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The "China effect" on commodity prices and Latin American export earnings

Rhys Jenkins

The commodity boom between 2002 and 2008 played an important role in increasing export earnings from Latin America. Growing demand from China for primary products was one factor stimulating the boom. While the direct effects of the growth of exports from Latin America to China have been extensively explored, the indirect impact of higher Chinese demand for commodities on global commodity prices has received less attention. This paper estimates the contribution made by the growth of Chinese demand to the rise in the prices of the 15 main commodities exported from the region. On the basis of these estimates, it calculates the total gain for the region as a whole in export revenues from the "China effect" on world prices. It also provides estimates for 17 Latin American countries of the net effect of Chinese-induced price increases on their trade balances.

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I
Introduction

The increased economic growth in Latin America since the start of the century has been linked to the commodity boom and the resulting improvement in the region's terms of trade. A key driver of the substantial increase in global commodity prices between 2002 and 2008, according to many sources, has been rapid economic growth and increased net imports of primary products by China or developing Asia more generally (UNCTAD, 2005, chapter II; IMF, 2006, chapter 5; Streifel, 2006; Park and Zhai, 2006; USITC, 2006; Cheung and Morin, 2007). Despite the drop in commodity prices since mid-2008, the fact that China has continued to grow rapidly indicates that it continues to help to maintain commodity prices at higher levels than would otherwise be the case.

Although previous studies have established that the growth of demand from China has been an important factor in recent primary commodity price dynamics, few have sought to estimate the extent to which China has increased the prices of particular commodities, focusing rather on the contribution of China to the growth of global demand, or the increased correlation between commodity prices and Chinese economic activity. The one exception is a study by the United States International Trade Commission (USITC, 2006) which provides estimates of the impact of China on the prices of oil and aluminium. However, this study is restricted to a small number of commodities.

Looked at from the Latin American side, several studies have noted the way in which output movements in China and Latin America have become more closely synchronized in recent years (Lehmann and others, 2007; Cesa-Bianchi and others, 2009; Calderón, 2009). It has been found that the major factor in explaining this increased synchronization has been "demand spillovers", operating particularly through the impact of China on global commodity prices, rather than increased bilateral trade between Latin America and China (Calderón, 2009). Further exploration of the impact of China on world commodity prices is therefore an important step in understanding the implications of the re-emergence of China as an economic power for the region.

The aim of the present paper is to provide an estimate of the extent to which Latin American export earnings have increased as a result of the impact of China's economic boom on global commodity prices. In the next section, the major commodities exported from Latin America are identified and the growth of Chinese demand for these commodities and the rise in international prices documented. Section III explains the partial equilibrium approach used to calculate the contribution of China to the increase in prices and the data used. Section IV provides empirical estimates of the impact of demand from China on the prices of the selected commodities between 2002 and 2007. Section V then estimates the total gain in export earnings for Latin America as a result of the increased commodity prices attributable to the rapid growth of demand from China. Section VI takes the analysis further by looking at the impacts on individual countries within the region. A concluding section summarizes the findings and compares them to the impact of direct trade between China and Latin America on the region.

II
Latin American commodity exports and the "China effect"

Despite active promotion of industrial development by Latin American governments in the second half of the twentieth century, the region as a whole remains heavily dependent on exports of primary commodities, which accounted for just over half of total export earnings in 2007, according to the United Nations Commodity Trade Database (comtrade). If Mexico is excluded, the share of primary commodities is even more significant, rising to over two thirds of the total. Unsurprisingly, Latin American economic performance is closely associated with movements in commodity prices (Lehmann, Moreno and Jaramillo, 2007).

For the purposes of this study, the top 15 primary commodities[1] exported from Latin America in 2007 were identified. These commodities can be grouped into six broad product groups with distinct characteristics (see table 1).

Total exports of these 15 products from Latin America came to around US$ 260 billion in 2007, accounting for two thirds of the region's exports of primary products and around a third of total export earnings.

TABLE 1

Latin America: primary commodity exports, 2007

Product group	Commodity
Energy	Crude oil
Minerals, ores and metals	Copper; iron ore; aluminium; zinc
Feedstuffs	Soybeans; soybean oil; fishmeal
Tropical food and beverages	Coffee; sugar; bananas
Meat products	Beef; poultry
Forest products	Timber; wood pulp

Source: prepared by the author on the basis of Standard International Trade Classification (SITC) Rev. 2.

China has become an increasingly important player in the world market for a number of the commodities which Latin America exports (ECLAC, 2008, chapter I.8; Gallagher and Porzecanski, 2009; Rosales and Kuwayama, 2007, p. 85). It is now the world's leading consumer of many commodities and accounts for a substantial share of world demand.

Table 2 shows, in common with other studies (e.g., Streifel, 2006; IMF, 2006, chapter 5), that the "China effect" on global demand has been most marked in the case of minerals, ores and metals. China has reached a level of income at which metal use relative to GDP tends to rise significantly (UNCTAD, 2005, figure 2.2). This has been a result of the rapid industrialization process in China, which has become increasingly metal-intensive over time as production has shifted from labour-intensive goods (such as clothing) to more capital-intensive sectors (such as electrical and electronics) (Cheung and Morin, 2007). Demand for metals has also been driven by construction and other infrastructure projects (World Bank, 2009, box 2.5).

[1] Primary commodities were defined as Standard International Trade Classification (SITC) Rev. 2 classes 0-4 and 68.

TABLE 2

China's share of global consumption of primary commodities, 2002 and 2007
(Percentages)

	China's share of global consumption		Increase in price
	2002	2007	2002-2007
Fuels			
Oil	6.9	9.3	185.1
Minerals, ores and metals			
Iron ore	22.3	43.9	184.7
Copper	18.2	27.1	356.5
Aluminium	21.1	33.2	95.4
Zinc	22.4	32.4	316.4
Feedstuffs			
Soybean	18.4	20.9	80.6
Soybean oil	21.2	25.9	85.1
Fishmeal	23.0	27.5	83.6
Tropical food and beverages			
Coffee	0.3	0.4	125.6
Sugar	7.9	9.3	46.4
Bananas	8.8	9.4	28.6
Meat products			
Beef	10.6	12.3	22.6
Poultry	16.8	17.2	23.9
Forest products			
Sawn wood	4.0	8.6	63.6
Chemical pulp	5.7	7.8	55.5

Source: China's share of consumption calculated by the author on the basis of sources cited in the text, price data taken from United Nations Conference on Trade and Development (UNCTAD) (2008), *Trade and Development Report 2008*, Geneva, table 2.1, United Nations publication, Sales No. E.08.II.D.21, and International Monetary Fund (IMF), *World Economic Outlook Database*.

Not surprisingly, the contribution to demand has been most striking in the case of iron ore, where China accounts for over 40% of world consumption. Thus, a significant initial share of world consumption in 2002 and a large increase in share between 2002 and 2007 combined to make China a major driver of world demand for iron ore in this period. The demand has been driven by the growth of the Chinese iron and steel industry, with China increasing its share of global steel production from a fifth in 2002 to a third by 2007 and moving from being a net steel importer to a net exporter (IISI, 2008 and 2004). Although not as striking as the case of iron ore, the growth of Chinese consumption of other metals (copper, aluminium and zinc) has also made an important contribution to global demand.

China's energy use grew more slowly than GDP during the 1980s and 1990s, following the economic reforms of the late 1970s. Since 2000, however, the energy intensity of GDP has begun to rise again (Cheung

and Morin, 2007, p. 4). Moreover, the share of coal, which accounts for the bulk of energy use, has been falling, while that of other sources of energy such as oil, natural gas and hydroelectric power has risen (UNCTAD, 2005, pp. 49-50). This has been reflected in China's increased share of world demand for crude oil since 2002 (see table 2).

After minerals and metals, the next most significant product group in terms of China's share of global consumption is feedstuffs. This reflects the rapid growth of demand for animal feed (including fish food for aquaculture) in China as living standards rise and consumption patterns change. By the end of the 1990s, China's level of daily calorie intake per capita was already relatively high and, particularly in urban areas, consumers were shifting towards meat, fish, vegetable oils and fruit (UNCTAD, 2005, p. 45). China is now a leading market for soybeans and fishmeal and its share of world consumption has increased over time.

In this context, it is perhaps surprising that the growth in China's share of world consumption of meat products in table 1 is not more significant. In the case of poultry, growth in demand in China between 2002 and 2007 was depressed by the impact of the 2004 avian flu outbreak.[2] In the case of beef, per capita consumption in China is around a tenth of the level in the United States and a quarter of the average level in the 27 countries of the European Union (Foreign Agricultural Service of the United States Department of Agriculture, Office of Global Analysis), so that although China's share of global demand is rising, it remains relatively limited.

In the case of forest products, China's growing share of world chemical pulp consumption has been driven by the growth of capacity in the domestic paper and packaging industry. Local consumption of paper more than doubled between 1995 and 2004 (USITC, 2006, table 4-3). A significant driver of this growth was the demand for packaging from the manufacturing sector. However, part of the increased demand has been met by production using waste paper, which has grown faster in recent years than the use of pulp (USITC, 2006, tables 4-1 and 4-2). As a result, China's share of global demand for pulp is less than might be expected.

China's global consumption share has increased more for sawn wood than for pulp since 2002 (see table 2). The pervasiveness of illegal logging, which has been widely commented upon, may have led to Chinese imports being underestimated in official statistics, so that the country's impact on global demand may be greater than the reported figures suggest (DFID, 2005).

China is not yet an important consumer in the world market for tropical agricultural products. Coffee consumption is still extremely limited in China, and while consumption of bananas and sugar is much more widespread, these are almost entirely produced domestically so that it is unlikely that the growth of Chinese consumption would have had a significant impact on the world market for either product.

Table 2 also shows the substantial price increases that occurred for most primary commodities between 2002 and 2007. The most dramatic rises were in metals, particularly copper and zinc, and in oil. Feedstuffs have also increased significantly in price, although this is largely attributable to dramatic increases in 2007 associated with the demand for land to grow biofuels (World Bank, 2009, pp. 61-63). Other agricultural products have generally had more modest price increases.

Although the Chinese economy has been growing rapidly for three decades, there are several reasons why China only began to have a significant impact on global commodity prices at the start of the twenty-first century. During the 1980s and 1990s, the energy and metal intensity of China's GDP fell, but this situation was reversed from the late 1990s or early 2000s (Cheung and Morin, 2007; UNCTAD, 2005, pp. 47-49). Increases in industrial efficiency as a result of the economic reforms of the late 1970s led to a fall in energy and metal use at the plant level. At the same time, this was reinforced by changes in the composition of industry as a result of the shift away from the emphasis on heavy industry during the period of central planning towards light industries during the early phase of China's transition to an export-oriented market economy. More recently, however, as noted above, there has been a shift to capital-intensive and energy-intensive industries, including road building and construction. This has led to an increase in the metal and energy elasticity of Chinese GDP growth since the turn of the millennium.

China has also become much more integrated with global commodity markets over the past decade as the growth of demand for a number of commodities has outstripped domestic supply.[3] This has been reflected in significant increases in net imports of commodities such as copper, iron ore, nickel, crude oil and soybeans

[2] Per capita consumption of poultry fell in China in 2004 and only recovered slowly after that (Foreign Agricultural Service of the United States Department of Agriculture, Office of Global Analysis).

[3] For example, whereas domestic production of iron ore covered 85% of domestic consumption in 1990, this had fallen to 45% by 2003 (UNCTAD, 2005, p. 74).

(UNCTAD, 2005, figure 2.8). Where China has remained largely self-sufficient in terms of supply, on the other hand, its impact on global commodity prices is likely to have been minimal.

Finally, the impact of China on global commodity prices depends not only on the growth rate of Chinese demand but also on its initial share of global consumption, and it was only at the beginning of the twenty-first century that China became a sufficiently important consumer to affect the prices of a number of key commodities. Calderón (2009, p. 54), for instance, suggests that "2002-2003 may represent the turning point in the relationship between Chinese industrial production and world commodity prices".

Although the focus of this study is the impact of the growth of Chinese demand on commodity prices, it is important to bear in mind that this is by no means the only factor that has affected prices in recent years. On the demand side, other markets for primary commodities have also grown and the contribution of China to global demand growth differs considerably between commodities. Demand may also be affected by movements in the prices of close substitutes.

Supply-side factors also have a significant impact on prices, particularly but by no means exclusively in the case of agricultural products whose supply is affected by climatic factors. All commodities may be affected by changes in the costs of inputs which shift the supply curve, and oil and minerals are affected by new resource discoveries. The supply of oil and minerals may also be disrupted by political conflict or labour unrest in major producing countries.

In addition to the forces of supply and demand in the real economy, commodity prices are also affected by financial factors. Since commodity prices are normally measured in United States dollar terms, changes in the value of the dollar affect the quoted price. The dollar was at a peak in 2002 and had fallen by around 25% by the end of 2007 (IMF, 2008, box 1.4). Commodity prices (excluding oil) rose by 113% in dollar terms between 2002 and 2007 but by only 80% when measured in terms of Special Drawing Rights (SDRs) (UNCTAD, 2008, table 2.1). The International Monetary Fun (IMF) estimates that the oil price would have been US$ 25 a barrel lower at the end of 2007 (i.e., over 25% lower than it actually was at the time), and non-fuel commodity prices 12% lower, if the dollar had maintained its 2002 value.

The impact of speculation on commodity prices has been a matter of controversy. There is general agreement that there has been an increase in the significance of financial investment in many commodity markets in recent years (World Bank, 2009, chapter 2; UNCTAD, 2009, chapter 2). A study of five commodities (crude oil, copper, sugar, coffee and cotton) by IMF concluded that there was little evidence that speculation affected either long-run price levels or short-run volatility, although this conclusion was subject to a number of caveats (IMF, 2006, box 5.1). In contrast, UNCTAD (2008, box 2.1 and 2009, chapter 2) argues that the growth of speculation probably accelerated and amplified price fluctuations.

No attempt will be made here to estimate the impact of these other factors on commodity prices in recent years. Rather, the challenge is to try and separate out the impact of the growth in demand from China. The approach adopted is a partial equilibrium one which only seeks to identify the first round effects of Chinese demand on global prices.

III

Methodology and data

The first step in the analysis is to identify the contribution of China's growth to global demand for the primary commodities exported from Latin America. The period covered is from the start of the recent commodity boom in 2002 to 2007. The volatility of prices with the collapse of the boom in 2008 and the fact that trade data were not available for all the Latin American countries for 2008 were the key reasons why the analysis was not extended beyond 2007. Global and Chinese demand for the 15 commodities identified in table 3 (in physical terms) were obtained from various sources.

There are several possible counterfactuals which could be used to estimate the "China effect" on global demand. One possibility would simply be to compare actual global demand for each commodity in 2007 with demand excluding China. This would be the equivalent of a counterfactual in which "China does not exist". A second approach would be simply to calculate the

increase in Chinese consumption of each commodity between 2002 and 2007, and subtract this from global demand. This implies a counterfactual in which Chinese consumption remains unchanged or "China does not grow". However, since we are interested in the impact of the exceptional growth of Chinese demand on commodity prices, a more appropriate counterfactual is one where Chinese demand grows at the same rate as demand in the rest of the world. Thus, a hypothetical global demand for the 15 commodities in 2007 is estimated on the assumption that China's demand growth between 2002 and 2007 was the same as the rest of the world's.[4] The difference between this figure and actual demand in 2007 provides an estimate of the extent to which China's exceptional economic performance increased world demand for the products concerned over the period since 2002. This is the approach adopted in the paper.

One limitation of this approach is that it assumes that the growth of demand in China and in the rest of the world are independent of each other. A first objection to this is that, to the extent that rapid growth in China boosts demand in the rest of the world, a slower rate of growth in China would also lead to a reduction in growth elsewhere. The question then is: how significant is Chinese demand for growth in the rest of the world?[5] China's relatively small share of global demand, averaging 4.6% between 2003 and 2007 (Timmer, 2010, table 1), suggests that its impact on demand in the rest of the world was quite limited during the period.

A second objection, relevant at the level of individual commodities, is that the growth in demand in China may partly be the result of the relocation of certain industries from other countries, rather than a result of increased global demand for commodities. For example, if the rapid growth in demand for iron ore in China is partly a result of the relocation of the global steel industry to China, this may have been at the expense of demand for iron ore in other countries. Thus, the estimated additional growth in demand from China may not represent additional world demand for iron ore, and the implicit assumption that the growth of demand in China and in the rest of the world are independent of each other is not strictly valid.

While the first objection suggests that ignoring the "China effect" on the rest of the world tends to result in underestimation of its total impact on global demand for commodities, the second suggests the opposite. Although there is no reason to suppose that these two effects necessarily balance each other out, the fact that they operate in opposite directions, and that these indirect effects may be small relative to the direct effects, provides a partial justification for not taking them into account here.

The counterfactual used to calculate the impact of China's exceptional growth on commodity prices assumes that the other factors affecting prices discussed earlier, such as shifts in supply curves, exchange-rate alterations and speculation, remain unchanged. In other words, we are interested in how much lower commodity prices would have been in 2007 had China's share of world demand remained at the same level as in 2002, *ceteris paribus*. Since in effect this means a counterfactual in which the demand curve has shifted downwards, the effect on prices will depend on the elasticity of global supply for each commodity.

Estimates of the global elasticity of supply for the commodities concerned are surprisingly difficult to come by, and when they are available there is often a considerable range of estimates. In the light of this, it was decided that it would be more useful to take a range rather than a single value for the elasticities used to calculate the impact on global prices. These elasticities were then applied to the estimated contribution of China's rapid growth to global demand for each commodity in order to arrive at the impact on world prices.

Finally, the gains to Latin America from the China effect on global demand were calculated by estimating how much lower in dollar terms Latin America's exports of each of these commodities would have been in 2007 in the absence of the China-induced price rise. This involved deflating the 2007 value of exports from the region by the price rise attributable to the excess growth of demand from China between 2002 and 2007. At the level of the region as a whole, this was done using gross exports in order to obtain an estimate of the additional export earnings accruing to Latin America as a result of the "China effect" (see table 5 below). However, since different countries within the region may be affected differently depending on whether they are net exporters or net importers of these commodities, the estimates at the individual country level are based on net exports and therefore reflect the influence of price changes on trade balances (table 6). The latter can of course be negative where a country is a net importer of a commodity which has increased significantly in price as a result of Chinese demand.

[4] This counterfactual could be termed the "China's share does not increase" scenario.

[5] This question is key to an ongoing debate about the extent to which China can become the engine for world economic recovery. For contrasting views, see Dollar (2009) and Timmer (2010).

The data on the volume of consumption of the various commodities globally and in China were obtained from a variety of sources. Oil consumption came from the *BP publication BP Statistical Review of World Energy, 2008*. Consumption of iron ore was from the International Iron and Steel Institute, *World Steel in Figures* (various issues), and other minerals were from the World Bureau of Metal Statistics, *World Metals Statistics*. The source for meat products, grains, meals and oil, and sugar was the Foreign Agricultural Service of the United States Department of Agriculture, while figures for forest products, coffee and bananas were based on United Nations Food and Agriculture Organization (FAO) data.

The elasticity estimates used in the study were based on a search of a large number of sources which are listed in the appendix. Since the period analysed is only five years and the increase in prices was most marked in the later years, use was made of short- or medium-run supply elasticities, which tend to be lower than their long-run counterparts. Studies from earlier periods were not necessarily always a good guide to the elasticity of supply in the early twenty-first century, so that an element of judgement had to be applied in determining a plausible range of elasticity estimates, based on recent studies of supply conditions for the commodities concerned.

In order to estimate the "China effect" on the export earnings and trade balances of the Latin American economies, data on exports and imports of each of the 15 commodities in 2007 were obtained for 17 countries from the United Nations Commodity Trade Database. In the case of the Bolivarian Republic of Venezuela, data for exports in 2007 were unavailable and were therefore estimated as the average of the values reported for each commodity in 2006 and 2008.

IV
The "China effect" on commodity prices

1. China's contribution to increasing global demand

As indicated above, the first step in estimating the "China effect" on global commodity prices is to calculate the addition to global demand resulting from China's rapid economic growth. In other words, the question being addressed is: how much greater is world demand for a commodity than it would have been if demand in China had grown at the same rate as in the rest of the world between 2002 and 2007?

The first two columns of table 3 compare the increase in consumption in China with that in the rest of the world for the key commodities between 2002 and 2007. In all cases other than poultry, demand grew much faster in China than in the rest of the world, and this was reflected in the increase in China's share of global consumption of these products, as shown in table 2. The third column of table 3 measures how much higher actual world consumption of these commodities is than it would have been had demand in China grown at the same rate as demand in the rest of the world. In other words, it measures the impact of China's high growth, relative to the rest of the world, on global demand.

Not surprisingly, table 3 shows that the "China effect" in terms of additional demand has been most marked in minerals, ores and metals, particularly iron ore. The next most significant group in terms of impact has been feedstuffs. The impact in terms of additional demand for oil and forest products has been relatively limited, while tropical food and beverages and meat products are the categories in which Chinese demand growth in the period had least effect.

2. The "China effect" on world prices

The impact of Chinese demand growth on the world price of different commodities depends not only on the size of the demand effect. It is also affected by the responsiveness of global supply to increased demand and the extent to which an integrated global market exists and China is part of it.

The second and third columns of table 4 present the estimates for the upper and lower bounds of the range of supply elasticities used for the various commodities. Since these relate to the short or medium term, they are all relatively low, reflecting the difficulty of increasing supply in the short term, particularly in the case of crude oil and some minerals. The supply elasticities of tree crops with long gestation periods (e.g., coffee and timber) are also relatively low, while livestock and grains tend to have a more elastic supply.

TABLE 3

Impact of demand from China on global demand, 2007
(Percentages)

	Consumption growth 2002-2007		China's demand effect[a]
	China	Rest of world	
Fuels			
Oil	48.7	6.6	2.7
Minerals, ores and metals			
Iron ore	224.9	19.5	38.4
Copper	77.6	6.1	12.3
Aluminium	124.3	20.4	18.2
Zinc	70.7	2.9	14.8
Feedstuffs			
Soybean	37.2	17.7	3.1
Soybean oil	54.2	18.4	6.4
Fishmeal	24.8	-1.9	6.3
Tropical food and beverages			
Coffee	32.3	-1.9	0.1
Sugar	30.6	9.2	1.5
Bananas	25.0	17.0	0.6
Meat products			
Beef	27.1	7.2	2.0
Poultry	21.6	18.7	0.4
Forest products			
Sawn wood	131.8	2.8	5.0
Chemical pulp	45.0	3.3	2.3

Source: prepared by the author on the basis of the source indicated in table 2.

[a] This measures how much higher global demand for the commodity was in 2007 than it would have been had demand in China increased at the same rate as in the rest of the world between 2002 and 2007.

TABLE 4

Estimated impact of Chinese demand on world prices, 2007

	Effect of Chinese demand (*percentages*)	Price elasticity of supply		"China effect" (*percentages*)[a]	
		Lower	Upper	Maximum	Minimum
Crude oil	2.7	0.1	0.25	27.1	10.8
Iron ore	38.4	0.25	0.4	153.6	96.0
Copper	12.3	0.1	0.25	122.6	49.1
Aluminium	18.2	0.25	0.4	72.8	45.5
Zinc	14.8	0.1	0.25	147.6	59.1
Soybean	3.1	0.4	0.6	7.7	5.1
Soybean oil	6.4	0.4	0.6	16.0	10.7
Fishmeal	6.3	0.4	0.6	15.6	10.4
Coffee	0.1	0.1	0.4	0.5	0.2
Sugar	1.5	0.1	0.5	15.5	3.1
Bananas	0.6	0.2	0.4	3.0	1.5
Beef	2.0	0.3	0.6	6.6	3.3
Poultry	0.4	0.3	0.6	1.4	0.7
Sawn wood	5.0	0.2	0.6	25.1	8.4
Chemical pulp	2.3	0.2	0.6	11.5	3.8

Source: prepared by the author from table 3 and sources of elasticity estimates cited in the appendix.

[a] This measures how much higher the world price for the commodity was in 2007 than it would have been had demand in China increased at the same rate as in the rest of the world between 2002 and 2007.

In metals, the elasticity of supply in the short run depends on the capacity available to increase output and the level of stocks. In the case of copper, low prices in the 1990s meant that there was very little investment in new capacity so that when demand increased after 2002, supply did not respond and stocks fell sharply from 1.7 million metric tons at the end of 2002 to 0.7 million in 2006 (COCHILCO, 2008). The low estimated supply elasticity reflects this. A similar situation is apparent in the case of zinc, where demand has outstripped supply in recent years and stocks fell by half between 2003 and 2006 (International Lead and Zinc Study Group). Most zinc comes from underground operations, and it is difficult to increase production from existing mines because of the high capital cost of expansion (Dr. Harlyn Meade quoted in Williams, 2007).

Higher supply elasticities were assumed for iron ore and aluminium. In the case of iron ore, the supply situation appears more favourable than for copper or zinc, with substantial increases in capacity in recent years (Ostensson, 2005). In contrast to other minerals, prices for iron ore are set by negotiation between the main producers and the importers rather than on commodity exchanges, so that it is unlikely that speculation could have affected prices. Finally, capacity expansion in aluminium, particularly in China, has meant that a margin of capacity has been maintained and stocks did not fall significantly between 2002 and 2006 (USGS, *Mineral Commodity Summaries: Aluminum*).

Supply problems have also been particularly apparent in the case of oil, where high prices have not led to increases in capacity, leading to a drop in the effective spare capacity of the Organization of the Petroleum Exporting Countries (OPEC) after 2002 (IMF, 2008, figure 1.18). The sluggish response of supply in the industry has been attributed to a longer lag between increased prices and new investment being made than in the past. This in turn partly reflects geological and technological factors such as the declining average size of oil fields and the challenges of exploiting non-conventional sources such as deep sea fields or oil sands (IMF, 2008, box 1.5). As with copper, this suggests a low estimate for the elasticity of supply.

Agricultural products tend to have a shorter gestation period and therefore a higher short-run elasticity of supply than oil and minerals. The exceptions are tree crops such as coffee and forest products, which take a number of years to mature. Annual crops such as soybeans respond relatively quickly to price increases, as land can be switched from other crops. The soybean acreage in Argentina and Brazil, for example, has doubled since the mid-1990s in response to the growth in world demand (Ray, 2008).

The fourth and fifth columns of table 4 calculate the impact of the growth of Chinese demand on world prices, given the supply elasticities in the second and third columns. The fourth column provides the upper end of the range based on the low elasticities of supply in the second column, while the fifth column provides the minimum likely impact on prices, based on the higher elasticities in the third column.

The most significant impacts are found for the four metals included. These are of course the commodities for which prices have risen most during the period under consideration, with zinc and copper increasing more than fourfold, iron ore almost threefold and aluminium almost twofold in price since 2002 (see table 2).

The growth of Chinese demand for iron ore above the rate of consumption growth in the rest of the world is estimated to have doubled the world price, although as noted above this is an overestimate to the extent that growth in China has led to a reduction in demand elsewhere. In the case of both copper and zinc, the "China effect" on global price levels was significant because the supply was inelastic, while the estimated effect on the price of aluminium was slightly lower because supply appears to have been more elastic. In all these cases, prices are estimated to have increased by at least 40% as a result of the growth in demand from China.

The "China effect" is estimated to have been in the range of 10% to 25% on the prices of four commodities. In the case of crude oil, despite China's relatively small share of total world demand, the fact that this share rose over the period plus the low elasticity of supply meant that prices were significantly affected by China's growth. Since the overall increase in oil prices during this period was more than 180%, however, other factors were clearly far more important than China in driving up prices.[6] The other three products are soybean oil, fishmeal and sawn wood. In the case of the first two, this reflects the high share of China in world consumption of these products, while in the case of wood it is the rapid increase in its share over the period that is most striking.

In the case of all the other commodities covered, the estimated effect of Chinese demand on prices over the period was less than 10%. The growth in demand for soybeans from China has largely been met by increases

[6] The United States International Trade Commission came to a similar conclusion for the 1995-2004 period, when it estimates that of an oil price increase of 200%, the growth of Chinese demand was responsible for between 12% and 37% (USITC, 2006, p. A.6).

in the area harvested in recent years, particularly in Argentina and Brazil, and it is only since 2007, with the increased competition for land (especially in the United States) to produce biofuels, that soybean prices have risen sharply (Ray, 2008).

The impact of Chinese demand on prices for tropical food and beverages is likely to have been very small. Table 4 makes this very clear in the case of coffee, where the estimated price increase attributable to China is negligible, and of bananas, where it is relatively small. The estimate for sugar is much higher, but given the fact that China is not a significant importer and that the global market for sugar is highly fragmented as a result of preferential agreements, it is unlikely that in practice China would have had any real impact on world prices for sugar products.

Meat product prices have also been relatively unaffected by Chinese demand. As noted above, poultry consumption in China was affected by the avian flu epidemic. Despite the growth in demand for beef in China, this has had a relatively minor effect on pricing. This is the product group for which world prices have increased least in the period since 2002 (see table 2).

In the case of forest products, Chinese demand has had a moderate impact on the price of chemical pulp and a much more significant effect on prices for sawn wood, as noted above. In the latter case, the effect may even be underestimated to the extent that the "China effect" is hidden by the scale of the illegal trade in timber that went unrecorded in the estimates of Chinese timber consumption. On the other hand, transport costs mean that the market for sawn wood tends to be quite regionalized and the main sources of imports to China are the Russian Federation and South-East Asia. Thus, any price impacts of growing Chinese demand are less likely to have affected the Latin American countries.

V

The "China effect" on Latin American export earnings

The final calculation that needs to be made is the extent to which Latin American export earnings have increased as a result of the rise in prices of primary products attributable to the rapid growth in demand from China. Table 5 provides estimates for each of the 15 commodities. The first column presents the value of exports in 2007. The second and third columns provide high and low estimates for the "China effect" through higher world prices on the value of Latin American exports of these commodities. The fourth column gives a best estimate which in most cases is simply the mid-point of the range indicated by the second and third columns. In the case of sugar and bananas, the best estimate reflects the fact that the most plausible assumption is that China has not affected the price of Latin American exports.

Table 5 shows that two commodities, oil and copper, account for roughly three quarters of the total gain in export revenues resulting from the "China effect" on commodity prices. The two contribute in roughly equal measure, despite the fact that total exports of oil from Latin America are much larger than those of copper. This reflects the greater impact that demand from China has had on copper prices compared to oil, as noted earlier. The third most important product is iron ore, accounting for a further 10% or so of the total gain in foreign-exchange earnings, followed by aluminium and zinc.

Following behind these in terms of their contribution are soybeans and soybean oil, but these are relatively limited in terms of the additional export earnings created, which totalled between US$ 1.2 billion and US$ 1.7 billion in 2007. The next most significant group of exports after feedstuffs is forest products, with estimates of the total impact ranging from US$ 450 million to US$ 1.2 billion, divided roughly equally between wood and pulp.

The impact on meat exports has been relatively small, with most of the gain being attributed to beef, while there has been virtually no additional revenue from poultry. Finally, as indicated above, China has had little impact on world prices of tropical fruits and beverages, so that it seems reasonable to disregard the estimated effects on bananas and sugar in order to arrive at a more realistic total.

The estimated total effect of Chinese demand on Latin American export earnings from all 15 commodities was between US$ 41 billion and US$ 73 billion, with a best estimate of over US$ 56 billion. This latter figure represents

TABLE 5

China: estimated impact on Latin American export earnings for 15 commodities, 2007
(Millions of dollars)

	Exports	Estimated effect of China on value of exports		
	2007	Maximum	Minimum	Best
Crude oil	129 294	27 580	12 651	20 116
Iron ore	11 585	7 016	5 674	6 345
Copper	50 494	27 815	16 618	22 217
Aluminium	6 587	2 775	2 060	2 418
Zinc	4 789	2 856	1 779	2 317
Soybean	11 237	799	546	672
Soybean oil	6 509	898	627	763
Fishmeal	1 970	266	186	226
Coffee	8 584	43	17	30
Sugar	6 251	838	188	0
Bananas	3 273	95	48	0
Beef	6 596	407	210	308
Poultry	4 708	65	33	49
Sawn wood	3 279	657	253	455
Chemical pulp	5 422	558	200	379
Total	*260 579*	*72 670*	*41 090*	*56 295*

Source: prepared by the author on the basis of the United Nations Commodity Trade Database (COMTRADE).

21% of the value of exports of all 15 commodities and 7% of total Latin American exports in 2007.

A number of warnings need to be attached to these estimates. First, they should be taken as orders of magnitude rather than precise values, since the elasticity estimates taken from a variety of sources may not be accurate. A doubling of the assumed elasticity for each commodity would halve the estimated effect. Since the elasticities used for the main commodities that contribute to the overall impact (oil and metals) are low, they are likely if anything to have caused the impact of China on Latin American export earnings to be overestimated.

A second factor that might lead to overestimation of the "China effect" on prices and export earnings is the possibility that the growth of Chinese demand is not entirely a net addition to global demand. It may be that some of the growth has been offset by a fall in demand in other markets because the industries which use the commodities as inputs have relocated to China. This is most likely to be the case for metals, which are a major contributor to the estimated additional earnings.

A third consideration is that the estimates presented here have been based on the total value of the region's exports of the 15 commodities in order to calculate the gain in export earnings. However, some countries in the region import some of these commodities, and it might therefore be more appropriate to look at net exports rather than the total value. If this were done, then the estimated gain to the region as a result of the "China effect" on commodity prices would be about 16% lower (between US$ 34 billion and US$ 61 billion, rather than between US$ 41 billion and US$ 73 billion).

VI

Winners and losers in the commodity lottery

The analysis of the previous section focuses on the aggregate effects of the rapid growth of Chinese commodity demand for Latin America as a whole. It is clear from what has been said about the differential impact of China on different commodities, however, that the effects are unlikely to be uniform across the countries of the region. Specifically, while the impact will have been positive for those countries which are net exporters of these commodities, particularly minerals and oil, some countries which are net importers may well have lost out from the higher commodity prices resulting from rapid Chinese growth. This section extends the analysis to the level of the individual Latin American countries.

The impact on foreign-exchange earnings was estimated by applying the price changes calculated in table 4 to net exports of the 15 commodities in each country. Thus, where a country is a net importer of a commodity whose price has risen as a result of the "China effect", this will be shown as a loss of foreign exchange, while for commodities where it is a net exporter, there will be a foreign-exchange gain.

Table 6 summarizes the results for 17 Latin American countries in 2007. It shows the percentage by which each country's trade balance in the 15 commodities is better (worse) than it would have been if China's share in world demand for these commodities had remained unchanged since 2002. As previously, two estimates are presented, based on lower- and upper-bound values for the price elasticities of each commodity.

TABLE 6

China: estimated impact on the net export earnings of Latin American economies, 2007
(Percentages)

Country	Maximum	Minimum
Argentina	11.9	6.9
Bolivia (Plurinational State of)	40.0	23.8
Brazil	16.0	11.9
Chile	47.8	28.8
Colombia	9.1	3.3
Ecuador	17.4	7.9
Mexico	16.2	6.7
Paraguay	7.2	4.4
Peru	48.2	29.3
Uruguay	-9.4	-3.9
Venezuela (Bolivarian Republic of)	21.4	10.1
Subtotal for Mexico and South America	*23.8*	*13.3*
Costa Rica	-13.3	-7.5
El Salvador	-37.0	-19.0
Guatemala	3.4	0.1
Honduras	3.6	1.6
Nicaragua	-14.9	-7.5
Panama	-9.3	-7.6
Subtotal for Central America	*-6.0*	*-4.0*
Total for Latin America	*23.3*	*13.0*

Source: prepared by the author on the basis of the United Nations Commodity Trade Database (COMTRADE).

The selected countries fall into four broad groups. First, there are those which are substantial beneficiaries of higher commodity prices, with estimated gains of between 20% and 50% as a result of the "China effect". These are the mineral-exporting economies of the region, Peru, Chile and the Plurinational State of Bolivia. The next group, with gains of between 7% and 20%, is made up of three significant oil exporters (the Bolivarian Republic of Venezuela, Mexico and Ecuador) and the two most diversified economies of the region (Brazil and Argentina). Four other countries have gained slightly on balance from the "China effect", with increases in foreign-exchange earnings of less than 10%. These include two Central American countries, where the gains are minimal, and Colombia and Paraguay. Finally, there are five countries where the net impact of Chinese demand on commodity prices has been negative. These are four Central American economies (El Salvador, Nicaragua, Costa Rica and Panama) and Uruguay. In all these cases, the gains from higher export prices for these commodities are more than offset by the increased cost of imports.

Previous analyses of the "China effect" on Latin America have noted the different effects on South America on the one hand and Mexico (and in some cases Central America) on the other (Devlin and others, 2006, chapter 2; Ellis, 2009, chapter 2; González, 2008). Whereas a number of South American countries, most notably Argentina, Brazil, Chile and Peru, have developed significant exports to China and are seen therefore as

major beneficiaries of Chinese growth, Mexico is seen as having been disadvantaged because of the increased competition that it has faced from Chinese manufactured goods in the United States market. This is also reflected in the bilateral trade balances between China and the different Latin American countries, with Mexico and Central America having large trade deficits, while the four South American countries have been in surplus. A further group of countries have been relatively unaffected in that they are neither significant exporters to China nor competitors with China in the United States market.

The discussion of commodity prices in this paper provides a further element in the analysis of the differential impacts of Chinese demand on the region. It shows that those countries which are major exporters to China have also benefited from the high world commodity prices induced by the growth of Chinese demand. There are also some countries which have benefited from higher prices even though they are not significant exporters to China, most notably the Plurinational State of Bolivia and the three oil exporters (Ecuador, the Bolivarian Republic of Venezuela and Mexico). The case of Mexico is particularly interesting since it is usually thought of as having been negatively affected by China.[7]

On the other hand, the Central American countries as a group have been most negatively affected by the impact of China on commodity prices. With the exception of Costa Rica, these countries continue to recognize Taiwan Province of China and do not have significant exports to mainland China. They are also (along with the Dominican Republic and Mexico) the countries which have suffered most from Chinese competition in the United States market (Jenkins, 2008). The commodities which they export, such as coffee and bananas, have not benefited significantly from the growth of demand, while the cost of imported commodities, particularly oil, has risen. Thus, the "China effect" on commodity prices has reinforced the negative effects on their economies from Chinese competition in export markets.

[7] Although Mexico has gained as a result of higher commodity prices, these have not necessarily compensated for the losses which it has suffered from Chinese competition in the United States market and possibly lower prices for its exports of manufactured goods.

VII
Conclusion

This paper is a first attempt to estimate one of the major indirect effects of the growth of China on the Latin American economies. While there have been a number of studies which have analysed the (negative) impact of Chinese competition on Latin American (particularly Mexican) exports of manufactures to third markets, and the role of China in the commodity boom is frequently mentioned, there have been no previous studies of the quantitative impact of Chinese demand on the value of the region's exports of primary commodities.

While it is impossible to arrive at an exact estimate of the gains to Latin America from higher commodity prices attributable to China, the analysis presented here suggests that it is in the range of between US$ 42 billion and US$ 75 billion, most of which is accounted for by oil and minerals. To put this into context, the total value of Latin American exports to China and Hong Kong Special Administrative Region in 2007 came to US$ 41 billion and the increase in exports after 2002 was of US$ 34 billion. Since the increase in the value of Latin American exports to China was partly a result of the increase in commodity prices induced by the growth of Chinese demand, it is clear that even on a conservative estimate, the indirect impact on world prices was a more significant source of additional export earnings to the region than the direct impact of exports to China.

It follows that any analysis which fails to consider this indirect impact will underestimate the effect of China on the Latin American economies. China's growth has undoubtedly boosted the export earnings of the region as a whole, both directly and indirectly. When individual countries in the region are considered, however, it becomes clear that, while the majority of countries have gained, there have also been losers from higher commodity prices. The main beneficiaries have been commodity exporters, particularly exporters of non-renewable resources, which raises questions about both the environmental sustainability of this pattern of growth and the implications for economic development of increasing specialization in primary commodities. The main losers in the region have been the Central American countries, and this negative impact has added to the negative effects which have resulted from the increased Chinese competition faced by their manufactured exports.

APPENDIX

Sources consulted in arriving at elasticity estimates

Commodity	Sources
Fuels	
Oil	Kirchene (2005)
Minerals, ores and metals	
Iron ore	Slade (1992); Behrman (1979)
Copper	Choe (1990); Behrman (1979)
Aluminium	Choe (1990); United States International Trade Commission (2006)
Zinc	Choe (1990)
Feedstuffs	
Soybean	FAPRI (n.d.); Williams and Thompson (1984)
Soybean oil	Valdez and Zietz (1980)
Tropical food and beverages	
Coffee	Akiyama and Varangis (1990); Behrman (1979)
Sugar	FAPRI (n.d.); Behrman (1979)
Bananas	Borrell and Hanslow (2004); Behrman (1979)
Meat products	
Beef	Sarmiento and Allen (2003); Behrman (1979)
Poultry	FAPRI (n.d.)
Forest products	
Sawn wood	Solingen and Sedjo (1996)
Chemical pulp	Bergman and Braunalund (1995)

(Original: English)

Bibliography

Akiyama, T. and P.N. Varangis (1990), "The impact of the International Coffee Agreement on Producing Countries", *World Bank Economic Review*, vol. 4, No. 2, Oxford, Oxford University Press.

Behrman, J. (1979), "International commodity agreements: an evaluation of the UNCTAD Integrated Commodity Programme", *Policy Alternatives for a New International Economic Order: an Economic Analysis*, W.R. Cline (ed.), New York, Praeger Publishers.

Bergman, M. and R. Braunalund (1995), "Measuring oligopsony power: an application to the Swedish pulp and paper industry", *Review of Industrial Organisation*, vol. 10, New York, Springer.

Borrell, B. and K. Hanslow (2004), *Banana Supply Elasticities*, Canberra, Centre for International Economics.

BP (British Petroleum) (2008), *BP Statistical Review of World Energy 2008*, London.

Calderón, C. (2009), "Trade, specialisation, and cycle synchronization: explaining output comovement between Latin America, China and India", *China's and India's Challenge to Latin America: Opportunity or Threat?*, D. Lederman, M. Olarreaga and G. Perry (eds.), Washington, D.C., World Bank.

Cesa-Bianchi, A. and others (2009), "On the Transmission of Global Shocks to Latin America Before and After China's Emergence in the World Economy", draft.

Cheung, C. and S. Morin (2007), "The impact of emerging Asia on commodity prices", *Working Paper*, No. 07-55, Ottawa, Bank of Canada.

Choe, B.J. (1990), "The metals price boom of 1987-89: the role of supply disruptions and stock changes", *Policy Research Working Paper Series*, No. 542, Washington, D.C., World Bank.

COCHILCO (Chilean Copper Commission) (2008), *Anuario de estadísticas del cobre y otros minerales, 1988-2007*, Santiago, Chile.

Devlin, R., A. Estevadeordal and A. Rodriguez-Clare (2006), *The Emergence of China: Opportunities and Challenges for Latin America and the Caribbean*, Washington, D.C., Inter-American Development Bank.

DFID (Department for International Development) (2005), *China and Forest Trade in the Asian Pacific Region: Implications for Forests and Livelihoods: Overview*, London.

Dollar, D. (2009), "Can China become the engine of world economic growth?", *East Asia & Pacific on the rise* [online] http://blogs.worldbank.org/eastpacific/print/2558

ECLAC (Economic Commission for Latin America and the Caribbean) (2008), *Economic and Trade Relations between Latin America and Asia-Pacific: the Link with China*, (LC/L.2959), Santiago, Chile, October.

Ellis, R.E. (2009), *China in Latin America: The Whats and Wherefores*, Boulder, Lynne Reiner.

FAPRI (Food and Agricultural Policy Research Institute) (s/f), *Elasticities Database*, University of Iowa [online] http://www.fapri.iastate.edu/tools/elasticity.aspx

Gallagher, K. and R. Porzecanski (2009), "China and the Latin America commodities boom: a critical assessment", *Working Paper*, No. 192, Amherst, Political Economy Research Institute, University of Massachusetts.

González, F. (2008), "Latin America in the economic equation. Winners and losers: what can losers do?", *China's Expansion into the Western Hemisphere: Implications for Latin America and the United States*, R. Roett and G. Paz (eds.), Washington, D.C., Brookings Institution Press.

IISI (International Iron and Steel Institute) (2008), *World Steel in Figures, 2008*, Brussels.

_____ (2004), *World Steel in Figures, 2004*, Brussels.

IMF (International Monetary Fund) (2008), *World Economic Outlook*, Washington, D.C., April.

_____ (2006), *World Economic Outlook*, Washington, D.C., September.

Jenkins, R. (2008), "China's global growth and Latin American exports", *WIDER Research Paper*, No. 2008/104, Helsinki, United Nations University/World Institute for Development Economics Research.

Krichene, N. (2005), "A simultaneous equation model for world crude oil and natural gas markets", *IMF Working Papers*, No. 05/32, Washington, D.C., International Monetary Fund.

Lehmann, S., D. Moreno and P. Jaramillo (2007), "China, commodity prices and Latin American performance: a few stylized facts", *Working Paper*, No. 424, Santiago, Chile, Central Bank of Chile.

Ostensson, O. (2005), *The Outlook for Iron Ore Supplies*, presentation at the OECD Special Meeting at High Level on Steel (Paris, 12 -13 January 2005).

Park, C-Y. and F. Zhai (2006), "Asia's imprint on global commodity markets", *ERD Working Paper*, No. 90, Manila, Asian Development Bank.

Ray, D. (2008), *China's Dramatic Growth in Soybean Imports and Its Commodity Price Impact*, Knoxville, University of Tennessee, Agricultural Policy Analysis Center.

Rosales, O. and M. Kuwayama (2007), "Latin America meets China and India: prospects and challenges for trade and investment", *CEPAL Review*, No. 93 (LC/G.2347-P), Santiago, December.

Sarmiento, C. and P.G. Allen (2003), "Dynamics of beef supply in the presence of co-integration: a new test of the backward bending hypothesis", *Review of Agricultural Economics*, vol. 22, No. 2, Wisconsin, Agricultural & Applied Economics Association.

Slade, M. (1992), "Environmental costs of natural resource commodities: magnitude and incidence", *Policy Research Working Papers*, No. 991, Washington, D.C., World Bank.

Solingen, B. and R. Sedjo (1996), "A comparison of timber models for use in public policy analysis", *Discussion Papers*, No. 96-12, Washington, D.C., Resources for the Future.

Streifel, S. (2006), *Impact of China and India on Global Commodity Markets: Focus on Metals and Minerals and Petroleum*, Washington, D.C., World Bank.

Timmer, H. (2010), "Can China become the engine for world economic growth?", *Prospects for Development* [online] http://blogs.worldbank.org/prospects/print/562

UNCTAD (United Nations Conference on Trade and Development) (2009), *Trade and Development Report 2009* (UNCTAD/TDR/2009), Geneva.

_____ (2008), *Trade and Development Report 2008* (UNCTAD/TDR/2008), Geneva. United Nations publication, Sales No. E.08.II.D.21.

_____ (2005), *Trade and Development Report 2005* (UNCTAD/TDR/2005), Geneva. United Nations publication, Sales No. E.05.II.D.13.

United States International Trade Commission (2006), "The effects of increasing Chinese demand on global commodity markets", *Staff Research Study*, No. 28, Washington, D.C.

Valdez, A. and J. Zietz (1980), *Agricultural Protection in OECD Countries*, Washington, D.C., International Food Policy Research Institute.

Williams, L. (2007), *Global Capital and the Zinc Market*, Global Capital Conference [online] http: //www.mineweb.com/mineweb/view/mineweb/en/page36?oid=37500&sn=Detail

Williams, G. and R.L. Thompson (1984), "Brazilian soybean policy: the international effects of intervention", *American Journal of Agricultural Economics*, vol. 66, No. 4, Wisconsin, Agricultural & Applied Economics Association.

World Bank (2009), *Global Economic Prospects 2009*, Washington, D.C.