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Comovement in GDP trends and cycles among trading partners☆

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ABSTRACT

It has long been recognized that business cycle comovement is greater between countries that trade more intensively with one another. However, nations face shocks to both the cyclical and trend components of their GDP series. Contrary to the result for cyclical fluctuations, we find comovement of shocks to the trend component of real GDP is weaker among countries that trade more intensively with one another. We simulate changes in ten-year output growth correlations corresponding to the estimated effects of trade and show that the impact of trade on trend comovement is quantitatively more important than its effect on cyclical comovement.

1. Introduction

It has long been recognized that business cycle comovement is greater between countries that trade more with one another. Frankel and Rose (1998) first demonstrated stronger correlations between business cycle fluctuations in real GDP for trading partners. A large ensuing literature has demonstrated that this result is robust to the inclusion of a battery of additional explanatory variables, country-pair effects, and is also present for intra-industry and infra-national trades.[1]

However, business cycle fluctuations are not the only, or even dominant, source of output growth fluctuations for many countries. Shocks to the trend component of aggregate output, which we define as shocks that have permanent effects on output levels, are also of primary importance. Indeed, shocks to the trend account for over half the variance of quarterly real GDP growth for the majority of countries in our sample. The extent of comovement in GDP trends is also substantial; the median absolute correlation between quarterly trend shocks is 0.3 over our sample period, and thus the capacity of trade to transmit trend shocks is of important policy relevance. In addition, because shocks to the trend have permanent effects on the level of output, while cyclical fluctuations have only transitory effects, trend shocks will be the dominant source of comovement in long-horizon output growth. We can then expect that any changes in correlations of long-horizon output growth work principally through changes in trend shock comovement. Given these facts, it is surprising that the existing literature has focused exclusively on transitory cyclical shocks. Our goal in this analysis is to empirically assess the impact of trade on comovement between shocks to countries' trend levels of output.

Our paper's main contribution is to demonstrate that, contrary to the standard result for cyclical fluctuations, the correlation between shocks to GDP trends is significantly *weaker* among G7 countries that trade more intensively with one another.[2] The negative association between trade openness and trend comovement is quantitatively important. A one-standard deviation increase in trade intensity between countries reduces the correlation in shocks to their output trends by approximately one-third of a standard deviation. Having estimated the effect of trade on comovement in both cyclical fluctuations and trend shocks, we then perform a simulation experiment to quantify the relative importance of

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[1] See for example Baxter and Kouparitsas (2005), Burstein et al. (2008), Levchenko and di Giovanni (2010), and Clark and van Wincoop (2001).

[2] As with cyclical comovement, the average correlation in trend fluctuations across all country-pairs is positive, with very few country-pairs experiencing negative correlations across the entire sample. Thus the negative impact of trade on the correlation between GDP trend fluctuations indicates a movement in correlations toward zero, or weaker comovement, on average.

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each effect on comovement in overall output growth. We find the negative effect of trade on trend comovement is quantitatively more important for explaining ten-year output growth correlations. For countries outside the G7, we find no relationship between trade openness and trend comovement. This finding that the effect of trade openness on trend comovement is relatively more important for G7 country pairs is also consistent with the standard results for cyclical comovement in Kose et al. (2003, 2008).

Our analysis requires that we obtain distinct measures of the trend and cyclical components of real GDP. To estimate these separate components of each nation's output series we use an unobserved-components model that identifies trend versus cyclical fluctuations by assuming that the trend represents the accumulation of the permanent effects of shocks to the level of real GDP, which is equivalent to the stochastic trend in real GDP. The cyclical component is the deviation of real GDP from this stochastic trend, and represents transitory fluctuations in the series. The unobserved-components model has been used extensively as a tool for trend and business cycle measurement,[3] and avoids issues associated with deterministic detrending and band-pass filters.[4] Having estimated shocks to nations' output trends, we construct our key dependent variable as the correlation between changes in the trend component of quarterly real GDP observed over the years 1980 to 2010 for 210 country-pairs.

We take several steps to ensure that the effect of trade on comovement that we identify is not due to other underlying factors. To avoid spuriously attributing common shocks across countries that occur within a period to the effect of trade linkages, we construct a panel of comovement periods for three distinct decades and control for decade fixed effects. By constructing a panel of comovement periods within each country-pair we can also include pair fixed effects, which accounts for *inter alia*, relative asset market completeness between countries. Relevant to our context, Ghironi (2006) and Baxter and Crucini (1995) find the differential output response to productivity shocks between complete and incomplete asset market structures is much larger when the shocks are permanent. Given our focus on the transmission of permanent shocks, constructing a panel of comovement periods and including pair-level effects to account for the nature of asset markets is likely important. The substantial literature on cyclical comovement suggests other factors that may contribute to comovement in output levels. Our empirical strategy incorporates these alternative channels which could potentially obfuscate the consequences of international trade.[5] The main result regarding weaker trend comovement among trading partners is robust to the inclusion of these other potential determinants of comovement patterns.

[3] Examples of macroeconomic detrending using the unobserved-components framework include Harvey (1985), Watson (1986), Clark (1987), Harvey and Jaeger (1993), Kuttner (1994), Kim and Nelson (1999), Kim and Piger (2002) and Sinclair (2009). Also, as shown in Morley et al. (2003), the unobserved-components decomposition is consistent with the identification of trend and cyclical components used in the Beveridge and Nelson (1981) decomposition. For a recent example of measurement of macroeconomic trends using the Beveridge-Nelson decomposition, see Cogley and Sargent (2005).

[4] Other popular approaches to business cycle measurement used in the existing literature on the trade–comovement relationship, such as the band-pass filter of Baxter and King (1999) or first differencing, have been shown to produce measures of the business cycle that conflate transitory and permanent shocks. See, e.g., Cogley and Nason (1995) and Murray (2003). Thus, the existing literature can be interpreted as providing a mixture of the effects of trade on permanent and transitory output variation. Here, we separate out these effects, and show they are very different.

[5] Imbs (2004) and Imbs and Wacziarg (2003) argue that specialization patterns in output across countries independently affect comovement patterns. Baxter and Kouparitsas (2005) evaluate the robustness of other country-pair specific features in generating cyclical comovement and find strong support for the inclusion of gravity variables (e.g., geography), which partially determine trade flows. Our use of country-pair fixed effects subsumes these gravity variables. There is also evidence that investment linkages impact comovement (Prasad et al., 2007) as does the presence of foreign affiliates of multinationals firms located partner countries (Kleinert, et al. 2014). Blonigen and Piger (2011) demonstrate that the best predictors of foreign direct investment patterns and multinational firm activity between countries are those suggested by gravity models. Thus our fixed-effects strategies also capture motives for nations to invest in one another.

The next section describes our methodology for estimating trend and cyclical fluctuations for the GDP series of each country, the calculation of comovement between country-pairs, and our empirical specification linking comovement to trade intensity. Section 3 presents the results for the effects of trade on comovement patterns, and presents a simulation exercise to quantify the effects of trade on trend comovement. The final section concludes.

2. Empirical strategy

Our analysis proceeds in two steps. First, we separate changes in the real GDP series for each country into trend and business cycle components, and calculate cross-country correlations for the fluctuations in both of these components. Second, we relate these correlations to trade intensity between country-pairs. This section provides details about each step of our empirical strategy.

2.1. Estimating trends and cycles in real GDP

The trend and business cycle components of real GDP are not directly observed. A large existing literature provides several alternative definitions of trend versus business cycle fluctuations, and corresponding methods to identify these defined components. Here, we define and identify trend versus business cycle components in real GDP using an unobserved-components (UC) model. The UC model has a long history in macroeconometrics as a tool for business cycle measurement.[6] In the UC framework, log real GDP for country i in period t, denoted $y_{i,t}$, is additively divided into trend ($\tau_{i,t}$) and cyclical ($c_{i,t}$) components:

$$y_{i,t} = \tau_{i,t} + c_{i,t}. \tag{1}$$

The UC framework then specifies explicit equations for the trend and cyclical components. The trend component is specified as a random walk process, while the cyclical component follows a covariance stationary autoregressive (AR) process:

$$\tau_{i,t} = \mu_i + \tau_{i,t-1} + v_{i,t}, \tag{2}$$

$$\phi_i(L)c_{i,t} = \epsilon_{i,t}, \tag{3}$$

where $\phi_i(L)$ is a p^{th} order lag polynomial with all roots outside the complex unit circle, $v_{i,t} \sim \text{i.i.d. } N\left(0, \sigma^2_{v_i}\right)$, and $\epsilon_{i,t} \sim \text{i.i.d. } N\left(0, \sigma^2_{ilon_i}\right)$. Following the bulk of the existing literature on business cycle measurement with UC models, we make the assumption of independence between trend and cyclical shocks, such that $\sigma_{v_i,\epsilon_i} = 0$.[7] The model in Eqs. (1)–(3) is estimated via maximum likelihood, and estimates of the trend and cycle components are constructed using the Kalman Smoother.

The UC model identifies trend versus business cycle fluctuations by assuming that the trend represents the accumulation of the permanent effects of shocks to the level of real GDP. In other words, the trend in real GDP is equivalent to the stochastic trend in real GDP. The business cycle component is then the deviation of real GDP from this stochastic trend, and represents transitory fluctuations in the series. This identification strategy is consistent with a wide range of macroeconomic models in which business cycle variation represents temporary fluctuations in real GDP away from trend. As shown in Morley et al. (2003), the UC approach to detrending is also equivalent to the well-known Beveridge

[6] Early examples of macroeconomic detrending using the UC framework include Harvey (1985), Watson (1986), and Clark (1987).

[7] See, e.g., Harvey (1985), Clark (1987) and Harvey and Jaeger (1993). Morley et al. (2003) provide analysis and application of UC models with correlated components.