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Biophysical structure of the Ecuadorian economy, foreign trade, and policy implications

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ABSTRACT

At the core of this paper lays the notion that a systematic analysis of material flow accounts enables us to discuss the sustainability of an economic model. Ecuador is going through a socio-ecological transition from an agrarian towards an industrial regime, based on the use of nonrenewable sources of materials and energy. Direct material flow indicators are used in this article to analyze the ecological dimension of the economy of Ecuador during 1970–2007. This approach enables the concept of societal metabolism to become operative. The paper compares societal metabolic profiles showing that per capita use of materials is still at about one-fifth of the average in the high income countries of the world. Physical flows of trade indicate that there is an ecologically unequal exchange. Whereas a positive trade balance is desirable from an economic policy, its counterpart in physical units has been a persistent net outflow of material resources, the extraction of which causes environmental impacts and social conflicts.

1. Introduction

This paper discusses issues of resource use in Ecuador by using the approach of societal metabolism (Ayres and Simonis, 1994; Fischer-Kowalski, 1998; Fischer-Kowalski and Haberl, 1993, 1997). This framework allows an analysis of the structure and trends in internal and foreign physical flows. The metabolic profile of Ecuador and its physical flows of exports and imports are placed in a global context to explore trends in ecologically unequal exchange. This is particularly relevant because the country's participation in world trade has implied environmental depletion and deterioration. Second, this article takes a broad perspective on the internal interactions that exist between the economy and the natural environment, through material flow accounting (MFA) over a forty year period. MFA describes in a simplified way the relationship that exists between the economy and nature. Physical flows illustrate some of the pressures that the use of materials puts on the natural environment. A third contribution of this article is the analysis of resource extraction conflicts in light of MFA, linking the study of social metabolism to the study of political ecology.

A current debate on economic policy confronts those in Ecuador who push for export-led growth (where mining exports would be added to – and substitute in the future for – declining oil exports) and those who take an ecological economics line (Acosta, 2009), emphasizing the environmental and social costs of primary exports. The present analysis is intended to contribute to this policy debate which is relevant also for other countries. Should Ecuador continue to be a primary exporter or should a totally different post-petroleum economy be developed? A related concern is the existence of a hypothetical 'resource curse' in the country, as abundant natural resources are progressively depleted or deteriorated because of the requirements of unsustainable economic growth.

This article presents direct material flows and indicators that have been calculated for the Ecuadorian economy (1970–2007). Flows assessed are domestic extraction (DE), physical imports (M), and physical exports (X). Material flow indicators are: direct material input (DMI), domestic material consumption (DMC), and physical trade balance (PTB). Although these accounts do not include unused extraction, nor do they include indirect flows of foreign trade, they describe the main biophysical dimensions of the economy.

This article is divided into four sections. The first section is the introduction; the second one explains the methodology used to calculate the material flow indicators of the Ecuadorian economy and identifies the data sources. The next section gives results for foreign trade and the domestic economy, including a brief analysis of the socio-ecological transition in the economy, a comparison with the global scale, and an analysis of resource extraction conflicts. The fourth section introduces some options for the future of the economy of Ecuador, taking into account the current debate on economic policy, and the growing visibility of environmental conflicts, and draws final conclusions.

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2. Methods and Data Sources

The empirical work presented in this article is based on the standardized methods and directions formulated in the official methodological guides available. In particular, the methodological guide of the European Office of Statistics (Eurostat) published in 2001, the empirical report on the European Union (Eurostat, 2002), and the Compilation guide of Eurostat (2007). More recently, OECD (2008) has become another source. At least at the time of writing, the ECLAC (UN Economic Commission for Latin America and the Caribbean) is not yet publishing and analyzing MFA for the countries that belong to this organization despite the fact that work on MFA is relevant to debates on international trade and economic policy. Leadership in this work has been taken on by university researchers only: Giljum (2004), Gonzalez and Schandl (2008), Pérez-Rincón (2006), Russi et al. (2008), Vallejo (2006a,b), Vallejo et al. (in press).

Although much progress has been made in MFA concepts and methodologies, building a complete balance of materials for an entire economy remains a complex undertaking. Many of the difficulties arise because economic statistics do not provide all information necessary for every MFA category. Although the mass balance principle[1] enables numerous double-checks for data quality, coherence and consistency; some flows, particularly the output flows and the balancing items are difficult to obtain or are irregularly available.

This study presents a compilation of direct material flows gathered at a macroeconomic scale in Ecuador. A series from 1970 to 2007 has been calculated. Figures presented in Russi et al. (2008) have been improved in this article, through updated methods and expanded data — in particular regarding metal ores and building materials.[2] Material flows accounted are: DE, X, M. Derived indicators computed are: DMI, DMC, and PTB. In Table 1 these flows, indicators, main material categories are classified and detailed data sources are given.

Material categories analyzed are: biomass, fossil fuels, metal ores, industrial minerals, and building materials. Biomass includes all renewable resources obtained through agriculture, cattle grazing and fodder, forestry, and fishing — although biomass may be extracted at unsustainable rates. Fossil fuels and minerals, on the other hand, account for nonrenewable resources. Increasing patterns of DE point to natural resource exhaustion.

The time series of these material categories are based on statistical data compiled by international organizations as detailed in Table 1. This information was originally collected by national statistical offices – as the Central Bank of Ecuador (BCE in Spanish) in the case of foreign trade figures – and afterwards officially reported to international offices. Even if certain weaknesses of the data persist because some flows are underestimated or not reported in official statistics – illegal forestry, and building materials – a standardized methodology was applied and estimations are in conformity with Eurostat methods. Therefore, international comparisons of the material flows and indicators assessed are consistent for the whole period analyzed.

In the case of wood harvested, although illegal forest clearance and the domestic consumption of fuel wood directly collected by rural households introduce some uncertainty in statistics, FAO is a reliable data source. The WB (2006) calculates that 70% of the total production comprises illegal extraction. In spite of the control and monitoring systems, the total quantity of wood extracted and commercialized in Ecuador remains unknown. According to assessments from ITTO (2008), the legal production of wood in 2007 was about 1.9 million m^3. As result, it can be estimated that production including illegal activities was around 5.3 Mt (million tons) in that year. In contrast, FAO reports 6.2 Mt extracted in the same year, taking into account for the DE of fuel wood, wood roughly prepared, and other industrial roundwood.

Minerals accounts reported by the USBM (2009) comprise metallic and nonmetallic minerals. The former are accounted for as mine outputs, which is the weight of ores as they emerge from the mine before treatment — instead of the net metal content, which excludes the output from auxiliary processing at or near the

Table 1
Definitions and data sources.
Sources: Eurostat (2001, 2002, 2007) and author's elaboration.

Category of flow, indicator or material	Description	Data sources
Material flows		
Domestic extraction	The purposeful extraction or movement of natural materials by humans or human-controlled technology (i.e., those involving labor).	See material categories.
Physical imports and exports	Import and export data classified by the level of processing (ISIC Rev. 2) and the main material component.	UNSD (2009) compared to BCE (2009).
Material flow indicators		
Direct Material Input (DMI)	Domestic and foreign material inputs for economic activities. Used domestic extraction + physical imports.	
Domestic Material Consumption (DMC)	The fraction of all materials that remains in the economic system until released to the environment. Used domestic extraction + physical imports – physical exports.	
Physical Trade Balance (PTB)	The net outflow (inflow) of materials from (towards) the domestic environment towards (from) foreign economies. Physical imports – physical exports	
Material categories		
Biomass	Biological materials moved by humans and livestock per year.	
Primary crops	Cereals, roots and tubers, dry legumes, oleaginous plants, vegetables and melons, fruits, fibers, and other primary crops (stimulants, sugar cane, spices, and flowers).	FAO (2009).
Grazed biomass	Demand for forage of livestock units.	FAO (2009).
Forage	Crop residues of sugar cane and cereals used as forage.	(FAO, 2009; OLADE, 2007).
Forestry	Wood harvested from forests, plantations, or agricultural lands: fuel wood, roundwood and wood roughly prepared.	FAO (2009).
Fishing	Captures of fish, crustaceans, mollusks, and aquatic invertebrates.	FAO (2009).
Minerals	Metal ores and industrial minerals production measured in its gross metal content.	USBM (2009).
Building materials	Sand and gravel used for concrete and asphalt production, and other building materials employed.	(IRF, 2009; UNSD, 2009; USBM, 2009).
Fossil fuels	Production of fossil fuels.	OLADE (2007) compared to OPEC (2007).

[1] This principle derived from the Lavoisier's law of mass conservation (Lavoisier, 1965 [1789]) establishes that for every process of process chain, the mass inputs must equal the mass outputs, including wastes (Ayres and Ayres, 2002).

[2] Information presented in Vallejo (2006a,b), and later used for comparative purposes in Russi et al. (2008) reported the periods 1980–2003 and 1980–2000, respectively.