ELSEVIER
www.elsevier.com/locate/worlddev

World Development Vol. xx, pp. xxx–xxx, 2016

http://dx.doi.org/10.1016/j.worlddev.2016.07.012

Long-Run Commodity Prices, Economic Growth, and Interest Rates: 17th Century to the Present Day

DAVID I. HARVEY [a], NEIL M. KELLARD [b], JAKOB B. MADSEN [c] and MARK E. WOHAR [d,*]

[a] *University of Nottingham, UK*
[b] *University of Essex, UK*
[c] *Monash University, Australia*
[d] *University of Nebraska at Omaha, USA*

Summary. — A significant proportion of the trade basket of many developing countries is comprised of primary commodities. This implies relative price movements in commodities may have important consequences for economic growth and poverty reduction. Taking a long-run perspective, we examine the historical relation between a new aggregate index of commodity prices, economic activity, and interest rates. Initial empirical tests show that commodity prices present a downward trend with breaks over the entire industrial age, providing clear support for the Prebisch–Singer hypothesis. It would also appear that this trend has declined at a faster rate since the 1870s. Conversely, several GDP series such as World, Chile, China, UK, and US, trend upward with breaks. Such trending behavior in both commodity prices and economic activity suggests a latent common factor like technological innovation.
To assess the relationships between economic series, we apply a stationary VAR (Vector Autoregression) to model movements around trends. Strikingly, there is evidence that commodity prices Granger cause income and interest rates, while interest rates Granger cause commodity prices. From these results and the related impulse response function analysis, the historical perspective provides some useful information for contemporary policy makers. For example, loose monetary policy has tended to support higher commodity prices. Moreover, commodity price movements have an asymmetric country effect on economic activity; periods of falling commodity prices will support GDP growth for commodity importers like the US but depress growth for commodity exporters such as Chile.

Key words — primary commodities, Prebisch–Singer hypothesis, economic growth, interest rates, structural breaks, VAR

1. INTRODUCTION

A significant proportion of national income for many developing countries is often generated by a small number of primary commodities (see Harvey, Kellard, Madsen, & Wohar, 2010), leading to a possible resource curse. [1] The nature and causes of any long-run trends and short-run movements in primary commodity prices therefore have significant implications for growth and poverty reduction policies in developing countries.

Analysis of long-run commodity prices is dominated by the Prebisch–Singer (PS) hypothesis which implies a secular, negative trend in commodity prices relative to manufactures. [2] Possible theoretical rationales include low-income elasticities of demand for commodities, asymmetric market structures that result from comparatively homogeneous commodity producers generating highly competitive commodity markets while facing oligopolistic manufacturing markets, and technological and productivity differentials between core (industrial) and periphery (non-industrial) countries. If a country's export commodities present long-run downward trends in their relative prices, the policy advice is typically to diversify the export mix to include significant proportions of manufactures and/or services. Additionally, as is noted in Arezki, Loungani, van der Ploeg, and Venables (2014), understanding the trend and other time series characteristics should enable improved forecasting of commodity price movements.

Empirical evidence examining the PS hypothesis provides an ambiguous picture. The vast majority of recent studies employ the Grilli and Yang (1988) dataset of 24 annual non-fuel primary commodity prices which commences in 1900. [3] However, the relatively large variance of commodity prices (see Deaton, 1999) and the possibility of trend structural breaks inhibits statistical determination of any trend magnitude and direction with this sample size. A possible approach to address this issue is to provide greater degrees of freedom via a backward extension of the sample. Recently, Harvey *et al.* (2010) and Arezki, Hadri, Loungani, and Rao (2014) employ a unique disaggregated dataset, comprised of 25 separate commodity time series and spanning the 17th to the 21st centuries.

Compared to long-run trends, shorter term fluctuations in commodity prices are relatively under-researched in the literature. This is surprising given that commodity prices are known to be extremely volatile, leading to uncertainty over future revenue and cost streams. This uncertainty may inhibit planning and deter investment by all the relevant agents in the commodity supply chain (i.e., household farmers, cooperatives, larger commercial farmers, and governments). The shortfalls in investment subsequently act as a drag on future growth and poverty reduction prospects (see Blattman, Hwang, & Williamson, 2007 and Poelhekke & van der Ploeg, 2009). Additionally, although severe price movements may be temporary in character, permanent and detrimental effects on physical and cognitive development, particularly during early childhood, can arise in commodity dependent communities

* Neil Kellard gratefully acknowledges support from grant number ES/L011859/1, from the Business and Local Government Data Research Centre, funded by the Economic and Social Research Council – United Kingdom. We are grateful to the Editor and three anonymous referees for their very helpful comments resulting in a much improved paper. Any errors remain our own. Final revision accepted: July 14, 2016.

Please cite this article in press as: Harvey, D. I. *et al.* Long-Run Commodity Prices, Economic Growth, and Interest Rates: 17th Century to the Present Day, *World Development* (2016), http://dx.doi.org/10.1016/j.worlddev.2016.07.012

(see, *inter alia*, Miller & Urdinola, 2010; Pongou, Salomon, & Ezzati, 2006).

Some studies have attempted to identify the macroeconomic variables that influence the behavior of commodity prices around any long-run trend. Among others, the structural approach of Gilbert (1989) and Chu and Morrison (1986) demonstrated that two demand side variables, the US dollar real exchange rate and industrial production of industrialized countries, adequately explained movements in commodity prices over the early 1980s. After 1984, when industrial countries started to recover from recession, this demand-side framework failed to explain the continuing weakness in prices. In response, Borensztein and Reinhart (1994) extended the traditional framework to include supply side factors, the relative price of oil and a new definition of demand, encompassing output changes from Eastern Europe and the Soviet Union. The model greatly improved empirical explanation of commodity price movements over the 1980s and early 1990s. More recent work, such as Arango, Arias, and Florez (2012), stresses that economic activity and interest rates are the primary determinants of commodity prices.

Papers attempting to explain movements in commodity prices typically use post World War 2 data. For example, the aforementioned Arango *et al.* (2012) employs annual data from 1960 to 2006. Our paper takes a different tack by examining relationships between commodity prices, economic activity, and interest rates over the very long-run. To do so, we first create an aggregate index for real commodity prices. This is achieved by collecting a large historical dataset on the export values of 23 individual commodities; not a straightforward task. These new data are then used as weights when combined with updated individual commodity series from Harvey *et al.* (2010) to construct the aggregate annual series beginning in 1650 and running continuously until 2014. Additionally, data for interest rates are obtained from the Bank of England, while historical GDP data (i.e., for the World and various individual countries) are obtained from the Maddison Project.

As a precursor to the multivariate approach, our second contribution is to examine the time series properties, and in particular the trend, of the long-run series. Given the well known problems of identifying the order of integration of commodity price or GDP series, and the pervasive influence of any unit root/stationarity pre-tests on subsequent tests of commodity time series characteristics (see Harvey *et al.*, 2010), we apply trend tests and multiple trend break tests which are robust to whether or not the series under consideration contains a unit root. The results show that the trend path of our new aggregate commodity series can be split into four regimes (i.e., 1650 to the early 1820s, the early 1820s to the early 1870s, the early 1870s to the mid-1940s, and the mid-1940s to 2014). Through all but the second regime, a long-run downward trend can be clearly detected, giving new historical support to the PS hypothesis. Moreover, although prices present a secular decline over the 17th and 18th centuries, this was at a slower rate as compared with the 20th century. The economic forces behind the PS hypothesis would appear to have intensified during the 1900s.

In terms of economic activity, it is shown that UK GDP presents an upward trend break in the 1820s and World GDP in the 1870s and 1950s. Interestingly, these dates are closely associated with those found for commodity prices. Additionally, the increasing rate of trend growth in GDP as the sample increases, mirrors the decreasing rate of trend growth for commodity prices, suggesting a common latent factor such as technological innovation.

Our third contribution is to model the relationships between our long-run series. The data are first demeaned and detrended according to the breaks found in the prior time series analysis. These detrended series are shown to be stationary and therefore, unlike other recent literature which does not allow for breaks, a cointegration approach is not appropriate. Using a stationary VAR (Vector Autoregression), there is evidence that (detrended) commodity prices Granger cause (detrended) GDP and interest rates, while interest rates Granger cause commodity prices. Such results have implications for the resource curse and the effect of monetary policy.

The remainder of the paper is organized as follows. Section 2 outlines the theory and empirical methodology, while Section 3 describes the new data. The empirical results and associated discussion are presented in Section 4, and Section 5 concludes.

2. THEORY AND EMPIRICAL METHODOLOGY

(a) *Demand and supply in the commodity market*

The theory of either long-run trend or cyclical movements about the trend are not well developed or evidenced (see Deaton & Laroque, 2003). As noted in the introduction, rationales for the trend include low-income elasticities of demand for commodities, technological and productivity differentials, or asymmetric market structures between the oligopolistic, manufacturing core and the competitive, commodity producing south. Additionally, new discoveries of commodities and technological innovation[4] in commodity production will increase supply and reduce costs respectively, also placing downward pressure on the trend in commodity prices. Movements around any trend, and including macroeconomic variables mentioned by the literature such as economic activity (see Borensztein and Reinhart, 1994) and interest rates (see Frankel, 2006), might be described by the following partial equilibrium model. Using a standard log-linear demand function (see Deaton & Laroque, 2003), it can be written that:

$$d_t = \alpha y_t - \beta p_t + \gamma + \varepsilon_t^d \tag{1}$$

where d_t is demand, y_t represents the logarithm of world income, and p_t is the world price for an internationally traded commodity. Moreover, a complementary supply function (see Arango *et al.*, 2012) can be stated:

$$p_t = \delta s_{t-1} + \eta r_{t-1} + \theta p_t + \varepsilon_t^s \tag{2}$$

where s_t is current supply as a function of last period's supply and r_t represents the interest rate. In equilibrium, supply is equal to demand, and it can be shown that:

$$p_t = (\beta + \delta)^{-1}[\alpha y_t + \gamma - \delta s_{t-1} + \eta r_{t-1} + \varepsilon_t^d - \varepsilon_t^s] \tag{3}$$

where (3) suggests that commodity prices around any trend are related to income, interest rates, and supply. Of course, before examining any multivariate association, the time series properties of each individual series require investigation. Given we will employ very long-run data, breaks in the individual data-generating processes (DGP) are likely. Therefore, the following sections will outline our testing procedure for trends and any breaks in trends and levels.

(b) *Testing for a linear trend*

We initially consider the following DGP for z_t, the logarithm of a variable of interest:

$$z_t = \alpha + \beta t + u_t, \quad t = 1, \ldots, T \tag{4}$$

$$u_t = \rho u_{t-1} + \varepsilon_t, \quad t = 2, \ldots, T \tag{5}$$

Please cite this article in press as: Harvey, D. I. *et al.* Long-Run Commodity Prices, Economic Growth, and Interest Rates: 17th Century to the Present Day, *World Development* (2016), http://dx.doi.org/10.1016/j.worlddev.2016.07.012