North-South Terms of Trade: An empirical investigation

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Abstract

My empirical analysis reveals a strong link between the terms of trade of industrial and developing countries. I show that the terms of trade of developing countries are essentially the relative prices of commodity exports and manufactured imports. Similarly, I find that terms of trade fluctuations of industrial countries are heavily influenced by movements in the relative price of manufactured exports and commodity imports. This means that improvements in the terms of trade of developing countries imply a worsening in the terms of trade of industrial countries, and vice versa. One example of this is the explosion of oil prices in the early 1970s. The terms of trade of industrial countries worsened considerably, while the terms of trade of oil exporting countries improved dramatically. This episode led to a sizeable loss of income for industrial countries (of around 3 percent) and a sizeable gain in real income for oil exporting countries (of roughly 80 percent).

Key words: Terms of trade; Commodity prices; International business cycles.

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1 Introduction

The terms of trade (ratio of export to import prices) is the relative price that determines the rate at which one country's traded goods exchange for another country's traded goods. Industrial and developing countries experienced frequent double digit percentage changes in their terms of trade during the 1970s and 1980s. For instance, the terms of trade of the major industrialized countries fell by roughly 20 percent in 1974. Industrial countries devote roughly 15 percent of their expenditure to imports, so it follows that terms of trade fluctuations, holding other things constant, caused a 3 percent loss in real income in 1974.[1] To put this in perspective, the loss of real income, in industrial countries, from the 1974 terms of trade deterioration was equivalent to that associated with a deep post-war recession.

Developing countries typically experience larger terms of trade fluctuations than their industrial counterparts. Developing countries also devote a greater share of their expenditure to imports. Taken together these facts suggest that terms of trade movements probably have a more dramatic impact on the real income of developing countries. For example, take a non-oil exporting country like Chile that is also a large exporter of a single commodity, in Chile's case copper. The decline in copper prices in 1975, that flowed from the worldwide recession, led to a 30 percent fall in Chile's terms of trade. Chile devotes 20 percent of its expenditure to imports, so the deterioration in Chile's terms of trade roughly led to a 6 percent loss in real income. The Chilean experience also extends to developing countries that are major oil exporters. In 1974 terms of trade fluctuations raised the level of real income in oil exporting countries, like Saudi Arabia, by 80 percent. These examples reveal that fluctuations in the terms of trade have indeed had a dramatic impact on the real income of developing countries.

This paper uncovers the sources of terms of trade fluctuations in industrial and developing countries. I do so by contrasting the sources of cyclical movements in the terms of trade of industrial and developing countries over the 1970s and 1980s. Figure 1 summarizes the paper's main results. In particular, figure 1 plots cyclical movements in the terms of trade of various countries against cyclical fluctuations of a selected relative price term.

[1] See appendix A for a detailed discussion of the link between terms of trade and real income fluctuations.

In the case of highly specialized fuel exporting countries, like Saudi Arabia, I find their terms of trade are virtually identical to the relative price of fuel exports and manufactured imports. Similarly, for large non-fuel commodity exporters, such as Australia and Chile, I find their terms of trade are closely related to the relative price of non-fuel exports and manufactured imports. Turning to the major industrial countries, such as Germany, Japan and the United States, I find their terms of trade are well described by the relative price of manufactured exports and commodity imports at cyclical frequencies. Overall, these results point to a strong link between cyclical fluctuation in the terms of trade of industrial and developing countries. In fact, these findings suggest that improvements in the terms of trade of developing countries are associated with a worsening in the terms of trade of industrial countries. Combining these results with my earlier discussion it follows that terms of trade fluctuations led to a significant transfer of real income between industrial and developing countries during the 1970s and 1980s.

Some researchers (see, for example, Easterly et al. 1993) argue that terms of trade fluctuations not only have a short-run impact they also have a sizeable impact on the medium-term growth performance of developing countries. These authors even argue that terms of trade fluctuations have a greater influence on growth than either trade or fiscal policy. At the same time other researchers (see, for example, Kouparitsas (1996), and Borensztein and Reinhart (1994)) have argued that commodity price fluctuations are driven by innovations to industrial country productivity. This suggests that industrial country business cycles may have a significant short-run and possibly medium- to long-run impact on developing countries.

The remainder of the paper is organized in the following way. In section 2, I introduce the paper's notation and analyze the various ways to decompose the terms of trade. Methodological issues relating to empirical variance decompositions are addressed in section 3. Section 4 describes the data set, while section 5 presents the paper's main results. I conclude the discussion in the following section by briefly recapping the paper's main findings and offering suggestions for future research.

2 Conceptual issues

In simple real trade models the terms of trade is the relative price of two different goods. For example, the terms of trade in Caves and Jones (1973) is the relative price of the exportable food and the importable clothing. I start by showing that the terms of trade can be expressed as a linear function of various relative prices. These relative prices fall into two groups. One group is made up of the relative prices of different types of goods (relative goods prices). The second group includes the relative prices of the same types of export and import goods (relative country prices). I show that there is no unique way to express the terms of trade in terms of its underlying relative prices. In other words, the terms of trade are explained by some subset of the available relative prices.

Letting lower-case p refer to the natural log of prices, the export deflator p^x can be conveniently approximated by

$$p^x = \sum_{i=1}^{n} \alpha_i^x p_i^x \tag{1}$$

where, α_i^x is the share of good i in the export basket, $\alpha_i^x \geq 0, \sum_{i=1}^{n} \alpha_i^x = 1$, p_i^x is export price of good i, and n denotes the number of goods. Similarly, the import deflator p^m can be conveniently approximated by

$$p^m = \sum_{i=1}^{n} \alpha_i^m p_i^m \tag{2}$$

where, α_i^m is the share of good i in the import basket, $\alpha_i^m \geq 0, \sum_{i=1}^{n} \alpha_i^m = 1$, and p_i^m is the country's import price of good i. The terms of trade is the ratio of aggregate export prices to aggregate import prices, so combining (1) and (2) the general form of the log of the terms of trade, $p^x - p^m$ is

$$p^x - p^m = \sum_{i=1}^{n} \alpha_i^x p_i^x - \sum_{i=1}^{n} \alpha_i^m p_i^m \tag{3}$$

To keep the analysis simple I limit the discussion to the case in which there are only two goods: commodities ($i = c$) and manufactures ($i = m$). The results extend to cases with more than two goods. With only two goods the terms of trade can be expressed as a linear combination of six relative price terms

$$p^x - p^m = \gamma_1(p^x_c - p^x_m) + \gamma_2(p^m_c - p^m_m) + \gamma_3(p^x_c - p^m_m) + \gamma_4(p^m_c - p^x_m) + \gamma_5(p^x_c - p^m_c) + \gamma_6(p^x_m - p^m_m) \quad (4)$$

where the coefficients γ_i are linear functions of export and import expenditure shares. The form of the γ_i's depends on the type of decomposition. In general there are three types of decompositions and only a subset of the relative prices appears in each (i.e., some γ_i's $= 0$). The type of decomposition one adopts depends critically on the question being asked.

2.1 Goods vs. country prices

The first type of decomposition I study highlights the link between trade structure and the terms of trade. In this example I define goods prices to be the relative prices of different goods within the export basket $p^x_c - p^x_m$ or import basket $p^m_c - p^m_m$, while the country prices are relative prices of the same types of exported and imported goods, $p^x_i - p^m_i$. Using these relative prices the terms of trade is described by

$$p^x - p^m = (\alpha^x_c - \alpha^m_c)(p^x_c - p^x_m) + \alpha^m_c(p^x_c - p^m_c) + (1 - \alpha^m_c)(p^x_m - p^m_m) \quad (5)$$

$$p^x - p^m = (\alpha^x_c - \alpha^m_c)(p^m_c - p^m_m) + \alpha^x_c(p^x_c - p^m_c) + (1 - \alpha^x_c)(p^x_m - p^m_m) \quad (6)$$

In these examples goods prices are weighted by the net export share of commodities $\alpha^x_c - \alpha^m_c$, while the country prices are weighted by gross exports or imports shares. If the exports and imports baskets are symmetric ($\alpha^x_i - \alpha^m_i = 0$), the terms of trade is explained by the relative prices of the same types of export and import goods. Goods prices take on greater importance when export and import bundles are more asymmetric.

I can use (5 and 6) to highlight a key difference between the import and export baskets of industrial and developing countries. Roughly 85 percent of the international trade of developing countries is with industrial countries. Trade between industrial and developing countries is asymmetric; industrial countries export manufactured goods to developing countries in exchange for developing country exports of fuel and non-fuel commodities. Therefore, the terms of trade of developing countries is heavily weighted towards the relative goods price. Trade between industrial countries is symmetric; intra-industrial region trade involves the exchange of differentiated goods. Therefore, the terms of trade of industrial countries is heavily weighted towards the intra-industrial region terms of trade, which is the relative country price. Overall, this suggests that a key difference between the terms of trade industrial and developing countries is the weight they place on the relative goods prices and the relative country prices.

Note, if the classification of goods is sufficiently narrow the export price of good i will be the same as the import price of good i, and the terms of trade is described by the goods price term alone. In practice the statistician reports price deflators for very broad export and import good types. In particular, p_i^x and p_i^m are export and import price deflators for good type i. Letting p_{ij}^x and p_{ij}^m denote the export and import price of the jth good in the ith good type I can describe p_i^x in the following way

$$p_i^x = \sum_{j=1}^{k} \alpha_{ij}^x p_{ij}^x \tag{7}$$

where, α_{ij}^x is the share of jth good in the ith export good basket, $\alpha_{ij}^x \geq 0, \sum_{j=1}^k \alpha_{ij}^x = 1, p_{ij}^x$ is export price of jth good in the ith export type, and k denotes the number of goods in the ith type. For example, if the jth good was a television or computer, the ith good type would be manufactured goods. At this level of aggregation I can assume that $p_{ij}^x = p_{ij}^m$, so

$$p_i^x - p_i^m = \sum_{j=1}^{k-1} (\alpha_{ij}^x - \alpha_{ij}^m)(p_{ij}^x - p_{ik}^x) \tag{8}$$

which reveals that relative country prices $p_i^x - p_i^m$ are actually functions of goods prices $p_{ij}^x - p_{ik}^x$. In other words, country prices come about because countries trade differentiated products of the same types of goods.

This type of decomposition is also motivated by recent empirical work that decomposes fluctuations in the real exchange rate into similar notions of relative goods and country price components (see, for example, Engel (1993), and Rodgers and Jenkins (1995)). In the context of real exchange rates goods prices refer to the relative prices of goods within the home (or foreign) country, while country prices refer to the exchange rate adjusted relative prices of the same types of goods in the home and foreign country. The structure of the home and foreign country's aggregate expenditure baskets determine the weight given to these relative prices. Industrial countries have very similar expenditure baskets. This symmetry between the home and foreign aggregate expenditure baskets means that the coefficient on goods prices is essentially zero (just as symmetric export and import bundles lead to a zero coefficient in (5 and 6)). Therefore, this line of research argues that real exchange rate fluctuations are driven by movements in country prices. My empirical work suggests that terms of trade fluctuations in industrial countries are also largely driven by country price movements when the terms of trade is decomposed along the lines of (5 and 6). In contrast, if I decompose the terms of trade fluctuations of developing countries using (5 and 6) I find that movements in goods prices dominate country prices. This reflects the fact that developing countries have asymmetric export and import bundles, while industrial countries have symmetric trade bundles.

2.2 Export specialization

The next decomposition highlights the link between industrial and developing country terms of trade. To do so I study specialization on the exports side. I do this by picking the numeraire to be an export price. Industrial countries are somewhat specialized in the export of manufactured goods, so I can carry out this decomposition from an industrial country perspective by choosing the numeraire to be the export price of manufactured goods. The goods term is composed of $p_c^x - p_m^x$ and $p_c^m - p_m^x$, while the country price is simply the ratio of the export and import price of manufactured goods. The industrial country terms of trade is represented by

$$p^x - p^m = \alpha_c^x(p_c^x - p_m^x) - \alpha_c^m(p_c^m - p_m^x) - (1 - \alpha_c^m)(p_m^m - p_m^x) \tag{9}$$

Similarly, I can take a developing country perspective by allowing the numeraire to be the export price of commodities. Now, the goods term is composed of $p_m^x - p_c^x$ and $p_m^m - p_c^x$, while the country price is simply the ratio of the export and import price of commodities. The developing country terms of trade is given by

$$p^x - p^m = \alpha_m^x(p_m^x - p_c^x) - \alpha_m^m(p_m^m - p_c^x) - (1 - \alpha_m^m)(p_c^m - p_c^x) \tag{10}$$

To simply the discussion assume that the industrial country is completely specialized in the export of manufactured goods ($\alpha_c^x = 0$) and the developing country is completely specialized in the export of commodities ($\alpha_m^x = 0$). Now, the industrial country terms of trade is simply

$$p^x - p^m = \alpha_c^m (p_m^x - p_c^m) + (1 - \alpha_c^m)(p_m^x - p_m^m) \tag{11}$$

while the developing country terms of trade is simply

$$p^x - p^m = \alpha_m^m (p_c^x - p_m^m) + (1 - \alpha_m^m)(p_c^x - p_c^m) \tag{12}$$

Trade between industrial and developing countries is asymmetric; industrial countries export manufactured goods to developing countries in exchange for exports of developing country commodities. The terms of trade between industrial and developing countries is captured by $p_m^x - p_c^m$ in the case of industrial countries and $p_c^x - p_m^m$ in the case of developing countries. This term is weighted by the share of commodities in the industrial country's import basket α_c^m and the share of manufactured goods in the developing country's import basket α_m^m. The terms of trade between industrial and developing countries becomes more important as α_c^m and α_m^m rise. In contrast, trade between industrial countries is symmetric; intra-industrial region trade essentially involves the exchange of differentiated manufactured goods. Therefore, the terms of trade between industrial countries is captured by $p_m^x - p_m^m$. This term is weighted by the share of manufacturing in the industrial country import basket $(1 - \alpha_c^m)$. The terms of trade between industrial countries becomes more important as $(1 - \alpha_c^m)$ rises. Similarly, the terms of trade between developing countries is captured by $p_c^x - p_c^m$. This term is weighted by the share of commodities in the developing country import basket $(1 - \alpha_m^m)$. The terms of trade between developing countries becomes more important as $(1 - \alpha_m^m)$ rises. Overall, the link between industrial and developing country terms of trade rises as goods price movements take on a more important role in explaining terms of trade fluctuations of industrial and developing countries.

2.3 Import specialization

Finally, I study specialization on the imports side. Most countries devote a large share of their import basket to manufactured goods, so I pick the numeraire to be the import price of manufactured goods. In this case the goods term is composed of $p_c^x - p_m^m$ and $p_c^m - p_m^m$, while the country price is the ratio of the prices of manufactured export and import goods

$$p^x - p^m = \alpha_c^x(p_c^x - p_m^m) - \alpha_c^m(p_c^m - p_m^m) + (1 - \alpha_c^x)(p_m^x - p_m^m) \tag{13}$$

In the case of developing countries, the terms of trade between industrial and developing countries is captured by $p_c^x - p_m^m$. This term is weighted by the share of commodities in the developing country export basket. For these countries the terms of trade between industrial and developing countries becomes more important as α_c^x rises. For industrial countries the terms of trade between industrial countries is captured by $p_m^x - p_m^m$. This term is weighted by the share of manufacturing in the industrial country export basket. Note, the terms of trade between industrial countries becomes more important as $(1 - \alpha_c^x)$ rises. In the industrial country case, one could loosely think of $p_m^m - p_c^m$ as capturing the terms of trade between industrial and developing countries. This relative price becomes more important as α_c^m rises.

3 Empirical methodology

My data analysis follows the approach of recent empirical work that decomposes the variance of the real exchange rate into similar notions of goods and country price components. Say I am interested in the share of the variance of the terms of trade attributable to fluctuations in goods prices. In particular, say I am interested in the share of the terms of trade variance explained by fluctuations in the price ratios of different goods in the export basket. To simplify the discussion I rewrite (5) using the following notation: $w = p^x - p^m$; $y = (\alpha_c^x - \alpha_c^m)(p_c^x - p_m^x)$; and $z = \alpha_c^m(p_c^x - p_c^m) + (1 - \alpha_c^m)(p_m^x - p_m^m)$, so $w = y + z$. In addition, I denote the sample variance of i by s_{ii}, and the sample covariance of i and j by s_{ij}. Decomposing the variance of the terms of trade would be easy if y and z were uncorrelated (i.e., $s_{yz} = 0$). In that case $s_{ww} = s_{yy} + 2s_{yz} + s_{zz} = s_{yy} + s_{zz}$ and the share of the variance of w explained by y would be s_{yy}/s_{ww}. Typically, y and z are correlated. This raises the question of how to deal with the covariance term $2s_{yz}$. I follow the approach of Rogers and Jenkins (1995) which is to divide the covariance between y and z. In other words, I assign $(s_{yy} + s_{yz})/s_{ww} = s_{wy}/s_{ww}$ to be the share of the variance of w attributed to

y. Note, in some cases y and z are negatively correlated, so s_{wy}/s_{ww} or s_{wz}/s_{ww} may exceed 1. In these cases it is always true that s_{wy}/s_{ww} or s_{wz}/s_{ww} is close to 1, which suggests a large share of the variation in w is due to y or z, respectively.

There is a large literature that studies the long-run behavior of the terms of trade of developing countries (see, for example, Bleeney and Greenaway, 1993). These studies find that the terms of trade and its underlying relative prices are non-stationary time series. This is undesirable because I am interested in second moment properties of the data. One way around this problem is to focus on a stationary component of the data. I follow the international business cycle literature by using a Hodrick and Prescott (1997) (HP) filter to isolate the stationary component of the data that is linked to the so called business cycle frequencies. Following the suggestion of Baxter and King (1994) I use a HP filter with penalty term $\lambda = 10$ to isolate these business cycle frequencies in annual data. There are many competing ways to decompose the data into stationary and non-stationary components (see, for examples, Cuddington and Urzua 1989, and Sapsford 1990). The results discussed in the following sections extend to terms of trade and relative price data that has been filtered using other widely used linear filters, such as, the first difference filter, or HP filters with $\lambda = 100$ and 400.

4 Data issues

The data used in this paper is limited to three broad good types: non-fuel commodities ($i = nf$), fuels ($i = f$), and manufactured goods ($i = m$). Non-fuels includes agricultural and mining products. Fuels includes commodities, such as crude oil and refined petroleum. Manufactured goods covers a broad range of manufactured items from textiles to machinery.[2] I use this data to answer two questions. First, do movements in the terms of trade reflect fluctuations in the relative prices of different goods or the relative prices of the same types of goods. In other words, are terms of trade fluctuations driven by movements in goods or country prices. Second, what is the most influential relative price in the goods and country price components.

The data includes export and import values and prices for 100 countries. I organize

[2] A more detailed description of the data is provided in appendix B.

the data by breaking the countries up into various regional and export groups (see appendix C for a listing of countries by region and export type). First, to highlight regional differences I divide the sample into developed and developing country groups–the distinction between a developed and developing country is based on International Monetary Fund (1993) classifications. Next, to emphasize the importance of trade structure I divide countries according to export type. Using the notation above, a country's net-export share for good i is $(\alpha_i^x - \alpha_i^m)$. A country is classified as a good i exporter if $(\alpha_i^x - \alpha_i^m) > (\alpha_j^x - \alpha_j^m)$ for all $i, j = nf, f, m$. my discussion will be confined to summary statistics for the regional and export groups (i.e., median or mean of the group) and country statistics for the major industrial countries.

5 Results

Table 1 provides summary statistics on the object of interest, the volatility of the terms of trade. Volatility is measured as the percentage standard deviation of the filtered data. The terms of trade of developing countries are on average twice as volatile as the terms of trade of their industrial counterparts. Fuel exporters have the most volatile terms of trade. In fact their terms of trade are roughly three times as volatile as those of developed countries. The lower part of the table reports little difference in the terms of trade volatility of major industrial countries. The obvious exception is Japan. Japan's terms of trade is roughly twice as volatile as that of the United States, which has the least volatile terms of trade.[3]

The discussion in section 2 shows that terms of trade decompositions involve two components. One element is the relative price terms and the other is the weight given to these relative prices. The weighting terms are linear functions of export and import expenditure shares. The remaining columns of table 1 describe the composition of exports and imports baskets for various regional and exporter types. Turning first to imports, there is little variation in the import share devoted to the 3 goods across countries. Most countries devote about 65 percent of their import basket to manufactured goods, 20 percent of their import basket to non-fuels, and roughly 15 percent of their import basket to fuels. Based on this I can think of countries as roughly specialized in the imports of manufactured goods. Cross

[3]Appendix D reports volatility statistics for selected relative prices.

country differences emerge on the exports side. By definition non-fuel exporters typically devote 70 percent of their export basket to non-fuels, fuel exporters on average allocate 70 percent of their export basket to fuels, and manufactured goods exporters typically devote 80 percent of their export basket to manufactured goods. In general, the export and import baskets of developing countries are less symmetric than those of their industrial counterparts. Italy and Japan are obvious exceptions to this rule. The composition of Italian and Japanese exports is similar to other industrial countries, but Italy and Japan devote only 47 and 25 percent of their respective import baskets to manufactured goods and a proportionately higher share to non-fuels and fuels. This suggests that Italy's and Japan's trade bundles are less symmetric than their industrial counterparts and are, in fact, more closely related to the trade bundles of developing countries.

5.1 Goods vs. country prices

The first question I ask of the data is whether terms of trade fluctuations reflect movements in relative prices of different goods within the export bundle or movements in the relative prices of the same types of export and import goods. Table 2 reports the findings of decompositions described by (5). As expected from section 2 the results are mixed. The first two columns indicate goods price fluctuations explain a large portion of the terms of trade movements in developing countries, while country price fluctuations explain a large portion of the terms of trade movements in developed countries. The results are also mixed for major industrial countries. Goods price fluctuations dominate in Italy and Japan, while country price fluctuations dominate in the other five countries. These results are consistent with my observation that developing countries place much greater weight on the goods price component because they have asymmetric export and import bundles. The findings for Italy and Japan can be explained similarly, because their trade bundles are less symmetric than their major industrial counterparts.

The third and fourth columns of table 2 break up the goods price term into two relative prices: the relative price of non-fuel and manufactured exports $p^x_{nf} - p^x_m$ and the relative price of fuel and manufactured exports $p^x_f - p^x_m$. Goods price movements are dominated by fluctuations in $p^x_{nf} - p^x_m$ in non-fuel exporting countries, while goods price movements in fuel and manufactured goods exporting countries are dominated by fluctuations in $p^x_f - p^x_m$.

The remaining three columns of table 2 break up the country price term into its various relative country prices: non-fuels $p^x_{nf} - p^m_{nf}$, fuels $p^x_f - p^m_f$, and manufactured goods $p^x_m - p^m_m$. There is no systematic relationship across export or regional types. Although, fluctuations in $p^x_f - p^m_f$ appear to dominate other relative prices in the major industrial countries, excluding Canada and the United Kingdom. If there is any result that seems to hold across countries it is that movements in $p^x_m - p^m_m$ explain a significant portion of the fluctuations in country prices.

5.2 Specialization

In my discussion of table 1 I observed that countries are roughly specialized in the export of a good (i.e., they devote around 70 percent of their export basket to exports of non-fuels, fuels or manufactured goods). If you recall the import baskets of countries in the sample are similar with 65 percent of their import basket allocated to manufactured goods, 15 percent allocated to fuels and 20 percent to non-fuels. Therefore, countries are roughly specialized in the imports of manufactured goods. With this in mind I turn to tables 3 and 4. Table 3 reports on the decomposition described by (9 and 10) using various export prices as the numeraire. Specifically, the numeraire for non-fuels exporters is non-fuel exports, the numeraire for fuel exporters is fuel exports, and the numeraire for manufactured goods exporters is manufactured goods exports. Table 4 looks at the case where the numeraire is the import price of manufactured goods. I focus on the export specialization case first.

5.2.1 Export specialization

Columns one and two of table 3 suggest that a large portion of the fluctuations in the terms of trade of all countries is explained by movements in the goods price component. In general, the goods price explains more than 60 percent of the variation in the terms of trade. This result is surprising for manufactured goods exporters, since this decomposition places a large weight on the country price term in these countries. The coefficient in question is the imports share of manufactured goods which is about 0.60. The result is expected for non-fuel and fuel exporters since their respective country prices have a small coefficient, 0.20 and 0.15 respectively.

The six remaining columns of table 3 decompose the variance of the goods price term.

There are two expected findings here. First, a large share of the variation in the goods price of non-fuel exporters is due to movements in the relative price of non-fuel exports and manufactured imports $p^x_{nf} - p^m_m$. Second, virtually all of the fluctuations in the terms of trade and goods price component of fuel exporting countries is explained by movements in the relative price of fuel exports and manufactured imports $p^x_f - p^m_m$. What is surprising is that fluctuations in the goods price of manufactured good exporters is explained by movements in the relative price of manufactured exports and fuel imports $p^x_m - p^m_f$, and to a lesser extent movements in the relative price of manufactured exports and non-fuel imports $p^x_m - p^m_{nf}$. This result emerges despite the fact that these relative prices have coefficients equal to the fuel and non-fuel share of imports, 0.17 and 0.23 respectively (note, the weight given to the country price component $p^x_m - p^m_m$ is 0.60). It also highlights the fact these relative prices are highly volatile.[4]

These findings are echoed in figure 1. Figure 1 plots the terms of trade for six countries against various relative prices. For manufactured goods exporters the relative price is the relative price of manufactured goods exports and commodity imports $p^x_m - p^m_c$, for fuel exporters I use $p^x_f - p^m_m$, and for non-fuel exporters I plot $p^x_{nf} - p^m_m$. In all cases there is a high correlation between the terms of trade and the relative price term. This suggests that at cyclical frequencies the terms of trade of fuel exporters, non-fuel exporters, and manufactured good exporters are well characterized by the following relative prices: $p^x_f - p^m_m$, $p^x_{nf} - p^m_m$, and $p^x_m - p^m_c$.

Overall, this decomposition reveals a strong link between the terms of trade of industrial and developing countries at cyclical frequencies. In particular, these findings suggest that improvements in the terms of trade of developing countries imply a worsening in the terms of trade of industrial countries, and vice versa. One of the most obvious examples of this is the oil price explosion of the early 1970s. During this period the terms of trade of industrial countries worsened considerably, while the terms of trade of oil exporting countries improved dramatically.

[4] Appendix D reports volatility statistics for selected relative prices.

5.2.2 Import specialization

Table 4 decomposes the terms of trade along the lines of (13) using imports of manufactured goods as the numeraire. Recall, this example is motivated by the observation that countries typically devote more than 65 percent of their imports to manufactured goods. Columns one and two reveal that a large proportion of the variation in the terms of trade is explained by fluctuations in goods prices. Fluctuations in the goods price component and the terms of trade of manufactured goods exporters is to a large degree explained by movements in the relative price of fuel and manufactured good imports $p_f^m - p_m^m$. This finding is difficult to interpret because manufactured goods exporters are fuel importers and manufactured goods exporters. With that in mind I argue that $p_f^m - p_m^m$ is acting as a proxy for $p_f^m - p_m^x$. Note, that country prices dominate in Japan and the United Kingdom. First, this reflects the fact that Japan devotes a small share of its imports to manufactured goods, so it is inappropriate to think of Japan as specialized in the imports of manufactured goods. Second, these results highlight the fact that the United Kingdom is both an importer and exporter of crude fuels, so the goods price terms $p_f^x - p_m^m$ and $p_f^m - p_m^m$ tend to cancel out each other.

Not surprisingly, terms of trade and goods price movements of fuel and non-fuel exporting countries are dominated by movements in the relative price of fuel exports and manufactured imports $p_f^x - p_m^m$, and non-fuel exports and manufactured imports $p_{nf}^x - p_m^m$, respectively. These results are expected because fuel and non-fuel exporters place a large weight on these relative prices. The coefficients in question are respectively the share of fuels and non-fuels in the export baskets of fuel and non-fuel exporters.

Overall, these results reinforce the findings of table 3. In particular, I have further evidence in favor of the notion that at cyclical frequencies the terms of trade of fuel exporters, non-fuel exporters and manufactured goods exporters are closely related to the terms of trade between industrial and developing countries.

6 Conclusion

This paper shows that fluctuations in the terms of trade can arise from movements in two type of relative prices. The first group is made up of the relative prices of different types of goods (relative goods prices). While the second group includes the relative prices of the same types of export and import goods (relative country prices). Irrespective of the way the terms of trade are decomposed, the relative prices of different goods always dominate in developing countries. In contrast, for some decompositions, the terms of trade of industrial countries are dominated by movements in the relative prices of different goods, in others the relative prices of the same types of goods dominate. These results highlight the fact that developing countries tend to have asymmetric export and import bundles, while industrial countries typically have symmetric export and import bundles.

My empirical analysis reveals a strong link between the terms of trade of industrial and developing countries. I show that the terms of trade of developing countries are essentially the relative prices of commodity exports and manufactured imports. Similarly, I find that terms of trade fluctuations of industrial countries are heavily influenced by movements in the relative price of manufactured exports and commodity imports. This means that improvements in the terms of trade of developing countries imply a worsening in the terms of trade of industrial countries, and vice versa. One example of this is the explosion of oil prices in the early 1970s. The terms of trade of industrial countries worsened considerably, while the terms of trade of oil exporting countries dramatically improved (note, there are other less dramatic examples involving non-fuel commodities). This episode led to a sizeable loss of income for the industrial region and a sizeable gain in real income for the developing region. Some authors have argued that terms of trade fluctuations have an important impact on the medium- and long-run growth performance of developing countries. In fact, it has been argued that terms of trade fluctuations are more important influence on growth than either trade or fiscal policy. With this in mind, future research on the factors underlying business cycles or long-run growth in developing countries should be directed at uncovering the factors that have led to large fluctuations in the terms of trade between industrial and developing countries. Kouparitsas (1996), and Borensztein and Reinhart (1994) have already taken a step in that direction.

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A Changes in real income[5]

Define real income in terms of good 1 (y_t) at time t from the expenditure side as

$$y_t = c_{1t} + p_o c_{2t}$$

where, c_{it} is consumption of good i at time t, and p_o is the base year ($t = 0$) relative price of good 1 and 2. Any change in the consumption bundle ($\hat{c}_{1t}, \hat{c}_{2t}$) affects real income

$$\hat{y}_t = sc_1 \hat{c}_{1t} + sc_2 \hat{c}_{2t}$$

where $sc_1 = c_{1o}/y_o$, $sc_2 = p_o c_{2o}/y_o$, and $\hat{w}_t = (w_t - w_o)/w_o$.

The budget constraint is

$$c_{1t} + p_t c_{2t} = x_{1t} + p_t x_{2t}$$

where, x_{it} is endowment of good i and p_t is the relative price of good 1 and 2 at time t. The source of any change in the real income $\hat{y}_t$ must reside in either a change in the endowment bundle ($\hat{x}_{1t}, \hat{x}_{2t}$) or a change in the relative price $\hat{p}_t$

$$sc_1 \hat{c}_{1t} + sc_2 \hat{p}_t + sc_2 \hat{c}_{2t} = sx_1 \hat{x}_{1t} + sx_{2t} \hat{p}_t + sx_2 \hat{x}_{2t}$$

where $sx_1 = x_{1o}/y_o$, and $sx_2 = p_o x_{2o}/y_o$. Subtracting $sc_2 \hat{p}_t$ from both sides and using the expression above for $\hat{y}_t$ I find

$$\hat{y}_t = sc_1 \hat{c}_{1t} + sc_2 \hat{c}_{2t} = sx_1 \hat{x}_{1t} + sx_2 \hat{x}_{2t} - (sc_2 - sx_2)\hat{p}_t = sx_1 \hat{x}_{1t} + sx_2 \hat{x}_{2t} - sm\hat{p}_t$$

This basic expression for the change of real income has two components. First, the term $-(sc_2 - sx_2)\hat{p}_t$ is the relative price effect. Assume the home country is a net importer of good 2. In that case p_t is the inverse of the terms of trade and $(sc_2 - sx_2)$ is the share of expenditure devoted to imports, which is denoted by sm. If the terms of trade deteriorate for the country in question, $\hat{p}_t$ is positive and real income falls by $sm\hat{p}_t$. Second, the term $sx_1 \hat{x}_{1t} + sx_2 \hat{x}_{2t}$, is the weighted sum of changes in the country's endowment bundle.

[5]This appendix draws heavily on the presentation in chapter 3 of Caves and Jones (1973).

B Data sources and definitions

The primary data source is World Bank (1991), World Tables. From this database I am able to draw on annual merchandise trade data for 100 countries, over the period from 1969 to 1988. These data include export price indices and trade value series for three broad categories of merchandise trade: non-fuel commodities, fuels and manufactured goods. Each of these categories conforms to a Standard International Trade Classification (SITC): non-fuels $= 0 + 1 + 2 + 4 + 68$; fuels $= 3$; and manufactured goods $= 5 + 6 + 7 + 8 - 68$.

World Tables does not have price data for individual import good categories. In general countries import goods from a large number of countries (see Michaely, 1984, chapter 4 for details). In response to this, I describe individual country import prices for fuels and non-fuel commodities by world price indices. Specifically, I construct the world price indices (P^*_{ikt}) for country k using a Paasche index

$$P^*_{ikt} \equiv \frac{\sum_{j \neq k} P_{ijt} X_{ijt}}{\sum_{j \neq k} P_{ijo} X_{ijt}},$$

where, P_{ijt} is the jth country's \$US export price for the ith, X_{ijt} is the volume of ith good exported by the jth country at time t, and P_{ijo} is the jth country's base year export price for the ith good. Note, import prices of manufactures are the residual in this analysis that ensures the constructed individual import prices are consistent with the actual aggregate import price. This solution introduces an additional error into the analysis. In particular, I can describe the error by the following

$$\varepsilon_{ikt} \equiv p^m_{ikt} - (s_{kt} + p^*_{ikt}),$$

where, p^m_{ikt} is country k's actual import price for good i, s_{kt} is the log of country k's \$US spot exchange rate, p^*_{ikt} is the log of country k's the world price for good type i, and ε_{ikt} is the individual country error associated with using the world price. Preliminary work using actual US export and import price indices yields qualitatively similar findings to those reported in this paper for the US using constructed world prices.

World Tables does not have a common base year for all countries. However, all price data are scaled so that they are equal to one in 1986 and this is the base year used in constructing the world price indices. Export and import expenditure shares are sample averages over 1969 to 1988.

Appendix C Country List

Developing Countries

Manufactured Goods Exporters

Hong Kong	Israel	Republic of Korea
Malta		

Primary Non-Fuel Exporters

Argentina	Guyana	Papua New Guinea
Barbados	Haiti	Paraguay
Benin	Honduras	Peru
Bolivia	India	Philippines
Botswana	Jamaica	Rwanda
Brazil	Jordan	Senegal
Burkina Faso	Kenya	Sierra Leone
Cameroon	Lesotho	Singapore
Central African Republic	Madagascar	Somalia
Chile	Malawi	South Africa
Colombia	Malaysia	Sudan
Costa Rica	Mali	Tanzania
Cyprus	Mauritania	Thailand
Dominican Republic	Mauritius	Togo
El Salvador	Morocco	Turkey
Ethiopia	Nepal	Uganda
Fiji	Nicaragua	Uruguay
Gambia, The	Niger	Zaire
Ghana	Pakistan	Zambia
Guatemala	Panama	Zimbabwe

Fuel Exporters

Algeria	Indonesia	Syrian Arab Republic
Congo	Kuwait	Trinidad and Tobago
Ecuador	Mexico	Tunisia
Egypt	Nigeria	United Arab Emirates
Gabon	Saudi Arabia	Venezuela

Industrial Countries

Manufactured Goods Exporters

Austria	Italy	Sweden
Finland	Japan	Switzerland
France	Portugal	United Kingdom
Germany	Spain	United States

Primary Non-Fuel Exporters

Australia	Greece	Netherlands
Canada	Iceland	New Zealand
Denmark	Ireland	

Fuel Exporters

Norway

Appendix D

Volatility of Selected Relative Prices (b)

Country/Region	Goods Price Components: pxnf-pmm	pxf-pmm	pmnf-pxm	pmf-pxm	Country price Components: pxnf-pmnf	pxf-pmf	pxm-pmm
Developing (a)							
Non-Fuel Exporters	12.03	22.60	6.78	17.40	9.49	5.06	5.09
Fuel Exporters	10.02	22.69	9.36	17.72	6.62	5.14	7.28
Total	11.32	22.64	7.29	17.46	8.70	5.07	5.51
Developed (a)							
Non-Fuel Exporters	8.15	19.28	7.95	19.13	5.04	17.42	5.03
Manufactures Exporters	8.27	19.15	8.05	19.34	3.94	15.32	3.91
Total	8.26	19.29	8.03	19.17	4.37	15.70	4.32
World (a)							
Non-Fuel Exporters	11.58	22.21	6.91	17.60	8.97	6.52	5.08
Fuel Exporters	9.96	22.59	9.30	17.71	6.46	5.23	7.05
Manufactures Exporters	7.58	20.13	7.84	18.86	4.12	12.73	4.24
Major Industrial Countries							
Canada	8.77	18.56	8.19	19.07	3.47	21.34	4.11
France	8.95	18.47	7.21	19.87	3.19	18.07	3.43
Germany	8.26	19.67	8.51	21.35	1.71	18.06	3.26
Italy	6.42	20.01	8.83	20.10	2.74	17.46	3.46
Japan	11.31	20.37	6.29	18.65	4.37	17.55	6.77
United Kingdom	7.46	21.65	8.45	20.00	1.34	4.39	3.61
United States	9.65	9.52	8.63	18.86	3.94	14.84	3.17

Notes:
Authors calculations based on data from World Bank (1991). (a) Values refer to the median of regional sample, except in the case of industrial countries where the reporte statistics are for individual countries. (b) Relative price volatility is measured by the percentage standard deviation from Hodrick and Prescott (1997) trend. pxnf-pmm denote the log of the relative price of non-fuel exports and manufactured imports. pxf-pmm denotes the log of the relative price of fuel exports and manufactured imports. pmnf-pxı denotes the log of the relative price of non-fuel imports and manufactured exports. pmf-pxm denotes the log of the relative price of fuel imports and manufacture exports. pxnf-pmnf denotes the log of the relative price of non-fuel exports and imports. pxf-pmf denotes the log of the relative price of fuel exports and imports. pxm-pmı denotes the log of the relative price of manufactured exports and imports.

Table 1

Terms of Trade Volatility and Trade Structure

Country/Region	Terms of Trade Volatility (a)	Export Shares (b) Non-Fuel	Fuel	Manufactures	Import Shares (b) Non-Fuel	Fuel	Manufactures
Developing							
Non-Fuel Exporters	8.80	**0.74**	0.05	0.22	0.20	0.14	**0.66**
Fuel Exporters	15.07	0.20	**0.68**	0.11	0.20	0.07	**0.73**
Total	9.76	**0.60**	0.17	0.23	0.20	0.12	**0.68**
Developed							
Non-Fuel Exporters	5.99	**0.54**	0.07	0.40	0.16	0.13	**0.71**
Manufactures Exporters	5.26	0.17	0.03	**0.80**	0.23	0.19	**0.58**
Total	5.50	0.31	0.06	**0.63**	0.20	0.16	**0.64**
World							
Non-Fuel Exporters	8.47	**0.71**	0.05	0.24	0.20	0.14	**0.67**
Fuel Exporters	14.40	0.21	**0.66**	0.13	0.19	0.07	**0.73**
Manufactures Exporters	5.00	0.16	0.03	**0.81**	0.23	0.17	**0.60**
Major Industrial Countries							
Canada	5.52	0.35	0.12	**0.53**	0.13	0.08	**0.79**
France	4.79	0.22	0.03	**0.75**	0.22	0.19	**0.59**
Germany	5.50	0.09	0.03	**0.88**	0.26	0.16	**0.58**
Italy	6.13	0.10	0.05	**0.84**	0.31	0.22	**0.47**
Japan	9.25	0.04	0.00	**0.96**	**0.38**	0.37	0.25
United Kingdom	4.72	0.13	0.10	**0.77**	0.28	0.12	**0.59**
United States	4.65	0.25	0.04	**0.71**	0.18	0.19	**0.63**

Notes:

Authors calculations based on data from World Bank (1991). (a) Values refer to the median of regional sample, except in the case of industrial countries where the reporte statistics are for individual countries. Terms of trade volatility is measured by the percentage standard deviation from Hodrick and Prescott (1997) trenc

(b) Values refer to the mean of regional sample, except in the case of industrial countries where the reported statistics are for individual countrie

Table 2

Terms of Trade Variance Decomposition (Goods vs. Country Prices)

Country/Region	Goods Price	Country Price	Goods Price Components: pxnf-pxm	Goods Price Components: pxf-pxm	Country Price Components: pxnf-pmnf	Country Price Components: pxf-pmf	Country Price Components: pxm-pmm
Developing (a)							
Non-Fuel Exporters	**0.72**	0.28	**0.92**	0.08	**0.63**	-0.04	0.43
Fuel Exporters	**0.82**	0.18	0.00	**1.00**	0.10	0.04	**0.88**
Total	**0.73**	0.27	**0.84**	0.16	0.38	-0.01	**0.63**
Developed (a)							
Non-Fuel Exporters	0.19	**0.81**	**0.99**	0.01	0.09	0.31	**0.57**
Manufactures Exporters	0.31	**0.69**	0.17	**0.83**	0.09	**0.48**	0.43
Total	0.29	**0.71**	0.26	**0.74**	0.08	**0.46**	0.45
World (a)							
Non-Fuel Exporters	**0.67**	0.33	**0.92**	0.08	**0.54**	-0.03	0.46
Fuel Exporters	**0.82**	0.18	0.00	**1.00**	0.08	0.04	**0.90**
Manufactures Exporters	0.29	**0.71**	0.23	**0.77**	0.08	0.41	**0.50**
Major Industrial Countries							
Canada	0.22	**0.78**	**0.52**	0.48	0.06	0.28	**0.66**
France	0.11	**0.89**	-0.02	**1.02**	-0.01	**0.64**	0.37
Germany	0.38	**0.62**	0.38	**0.62**	0.05	**0.49**	0.45
Italy	**0.59**	0.41	0.30	**0.70**	0.11	**0.46**	0.43
Japan	**0.68**	0.32	0.21	**0.79**	-0.11	**0.68**	0.43
United Kingdom	0.37	**0.63**	**0.77**	0.23	0.11	-0.01	**0.90**
United States	0.11	**0.89**	-0.28	**1.28**	-0.01	**0.63**	0.38

Notes:
Authors calculations based on data from World Bank (1991). (a) Values refer to the median of regional sample, except in the case of industrial countries where the reported statistics are for individual countries. pxnf-pxm denotes the log of the relative price of non-fuel and manufactured exports. pxf-pxm denotes the log of the relative price of fuel and manufactured exports. pxnf-pmnf denotes the log of the relative price of non-fuel exports and imports. pxf-pmf denotes the log of the relative price of fuel exports and imports. pxm-pmm denotes the log of relative price of manufactured exports and imports.

Table 3

Terms of Trade Variance Decomposition (Export Specialization)

Country/Region	Goods Price	Country Price pxnf-pmnf (b) pxf-pmf (c) pxm-pmm (d)	Goods Price Components pxf-pxnf (c) pxm-pxnf (d)	pxnf-pxf (b) pxm-pxf (d)	pxnf-pxm (b) pxf-pxm (c)	pxf-pmnf (c) pxm-pmnf (d)	pxnf-pmf (b) pxm-pmf (d)	pxnf-pmm (b) pxf-pmm (c)
Developing (a)								
Non-Fuel Exporters (b)	**0.86**	0.14		-0.01	-0.18		0.20	**1.03**
Fuel Exporters (c)	**0.99**	0.01	-0.41		-0.07	0.27		**1.10**
Total	**0.88**	0.12						
Developed (a)								
Non-Fuel Exporters (b)	**0.94**	0.06		-0.01	-0.21		0.26	**0.84**
Manufactures Exporters (d)	**0.67**	0.33	-0.11	-0.05		0.22	**0.86**	
Total	**0.83**	0.17						
World (a)								
Non-Fuel Exporters (b)	**0.88**	0.12		-0.01	-0.18		0.21	**0.98**
Fuel Exporters (c)	**0.99**	0.01	-0.42		-0.10	0.27		**1.17**
Manufactures Exporters (d)	**0.67**	0.33	-0.12	-0.04		0.33	**0.83**	
Major Industrial Countries								
Canada (b)	**0.96**	0.04		0.27	-0.29		0.04	**0.97**
France (d)	**0.67**	0.33	-0.14	-0.03		0.12	**1.05**	
Germany (d)	**0.72**	0.28	-0.10	-0.07		0.35	**0.83**	
Italy (d)	**0.82**	0.18	-0.11	-0.15		0.38	**0.88**	
Japan (d)	**0.86**	0.14	-0.02	-0.01		0.14	**0.88**	
United Kingdom (d)	0.43	**0.57**	-0.54	-0.78		**1.37**	0.95	
United States (d)	**0.66**	0.34	-0.16	-0.05		0.10	**1.11**	

Notes:
Authors calculations based on data from World Bank (1991). (a) Values refer to the median of regional sample, except in the case of industrial countries where the reported statistics are for individual countries. (b) Relative prices for non-fuel exporters. (c) Relative prices for fuel exporters. (d) Relative prices for manufactures exporters.
pxnf-pmnf denotes the log of the relative price of non-fuel exports and imports. pxf-pmf denotes the log of the relative price of fuel exports and imports.
pxm-pmm denotes the log of the relative price of manufactured exports and imports. pxnf-pxf denotes the log of the relative price of non-fuel and fuel exports
pxnf-pxm denotes the log of relative price of non-fuel and manufactured exports. pxnf-pmf denotes the log of the relative price of non-fuel exports and fuel imports.
pxnf-pmm denotes the log of the relative price of non-fuel exports and manufactured imports. pxf-pxnf denotes the log of the relative price of fuel and non-fuel exports.
pxf-pxm denotes the log of the relative price of fuel and manufactured exports. pxf-pmnf denotes the log of the relative price of fuel exports and non-fuel imports.
pxf-pmm denotes the log of the relative price of fuel exports and manufactured imports. pxm-pxnf denotes the log of the relative price of manufactured and non-fuel exports.
pxm-pxf denotes the log of the relative price of manufactured anf fuel exports. pxm-pmnf denotes the log of the relative price of manufactured exports and non-fuel imports.
pxm-pmf denotes the log of the relative price of manufactured exports and fuel imports.

Table 4

Terms of Trade Variance Decomposition (Import Specialization)

Country/Region	Goods Price	Country Price pxm-pmm	Goods Price Components pxnf-pmm	pxf-pmm	pmnf-pmm	pmf-pmm
Developing (a)						
Non-Fuel Exporters	**0.98**	0.02	**1.07**	-0.00	-0.09	0.02
Fuel Exporters	**0.99**	0.01	0.04	**1.02**	-0.02	-0.07
Total	**0.98**	0.02	**0.95**	0.00	-0.06	-0.01
Developed (a)						
Non-Fuel Exporters	**0.80**	0.20	**0.79**	0.04	-0.13	0.18
Manufactures Exporters	**0.58**	0.42	0.05	-0.03	0.03	**0.92**
Total	**0.65**	0.35	0.24	-0.01	-0.06	**0.73**
World (a)						
Non-Fuel Exporters	**0.97**	0.03	**1.02**	-0.00	-0.09	0.02
Fuel Exporters	**0.99**	0.01	0.05	**1.03**	-0.02	-0.08
Manufactures Exporters	0.48	**0.52**	-0.00	-0.03	0.03	**0.97**
Major Industrial Countries						
Canada	**0.65**	0.35	**0.63**	0.62	-0.17	-0.08
France	**0.58**	0.42	0.06	-0.01	-0.08	**1.03**
Germany	**0.57**	0.43	-0.06	-0.07	0.22	**0.90**
Italy	**0.67**	0.33	-0.07	-0.15	0.29	**0.94**
Japan	0.46	**0.54**	0.01	-0.01	-0.21	**1.20**
United Kingdom	0.26	**0.74**	-0.43	-0.93	**1.23**	1.13
United States	**0.62**	0.38	0.05	-0.02	-0.05	**1.02**

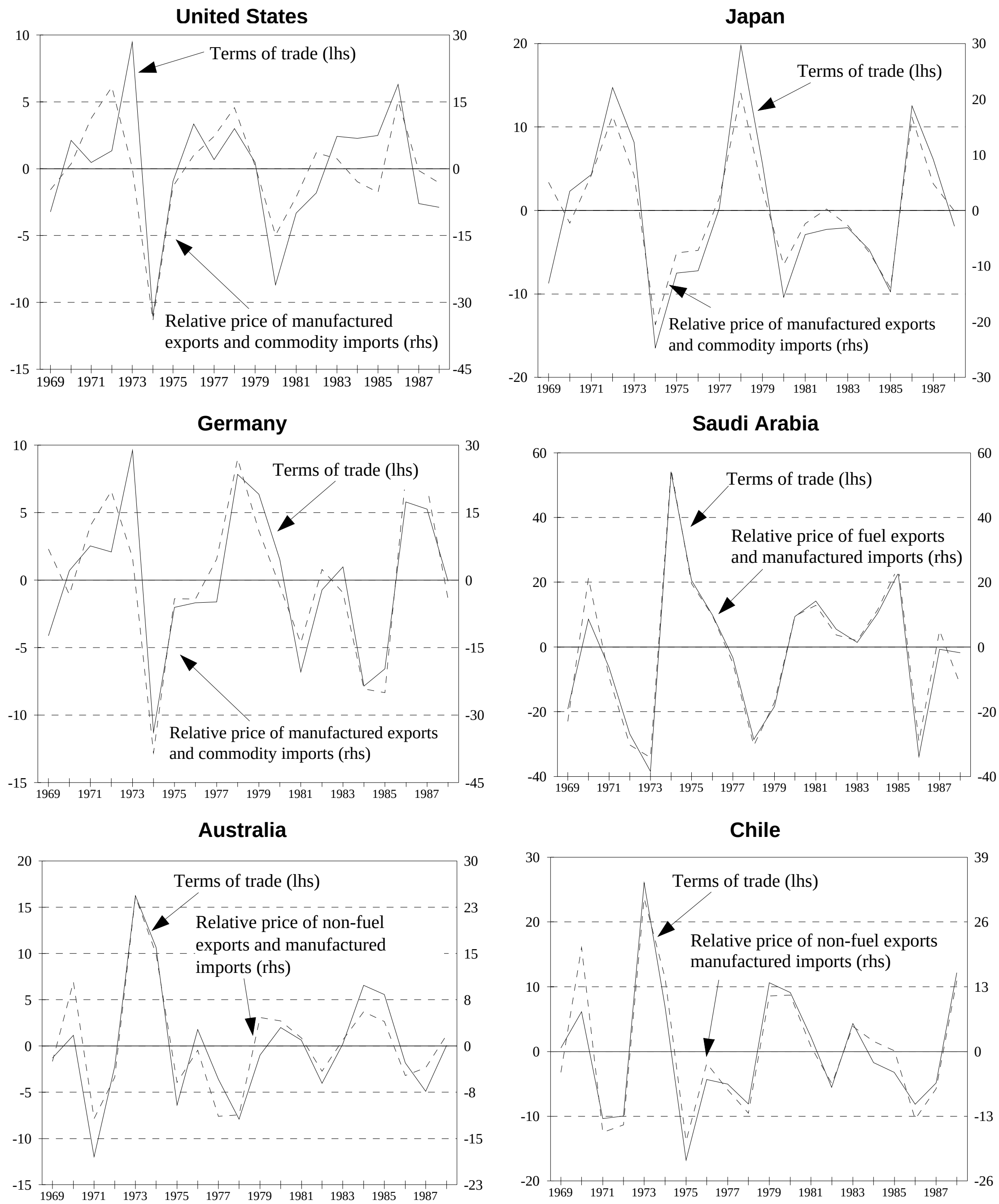
Notes:

Authors calculations based on data from World Bank (1991). (a) Values refer to the median of regional sample, except in the case of industrial countries where the reported statistics are for individual countries. pxm-pmm denotes the log of the relative price of manufactured exports and imports. pxnf-pmm denotes the log of the relative price of non-fuel exports and manufactured imports. pxf-pmm denotes the log of the relative price of fuel exports and manufactured imports. pmnf-pmm denotes the log of the relative price of non-fuel and manufactured imports. pmf-pmm denotes the log of the relative price of fuel and manufactured imports.

Figure 1

Goods Prices vs. the Terms of Trade

Percentage deviation from trend (a)



Notes:

(a) Authors calculations based on data from World Bank (1991). Data are Hodrick and Prescott (1997) filtered with a smoothing parameter of 10. The terms of trade and relative prices are logged prior to filtering.