982, the figure suddenly turned negative (-114.1 mill. US$ - see World Bank 1992:234/5). Simultaneously, external debt had in only 6 years risen tenfold to 7,705 mill US$ in 1982 and, with the sudden rise in real interest rates, long-term interest payments went up to 764.7 mill. US$.

Figure 1 gives an overview of the two types of inflation-corrected foreign exchange inflows from 1970 to 1990 (in fixed 1987 US $). Net foreign capital inflows [Defined as the sum of "long-term net capital flows" and "other net capital flows", in current US$, divided by the US$ consumer price index with 1987=100. Sources: World Bank (1992:234/5) and IMF (1991:628/9).] boomed from 1977 to 1982, and almost reached zero during 1983-85. The real value of crude petroleum exports [Sources: IMF (1991:342/3, 628/9).] rises to a high level in 1974, but stays there onwards, though modified by the oil price drop in the last half of the 1980s. The aggregate picture of the two inflows is perhaps somewhat surprising, compared to the common perception of deep external crisis in the 1980s: It is true that foreign exchange inflows peaked from 1979 to 1982, but the post-boom levels were still much higher than the pre-boom levels.

Figure 1

It may be argued that, as the economy was growing rapidly during our study period, the absolute, real levels of foreign exchange receipts may not be the most appropriate indicator, given that Dutch Disease impacts are to be seen as *relative* to other trends in the economy. Figure 2 takes this into account, by calculating the variables in figure 1 as shares of national income. This changes the picture slightly, towards a stronger boom impact also during 1974-77, and a downward adjustment for the 1980s, although 1983-90 inflows are still higher than the corresponding 1970-73 levels.

In regard to the Dutch Disease framework, two conclusions should be borne in mind. First, the period to consider as the combined oil and borrowing boom should be 1974-82 - judged by the GDP share yardstick of relative impacts (figure 2). Second, compared to other oil exporting countries that faced a purely temporary price boom, the emergence of oil exports as a new sector in Ecuador added the element of a permanent quantity boom. With real growth rates averaging 9% during the 1970s, Ecuador jumped from a status as low-income country to that of a middle-income country - a permanent wealth effect which was only marginally reversed by the severe economic crisis of the 1980s.

To understand how a foreign exchange windfall accruing to the public sector affects the economy, one must analyse how revenues are distributed, i.e. who are the beneficiaries of Dutch Disease income effects. As a custodian of oil wealth and external credit, the Ecuadorean governments of the 1970s basically followed three distributional objectives:

- to strengthen national integration in a country traditionally divided between highlands (*Sierra*), coastal lowlands (*Costa*), and an undeveloped Amazon region (*Oriente*);

- to attain high growth rates and to achieve industrialization that could help to absorb the significant labour surplus;

- to develop social infrastructure (health, education) and improve rural and urban living standards.

This developmental agenda was achieved in many areas. Current GNP per capita grew from 300 US$ in 1972 to 1,490 US$ in 1981 (and declined to 1,010 US$ in 1989 - World Bank 1992:232/3). Employment grew, mostly in the cities, and both rural and urban incomes and real salaries grew. In broad accordance with the development objectives, the main recipients of oil incomes were the following:

* infrastructural development, mainly road building

* industrial subsidies

Figure 2

* energy consumption subsidies

* growing public employment

* education and health

Returning to the Dutch Disease framework, if oil and foreign borrowing are the foreign exchange-generating "booming sectors" (B), which ones are the non-booming "traded goods" (T) sectors that are supposed to be squeezed by a loss of competitiveness and to experience a relative decline?

Normally, a pattern exists where agriculture and other primary commodity sectors (fishery, forestry) are T sectors in developing countries, whereas industry is a "quasi-NT" sector, because of its trade protection under import-substituting industrialization strategies. Developed economies, however, tend to protect their agricultural sector, and industry, as the exposed sector, is declining ("deindustrialization"). [For both LDC and DC comparative case studies, see e.g. Gelb et al. (1988) and Neary & van Wijnbergen (1986).] All export sectors (industrial, agricultural, and occasionally traded services) are *per se* exposed to foreign competition, and thus to be classified as T sectors.

In the Ecuadorean case, protective trade policies clearly made industry a "quasi-non-traded" sector. This position was reinforced by a number of industrial subsidies and protectionist measures under the industrialization strategy of the Ecuadorean military *junta* of the 1970s.

Furthermore, the nominal exchange rate was held constant from 1971 to 1981, at 25 *sucre* to the dollar (IMF 1991:340/1). At the same time, yearly inflation - as measured by the consumer price index (CPI), rose gradually from 7.5% in 1973 to 21.7% in 1981 (World Bank 1992:232/3). As these rates continuously exceeded the corresponding US$ inflation rates, the Ecuadorean economy faced a severe real currency appreciation during this period. This favoured both consumption goods imports and, in particular, industrial investment in imported machinery and equipment, an effect that during 1975-81 equalled a yearly subsidy of between 3.8% and 5.3% of Ecuadorean GDP (Gelb & Marshall-Silva 1988:182).

Besides industry, the conventional NT sectors such as urban construction and the service sector also benefited from the boom: Higher national income and a rise in purchasing power increased prices and quantities. It is noteworthy that both the industrial and service goods sectors are concentrated in urban areas. The oil boom and foreign borrowing inflows thus accelerated migration to the cities and growing urbanization (Commander & Peek 1986): The share of urban population rose from 40.7% in 1972 to 48.8% in 1982; however, this trend continued throughout the 1980s, reaching 55.1% in 1989 (World Bank 1992:234/5).

The boom also partly shifted the economic power from the agribusiness centre and main export port of Guayaquil on the coast to the capital, Quito, in the highlands. However, even if there was an overall policy bias against agricultural interests in the 1970s, there were also counteracting trends.

First, similar to neighbouring Colombia, [See Thomas (1985) and Garc ía-Garc ía (1987).] domestically consumed agricultural commodities potentially exposed to import competition (wheat, rice, dairy products, etc.) were protected through trade restrictions and minor subsidies during certain sub-periods. In turn, for the "pure" traded agricultural export commodities such as bananas and coffee, the Dutch Disease impacts were cushioned by favourable international price trends: Coffee experienced a price boom of its own from 1976 to 1979 (and again in 1986), and expanded export quantities during the price slack of most of the 1980s. Banana prices had also increased by the end of the 1970s, and stayed rather favourable during the 1980s; export quantities only began a period of sustained growth from 1984 onwards (IMF 1991:342/3). In terms of production quantities, it seems correct to say that the Dutch Disease hampered and delayed the growth of agricultural exports, compared to what counterfactually would have been the case without an oil boom.

However, other points on the developmental agenda during the oil boom clearly favoured agriculture. In 1974, no less than 48.4% of public investments were channelled to road construction, a share that only gradually declined to 18.2% in 1981 (Gelb & Marshall-Silva 1988:184). The improved infrastructural access helped rural areas to take advantage of fast growing urban markets by shifting from a subsistence orientation to commercial crops and cattle ranching (see section 5). The costly policy of heavy subsidies to domestic energy consumption (amounting to no less than 7.3% of GDP in 1980 - Gelb & Marshall-Silva 1988:182) in part worked in the same direction, increasing rural mobility and market access of agricultural products.

At the same time, an expansive monetary policy during the 1970s, plus the low international real interest rates, made rural credit extremely cheap - with negative real interest rates, especially for the subsidized credits from the public *Banco Nacional de Fomento* (BNF). Obviously, this made the shift to commercial activities easier by keeping the cost of new investments low. As a result, the livestock sector, the most important rural income source in the *Sierra*, grew by 4.6% yearly during 1965-81, while growth rates actually declined to 1.9% for the post-boom period 1981-89 (Southgate & Whitaker 1992:40).

An important conclusion is that the Ecuadorean version of the Dutch Disease was not as sectorally skewed as in many other cases, e.g. Nigeria or Trinidad and Tobago. The government took less of an entrepreneurial role, and chose to distribute a large partof the benefits through sectorally balanced subsidies. At the same time, public investment also took directions that favoured a balanced sectoral growth. Finally, commodity export prices for T sectors, such as bananas and coffee, were favourable during the 1970s. All these factors in conjunction meant that in Ecuador, the boom did not trigger as strong changes in the sectoral composition as in comparable Dutch Disease cases; in particular, an outright decline in agricultural production and exports was avoided. [Rather, as should be expected, agriculture lost ground in relative terms: From 1970 to 1982, the agricultural GDP share declined from 21.9% to 13.9%; manufacturing increased from 17.3% to 20.5%; and other (non-traded) sectors increased from 60.8 to 65.7% (Fardmanesh 1991:713).]

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5 Deforestation and the Dutch Disease

5.1 Ecuadorean deforestation

Having accounted for the main features regarding the distribution, duration and sectoral beneficiaries of the Ecuadorean Dutch Disease, our task is now to relate economic impacts to deforestation trends. As the foreign exchange inflows from oil and foreign borrowing are concentrated in the 1974-1982 period, we would need to compare deforestation in this period with the periods prior to and following the boom. Although different counteracting effects were found in the analysis above, we would *a priori* expect that deforestation during the boom is lower than both before and after, because of the contractionary forces affecting deforesting traded or semi-traded sectors (agriculture, cattle ranching, timber), compared to the expansion of more or less forest-neutral urban non-traded sectors (services, construction), [The construction sector, though, uses timber and poles, mainly from forests in the vicinity of the expanding cities (see Wunder 1996). This may accelerate deforestation in some cases, although in general, it is to be regarded as a comparatively minor impact.] and because of the alleged poverty alleviation impact on small-scale rural producers.

Nevertheless, the scattered and ambiguous data on Ecuadorean deforestation make the test of this hypothesis a difficult task. There is no consistent source or regular monitoring of deforestation for the whole period; rather, a number of occasional studies with distinct deforestation definitions, study methodologies and assumptions exist. As in many other tropical developing countries, this reflects that, in the past, data on forest cover were both more difficult to obtain, and had a low priority among national policy makers.

The FAO Forest Resources Assessment (FRA) 1990 (FAO 1993) is probably the most reliable source for the 1981-1990 period. Based on the comparison of 1980 and1990 estimates, FAO reports a 1990 total forest area of 11,962,000 ha, and average annual deforestation [Deforestation is by FAO (1993:10) defined as "...a change in land use with depletion of tree crown to less than 10%". Thus, it does not include different types of forest degradation that eliminate less than 90%. Below, we will refer to this as the "narrow" definition of deforestation.] of 238,000 ha, of which 142,300 ha (59.8%) correspond to tropical rain forests, 34,100 ha (14.3%) to deciduous forests and 61,700 ha (25.9%) to hill and montane areas. This equals an annual deforestation rate of 1.8% -currently the highest in South America, except for Paraguay (2.7%).

FAO's FRA data for all tropical countries are based on national forest inventories, satellite images, pre-existing maps, etc.. FAO has built a statistical model to intra-and extrapolate trends. Deforestation is estimated as a logistic function of remaining forest stocks and of population densities. Model estimates and other information are combined by means of geographical information systems (GIS). This indirect method has the advantage of generating comparable international data but, in terms of tests of the causes of deforestation, there is an obvious risk of circularity. [Rudel & Roper (1997:54/5) criticize various scholars that confirm the significance of population variables for deforestation which use FAO data generated in the first place by models based on population densities.] In the case of Ecuador, FRA data was based on two surveys, from 1963 and 1987, respectively (FAO 1997). It is unclear whether annual deforestation figures are purely model-based intra- and extrapolations, or if additional information (maps, regional reports etc.) from other years enters into the calculations.

Alternative national estimates of deforestation exist, but do not seem to be preferable. Some are higher and some lower than FAO's 238,000 ha per year. For instance, the World Resources Institute (WRI 1992) estimated that annual deforestation during 1981-85 was 340,000 ha (2.3%). Apparently, these figures draw on other FAO data which may equally be based on remote sensing analysis. [No further explanation is given by WRI on the origin of these higher FAO estimates. However, Rudel (1993:193) refers to a remote sensing study for 1978 to 1985 which arrives at the same overall result.] In corresponding recent yearbooks (e.g. WRI 1994:307), this estimate has been directly juxtaposed to the FAO FRA figure for 1981-90. Consequently, for the 1981-90 and 1981-85 WRI estimates to remain consistent, annual deforestation should have dropped from 340,000 in 1981-85 to a mere 136,000 ha in 1986-90. Although some reduction may have occurred, a decrease of this magnitude is very unlikely. [An additional uneasy feeling about the validity of these figures is due to the fact that the decomposed deforestation rates for FAO's four different forest types are all exactly 1.7%, i.e. the same as the overall rate, making this look like a mechanical projection (WRI 1994:309).]

Another popular source for deforestation data is FAO's own Production Yearbook, that gives general estimates on land use changes (e.g. FAO 1996). However, the information given here is simply inadequate: It is an uncritical reproduction of the forestry agencies' own (rather subjective) report figures. Forest cover includes scrub growth and areas that are **intended** for reforestation "...in the foreseeable future"; on the other hand, estimations exclude "forests used only for recreation purposes" (FAO 1996:viii, note 6). The awkward overall result for Ecuador is that deforestation simply does not seem to exist: Forest and woodland area should have **increased** from 15.5 mio ha in 1979 to 15.6 mio ha in 1994 (*ibid*:8)!

In a joint effort, the World Conservation Monitoring Centre (WCMC), The World Conservation Union (IUCN) and The Center for International Forestry Research (CIFOR) have produced a Conservation Atlas for the Americas (Sayer & Harcourt eds. 1996). Revised estimates of forest cover, based on recently available maps, may give more accurate forest stock information than the FAO FRA data. The estimates for Ecuador's closed broadleaf forest cover (the Atlas excludes dry deciduous forests), based on maps collected between 1977 and 1987, is 14,237,000 ha; the corresponding FRA model estimate for 1990 is 11,771,000 ha (*ibid*:264). In spite of the time difference in estimates, we cannot exclude the possibility that FRA forest stock figures are slightly underestimated. In any case, the Atlas figures do not provide own change estimates, so at present they cannot challenge the FRA figures in terms of documenting deforestation over time.

Finally, the survey estimates from SUFOREN (1991), then the Ecuadorean forestry agency, indicate an average yearly deforestation of only 120,000 ha from 1965 to 1984, of which 12,000 ha would occur in the Northwestern province of Esmeraldas, 9,500 ha in the Pichincha province (where Quito is located) and 98,500 ha in the four Amazon provinces. However, these estimates only refer to the main colonization frontiers (7 out of the then 13 Ecuadorean provinces); [In the 1980s, the Napo-Sucumb íos province was split into Napo and Sucumb íos.] they do not include the more gradual forest cover removal in the more established agricultural zones of the Southern zones of the *Costa* (e.g. Manabí, the Guayas river basin) and in most of the *Sierra* (the Inter-Andean Valley and the slopes of the Andes towards the Coast and the Amazon).

It should be noted that official Ecuadorean deforestation estimates are just as contradictory as those adopted by international organizations. Compared to the 1965-84 figure of 120,000 ha in SUFOREN (1991), SUFOREN officials reported a yearlyfigure of 200,000 ha in the late 1980s, [Cited in Southgate & Whitaker (1992:105).] and the Ministry of Agriculture (MAG) a total of 182,800 ha. [Cited in Rudel (1993:193, footnote 3).]

A complementary, indirect approach to the quantification of deforestation would be to look at the change in agropastoral land use, where survey data from the Ministry of Agriculture (MAG) and the National Institute of Statistics and Censuses (INEC) have been produced on a more regular basis. Southgate & Whitaker (1992:19) reproduce these survey results that we have elaborated further in table 1.

Table 1 Agropastoral Land Use Trends in Ecuador, 1972/73 - 1988/89

(in thousand hectares)

Land use	1972/73[a]	1984/85[a]	1988/89[b]	Change 1972/73 to 1984/85	Change 1972/73 to 1988/89
Land planted to major highland crops[c]	503	249	325	-254	-178
Land planted to major tropical crops[d]	1090	1364	1393	274	303
- in Costa	1060	1304	1258	244	198
- in Oriente	30	60	135	30	105
Total cropland	1593	1613	1718	20	125
Pasture	2241	4406	6021	2165	3780
- 10 Sierrra provinces	1024	1917	2349	893	1325
- 5 Costa provinces	833	2005	2792	1172	1959
- 5 Oriente provinces	384	484	880	100	496
Net change in total land use	*	*	*	2185	3905
Yearly change	*	*	*	182	244

Source: Southgate & Whitaker (1992: 19) and own calculations.

Notes: *a.* MAG annual surveys; *b.* INEC annual surveys; *c.* Major highland crops: barley, legumes, potatoes, soft corn, wheat, temperate vegetables and fruits; *d.* Major tropical crops: bananas, cocoa, cassava, coffee, rice, plantains, soybeans, cotton, sugar cane, hard corn, oil palm, manila hemp, peanuts, castor oil, lowland fruit and vegetables.

The most striking overall feature in the table is the dramatic increase in pastures, which almost tripled from 1972/3 to 1988/9. [Degraded agricultural soils that are little used as pastures are included in this category.] Total cropland only expands slightly, but there is a shift from typical highland crops to tropical crops. This indicates a specialization in the *Sierra* on cattle ranching and in the *Costa* on commercial crops. However, we are most interested in the net amount of additional land used for agropastoral purposes at the national level, calculated in the last two columns. The totals of 2,185,000 ha (until 1984/85) and 3,905,000 ha (until 1988/89) must be divided by the respective number of years, yielding an annual net increase in agropastoral land use of 244,063 ha and 182,083 ha, respectively.

To what extent are these figures indicative for deforestation? Obviously, they are not very precise measures: On the one hand, although forests clearly constitute the main "reservoir" of agricultural lands, other land categories are also converted to agropastoral uses, such as shrublands, natural pastures or *páramo*; on the other hand, deforestation with non-agropastoral end uses (road building and other infrastructure, urbanization, oil, mining and industrial land uses) are not included. It suffices to say that the exercise provides a useful check of the wildly diverging deforestation estimates above: Obviously, for the 1970s and 1980s as a whole, an annual deforestation of 120,000 ha is too low a figure, while 340,000 may appear too high.

If it is difficult to determine the absolute level of Ecuadorean deforestation at a given point in time, it is definitely not easier to estimate changes between various sub-periods. From the above, i.e. the comparison of FAO and WRI data and the SUFOREN estimates, there is an approximate consensus about a peak in deforestation more or less from the mid-1970s to the mid-1980s, then slowing down during the end of the 1980s and beginning of the 1990s. This trend seems to be supported by some of the regionally confined deforestation evaluations. Schmidt [Schmidt , R. (1990): "Sustainable development of tropical moist forests", FAO Forestry Department, Rome, cited in: Southgate & Whitaker (1992:105).] e.g. estimated in 1990 that deforestation in the Amazon region - the major 'hot spot' for land clearing - had now declined to about 60,000 ha per year. At the same time, a major development of the Amazon region only started with oil development in the early 1970s; in the northern provinces, in-migration and settlement commenced in the 1970s, and peaked during 1979-81. [Pich ón (1997:70/73); see also next section.] The same pattern is apparently found in the Southern Amazon provinces: Forest clearing experienced a spur in the 1975-80 period. [Rudel (1993:56/7 and ch.5/6) describes this in detail for deforestation in the Santiago- Morona province, arguing that initial clearing of large forest tracts is partially linked to road building and to the support by government agencies in the 1970s.]

The first impression of land use data in table 1 would suggest a somewhat different pattern, as expressed by higher annual agropastoral land expansion from 1972/73 to 1984/85 than from 1984/85 to 1988/89. Nevertheless, this difference is mainly attributable to methodological differences between the MAG and INEC surveys, rather than to actual changes between the two sub-periods. [Southgate & Whitaker (1992:19) mention that the MAG figures may underestimate certain land uses, compared to INEC data. In addition, we note that pasture expansion in the Costa and Oriente would appear unrealistically drastic between 1984/85 and 1988/89.] However, an expansion in agropastoral land may have occurred specifically in the *Costa* in the 1980s, which is not accounted for by the deforestation studies that focus on new agricultural frontiers, mainly the Amazon.

On aggregate, it is a strenuous task to find orientation in the labyrinth of Ecuadorean deforestation data - or perhaps they should rather be referred to as "guesstimates". However, on the national scale, there is little evidence indeed that forest clearing and conversion should have been reduced during the boom period 1973-81, compared to what happened both before and after; rather, indications exist that the reverse may be true. Yet, beyond any doubts related to the data, it is obvious that Ecuadorean deforestation is high **both** during the 1970s and the 1980s - compared to other Latin American countries. [Following a review of local deforestation reports, Rudel & Roper (1997) arrive at the same conclusion: They classify Ecuadorean deforestation as "high", separately for both decades, in their dichotomization of the deforestation variable.] In the search for explanations of the unexpectedly high deforestation rates in the 1970s, we will first turn to the booming oil sector itself, analysing its impact on forests.

5.2 Resource movement effects

Historically, natural-resource dependent Ecuador has faced several agricultural export booms - the cacao boom at the turn of the century and banana expansion in the 1950/60s - that gave major pushes to deforestation in the Coastal lowlands: New trade-generated opportunities went hand in hand with a higher demand for agricultural soils, which mainly had to be drawn from the reservoir of lowland forests (Bromley 1981).

An initial question is therefore whether the 1970s' exploration and production efforts in the booming oil sector itself were accompanied by deforestation. In this discussion, the direct and indirect impacts of the oil activities must be distinguished.

Concerning direct impacts, it is estimated that in the exploration phase, each oil platform causes complete clear-felling of 2 to 5 ha, whereas an additional 15 ha arealmost entirely deforested for the use of construction timber. [See Southgate & Whitaker (1992:ch.10) for an overview of environmental aspects of Ecuadorean oil production..] In the production phase, the most important direct impact is caused by the construction of penetration roads. There are also significant impacts of river pollution, wildlife reduction, etc. that may reduce forest *quality*, but we will not consider these here as "deforestation", adopting thus the narrow definition of the term. [The "narrow" definition is e.g. used by FAO (1993 - see above) and focuses on forest conversion and changing land use; the "broad" definition adopted by many biologists and conservationists, e.g. Myers (1989), includes degradation as "forest loss", thus focusing more on forest functions, quality and habitat destruction.]

Direct deforestation impacts are thus probably intermediate. Technical solutions would exist to reduce these impacts (e.g. minimizing roads and the use of con struction timber), but due to the already high production costs and current low oil prices on the world market, there is limited political will to sacrifice a share of the reduced profit margins for environmental mitigation.

More important than the direct clear-felling are the indirect impacts of road construction: It is generally recognized that oil activities "opened up" new agricultural frontiers in the Northern Amazon region by building penetration roads into primary forest areas. Roads thus act as local determinants of deforestation, even in advance of their actual construction (Pichón 1997:71). In the first wave, this gives access to industrial logging operations; second, agricultural squatters follow in order to gradually clear the land by "slash and mulch" methods, [Because of the high humidity in the Ecuadorean Amazon, this is an alternative to the "slash and burn" method that is used e.g. in the Brazilian Amazon (Thapa, Bilsborrow & Murphy 1996:1330).] utilizing it mostly for commercial crops and extensive cattle ranching.

For the new-coming smallholder, the process of securing land titles *post facto* can take many years and is directly contingent on the continuous clearing of land: the responsible state agency, the Ecuadorean Institute for Agrarian Reform and Colonization

(IERAC) requires evidence that "the land has been worked" to provide a formal land title, which in turn is a requirement for obtaining credits. In a statistical analysis of deforestation in the Northern Ecuadorean Amazon, it has been shown that tenure insecurity is a significant factor in accelerating deforestation (Southgate, Sierra & Brown 1991); the same has been confirmed in case studies of a Southern Amazon province (Rudel 1993). Of course, poor soil quality and rapid exhaustion of nutrients by inadequate crops and farming techniques are other factors that induce smallholders to abandon degraded lands and clear new areas (Thapa, Bilsborrow & Murphy1996:1321). In some cases, land has been acquired by large entrepreneurs to establish African palm plantations.

Besides road construction, deforestation "pull factors" provided by the oil sector to agricultural squatters also include the establishment of other local infrastructure and of occasional off-farm employment opportunities. However, about 60% of the population in the Ecuadorean Amazon region's active population works in agriculture (Southgate, Sierra & Brown 1991:1146). In principle, one could therefore question the additional deforestation impact of the oil boom: Maybe road construction directed settlers to specific areas, but in counterfactual terms, the same amount of deforestation might have occurred elsewhere, even without oil production.

The available data give limited support to this hypothesis. On the one hand, migration to the *Oriente* did not experience a take-off before the 1970s. However, during 1974-90, the region was faced with 6.7%, by far the highest population growth in the country; a total of 92,700 people moved to the region between 1974 and 1982. [Thapa, Bilsborrow & Murphy (1996:1321) and Southgate, Sierra & Brown (1991:1147).] In comparing the four different Amazon provinces, the data mentioned above from SUFOREN (1991) about changes in the forested area between 1965 and 1984 confirm that the most oil-affected province, Napo-Sucumbíos, had 770,000 ha deforestation, much higher than the three Southern provinces of Pastaza (250,000 ha), Morona-Santiago (550,000 ha) and Zamora-Chinchipe (400,000 ha). On the other hand, adding up the three Southern provinces' deforestation (1,200,000 ha) indicates that non-oil factors at work in the South have played an important and oil-independent role.

On aggregate, unlike the situation for enclave oil exporters, the oil boom's "resource movement effect" did in fact cause a deforestation process of its own in Ecuador. This is true both for the direct clear-felling and especially the indirect impacts of making virgin forest areas accessible and attractive for agricultural settlement. However, it can be discussed how much of this indirect impact in fact caused an additional deforestation, compared to what would have occurred if the boom had just had pure spending effects, i.e. if it had been a financial transfer without oil ex ploration and production.

5.3 Spending effects - urbanization and trickle down

In section 4, we noted that the boom caused an expansion of urban non-traded (construction, services) and quasi non-traded sectors (protected industries). This accelerated urban labour absorption and migration to the cities. Such a productiveshift from primary to secondary and tertiary sectors will, other things being equal, tend to reduce migration to the agricultural frontier, thus reducing deforestation.

The data on expansion of urban sectors underline that this is bound to have been a strong Dutch Disease effect; yet they even understate the extent, by not taking into account the rise of significant rural-urban commuting in the 1970s. Commander & Peek (1986) show how especially the smallest farms (0-5 ha) supplemented their agricultural incomes by urban off-farm employment (e. g. in the construction sector), yielding about 50% of household incomes from this source. The process was further stimulated by road construction and the huge energy subsidies that increased the mobility of both rural workers and products. These policies thus became the means, not only to achieve a "trickle down" of boom incomes from rich to poor, but also from urban to rural areas.

Rising urban employment and overall higher welfare [Ecuadorean GNP per capita quintupled from 300 US$ in 1972 to 1,490 US $ in 1981.] also create an increasing demand for food and shift demand patterns towards livestock products: With higher incomes, people tend to spend less on basic food staples, and more on 'luxury' foodstuffs, such as vegetables, fruits, meat and dairy products. [For Ecuador, this "Engel effect" is confirmed by Southgate & Whitaker (1992:38). The respective income elasticity for foodstuff as a whole is 0.55 for 1965-89.]

Consequently, meat and dairy products experienced higher sales in the 1970s and, together with infrastructural improvements, this reinforced an existing pattern of *Sierra* specialization as was shown in table 1: Highland staple food crops were increasingly substituted by rice from the Guayas river basin in the *Costa*, while the *Sierra* gradually shifted to livestock production, mainly cattle ranching. [From 1970 to 1990, heads of cattle in Sierra cattle ranching doubled (FLACSO 1994:144).] On the aggregate national level, cattle ranching also received a stimulus from this structural change, which lasted beyond the boom period, although the emphasis was on an increasingly extensive type of cattle ranching, including lands previously degraded by agriculture. [Between 1964 and 1993, pastures expanded from less than a third to about two-thirds of total agropastoral land in use. In relative terms, this expansion was clearly superior to the rise in the number of cattle, indicating an average falling intensity (El Comercio:1995:12).]

Another welfare-led impact would be the general trickle-down of boom incomes to rural sectors, diminishing 'impoverishment' deforestation (section 3): Poverty alleviation curbs forest loss induced by needy peasants that 'cut because they must'. The empirical literature is rather sceptical towards this mechanism. Rudel (1993) and Jones (1990) both underline that frontier settlers typically are not the landless andextremely poor, but rather an entrepreneurial, risk-taking peasant class that is able to mobilize the capital required to engage in frontier colonization. Pull factors such as favourable market prices thus prove to be more important deforestation incentives than a poverty-led push.

On aggregate, the urban development bias of the boom has, *ceteris paribus*, reduced deforestation, especially in the frontier regions. However, it is obvious that growing cities like Guayaquil and especially Quito have left their own "ecological footprint" on close-by forests. The example of the Northeastern part of the Pichincha province in the vicinity of Quito, with rapid forest conversion almost exclusively for pasture, is quite illustrative; [In 1984, only 210,500 ha of the 1965 forest cover of 400,000 were left. About 87% of the deforested areas are under pasture (Rosero 1992).] yet the same general pattern can be found in other areas of the *Sierra*. [Wunder (1996) underlines the significance of conversion to pasture for deforestation decisions in 4 different study zones of the Sierra .]

5.4 Spending effects - infrastructure and transport

The extension of the poor road infrastructure was a *sine qua non* condition for the implementation of a strategy of national integration, increased factor and goods mobility, structural change, and specialization in accordance with regional comparative advantage. We saw in section 4 that a major share of public investment was used for this purpose. Additionally, the heavy subsidies to domestic oil consumption had a similar (though temporary) impact of improving transport options and lessening their costs.

Although this earmarking of oil wealth may have been a rational element of a regionally balanced development strategy, it had a very high cost in terms of forest loss. In the literature on world-wide deforestation, it is broadly recognized that road construction is the single policy variable that has the strongest deforestation impact, in terms of promoting an expansion of the agricultural frontier. [For example, Jones (1990) confirms this for Central America, Andersen et al. (1996) for the Brazilian Amazon, and Rudel & Roper (1997) for a cross-country analysis.]

For Ecuador, the crucial role of roads is exemplified by the 1964 completion of the road from Quito to Santo Domingo, which was a benchmark in the colonization of the coastal lowlands and the Western flanks of the Andes. [See e.g. Rosero (1992:A4/A10).] In section 5.2, we have already commented on the colonization impact of roads for oil production in theNorthern *Oriente*. However, the pattern was quite similar in the Southern Amazon provinces. In his historical analysis of the Morona-Santiago province, Rudel (1993) convincingly demonstrates how the first wave of *colonos* tended to arrive in anticipation of future road construction in a given area. A main factor in determining the long-run success or failure of this settlement effort was then whether the road actually was constructed as expected, or whether their speculations were not fulfilled. Similar speculative land occupation patterns focused on road construction can be observed elsewhere in Ecuador. [The decade-long plans to construct a road through the National Park Sangay, from Guamote (Sierra) to Macas (Oriente), have spurred various waves of land claims, abandonments and reclaims along the proposed road track, all according to the shifts over time in the political and financial prospects for implementing road construction (see Wunder 1995).]

Analytically, Rudel distinguishes between the clearing of large forest tracts (i.e. on the agricultural frontier) and forest fragments (in already developed areas): Roads are likely to have an impact on the former, rather than on the latter type. This may also be a useful categorization for our purposes: Boom-led urbanization would e.g. have the partial effect of diminishing frontier expansion, but it would also tend to increase deforestation of forest fragments in the vicinity of growing cities.

Considering that the new colonization lots distributed by the land titling agency IERAC, e.g. in the Amazon region, were large by international standards (40-50 ha), and the extremely time- and labour-consuming process of clearing the land, it becomes clear that on-farm deforestation must necessarily be a gradual, year-long process. [E.g. Rudel (1993), Pich ón (1997) and Thapa, Bilsborrow & Murphy (1996).] The ambitious road construction in the 1970s thus probably had an immediate impact on frontier clearing (the first 3-5 years), whereas the clearing of remaining forest fragments followed only gradually hereafter. This means that part of the deforestation impact of roads occurred instantaneously, but it also enabled future clearing processes, implying that roads also had lagged deforestation impacts continuing throughout the 1980s. [Of course, the same is not true for the other component considered in this section, energy subsidies, which were gradually reduced throughout the 1980s and 1990s, and hence had a fully reversible impact.]

5.5 Spending effects - declining competitiveness

If agriculture is the main traded sector, it should have been expected from Dutch Disease theory that the significant real currency appreciation caused a crowding out of this sector. However, as we have shown in section 4, no absolute decline in agriculture occurred, which is explained by several factors. First, rapid overallincome growth also increased demand for some domestic agricultural products, which were "semi-traded", i.e. not unambiguously exposed to foreign competition. Second, policies of national integration promoted agricultural specialization. Third, the "purely traded" export sectors like bananas and coffee coincidentally also faced favourable prices in the late 1970s.

Of course, one can always argue that in a counterfactual "no boom" scenario, agriculture would have been growing at faster rates, causing additional conversion of forest area - an argument that finds some empirical support. It is e.g. remarkable that a major expansion in banana production occurred in the last half of the 1980s, when foreign exchange availability was low and exchange rates had been heavily devalued. Agricultural exports as a whole grew by a yearly 11.4% in the post-boom period 1983-88 - one of the highest rates in Latin America (Southgate & Whitaker 1992:41).

The same is true for the development of new land-using export sectors, like shrimp production in ponds located in Coastal areas. [This paragraph draws on Parks & Bonifaz (1995) and Southgate & Whitaker (1992:ch.11).] Shrimps emerged as a new export sector in 1979, but started to grow rapidly from 1981-88, and again in 1991, making Ecuador in less than a decade the largest shrimp producer in the Western Hemisphere. As producers adopt land-extensive, low-cost and low-yield production methods, and command-and-control regulations have proved inefficient in impeding open access, the sector's dramatic growth has had a marked impact on ecosystem degradation and mangrove swamp deforestation: From 203,700 ha in 1969, mangroves declined to 182,100 ha in 1984 and 175,100 ha in 1987. [CLIRSEN data, reported in Southgate & Whitaker (1992:130). The change from 1969 to 1984 is likely to have occurred mainly in the 1980s when the shrimp sector started to grow.] One can conjecture that, had the Ecuadorean *sucre* been heavily overvalued throughout a foreign exchange boom in the 1980s, the spectacular growth and resulting deforestation caused by this sector would probably have been adjusted downward.

Besides agriculture, a second potential victim of the Dutch Disease is the timber export sector, which e.g. has been affected by the macroeconomic framework in the Bolivian case. [Kaimowitz, Thiele & Pacheco (1986) quantify the impact of Bolivian structural adjustment policies on timber exports.] In the case of Ecuador, the timber sector is rather inefficient, and mainly oriented towards the home market: In terms of the quantities produced, exports account for less than 2% of total production and are dominated by balsa wood and eucalyptus, that are mainly produced in plantations. This reduces their potentialdeforestation impact. The trade balance of the Ecuadorean forestry sector is in fact negative, due to the significant imports of pulp and paper. [ITTO & INEFAN (1994a) and ITTO & INEFAN (1994b), various tables.]

Changes in the external economic environment are thus unlikely to be driving forces for the development of the Ecuadorean timber sector. This is also reflected in the sectoral growth rates, which behave contrary to what the Dutch Disease should make us expect, because of the dominance of internal trends specific to the forestry sector. [Forestry sectoral growth rates were 9.6% during 1965-81, but only 2.4% for 1982-89 (Southgate & Whitaker 1992:40).] Finally, although conservationists in Ecuador stress the deforestation impact of timber companies, especially in the Western lowlands of Esmeraldas province, one can discuss whether their impact is not primarily one of forest degradation. [This is the traditional discussion about to what extent selective logging degrades or deforests native forests. To use the terminology of Rudel (1993), logging companies may be "lead actors" in opening up new areas for settlement - and hence indirectly responsible for deforestation; however, they may also act in "strategic alliances" with squatters that independently exercise political pressure for new road construction.]

5.6 Spending effects - factor market impacts

In the Dutch Disease core model, only one production factor (typically: labour) is assumed to be mobile between sectors. Once this assumption is relaxed, some of the boom spending effects may under certain circumstances be altered, because changes in production factor remunerations (real wages, real interest rates) and corresponding cost effects are allowed to occur. [See Long, V. in Siebert (ed., 1984) for a Dutch Disease theoretical model with multi-factor mobility between sectors.]

In the case of Ecuador, real wages did not rise significantly in the first boom years. In real 1971 *sucres*, official minimum rural wages stayed almost constant from 1971 to 1979, both in the *Sierra* and *Costa*, but then jumped by 40-50% to 1980; the same applies to urban minimum wages (Commander & Peek 1986:92). Real earnings in manufacturing followed a similar trend. The rate rose further up to 1982, and survived the downward adjustment during the 1980s with a decline of less than 10% (World Bank 1992:232/3).

What does this mean for deforestation? It should be noted that the impacts are multiple, depending on cross factor ratios of land, capital, and labour in different sectors of the economy. Perhaps here it suffices to say that, in the most direct sense,forest clearing and conversion is a highly labour-intensive activity. Consequently, a relatively high rural real wage will tend to partially discourage forest clearing, in terms of a higher cost of contracted labour and/or a higher opportunity cost of family labour, compared to off-farm employment opportunities.

Second, the Ecuadorean government followed an expansionary monetary policy in the 1970s, allowing oil revenues and foreign borrowing inflows to monetize. Together with rising inflation and controlled nominal interest rates, this created negative real interest rates that discouraged domestic savings.

It is ambiguous what impact this might have had on forest clearing. Southgate & Whitaker (1992) argue that credit was constrained to urban interests and did not reach rural producers, who thus would have had less interest in making long-term investments in agricultural soils, and opted for myopic strategies of land degradation. However, earmarked oil receipts made available for subsidized rural credits were in fact significant. If we accept the premise that rural producers did benefit from subsidized credit, there is still the question of how these funds were actually used. At least part was utilized for the purchase of cattle, rather than for soil improvements, thus exacerbating forest clearing.

In summary, factor market and factor remuneration effects tend to be fairly complex, and should preferably be analysed in economy-wide models that allow for a specification and quantification of sectoral spill-overs (see section 2). In any case, we would not expect factor market outcomes to be a decisive element in the link between Dutch Disease and deforestation.

5.7 Spending effects - institutional funding

It is sometimes argued that the nexus of foreign exchange shortages, economic crisis and the subsequent adoption of structural adjustment and state 'modernization' programmes tends to increase deforestation, through the severe cut-backs in the budgets and staff of forestry and national park agencies, thus limiting their ability to enforce forest laws on the ground. [E.g. Sunderlin & Rodr íguez (1996) for the case of Olancho, Honduras.] Consequently, the reverse might apply during a foreign exchange boom accruing to the public sector: If the budgets of the forest administration benefit from the boom, their implementation capacity should be raised, helping to prevent undesirable and illegal forest degradation and conversion.

In Ecuador, this effect was also at work, in the sense that additional funds for public forest administration were made available during the bonanza. As one of the resulting achievements, the 1970s were the decade when most of the Ecuadorean nationalparks were both planned and created, culminating in the 1981 creation of the Ecuadorean Protected Area System; by 1995, the system included 18 protected areas, corresponding to an impressive 11% of total land area (Figueroa 1995:223).

Nevertheless, there are two reasons for questioning the general effectiveness of increased funding for the Ecuadorean public sector in curbing deforestation. On the one hand, past bureaucratic and centralistic institutional structures have made it difficult for the forestry agency to achieve the desired results in the field, especially in new areas such as nature conservation. Political changes have several times caused the closing down of forestry agencies and the setting up of new institutions. In some cases, these institutional discontinuities have been coupled with local corruption episodes in the enforcement of Ecuadorean forest laws. [See Wunder (1996a:370/1) for the case of three protective forests in the Sierra .] In fact, with due respect to the genuine efforts of many agency employees, one may postulate that local NGOs, enabled by international funding and technical assistance, have been the most proactive and consistent agents of forest protection in Ecuador over the last two decades.

Second, in determining overall deforestation impacts of the Ecuadorean public institutions, it is too isolated to look at the boom (or bust) budgetary impact on one single government agency. The money flowing into forest conservation and management was unable to match the funding made available to developmental agencies, such as the Ecuadorean Institute for Agrarian Reform and Colonization (IERAC), the National Development Bank (BNF) or the Centre for the Economic Recovery of Azuay, Cañar, and Morona-Santiago (CREA).

Their agenda was in most cases in direct contradiction to the objectives of sustainable forest management. IERAC, the land tenure agency, followed the traditional concept of "bringing people without land to land without people", posing continuous on-farm forest clearing as a prerequisite for granting land titles and, on the local level, engaging in dubious transactions of land trafficking. Alone from 1974 to 1975, earmarked oil incomes caused a tripling of IERAC's budget. BNF in the *Sierra* provided subsidized credits almost exclusively for cattle ranching, the most wasteful type of land use. CREA, a regional development institution of Southern Ecuador, saw its main task to be linking the highland industrial area of Cuenca to the Southern Amazon region, promoting infrastructure and agricultural production in the latter. Rudel (1993:56/7) describes how, in this sense, the oil bonanza constituted a highly exceptional situation, given that government agencies normally tended to be short of funding for the assistance of the *colonos*.

In methodological terms, these examples underline that it may be wise to first analyse in a holistic way the specific government development strategies that are applied fora certain period, and then consider the constraints or options that external financing conditions and economic crisis pose on these strategies: Partial impacts of strengthening forest management institutions may be overshadowed by much greater financial injections to development institutions that directly counteract forest conservation objectives.

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6 Conclusions

From 1974 to 1982, Ecuador received a foreign exchange bonanza from oil exports and foreign borrowing. The boom had both transitory (borrowing, oil price hike) and permanent elements (rising oil production). In macroeconomic terms, the boom caused the expected real currency appreciation, and led a decade of rapid economic growth. The economic policy package emphasized national integration through infrastructural expansion, education and health improvements and a balanced distribution of subsidies to the private sector. This combination meant that sectoral impacts were less skewed than in most other countries hit by Dutch Disease.

Just as some analysts expect debt service, structural adjustment policies and foreign exchange shortage to cause additional deforestation, a foreign exchange boom could be expected to reduce deforestation symmetrically, mainly by alleviating poverty and reducing incentives for the expansion of land-using primary commodity production.

Nevertheless, the impact of the Dutch Disease on deforestation in Ecuador proved to differ notably from this stylized picture. Although deforestation data are extremely weak, definitely no indications exist that deforestation should have been lower during 1974-82 than both before and after the boom; rather, the opposite may have happened. To understand this apparent paradox, it is necessary to review the numerous and complex partial economic effects of the boom, and compare their respective deforestation signs and strength.

Table 2 gives a summary of 10 different boom impacts on forests. The five shaded areas represent impacts that reduce deforestation; the others tend to accelerate forest loss. Deforestation impacts are also classified as to their likely intensity, which depends on a combination of the intensity of the economic impact and the degree to which this impact is linked to deforestation. A quick glance at the last column of table 2 explains the 'paradox' of the boom *cum* deforestation scenario. Only one partial impact (urbanization) had a strong reduction impact, while another (decline of agricultural competitiveness) was intermediate. The others were either weak (forest agencies' budgets, higher rural wages) or close to zero (timber contraction). This compares to two strong boom deforestation impacts (road construction, oil sector expansion in the *Oriente*), two intermediate ones (developmental budgets, shifting food demand) and one weak impact (agricultural credits).

Table 2

Dutch Disease effects and Ecuadorean deforestation - an analytical overview

Economic and productive impacts			Links to deforestation		Deforestation impact	
No.	Type	Intensity	Type	Strength	Type	Intensity
1.	New road con struction and energy subsidies	Strong	Promoting settle ment and agricul tural production	Close link	Opening up frontier areas	Very strong, lasting
2.	Oil sector expansion in Oriente	Strong	Direct (roads, timber) and indirect (settle ment) clearing	Close link	Partly overlapping with impact 1	Strong, regional
3.	Loss of agricultural competitiveness	Inter- mediate	Reducing crop and pasture area expansion	Close link	Less forest conversion	Inter- mediate
4.	Soaring budgets of forestry agency	Inter- mediate	Augmenting forest control and field management	Weak	Less encroach ment and degra dation	Weak
5.	Soaring budgets of development agencies	Strong	Supporting colonization efforts	Inter- mediate	Augmenting and sustaining encroachment	Inter- mediate
6.	Higher urban labour absorp tion (industry, services)	Strong	Less migration to the agricultural frontiers	Strong link	Less forest conversion	Strong

7.	Higher urban incomes and shifts in food demand	Strong but gradual	Expands particularly cattle ranching	Inter- mediate	Forest conversion to pasture	Inter- mediate, with lag
8.	Higher rural real wages	Weak	Makes forest conversion more costly	Weak link	Reduces forest conversion	Weak
9.	Cheap and subsidized credits	Inter- mediate	Encourages cattle investment, etc.	Weak link (contro- versial)	Augments forest conversion	Weak
10.	Timber exports lose competi tiveness	Negli-gible	Less degradation (direct) and frontier opening	Contro-versial link	Less degradation and encroachment	Negli-gible

*Note:*Shaded areas indicate that the impact is expected to, *ceteris paribus*, reduce deforestation; *vice versa* for non-shaded areas.

Two of the boom deforestation impacts, rapidly expanding road construction and the increasing income-led demand for livestock products, accelerated processes of structural change that were not reversed after the boom. These asymmetries and lags can in fact help to explain why Ecuadorean deforestation rates remained high in the post-boom period of the 1980s.

There are three overall conclusions of the present paper which may be of a more general interest, beyond the analysis of the Ecuadorean case.

First, the specific sectoral structure, the nature of traded vs. non-traded sectors in a developing economy, and especially the national development strategies and policy packages accompanying the external macroeconomic environment can set the stage to such an extent, that they alone determine whether a boom causes a halt or a spur in deforestation. This fits well with the findings in previous country case studies (e.g. Reid 1992).

Second, the 'easy' deductions from the macroeconomic sphere to deforestation that are often found in the conservationist literature [See e.g. WWF & IUCN (1996:13): "Of the 17 most indebted countries, 14 have tropical forests...In practice, debt servicing is often achieved by cashing in natural resources such as timber."] can indeed be misleading. At the other extreme, the conclusion by Shafik (1994:95) that "...there are very few macroeconomic causes of deforestation at the aggregate level" may apply only for cross-country data. At the national time series level, these causes are indeed present, but they are highly complex, have altering signs, and need to be analysed with extreme care.

Finally, where there is a scarcity of resources for study and research, priorities need to be set regarding future investigations on the causes of deforestation. Is there an argument for shifting emphasis towards externally determined macroeconomic factors? The specific Ecuadorean case revealed interesting and *ex ante* unexpected macroeconomic links, but also missing information and lack of analysis on seemingly important issues, such as:

- the impact of development agencies and strategies

- local land use dynamics

- the profitability of sustainable forest uses

- the impacts of high population growth during 1970-90

- *de facto* open access to forested land

- the role of asset inequalities in rural areas

- insufficient public investment in human resources, and

- last but not least: the poor quality and ambiguity of the deforestation data.

At the risk of being too provocative, it may appear that in the present context, the external macroeconomic framework does not deserve a top priority on the deforestation agenda.

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