COMMODITY PRICES AND THE MACROECONOMY: 
AN EXTENDED DEPENDENT ECONOMY APPROACH

1. Introduction

Many developing and emerging economies in Asia, Africa and Latin America, as well as some OECD economies such as Australia and New Zealand, are frequently exposed to sizeable international commodity price shocks that have important implications for macroeconomic stability and policy. In particular, international price shocks for commodity-export economies significantly affect their economic growth rates, trade balances, price levels, and nominal exchange rates or, for those with pegged currencies, international reserves.

Although a literature has developed that focuses on the empirical dimension of the nexus between international commodity prices and economic growth in particular (Deaton and Miller 1995, Kose 2002, Collier and Goderis 2007, Radditz 2007 and Bruckner and Ciccone 2010), there is a dearth of research on the theoretical linkages between export commodity prices and key international macroeconomic variables in small open economies, especially exchange rates, national output levels, trade balances and capital flows. Consequently, there are no straightforward macroeconomic frameworks that provide ready answers to the following basic questions.

Why do the nominal and real exchange rates of many commodity exporters move in sync with world commodity prices received for their particular exports? In other words, why do so-called ‘commodity currencies’ appreciate with commodity price rises and depreciate with commodity price falls? How does the exchange rate insulate
national output and income from world commodity price volatility? To what extent does this insulation depend on the openness of the economy? How do trade balances behave under these circumstances? And what are the implications for the economy’s industry structure and exchange rate management if commodity price movements are sustained rather than temporary?

This paper aims to answer these questions by outlining a straightforward international macroeconomic model for analysing how commodity price fluctuations simultaneously influence the exchange rate, the price level, national output, and the trade balance. To do this, it extends the dependent economy model originally proposed by Salter (1959) and Swan (1960) and adapted by, inter alia, Fischer and Frenkel (1972), Bruno (1976) and Yano and Nugent (1999). Methodologically, in the tradition of the original dependent economy approach, the model focuses directly on macroeconomic variables of most interest to policymakers, without recourse to microeconomic foundations.

The dependent economy approach is based on a dichotomy between tradables, the foreign currency prices of which are set in world markets, and non-tradables, whose prices are set by domestic demand and supply factors. An innovation of this paper is that tradables are further split into exportables, including commodities whose world prices tend to be highly volatile, and importables, including manufactures, whose prices are relatively stable. The ratio of the world price of its exportables to its importables defines an economy’s terms of trade which in the following analysis are driven by world commodity price swings.
The next section develops a simple framework that relates terms of trade shocks to the real and monetary sides of small macroeconomies. Section 3 then employs the framework to answer the questions posed above. The final section highlights the main lessons of the analysis.

2. The Analytical Framework

This section develops a straightforward framework for examining the impact of world commodity price shocks on the exchange rate, national income and the trade balance in a small open economy comprised of a real side producing exportable, importable and non-tradable output, and a monetary side where residents’ demand a given stock of money determined by the central bank. The key relationships underpinning national income generation are first outlined before turning attention to the monetary foundations of the model.

Real Sector Linkages

Gross domestic product, the total quantity of exportable, importable and non-tradable goods and services made available for sale to resident and non-resident entities, is generated by a macroeconomic production function. Real output is produced in proportion to the capital stock employed in each sector, such that

\[
O_x = \gamma K_X, \quad O_M = \zeta K_M \quad \text{and} \quad O_N = \chi K_N
\]

(1)

where \(O_x\) is the volume of exportable production, \(O_M\) is the volume of importable production, and \(O_N\) is the volume of non-tradable production, \(K_X, K_M\) and \(K_N\) are the real capital stocks, and \(\gamma, \zeta\) and \(\chi\) are the output to capital ratios in the exportable, importable and non-tradable sectors respectively.
In nominal terms, national output, \( y \), is therefore

\[
y = p_XO_X + p_MO_M + p_NO_N = p_X\gamma K_X + p_M\zeta K_M + p_N\xi K_N \quad (2)
\]

where \( p_X \) is the price index for exportable output, \( p_M \) is the price index for importable output, and \( p_N \) is the price index for non-tradable output. Since the nominal exchange rate converts the foreign value of exportables and importables to their domestic currency values, (2) can be re-expressed as

\[
y = ep_X^*\gamma K_X + ep_M^*\zeta K_M + p_N^*\xi K_n \quad (3)
\]

The exogenous terms of trade, \( \tau \), is the ratio \( \frac{p_X^*}{p_M^*} \). If we normalise the foreign currency price index for importables \( (p_M^* = 1) \) and divide through by \( p_M^* \), making the price of importables the numeraire, equation (3) becomes

\[
y = e\tau\gamma K_X + e\zeta K_M + p_N^*\xi K_n \quad (4)
\]

Partially differentiating (4) with respect to the nominal exchange rate yields

\[
\frac{\partial y}{\partial e} = \tau\gamma K_X + \zeta K_M > 0 \quad (5)
\]

This result implies national output is positively related to the nominal exchange rate in the short run and that a movement in the terms of trade due to changing export commodity prices is a shift factor, since \( \frac{\partial y}{\partial \tau} > 0 \).

For the purposes of the exposition to follow, the exchange rate is redefined as

\[
E = \frac{1}{e},
\]

such that a rise (fall) in the value of \( E \) denotes appreciation (depreciation).
Given the result above, this allows us to draw an downward sloping schedule, labelled the \( YY \) schedule in exchange rate-output (or \( E - y \)) space, as shown in Figure 1.

**Figure 1 - General Equilibrium**

On the monetary side of the economy, residents’ demand for cash balances equals the real money supply. In the standard way, money demand depends positively on national income according to parameter, \( \varepsilon \), and negatively on the domestic interest rate, \( r \), according to parameter, \( \delta \). Hence,

\[
\frac{M}{P} = \varepsilon y - \delta r \quad 0 < \varepsilon, \delta < 1
\]
The national price level is a weighted measure of the domestic currency value of importable and non-tradables prices,

\[ P = \alpha p^*_M + \beta p_N \quad \text{where} \quad \alpha + \beta = 1 \]  

(7)

It is assumed that the price of the commodity exportables in which the economy specialises for sale abroad does not significantly affect the domestic price level. This assumption can easily be relaxed, but doing so unnecessarily complicates the analysis without altering key results that follow.

Substituting (7) into (6) and solving for e, yields

\[ e = \left[ \frac{M}{\alpha(\varepsilon y - \delta r)} - \frac{\beta p_N}{\alpha} \right] > 0 \]

(8)

Partially differentiating (8) with respect to the nominal exchange rate, we find that

\[ \frac{\partial e}{\partial \varepsilon y} = -[\varepsilon]^{-2}(\alpha \varepsilon) < 0 \]

(9)

Again, since \( E = \frac{1}{e} \), this implies an upward sloping schedule labelled \( MM \) in exchange rate-national income (or \( E - y \)) space, as shown in Figure 1. The more open the economy the larger is \( \alpha \), the weight for importables in the domestic price index. Expression (9) therefore implies the slope of the MM schedule would be relatively flatter the more open the economy is, and steeper the less open it is.
In reality, the speed at which changes in the foreign currency prices of importables translates to the domestic price level is also governed by the rate of exchange rate pass-through. See, inter alia, Froot and Rogoff (1995), Isard (1995), Frankel and Rose (1996) and Goldberg and Knetter (1997). In the limit case of no short run pass-through, the value of $\alpha$ would be zero and the MM schedule vertical.

In initial equilibrium, it is also assumed that the trade account is balanced. Hence, aggregate demand equals aggregate output at this point with net exports at zero,

$$c + i + (x - m = 0) = y$$

(10)

where $c$ is consumption of, and $i$ is investment in, exportables, importables and non-tradables; $x$ is exports, and $m$ is imports.

A currency appreciation from initial equilibrium will lower net exports, as foreign demand for exportables falls and domestic demand for importables rises. Hence, in Figure 1 the zone above the line drawn from the initial equilibrium exchange rate, $E_0$, associates equilibria in the real and monetary sectors with a trade deficit (TD), whereas in the zone below the $E_0$ line a trade surplus (TS) prevails.

Trade deficits (surpluses) are matched by international capital inflow (outflow). These cross border flows arise because it is assumed that in initial equilibrium the domestic interest rate, $r$, equals the foreign interest rate, $r^*$, plus a time varying risk premium, $\rho$, in accordance with the interest parity relation.

$$r = r^* + \rho$$

(11)

International capital will flow in response to incipient pressure on the domestic interest which will rise (fall) relative to the world interest rate whenever domestic...
money demand rises (falls) for a given real money supply, the quantity of which is determined by the central bank. International capital inflow yields a positive capital account balance, KB, which is functionally related to the interest rate differential, and from balance of payments accounting, to the current account balance (or trade balance in the absence of income paid abroad) as

$$KB = KB(r - r^* - \rho) = -TB \quad \frac{\partial KB}{\partial r} > 0, \frac{\partial KB}{\partial \rho} < 0 \quad (12)$$

3. Commodity Price Fluctuations and the Macroeconomy

Having established the basic framework, now consider what happens to the economy in response to two different kinds of commodity price fluctuations. First, we examine the effects of a temporary slump in world commodity prices on the exchange rate, national income and the trade balance. Second, we analyse the implications of a more sustained rise in world commodity prices on these key variables.

Temporary Export Commodity Price Falls

As shown in Figure 2, a sharp fall in commodity prices shifts the \(Y_0Y_0\) schedule leftwards to \(Y_1Y_1\), as the value of national output in terms of importables prices decreases. For a given real money supply, the \(M_0M_0\) schedule remains stationary.
Under a floating exchange rate, the size of the depreciation and the extent to which real national output is insulated from the commodity price shock depends in the immediate term on the rate of pass-through and in the medium term on the openness of the economy. For instance, if pass-through is minimal and the economy is relatively closed, the MM schedule would be relatively steep, as shown by schedule \( M^C \cdot M^C \). Accordingly, in the medium term, the price fall would cause a relatively large depreciation, yet allow a minimal fall in output from \( y \) to \( y^C \).
Alternatively, if the economy was relatively open, the MM schedule would be relatively flat, as shown by schedule $M^oM^o$. The commodity price slump would then lead to a smaller depreciation than the relatively closed case, but permit a larger output fall from $y$ to $y^o$. Hence, the more open (closed) the economy, the less (more) national output is insulated from commodity price fluctuations.

Had the exchange rate been pegged at $E_0$, the central bank would have had to contract the money supply through foreign exchange market intervention by buying domestic currency with foreign exchange. In the process, assuming the intervention is unsterilized, the MM schedule would shift leftward, causing national output to contract by the full distance between $y_o$ and $y_{E_0}$. Here, national output is not insulated at all from the commodity price shock under a pegged exchange rate. Instead, national output bears the full recessionary brunt of the commodity price fall.

**Sustained Commodity Price Rises and Exchange Rate Management**

The foregoing demonstrates that if commodity price rises were temporary and over time simply offset commodity price falls of similar duration, maintaining a fully flexible exchange rate would be the optimal exchange rate system choice because the exchange rate would minimise destabilising fluctuations in national output and hence employment levels. Now consider the case of more sustained export commodity price rises illustrated in Figure 3.
Under these circumstances, arising for instance from increased world commodity demand due to prolonged output expansion in large, rapidly industrialising Asian economies like China and India, the small economy’s YY schedule will keep shifting rightward. However, in this case as shown in Figure 3, the nominal exchange rate would naturally appreciate to \( E_1 \) and restrict the output increase to \( y_1 \). Compare this to the case of a pegged exchange rate where monetary policy accommodates the commodity price driven expansion.
Then, the exchange rate remains pegged at $E_0$, the domestic money supply increases to satisfy increased money demand, and national output expands to its maximum potential level of $y_{E0}$. Therefore, if commodity price fluctuations were not symmetric or mean reverting, with secular commodity price rises expected to be the norm, a fully flexible exchange rate would not be optimal, as it would stymy potential output growth.

Moreover, the composition of output would alter irreversibly if commodity price rises were sustained. Specifically, persistent currency appreciation squeezes out traditional tradable industries, such as manufacturing, as a result of lost competitiveness. In this way, the figure illustrates the so-called ‘Dutch disease’ phenomenon canvassed in an earlier literature in the context of rising world energy prices. The extent of this domestic production squeeze is shown in Figure 3 as the distance between $y_1$ and $y_{E0}$.

4. Concluding Comments

In reality, many Asian and other emerging economies in the world are subject to often severe terms of trade fluctuations that arise from their particular export commodity specialisation. To improve understanding of the international macroeconomic implications of terms of trade movements, this paper proposes a new framework for analysing their impact on such economies’ exchange rates, national output and trade balances.

Founded on assumptions that underpin the dependent economy model, key innovations of the paper include its extension of the tradables-non-tradables
dichotomy to a trichotomy of exportables, importables and non-tradables, as well as the incorporation of a monetary sector explicitly related to the specification of goods and services markets in the real sector.

Exchange rate economics has traditionally been dominated by a preoccupation with purchasing power parity and the role of monetary factors in determining currency values (see, for instance, Dornbusch 1976, Meese and Rogoff 1983, Isard 1995, Taylor 2002, Frankel and Rose 1995, Macdonald 1999, and Sarno and Taylor 2003). The model outlined above however fills a gap in the exchange rate literature by providing a theoretical rationale for the hitherto neglected ‘commodity currency’ phenomenon of particular relevance to many emerging Asian and other economies.

Its main lessons for macroeconomic policy in these economies are as follows. First, a free floating exchange rate acts as a useful shock absorber for national output in the face of commodity price shocks; it shields national income more (less), the less (more) open the economy. As a corollary, maintaining a pegged exchange change implies that GDP will bear the full brunt of any commodity price shock and hence be more variable, the more frequent the shocks are.

Second, under a floating exchange, the trade balance reacts oppositely to what may be expected. For instance, instead of positive commodity price shocks yielding trade surpluses via increased export values on the real side of the economy, they generate trade deficits due to exchange rate appreciation stemming from pressures exerted on the monetary side. This is consistent with the experience of economies like Australia
and New Zealand which have tended to experience higher current account deficits during commodity price upswings.

Finally, a flexible exchange rate may not be optimal if over longer periods commodity prices exhibit a sustained trend rise. This is because national output then falls short of its potential level due to persistent currency appreciation which reduces production elsewhere in the economy. In other words, a monetary policy response to a resources boom that simply allows nominal exchange rate appreciation may be ill-advised because this crowds out labour-intensive economic activity in domestic importable industries, such as manufacturing, and simultaneously enlarges the trade deficit.
References


