BOFIT Discussion Papers
17 • 2012

Pierre L. Siklos

No coupling, no decoupling, only mutual inter-dependence: Business cycles in emerging vs. mature economies

Bank of Finland, BOFIT
Institute for Economies in Transition

BOFIT Discussion Papers
Editor-in-Chief Laura Solanko

BOFIT Discussion Papers 17/2012
31.8.2012

Pierre L. Siklos: No coupling, no decoupling, only mutual inter-dependence: Business cycles in emerging vs. mature economies

ISBN 978-952-462-748-1
ISSN 1456-5889
(online)

Suomen Pankki
Helsinki 2012

Contents

Abstract 4

Introduction 5

1 The coupling and de-coupling of business cycles: A brief overview 8

2 Data, stylized facts, and methodological considerations 11

3 Factor model and factor-augmented factor model results 17

4 Conclusions 20

Appendix: Country group listing 22

References 24

Tables and figures 27

Pierre L. Siklos*

No coupling, no decoupling, only mutual inter-dependence: Business cycles in emerging vs. mature economies

Abstract

Even before the events of the past few years, economists and policy makers were musing about the apparent contradiction between globalization, as it is generally understood, and the seemingly different paths in overall economic activity taken by the emerging and more mature economies of the world. The present paper reconsiders whether it is, in fact, useful to think of correlations in business cycle movements as reflecting some form of coupling or decoupling and, instead, suggests that, even if business cycles may well have become more synchronous for a time, it is more useful to think of international business cycle co-movements as reflecting their mutual dependence that can be subjected to short-run interruptions or affected by a variety of other economic factors. I report evidence based on factor-augmented quantile regressions for a panel of annual data since 1980 from 9 regions of the world. A panel is used to estimate the common factors which are then applied to the quantile regression model to determine the sources of business cycle co-movements across countries and regions of the world.

JEL Classification numbers: E32, C21, C22, C23

Keywords: business cycles, quantile regression, panel estimation, factor model, coupling, decoupling

* Department of Economics, Wilfrid Laurier University, Viessmann European Research Centre.
Correspondence: Department of Economics, Wilfrid Laurier University, 75 University Ave., Waterloo, ON, CANADA, N2L 3C5, phone: (519) 884-0710 x2491, FAX: (519) 884-5922, e-mail: psiklos@wlu.ca.

The author is grateful to Yin-Wong Cheung and Frank Westermann, the Editors, and to Xing Wang Qin, the discussant, and an anonymous referee for helpful comments on an earlier draft. An earlier draft of this paper was presented at the BOFIT (Bank of Finland) in May 2012. Comments by seminar participants are also gratefully acknowledged.

Introduction

There is little need to dwell on the apparent success of emerging markets' ability to withstand the worst economic effects from the 'global' financial crisis of 2007-9. Indeed, as Guillermo Ortiz, former Governor of the Banco de Mexico, put it, the crisis was in reality a "North Atlantic Financial Crisis" (Wessel 2011). While this interpretation may not be entirely accurate the sentiment at least focuses attention on the mature industrial economies that appear to have suffered most from the events of the past few years. Emerging markets, including China, Brazil, and emerging economies elsewhere, weathered the downturn in part because of the lessons learned from their own brushes with earlier crises (e.g., the Asian financial crisis), as well as because their financial sectors were relatively smaller thanks to the relative immaturity of their financial markets.[i] Nevertheless, even before the events of the past few years, economists and policy makers were musing about the apparent contradiction between globalization, as it is generally understood, and the seemingly different paths in overall economic performance taken by the emerging and more mature economies of the world.

Of course, has to be clear about what is meant by coincident business cycle movements across regions or countries, not to mention the sources of such correlations. In what follows, this study is primarily interested in what drives similarities or differences in real GDP growth or in the behavior of output gaps. Hence, the reference to business cycle movements should be thought of in these terms. Clearly, differential growth rates in overall economic activity also have longer run implications for whether economies converge, or not, in levels (or per capita) real GDP terms. While the chapter alludes to this aspect of the analysis it is not directly concerned, as we shall see, with the issue of coupling, pr decoupling, of business cycles as it is usually understood in the literature.

Paralleling developments in real GDP growth or output gaps worldwide, there is some evidence of a form of convergence in the chosen monetary policy strategy (e.g., see Bohl, Mayes, and Siklos 2011, and references therein). More recently, fiscal policy has, if only for a brief period, shared the burdens of stabilization policy with monetary policy.

Clearly, over time, important differences in monetary policies emerge that may not be reflected in analyses that focus on, say, inflation performance alone. For example, correlations in output gaps between inflation and non-inflation targeting economies (excluding, of course, the US) and the US can be fairly high and seem broadly comparable

across groups of countries in spite differing monetary policy strategies. Nevertheless, beginning around 2004, these same types of correlations with the inflation targeting camp of countries drop substantially and become insignificantly small (e.g., see Siklos 2009). Yet, the synchronicity in business cycle movements within the inflation targeting (IT) community has actually been fairly significant which may be surprising given that these countries share a desire for floating exchange rates (see Flood and Rose 2010). Unfortunately, these results are not necessarily indicative about the role of the inflation targeting regime *per se* in generating this outcome, nor are they necessarily informative about other potential source of coupling or decoupling although the evidence may be helpful in explaining the differing monetary policy stances adopted around the world, particularly since at least 2004.[ii]

While results such as these are instructive one would like to know not only whether business cycle correlations between economies in various regions of the world are, in fact, significantly different from each other over time but also some of the sources of change, as well as whether the broader stage of a nation's institutional and economic development may also play a role. If 'decoupling,' or, preferably, growing divergences in business cycles between these two sets of countries has emerged, it may well be only a recent phenomenon.

Whereas a veritable cottage industry has emerged that is devoted to the notion of decoupling between the US economy and business cycles elsewhere in the world (e.g., Eichengreen and Park 2008, and sources therein), a decoupling of monetary policy actions, which became evident beginning in later 2007, may well represent a more lasting form of decoupling. The resulting divergences in monetary policy have also raised suspicions that fears of a recession, and not just worries over the consequences of financial system instability, are at the centre, for example, of the U.S. Federal Reserve's actions from late 2007 through the Spring of 2009 and beyond, and that this singular event may have contributed more than most to giving the appearance of decoupling, especially vis-à-vis economies in the Asia-Pacific region.

The present paper reconsiders whether it is, in fact, useful to think of correlations in business cycle movements as reflecting some form of coupling or decoupling and, instead, suggests that, even if output growth rates may well have become more synchronous for a time, it is more useful to think of international business cycle co-movements as reflecting their mutual dependence that are susceptible to short-run interruptions or affected

by a variety of other economic factors. This interpretation has the virtue, I think, of focusing attention some of the main sources of changes in business cycles co-movements among a cross-section of regions or countries as opposed to a single and more contentious explanation often raised in these contexts but difficult to define, namely the impact of 'globalization'.

The remainder of the paper is organized as follows. The next section selectively surveys the coupling and de-coupling hypotheses, the role of policy strategies, as well as the broader economic forces involved. In order to highlight the role of economic development in influencing how much business cycle synchronicity is observed, I report evidence based on quantile regressions augmented with variables generated from a factor model. A panel is used to estimate the common factors which are then applied to the quantile regression model to determine the sources of business cycle co-movements across countries and regions of the world. For reasons to be outlined in greater detail below estimates of business cycle co-movements using this type of approach permits a more insightful identification of the role of covariates determining real GDP growth not only at the median of a distribution but also at the upper and lower tails of the response distribution.

Given the disparate economic performance of major economies around the world over the past three decades, the quantile regression approach is likely to be particularly suitable under the circumstances. An additional reason for adopting this type of estimation strategy is that studies of this kind not only face data related challenges but, perhaps more importantly, the number of relevant covariates is very likely to be considerably larger than the number of available observations. The technique was recently proposed by Ando and Tsay (2011).

Section 3 describes the data and the methodological considerations that will be the subject of the econometric investigation whose results are discussed in section 4. In particular, I rely on a variety of macroeconomic and institutional factors covering nine regions of the world using annual data since 1980 to address the issue of the strength of co-movements in economic growth. Section 5 concludes.

The principal message of the paper can be summarized as follows: there is significant evidence of business cycle co-movements across the major regions of the globe. Hence, while there is 'coupling' this can be upset by certain shocks that, if large enough, can give the appearance of 'decoupling' of business cycles. In other, business cycle co-

movements are highly sensitive to a variety of factors that can be traced to aggregate demand and aggregate supply shocks or, alternatively, to domestic versus global type shocks.

Exchange rate regimes appear to play a lesser role while the monetary policy strategy is an important factor in the mix explaining the degree of synchronicity in business cycles especially as between the Asia-Pacific region and the rest of the world. Finally, the increased emphasis on a monetary policy focused on price stability, broadly speaking, reflected in the rise of central bank transparency around the globe, has also proved to be an ingredient in explaining the greater coherence in business cycles. Rather than seen as reflecting the 'globalization' phenomenon it is preferable to think of this development as reflecting a shared belief in the desirability of price stability. Nevertheless, it is equally true that this view is unlikely to survive the events of 2007-10. Indeed, the future of business cycle co-movements may well be influenced by the addition of a financial stability objective in ways that are still not well understood.

Ultimately then the coupling, or de-coupling views of business cycle co-movements may not be a helpful one since varieties of economic shocks lead to transitory changes in economic interdependence across time and regions, at least in the manner defined here. Instead, it is the emergence of comparable aggregate demand and/or aggregate supply shocks that gives rise to an apparent rise in business cycle synchronicity while regional factors give the appearance of 'a rising tide that lifts all boats'. In other words, rather than focus only on the aggregate outcomes of various economic forces that influence cross-country correlations in output growth, it is more important to identify the sources of business cycle co-movements. Finally, I report some evidence that business cycle synchronicity is also affected by large shocks which are akin to a structural break in a world where there can otherwise exist significant business cycle co-movements, particularly if the monetary policy strategies are, broadly speaking, comparable.

1 The coupling and de-coupling of business cycles: A brief overview

There is a long-standing tradition in economics of investigating co-movements in business cycles across countries, and across regions. Interest in this line of research has been spurred in recent years by at least three developments. First, the successful launch of the

single European currency raised questions about the coincidence of business cycles within the euro area and between the euro area and the rest of the world (e.g., see Mink, Jacobs, and de Haan 2008; Gonçalves, Rodrigues, and Soares, 2009). Next, the expansion of the EU in 2004, and the expectation that members in Central and Eastern Europe would eventually join the euro area together with the rebound in Asia of emerging markets there following the Asian financial crisis, also led to a number of studies dealing with business cycle correlations (e.g., Fidrmuc, Korhonen, and Bartorova 2008; Fidrmuc and Korhonen 2006 for Europe, and He and Liao 2012 for the Asian economies). Finally, research in matters relating to 'globalization' of trade and finance further inspired studies dealing with the implications of this phenomenon for business cycle co-movements (inter alia, see Kose, Otrok, and Prasad 2010).

At the most rudimentary level the synchronicity of business cycle movements can be evaluated via simple correlation measures. Indeed, this approach continues to be popular because it is straightforward and may be reasonably informative under certain circumstances. For such correlations to be meaningful these have to be evaluated for series that are stationary. Growth rates are more likely to be stationary than, say, levels of real GDP while popular data filters such as the Hodrick-Prescott filter, are designed not only to capture business cycle like behaviour but are also likely to produce stationary series.[iii] Indeed, authors such as Backus and Kehoe (1992) combined simple correlation measures with H-P filtered series to investigate business cycle co-movements for almost a century of data. Siklos (2011a) reprises their analysis and updates their results before addressing broader issues concerning business cycle co-movements in select industrial countries covering almost two centuries century of data. Bordo and Helbling (2010) also contribute to the research on the long sweep of history by reporting a secular rise in business cycle synchronicity and the significant role played by common economic shocks in influencing correlations in output movements.

Some of the behaviour in the time series of economic growth may well reflect the impact of the stage of economic development. Clearly, if a group of countries experiences strong economic growth while another undergoes a phase of slow but stable growth then the emergence of this kind of phenomenon can give rise to a form of de-coupling in business cycle movements. It is tempting then, particularly when the time series of interest display non-stationary behaviour, to apply cointegration testing to determine whether differences in growth rates are stationary.[iv] Care must be taken, however, in relying on this kind

of methodology unless one is clear about the sources of non-stationarity. For example, a structural break is well-known to create the appearance of non-stationarity. Moreover, only under specific circumstances can cointegration testing be informative about whether there is a form of convergence nor does the finding of cointegration necessarily imply that there are good economic reasons for growth rates between countries or regions of the world to be attracted to each other, thereby giving the impression that a form of coupling exists. Also germane is Siklos and Granger (1997) who demonstrate that adding a common stochastic trend can switch 'off' the cointegration property of time series so that any attraction, or long-run type of convergence, between series can be temporarily upset. This too can give the appearance of 'coupling' which periodically turns into decoupling.

More recently, the literature has shifted away from simple correlations to asking whether the synchronicity of business cycle movements can be traced to specific kinds of economic shocks and whether the strength and statistical significance of any co-movements is a product of certain regions of the world or of certain episodes in economic history. Indeed, there is some consensus that trade figures are prominent in boosting business cycle correlations though this is clearly not the only determinant at play since, as pointed out above, monetary policy performance is also involved (e.g., see A'Hearn and Woitek 2001, Dewald 2003, and Mumtaz, Simonelli and Surico 2009). Moreover, economic theory provides ambiguous guidance about whether trade enhances or not business cycle synchronicity (e.g., Kose, Prasad, and Terrones (2003), and Baxter and Kouparitsas 2005).

The recent strong performance of emerging market economies relative to the experience of more mature economies has, perhaps more than any other explanation, given the impression to some observers that de-coupling has taken hold. What often tends to be left out in these discussions is whether the phenomenon in question is a temporary one or a more permanent one in nature. If business cycle synchronicity is indeed a permanent feature of the data then, under suitable circumstances, cointegration or certain forms of frequency domain testing can indeed be helpful in detecting whether observed deviations in growth rates are a long-run feature of the data. Any empirical investigation must also confront the problem that, since business cycle movements are slow and fairly persistent, the investigator will require data over a long time span to perform the necessary tests with a reasonable amount of statistical confidence. Unfortunately, for the present study, the requisite data are available for a relatively small number of countries and the varying quality

of the data over time, not to mention the likelihood that structural breaks will play havoc with the analysis, makes such forms of testing challenging. Therefore, the empirical analysis which follows eschews the analysis of whether there are common attractors in long-run economic growth across the countries or regions considered.

2 Data, stylized facts, and methodological considerations

The objective of the present study is to examine the behaviour of business cycles around the world as well as control for selected economic and institutional determinants to identify what does and what does not contribute to explaining business cycle synchronicity. I rely on annual data since 1980 for groups of countries belonging to nine separate regions of the world. Given that the exercise is applied to data covering the entire globe it is highly unlikely that relying on a higher sampling frequency is practical owing to the uneven availability of data across the regions considered let alone across a long span of time. This also implies that certain 'high frequency' events, such as temporary crises, whether of the financial or non-financial varieties, cannot be properly captured.

The U.S., Japan, and China are included in the empirical analysis in their own right, while much of the rest of the globe is grouped into regional blocks as defined by the International Monetary Fund in its *World Economic Outlook.* They are: developing Asia, Latin American and the Caribbean, the Middle East and North Africa, the European Union, the ASEAN-5 countries, and the so-called Newly Industrialized countries or NICs. Needless to say, the grouping of countries into regional blocks also reduces the scope for considering a large number of determinants of business cycle co-movements. An appendix provides a detailed listing of the countries included in each of the regions considered. Figure 1 plots annual real GDP growth rates for the nine series considered. The era of 'globalization' shown in the Figure highlights the period when forces were at play to raise the coincidence of business cycle co-movements (viz., as in Kose, Otrok, and Prasad 2010).[v] The sharp downturns in economic activity around the time the economies of Central and Eastern Europe were beginning their economic transition to market-based economies, during the Asian financial crisis (1997-98), and the 'global financial crisis' starting in 2007, are also evident from the data. I also consider an estimate of the output gap, where the Hodrick-Prescott (H-P) filter was applied to the logarithm of real GDP.[vi] Since none of the

main conclusions in the analysis which follows was affected I do not discuss the estimates based on the output gap.

Other sources of time series macroeconomic data include the International Monetary Fund's *International Financial Statistics* (CD-ROM, March and June 2011) or the IMF's *World Economic Outllook* database (October 2010 edition; http://www.imf.org/external/pubs/ft/weo/2010/02/weodata/index.aspx), while institutional variables were obtained from a variety of sources discussed below. The remaining macroeconomic time series include: the current account balance (as a percent of GDP), inflation (percent change in a consumer price index), stock prices, the change in foreign exchange reserves, and the terms of trade. Additional time series, such as gross government debt (an indicator of fiscal policy), were obtained from the data base 'External Debt Statistics: Joint BIS-IMF-OECD World Bank Statistics which is found at http://www.jedh.org/. All of the macroeconomic time series were subjected to panel unit root tests. Note that stock prices, real GDP, and inflation are in rate of change form in the estimation specifications considered. All of the series mentioned above were found to be I(0), that is, the null of a unit root was rejected at levels of significance greater than 5% with the possible exception of gross government debt to GDP though this conclusion is sensitive according to whether the test is conducted on a balanced panel or not, and whether a linear time trend is included in the test specification. The conclusions reached for the other series are insensitive to the inclusion of a trend. A table summarizing the results in relegated to an appendix.[vii] Plots of the transformed data are also relegated to an appendix.

Turning to institutional variables, an annual index of central bank transparency is from Siklos (2011), an indicator of exchange rate regime types is from Carmen Reinhart (tepconnect.umd.edu/~creinhar/Course.html) and is based on her work with Rogoff and Ilzetzki (Reinhart and Rogoff 2004, Ilzetzki, Reinhart and Rogoff 2009), as are indicators of crises, while institutional variables that measure the quality of economic governance are from the World Bank (see the Appendix for the data sources). We also relied on Freedom House's index of political rights and civil liberties found at http://www.freedomhouse.org/template.cfm?page=1 while Chinn and Ito's (2006) updated capital account openness index (http://web.pdx.edu/~ito/Chinn-Ito_website.htm) was also considered in the empirical analysis below. It should be pointed out that data availability varies across all of these series.

Institutional variables are generally slow moving and typically are only available at the annual frequency. Hence, this provides additional justification for conducting the empirical analysis based on annual observations. Because some time series for certain regions and countries of the world are not available for the entire sample considered (1980-2010) the panel estimation that forms the first part of a two stage estimation strategy is based on an unbalanced sample. An appendix provides additional details about data availability. Note also that, in what follows and to conserve space, not all results are reported nor were all institutional variables used in the estimation results presented in section 4.

One final observation is in order concerning data transformations. Other than China, Japan, and the USA, the remaining series must also be converted into regional equivalents. Although several series are available from the sources listed above in regional format, stock prices, and the various institutional variables are country-specific. To create regional equivalents for these series I generated weighted averages of the relevant variables where the weights are individual countries' share of real GDP in the world economy. Annual estimates of the share are available from http://www.ers.usda.gov/Data/Macroeconomics/. Since many of the countries that are part of any given region have a very small share of GDP in the region, let alone the world economy, only the 3 to 5 largest economies in the regions concerned were considered.[viii] Clearly, there is an *ad hoc* element to any form of aggregation. Nevertheless, using a relative income measure as the basis for creating a weighted average is a common practice whereas simple averaging, for example, seems inadequate given the vastly different sizes of the economies in question.

Table 1 presents some summary statistics. It is clear that excluding the crises years has a large effect on average economic growth in 6 of the 9 regions concerned and they represent the lion's share of the world's real GDP. In addition, one readily observes that China and the CEE were largely unaffected by these events even if neighbouring countries were impacted by the crises.[ix]

The simple unconditional correlations in returns are shown in Tables 2A and 2B while Figure 2 plots moving correlations based on a 5 year window. In spite of the fact that the non-globalization sample covers only slightly more than one quarter of the sample, the unconditional correlations shown in Table 2A can be substantially different from those reported for the era of 'globalization'. The most noticeable impact is on the pair-wise correlations in economic growth with the U.S. where a de-coupling of sorts can be character-

ized without too much exaggeration as global in nature. In contrast, there is less evidence of a similar rupture in the business cycle correlations involving China or Japan. Nevertheless, it is worth mentioning the fall in correlations between Japan and the EU and the U.S. and the similar breakdown in co-movements between China and the two regions of the world with the most mature economies, that is, the EU and the U.S. The picture is somewhat different if business cycle activity is measured using per capita real GDP growth at purchasing power parities. In this case there is far less evidence of a change due to the advent of the 'globalization' era although it is unclear whether this is the appropriate metric to use, especially since an H-P filter was used to generate output gaps.

Turning to the moving unconditional correlations displayed in Figure 2 these reveal a starkly different picture of business cycle co-movements over time. For example, pair-wise real GDP growth correlations remain high in all the cases shown toward the end of the sample. It is hard to see a 'break' as a result of the financial crisis of 2007-9, except temporarily. Nevertheless, it is also evident that coupling is more of a non-U.S. phenomenon. Indeed, it is difficult to speak of coupling or, for that matter, de-coupling when pair-wise correlations based on U.S. data alone are considered.

Some studies (e.g., Fidrmuc, Korhonen, and Batorova 2008; Koopman Valle e Azevedo 2003) correctly point out that it is preferable to consider a correlation measure that allows for changes in the mean and volatility across the various economies examined. Engle's dynamic conditional correlation model (DCC) is well suited to the task.[x] Although readers are referred to Engle (2002), and the voluminous literature that has since emerged, the basic idea is as follows. In the multivariate case the conditional covariance matrix (H) of rates of change would be written

$$H_t = D_t R D_t, \quad D_t = diag\{\sqrt{h_{it}}\}$$

where R is the correlation matrix.[xi] In DCC models, R becomes time-varying but H must be unity so that

$$H_t = D_t R_t D_t$$

Figure 3 displays two sets of pair-wise estimates for DCC relying on U.S. real GDP growth (top) or Chinese economic growth (bottom). Limitations of the technique under the restricted sample available here means that estimates before 2000 are either unavailable or would prove statistically unreliable. Now the data reveal that there is coupling of sorts

even when the U.S. is included though the decrease in the conditional correlations is quite evident between the U.S. and the ASEAN-5 but less so for the major remaining partners around the globe. A similar impact is noticeable for the DCC between Japan and China although the effect emerges in 2009.

Even if the results are sensitive to how business cycles are measured, at the time when the era of globalization is supposed to have come into effect, it seems clear that there are temporal, regional, and secular forces at play in explaining co-movements in economic activity around the globe.

Knowing whether business cycle movements move together, even in a statistical sense, is useful. However, it is equally important to determine the extent to which the links may be ruptured by momentous events, and whether certain factors, real or ones associated, for example, with monetary policy can explain how business cycle shocks are transmitted among countries. Because economic shocks are not readily observed it may be useful to consider a factor model. Factor models have considerable appeal, especially in a data rich environment. The following specification illustrates the essence of this approach:

$$\Upsilon_t \mathbf{A}' = \Upsilon_t \boldsymbol{\varphi}(\mathbf{L}) + \mathbf{z}_t \boldsymbol{\Gamma}' + \boldsymbol{\varepsilon}_t \quad (1)$$

where Υ_t is the vector of observable endogenous variables augmented to include relevant macroeconomic variables (see below) and not simply real GDP growth (or the output gap) of the countries or regions in the dataset. These capture the country specific shocks that are possibly interdependent across countries. The matrix z_t represents unobservable common shocks that can also drive output over time. Although equation (1) is written in the time series format it is a straightforward extension to estimate a version in the panel setting.

There are many possible variables that can explain what drives output growth. Hence, potentially a large number of correlations are possible, likely far too many that can be usefully interpreted. Consequently, the objective of factor analysis is to establish the statistical nature of interdependence among a large number of covariates by reducing the dimensionality of the potential number of determinants of any hypothesized relationship. For example, we can speak of aggregate demand, supply, or monetary policy factors instead of the broader set of factors that would otherwise be contemplated. Hopefully, this enables a simpler characterization of the forces linking economic growth across countries

such as ones associated, say, with monetary policy, among other candidates to be considered.

In the second stage the vector of common factors, denoted **F**, can be combined with a set of other exogenous variables, denoted, **P**, to estimate a factor-augmented model of the form

$$y_t = \boldsymbol{\alpha}' \mathbf{F}_t + \boldsymbol{\beta}' \mathbf{P}_t + e_t \tag{2}$$

where $\boldsymbol{\alpha}$' and $\boldsymbol{\beta}$' are coefficient parameters. In the Ando and Tsay (2011) formulation we observe a panel $\mathbf{X}_{it}$ that contains information about **F** from information for country or region *i* at time *t*. If y_t denotes, say, U.S. real GDP growth (or deviations from some trend) then **P** represents the vector of growth variables for the other countries and regions considered. The dimension of **P** is then 8 while the dimension of **X**, which goes into determining **F**, includes the variety of institutional and macroeconomic determinants of growth, can be much larger. Therefore, it is easy to see the advantage of reducing the dimensionality of the problem in the present context.

Finally, in a second stage, a version of (2) is estimated via the quantile regression (QR) method (e.g., see Koenker 2005). The QR estimates the τ-th quantile of y_t conditional on the common and idiosyncratic components of the regression relationship and is written as follows:

$$Q_y(\tau | \mathbf{F}; \mathbf{P}) = \boldsymbol{\alpha}(\tau)' \mathbf{F}_t + \boldsymbol{\beta}(\tau)' \mathbf{P}_t \equiv \boldsymbol{\Lambda}(\tau)' y_t \tag{3}$$

where $\boldsymbol{\Lambda}(\tau)$ is a vector of variables that are a function of the quantile, τ, and all other terms have been previously defined. For example, if $\tau = 0.5$ estimates are for the median, and so on.[xii] As noted above, even if there are reasons to believe that business cycles are synchronous, the fact that some regions of the world are in different secular phases of economic growth (e.g., emerging markets are in the catching-up phase and are likely to experience relatively stronger growth) implies that the degree of coincidence may differ depending upon whether the investigator considers the tails of the distribution of responses. The resulting model is referred to as a factor-augmented quantile regression (FAQR) model.

3 Factor model and factor-augmented factor model results

I consider several sets of factor models. The first set incorporates 10 variables, four of which are institutional, that is, in the main qualitative in nature. The details are provided in Table 3A. Next, owing to the possibility that some of the institutional variables may be strongly related to each other, as these proxy broad institutional developments across the regions considered I consider a factor model which excludes one of the Freedom House indexes, namely the civil liberties index, and repeat the exercise of estimating a factor model. In another test of the sensitivity of the results to the choice of variables and model dimension, a factor model is estimated excluding the political rights and civil liberties index, as well as the gross government debt series (GGD). The latter series is available for a much shorter sample than for most of the remaining series. In another variant I consider the impact of augmenting the last factor model either with a commodity price index (oil prices), or real GDP growth. The latter series is included to see how the results of the estimation of equation (3) are influenced by the possibility that the other factor models might possibly be contaminated by the inclusion of common factors in the relationship between real GDP growth across regions and the other macroeconomic and institutional determinants of economic growth. Finally, the index of central bank transparency is only available since 1998. Hence, excluding the index gives us a model with 7 variables from which a factor model can be estimated and provides what amounts to a full sample (i.e., 1980-2010) estimate of equation (3).

All factor models were estimated via maximum likelihood with the number of factors estimated by the Kaiser-Guttman method. The Quantile regressions reported below are for the .1, .25, median ,75 and .9 quantiles only. The range of quantiles considered ought to be sufficient to provide a broad characterization of the entire distribution. Standard errors are estimated via the bootstrap method, sparsity using the Epanechnikov method is employed and the Hall-Sheater bandwidth method is applied.

Table 3 reveals that when the full set of variables is used (except for real GDP) the estimation method finds 3 factors. Based on the factor loadings and the communalities[xiii] the first two factors appear to capture the role of the institutional environment while the third factor captures a role for monetary policy. For example, the first factor finds a negative relationship between inflation and at least three institutional variables, namely the transparency index, the political rights proxy, and capital account openness. Hence, for ex-

ample, one would expect greater central bank transparency is associated with lower inflation. Note also that fiscal policy (i.e., Gross Government Debt or GGD) and foreign exchange reserves are also important loadings in the first factor. The second factor highlights the critical role of political rights and civil rights while the third factor links primarily inflation against the current account balance, foreign exchange reserves, and the terms of trade, all of which are influenced by monetary policy.[xiv] Since two of the factors primarily involve institutional variables the first model was re-estimated by imposing the restriction that there are, at most, two factors. The factor loadings are also displayed in Table 3A and, broadly speaking, the results reveal that it is sensible to include two factors when estimating equation (3). When multiple factors are estimated these are often rotated to improve their interpretation in terms of economic factors.[xv] Hence, when we restrict the estimation to two factors this highlights how, in the first factor, the relationship between inflation and the institutional environment[xvi] such that improvements in inflation (i.e., lower inflation) imply more freedom (i.e., a lower value for the relevant index). The second factor reveals how an improvement in inflation (i.e., lower inflation) reduces both the current account balance (as a percent of GDP) and improves the terms of trade. As a result, when reporting estimates of equation (3) based on the factor model with 10 variables, I have relied on the case where two factors are included.

The remaining factor models are shown in Table 3B. In every case one factor is obtained and all highlight the positive relationship between inflation and the change in reserves.[xvii] This effectively highlights how monetary policy, outside the USA has traded off exchange rate flexibility over the sample considered against inflation. All other factor models shown in Table 3B lead to the same conclusion. Therefore, the factor model estimates appear largely insensitive to the sample period being chosen or to the inclusion of certain institutional variables that are available for the complete sample.

I now turn to a discussion of the estimates of the factor augmented quantile regression results. These are shown in Tables 4A through 4C. Also shown are the estimates for a conventional regression on the mean which clearly highlights the substantial differences that emerge when contrasted with even a regression at the median quantile. Thus, for example, the mean regression reveals that in the model with the full set of variables both factors, interpreted as the institutional environment and monetary policy, respectively, are highly statistically significant but neither factor can statistically explain mean growth rates at the median. Other differences emerge when contrasted with coefficient estimates at

other quantiles. This kind of conclusion extends to several of the other variables in the estimated regression model.

If we now turn to the FAQR estimates for the model with the full set of factors there are three salient results. First, improvements in the institutional environment helps raise real GDP growth at the low end of the distribution, that is, for low growth regions and outcomes while poorer monetary policy tends to reduce growth at the .25 and .75 quantiles. Therefore, monetary policy does not explain economic growth in low or very high growth countries. Second, the degree to which real GDP growth is persistent, based on the autoregressive parameter, tends to decline as one goes from the low end to the top end of the economic growth distribution. It is conceivable that it can take a long time for some countries to escape from the low end of the growth distribution while, at the high end of the distribution, the previous year's growth rate has a smaller impact on current year economic growth.[xviii] Finally, the fixed effects reveal that Latin American countries tend to be at the low end of the distribution while one can classify the ASEAN and China at the high end of the growth distribution. This last result, unsurprisingly, is repeated for all estimated factor models.

Next, estimates for two other sets of factor models are shown (others are available on request). Generally speaking, the role of growth persistence remains unchanged although the profile of how the impact of past growth affects current growth is not exactly the same under the different factor models considered (see below). Improvements in monetary and exchange rate policy are also seen as boosting growth, as before, though the impact seems greatest for the bottom three quarters of the distribution. The fixed effects, while also broadly comparable with those reported based on the first factor model considered this time highlight the relatively low growth status of Japan, especially throughout the middle of the distribution (i.e., .25 to .7 quantiles). Finally, a slightly modified factor model that excludes GGD, and the two Freedom House indexes, also supports all of the earlier results based on the other factor models shown in Table 4 with a couple of notable exceptions: growth persistence is now seen as rising over the quantiles and the turnaround in the economic fortunes of Latin America and the CEE is clearly observable. Since one of the remaining institutional variables, namely central bank transparency, is only available since 1998, the last FAQR estimates are effectively for the sub-sample that excludes the 1980s and much of the 1990s. These results highlight the possibility of the de-coupling of

Asia and the emerging markets from the rest of the world but do not, however, contradict the continued interdependence with other regions.

Figure 4 provides a more detailed picture of the sensitivity of estimates of two crucial sets of determinants, namely the hypothesized factors and growth persistence, across various quantiles. The shaded areas highlight the regions where the coefficients of interest were found to be statistically significant at the 5% level (a 10% level is used in the results reported in Table 4). In general, the results provide further support for the notion that improvements in monetary and exchange rate policies can assist growth but not irrespective of the stage of economic development countries or regions find themselves in. Similarly, while a considerable amount of growth persistence is present in the data this is not a feature of the experience of relatively high growth countries. This may be consistent with the notion that very high growth rates represent a temporary phenomenon.

While it is, a priori, impossible to determine which one of the factor models is best suited to uncover the underlying drivers of the links in economic growth across regions of the world it seems likely that the more parsimonious approach produces the most reliable results.

4 Conclusions

This chapter considers the relationship between economic growth in 9 separate regions of the world. Annual data since 1980 are used to investigate both the determinants and the evolution of the links in economic activity across various parts of the world as a means to determine how much coupling or, rather, decoupling in economic performance can be detected in the data. Emphasis is placed on the possibility that there are possibly numerous determinants of the growth nexus that can explain changes in economic activity around the world and over time. In part for this reason, a well as to highlight the fact that conventional regression approaches mask the richness in the nature of cross-country or regional links, it is suggested that a factor-augmented quantile regression approach is suitable to investigate the relationships of interest.

The hypothesis put forward is that notions of coupling or decoupling are, at best, misleading, or, at worst, incorrect. Instead, economic activity across regions are linked to each other not only by the degree of institutional development but also by the overall qual-

ity of monetary policy. To the extent that some countries appear to experience growth either faster than others for some time, or their growth performance can appear to run counter to that experienced in other regions, may well be explained by the phase of economic development these countries or regions find themselves in. This helps explain why Asian economies of late seem to be growing at rates that set them apart from many other parts of the world. However, many emerging markets in Europe and Latin American have also begun distinguishing themselves as members of the higher economic growth club. Other than for Japan, which appears to be suffering from lower economic growth relative to most parts of the world, there are economic factors that can both explain why overall economic performance in some regions of the world appear to decouple at times but not at other times. However, these outcomes do not represent a form of decoupling. Instead, it seems preferable to think of economic growth across regions and over time as capturing mutual dependence, or interdependence, in growth performance.

Appendix: Country group listing

Definitions are from the October 2010 version of the World Economic Outlook data base (International Monetary Fund). The link can be found at
http://www.imf.org/external/pubs/ft/weo/2010/02/weodata/weoselagr.aspx

European Union (EU)

Composed of 27 countries: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Romania, and United Kingdom.

Newly industrialized Asian economies (NIC)

Composed of 4 countries: Hong Kong SAR, Korea, Singapore, and Taiwan Province of China.

Central and eastern Europe (CEE)

Composed of 15 countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Estonia, Hungary, Kosovo, Latvia, Lithuania, Former Yugoslav Republic of Macedonia, Montenegro, Poland, Romania, Serbia, and Turkey.

ASEAN-5 (ASEAN)

Composed of 5 countries: Indonesia, Malaysia, Philippines, Thailand, and Vietnam.

Latin America and the Caribbean (LA)

Composed of 32 countries: Antigua and Barbuda, Argentina, The Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, and Venezuela.

Middle East and North Africa (ME)

Composed of 20 countries: Algeria, Bahrain, Djibouti, Egypt, Islamic Republic of Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates, and Republic of Yemen.
Other: USA (United States), JAP (Japan), CHN (China).
Source: http://www.imf.org/external/pubs/ft/weo/2010/02/weodata/weoselagr.aspx

Exchange rate regime and crises indicators

These can be downloaded from Carmen Reinhart's data page found at
http://terpconnect.umd.edu/~creinhar/Courses.html

Central Bank transparency index

The transparency index, originally created by Dincer and Eichngreen from 1998—2006 has been updated by Siklos. The data set can be found at http://www.central-bank-communication.net/links/

Governance indicators

World Bank governance indicators can be found at
http://info.worldbank.org/governance/wgi/index.asp

Series used in factor analysis

Label	Description
CAB	Current account balance (% of GDP)
DR	Change in foreign exchange reserves (millions US $)
GGD	Gross Government Debt (% of GDP)
π	Consumer Price Inflation (% change annualized)
YGAP	Output Gap (H-P Filtered)
RGDP	Real GDP Growth (% annualized)
PR	Political rights Index (0 max – 7 min)
Cl	Civil Rights Index (0 max – 7 min)
TI	Transparency Index (1 min-15 max)
KAOPEN	Capital Account Openness Index
S	Stock returns (% annualized)
TOT	Terms of trade

References

A'Hearn, B., and U. Woitek (2001), "More International Evidence on the Historical Properties of Business Cycles", Journal of Monetary Economics 47 (April): 321-46.

Ando, T., and R. Tsay (2011), "Quantle Regression Models with Factor-Augmented Predictors and Information Criterion", Econometrics Journal 14: 1-24.

Backus, D., and P. Kehoe (1992), "International Evidence on the Historical Properties of Business Cycles", American Economic Review 58 (December): 377-409.

Baxter, M., and M. Kouparitsas (2005), "Determinants of Business Cycle Comovement: A Robust Analysis", Journal of Monetary Economics 52 (January): 113-57.

Beck. T., A. Demigürç-Kunt, and R. Levene (2010), "Financial Institutions and Markets Across Countries and Over Time: The Updated Financial Development and Structure Database", World Bank Economic Review 24(1): 77-92.

Bernard, A., and S. Durlauf (1995), "Convergence in International Output", Journal of Applied Econometrics 10 (April-June): 97-108.

Bohl, M., D. Mayes, and P. Siklos (2011), "The Quality of Monetary Policy and Inflation Performance", Manchester School, 79 (June 2011): 617–645.

Bordo, M., and T. Helbling (2011), "International Business Cycles in Historical Perspective" Manchester School 79 (March): 208-38.

Canova, F. (2004), "Testing for Convergence Clubs in Income Per Capita: A Predictive Density Approach", International Economic Review 45 (February): 49-77.

Chinn, M., and H. Ito (2006), "What Matters for Financial Develoment? Capital Controls, Institutions, and Interactions", Journal of Development Economics 81 (October): 163-92.

Dewald, W. (2003), "Bond Market Expectations and Longer Term Trends in in Broad Money Growth and Inflation in Industrial Countries, 180-2001", European Central Bank working paper 253.

Eichengreen, B. And Y. C. Park (2008), "Asia and the Decoupling Myth", working paper, University of California, Berkeley, May.

Enders, W. (2004), Applied Time Series Analysis, Second Edition (John Wiley & Sons).

Engle, R.F. (2002), "Dynamic Conditional Correlation: A Simple Class of Multivariate GARCH Models", Journal of Business and Economic Statistics 20 (July): 339-50.

Fidrmuc, J., and I. Korhonen (2006), "Meta-Analysis of the Business Cycle Correlation Between the Euro Area and the CEECs", Journal of Comparative Economics 34 (September): 518-37.

Fidrmuc, J., I. Korhonen, and I. Bartoova (2008), "Dynamic Correlation Analysis of Business Cycles of Emerging market Economies", working paper.

Flood, R., and A. Rose (2010), "Inflation Targeting and Business Cycle Synchronization", Journal of International Money and Finance,

Galor, O. (1996), "Convergence? Inference from Theoretical Models", Economic Journal 106: 1056-69.

Gonçalves, E., M. Rodrigues, and T. Soares (2009), "Correlations of Business Cycles in the Europ Area", Economics Letters 102 (January): 56-58.

He, D., and W. Liao (2012), "Asian Business Cycle Synchronisation", Pacific Economic Review 17 (February): 106-35.

Ilzeztki, E.O., C. Reinhart, and K. Rogoff (2009), "Exchange Arrangements Entering the 21st Century: Which Anchor Will Hold?", working paper, University of Maryland.

Im, H.M. Pesaran, and Y. Shin (2003), "Testing for Unit Roots in Heterogeneous Panels", Journal of Econometrics 115 (July): 53-74.

Koenker, R. (2005), Quantile Regression (Cambridge University Press: Cambridge, Mass).

Koopman, S.J., and J. Valle e Azevedo (2003), "Measuring Synchronisation and Convergence of Business Cycles", Tinbergen Institute Discussion Paper, TI 2003-052/4, June.

Kose, M.A., C. Otrok, and E. Prasad (2010), "Global Business Cycles: Global or Converging?", working paper, April.

Kose, A., E. Prasad, and M. Terrones (2003), "How Does Globalization Affect the Synchronization of Business Cycles?", American Economic Review 93 (May): 57-62.

Levin, A., C-F. Lin, and C-S. Chu (2002), "Unit Root Tests in Panel Data: Asymptotic and Finite Sample Properties", Journal of Applied Econometrics 108 (May): 1-24.

Mink, M., J. Jacobs, and J. de Haan (2008), "Measuring the Similarity of Business Cycles in the Euro Area and the U.S.", working paper, University of Groningen, December.

Mumtaz, H., S. Simonelli, and P. Surico (2009), "International Comovements, Business Cycle and Inflation: A Historical Perspective", Bank of England working paper No. 28, External MPC Unit.

Reinhart, C., and K. Rogoff (2004), "The Modern History of Exchange rate Arrangements: A Reinterpretation", Quarterly Journal of Economics 119 (February): 1-48.

Siklos, P.L., and C.W.J. Granger (1997), "Regime-Sensitive Cointegration With an Application to Interest-Rate Parity", Macroeconomic Dynamics 1: 640-57.

Siklos, P.L. (2009), "As Good as it Gets? The International Dinension to Canada's Monetary Policy Strategy Choices", C.D. Howe Commentary, No. 292, available from www.cdhowe.org.

Siklos, P.L. (2011), "Central Bank Transparency: Another Look", Applied Economics Letters, 18 (July): 929-933.

Siklos, P.L. (2011a), "The Coupling And Decoupling of Business Cycles In Historical Perspective: Scandinavian Evidence From The Early 19th Century", The Manchester School 79 (March): 239-67.

Wessel, D. (2011), "Recovery Traverses A Minefield", Wall Street Journal 10 March.

Tables and figures

Table 1 Summary statistics, real GDP growth rates

Region	1980-2010	Excluding 'Crises' Years
ASEAN	5.16 (3.12)	2.50 (5.61)
CEE	2.61 (3.09)	2.80 (3.31)
China	10.03 (2.81)	10.07 (2.19)
EU	1.97 (1.58)	1.21 (2.76)
Japan	2.22 (2.51)	-0.29 (3.11)
LA	2.86 (2.35)	3.60 (2.91)
ME	3.44 (1.35)	4.15 (1.32)
NIC	6.23 (3.17)	2.96 (4.17)
USA	2.68 (2.04)	1.79 (2.73)

Note: Standard deviations in parentheses. Crises years are 1997-98 and 2007-2010. See the appendix for region definitions.

Table 2A Unconditional correlations of real GDP growth rates

Region	**U.S.**		**China**		**Japan**	
	FULL	Globalization	FULL	Globalization	FULL	Globalization
ASEAN	-0.04	-0.24	0.06	0.10	0.45	0.45
CEE	0.49	0.35	0.38	0.30	0.09	-0.13
China	0.27	0.05	-	-	-0.04	-0.12
EU	0.66	0.44	0.06	-0.27	0.53	0.36
Japan	0.35	0.005	-0.04	-0.12	-	-
LA	0.19	0.11	0.35	0.52	0.12	-0.05
ME	0.03	-0.41	-0.04	-0.18	-0.06	-0.07
NIC	0.42	0.03	0.14	0.05	0.66	0.53
USA	-	-	0.27	0.05	0.35	0.005

Table 2B Unconditional correlations in output gaps

Region	**U.S.**		**China**		**Japan**	
	FULL	Globalization	FULL	Globalization	FULL	Globalization
ASEAN	-0.06	-0.15	0.28	0.30	0.62	0.65
CEE	0.74	0.74	0.47	0.44	0.48	0.37
China	0.22	0.12	-	-	0.05	-0.02
EU	0.78	0.74	-0.10	-0.28	0.75	0.69
Japan	0.51	0.40	0.05	-0.02	-	-
LA	0.33	0.28	0.60	0.69	0.49	0.40
ME	0.21	0.04	0.22	0.15	0.47	0.43
NIC	0.24	-	0.60	-	0.57	-
USA	-	-	0.22	0.12	0.51	0.40

Note: The FULL sample is 1980-2010, the globalization period is 1985-2007, inclusive. The output gap is based on an H-P filter applied to the full sample using a smoothing parameter of 100. The H-P filter was applied to the log of real per capita GDP at PPP. There was insufficient data for the NIC countries in Table 2B. See the appendix for region definitions.

Table 3 Factor loadings and communalities

A) Full Model

	Full Set							Full Set – Restricted				
Series	Factor #1		Factor # 2		Factor # 3		**Comm**	Factor # 1		Factor # 2		**Comm**
	Loadings							Loadings				
	Unro-tated	Rotated	Unro-tated	Rotated	Unro-tated	Rotated		Unro-tated	Rotated	Unro-tated	Rotated	
CAB	.11	.09	.13	.14	.46	.46	**.24**	.30	.35	.35	.31	**.22**
TOT	.02	-.05	-.18	-.14	.38	.39	**.18**	-.14	-.08	.41	.43	**.19**
DR	.33	.23	-.15	-.17	.55	.59	**.44**	-.17	-.06	.76	.77	**.60**
GGD	.36	.23	-.49	-.53	.16	.23	**.39**	-.60	-.59	.04	.13	**.36**
π	-.36	-.25	.19	.20	-.62	-.67	**.56**	.31	.21	-.65	-.68	**.51**
S	-.17	-.23	-.05	.04	.53	.51	**.31**	.17	.24	.54	.51	**.31**
TI	.42	.41	-.13	-.23	-.24	-.18	**.25**	-.28	-.32	-.28	-.23	**.16**
PR	-.35	-.16	.87	.92	.03	-.07	**.89**	.93	.92	-.001	-.13	**.87**
CL	-.29	-.14	.71	.75	.06	-.02	**.59**	.73	.75	.22	.12	**.58**
KAOPEN	.97	.95	.00	-.19	.00	.11	**.94**	-.27	-.29	-.15	-.11	**.10**

B) Other Factor Models

Series	Factor #1A		Factor # 1B		Factor # 1C		Factor # 1D	
	Unrotated	**Comm.**	Unrotated	**Comm**	Unrotated	**Comm**	Unrotated	**Comm**
CAB	.35	**.12**	.37	**.14**	.38	**.14**	.38	**.86**
TOT	.36	**.13**	.36	**.13**	.37	**.13**	.37	**.87**
DR	.66	**.44**	.66	**.43**	.66	**.43**	.65	**.57**
GGD	-		-		-		-	
π	-.78	**.62**	-.78	**.61**	-.78	**.61**	-.78	**.39**
S	.31	**.10**	.33	**.11**	.34	**.11**	.34	**.88**
TI	-		.06	**.003**	.06	**.003**	.05	**.97**
PR	-.34	**.12**	-					
KAOPEN	.42	**.18**	.39	**.16**	.39	**.16**	.39	**.79**
OIL	-		-		.12	**.01**		
RGDP	-		-				.06	**.997**

Note: See Appendix and text for variable definitions. Comm refers to 'Communality'. The factor models include only the series listed in the first column. The unrotated and rotated columns show the factor loadings. In a) Factor #1 is the 'institutional environment'; Factor # 2 is 'Monetary and exchange rate policy'; In B) Factor # 1A to 1D is 'Monetary and exchange rate policy'.

Table 4 Factor-augmented quantile regression estimates

A) Full Set of Variables

Dep. Var.: Real GDP Growth	Quantiles					
	.9	**.75**	**.5**	**MEAN**	**.25**	**.1**
Independent Variables	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)
Constant	3.22 (2.22; .15)	**4.23 (1.59; .01)**	**2.99 (1.42; .04)**	**2.17 (1.12; .06)**	.57 (1.84; .76)	1.69 (2.06; .41)
Institutional Environment	-.27 (1.41; .85)	1.33 (.93; .16)	1.38 (1.25; .28)	**1.51 (.89; .09)**	.97 (1.84; .55)	**3.41 (2.01; .09)**
Mon. & Exch. Rate pol.	-.32 (.31; .31)	-.49 (.25;).06	-.21 (.28; .45)	**-.37 (.16; .02)**	**-.52 (1.62; .04)**	**-.60 (.33; .07)**
RGDP(-1)	.27 (.31; .40)	.38 (.26; .15)	**.49 (.22; .03)**	**.71 (.15; .00)**	**.62 (1.84; .02)**	**.97 (.30; .00)**
ASEAN	**2.53 (1.10; .02)**	1.33 (1.09; .22)	.89 (1.40; .53)	.85 (1.10; .45)	2.46 (.27; .24)	-1.21 (2.51; .63)
CEE	**2.83 (1.29; .03)**	1.23 (1.45; .40)	.41 (1.78; .82)	-.56 (1.14; .62)	.23 (2.09; .93)	**-5.18 (2.13; .02)**
CHN	**7.80 (4.41; .08)**	2.81 (3.12; .37)	-.07 (3.91; .99)	-.88 (2.70; .74)	.72 (5.56; .90)	-7.63 (6.81; .27)
EU	-1.14 (.99; .25)	-.83 (.96; .39)	-.28 (1.08; .79)	-.22 (.91; .81)	.36 (1.23; .77)	-.11 (1.75; .95)
JAP	-.92 (1.17; .44)	-1.28 (1.15; .27)	-1.31 (1.17; .26)	-1.18 (.90; .19)	-1.72 (1.74; .33)	**-2.15 (1.16; .07)**
ME	2.47 (1.96; .21)	.58 (1.76; .74)	-.37 (2.19; .86)	-.54 (1.46; .71)	1.10 (2.89; .71)	-3.32 (3.39; .33)
LA	1.89 (2.76; .50)	-1.68 (1.56; .29)	-1.55 (2.11; .46)	-1.66 (1.55; .29)	-.20 (2.93; .95)	-4.70 (3.75; .21)
NIC	.93 (1.08; .39)	.28 (1.30; .83)	-.16 (1.88; .93)	-1.09 (1.18; .36)	-1.97 (1.74; .26)	-3.09 (2.06; .14)
$\bar{R}^2$	*.62*	*.50*	*.43*	*.36*	*.36*	*.43*

Note: In bold characters are statistically significant coefficients at the 10% level of significance. Mean equation estimated via OLS.

B) Factor 1B

Dep. Var.: Real GDP Growth	Quantiles					
	.9	**.75**	**.5**	**MEAN**	**.25**	**.1**
Independent Variables	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)
Constant	**3.80 (.44; .00)**	**3.29 (.41; .00)**	**2.14 (.43; .00)**	**1.71 (.49; .00)**	.68 (.87; .43)	-1.78 (1.24; .15)
Institutional Environment	NA	NA	NA	NA	NA	NA
Monetary & Exchange rate policy	**1.64 (.99; .10)**	**.86 (.33; .01)**	**1.80 (1.80; .09)**	**1.70 (.36; .00)**	**1.66 (.58; .00)**	1.70 (1.66; .31)
RGDP(-1)	**.16 (.07; .02)**	**.20 (.07; .00)**	**.24 (.09; .01)**	**.31 (.08; .00)**	**.36 (.20; .08)**	**.72 (.33; .03)**
ASEAN	**.87 (.46; .06)**	**1.31 (.52; .01)**	**1.76 (.56; .00)**	.81 (.82; .33)	**1.87 (.86; .03)**	.80 (2.08; .70)
CEE	**1.91 (.89; .03)**	1.04 (.69; .14)	**1.43 (.72; .05)**	.46 (.90; .61)	.98 (1.53; .52)	**-3.73 (2.28; .10)**
CHN	**6.02 (1.50; .00)**	**4.84 (.99; .00)**	2.38 (1.76; .18)	**2.53 (1.00; .01)**	1.39 (1.00; .16)	-1.34 (5.91; .82)
EU	**-1.20 (.42; .00)**	**-.89 (.47; .06)**	-.40 (.45; .37)	-.55 (.66; .41)	.03 (.59; .95)	.84 (.72; .24)
JAP	-1.07 (1.13; .35)	**-1.48 (.75; .05)**	**-3.20 (1.70; .06)**	**-2.67 (.76; .00)**	**-2.50 (1.24; .05)**	-3.19 (2.54; .21)
ME	**1.90 (.86; .03)**	**1.36 (.67; .04)**	**1.40 (.76; .07)**	1.35 (.86; .12)	1.05 (.78; .18)	1.16 (.98; .24)
NIC	**3.05 (1.38; .03)**	**1.74 (.88; .05)**	.61 (1.48; .68)	.62 (.80; .44)	-1.42 (1.34; .29)	-1.76 (2.16; .42)
LA	-.51 (.91; .58)	.41 (.75; .59)	-.12 (.86; .89)	-.60 (.83; .47)	-.92 (1.77; .61)	-.54 (1.26; .67)
$\bar{R}^2$	*.56*	*.48*	*.38*	*.59*	*.30*	*.27*

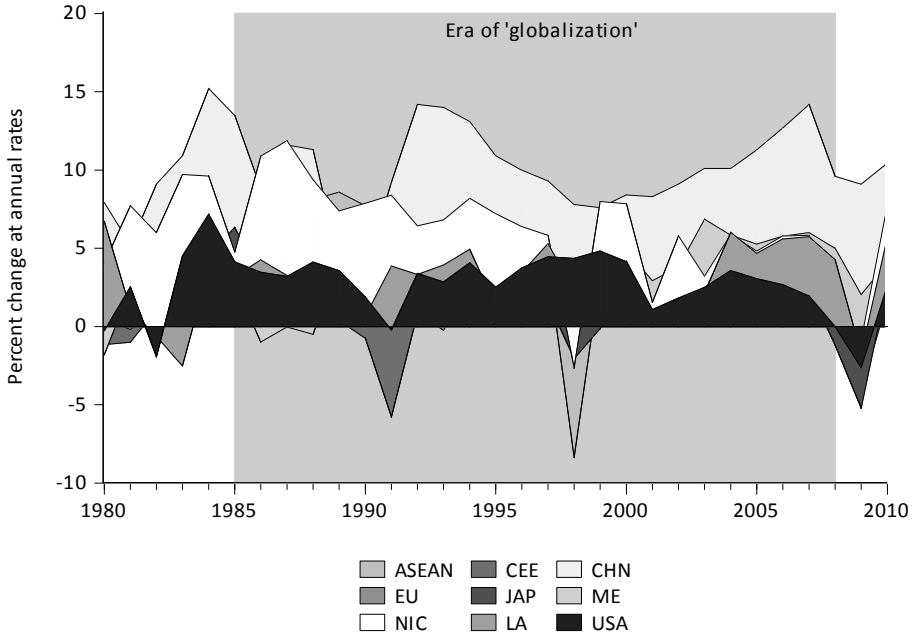
Note: See Table 3 note for definition of Factor 1B.

C) Factor 1C

Dep. Var.: Real GDP Growth	Quantiles					
	.9	**.75**	**.5**	**MEAN**	**.25**	**.1**
Independent Variables	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)	Coefficient (S.E.; p-value)
Constant	**3.86 (.52; .00)**	**3.51 (.71; .00)**	**2.62 (.70; .00)**	**2.31 (.81; .01)**	1.16 (1.12; .30)	-1.59 (2.23; .48)
Institutional Environment	NA	NA	NA	NA	NA	NA
Monetary & Exchange rate policy	**3.94 (2.28; .09)**	3.08 (2.35; .19)	**2.70 (.90; .00)**	**2.79 (.70; .00)**	**2.57 (.67; .00)**	1.86 (5.35; .73)
RGDP(-1)	**.27 (.08; .00)**	**.22 (.08; .01)**	**.21 (.10; .03)**	**.20 (.11; .09)**	**.17 (.10; .08)**	.79 (.80; .33)
ASEAN	**2.31 (.55; .00)**	**2.06 (.66; .00)**	**2.81 (.76; .00)**	**1.88 (1.06; .08)**	**3.94 (1.12; .00)**	.66 (4.52; .88)
CEE	**3.45 (.97; .00)**	**3.08 (1.03; .00)**	**2.80 (1.01; .01)**	**2.26 (1.17; .06)**	**3.34 (1.65; .05)**	-3.14 (3.61; .39)
CHN	-1.32 (4.04; .74)	.61 (3.91; .88)	.18 (1.75; .92)	.25 (1.93; .90)	1.79 (1.72; .30)	-3.09 (23.42; .90)
EU	1.08 (1.11; .33)	.80 (2.85; .49)	.92 (.83; .27)	.93 (1.07; .39)	1.98 (1.14; .09)	1.41 (2.74; .61)
JAP	**-5.34 (2.31; .02)**	**-5.50 (2.85; .06)**	**-4.47 (1.43; .00)**	**-4.74 (1.34; .00)**	**-3.39 (1.54; .03)**	-3.60 (6.37; .57)
LA	**3.41 (1.25; .01)**	**3.04 (1.36; .03)**	**2.64 (1.06; .01)**	**2.15 (1.12; .06)**	1.53 (1.97; .44)	.97 (3.06; .75)
ME	**2.01 (.99; .05)**	1.22 (.88; .17)	1.46 (.91; .11)	1.77 (1.10; .11)	**2.07 (1.21; .09)**	.88 (3.39; .80)
NIC	**4.19 (1.08; .00)**	**2.77 (1.05; .01)**	1.84 (1.47; .22)	**1.90 (1.05; .08)**	.76 (2.24; .74)	-1.77 (5.22; .74)
$\bar{R}^2$	*.59*	*.47*	*.40*	*.54*	*.24*	*.19*

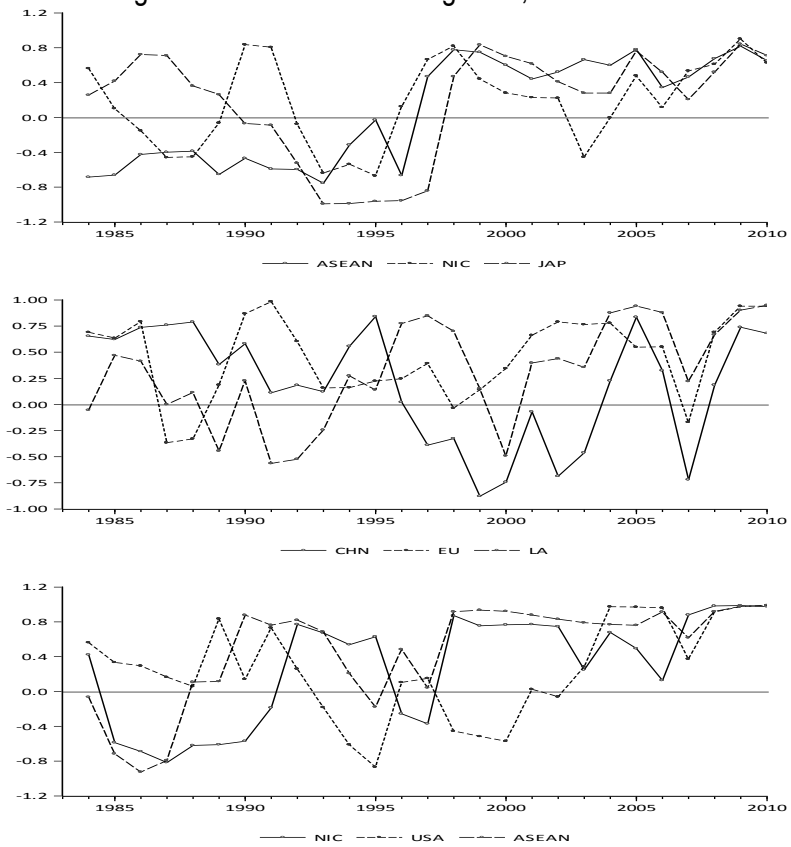
Note: See Table 3 note for definition of Factor 1C.

Figure 1 Real GDP growth in nine regions of the World, 1980-2010



Source: IFS CD-ROM. See Appendix for definitions of regions. The era of globalization, shown as the shaded area, is 1985-2007, inclusive, is used in the various tests reported in the paper. Kose, Otrok, and Prasad (2010) define the era of globalization as ranging from 1985-2008, as shown above.

Figure 2 Select moving correlations in real GDP growth, 1980-2010



Note: See Appendix for definitions. The moving correlations are based on a five year rolling window. The top figure are based on pair-wise correlations vis-a-vis China (CHN), the middle graph relies on U.S. real GDP growth (USA) while the bottom plot uses Japanese (JAP) real GDP data. NIC represents the newly industrialized countries, ASEAN are Asian economies, LA are the economies of Latin America, while EU are the European Union economies.

Figure 3 Dynamic conditional correlations, USA versus other regions, 2000-2010

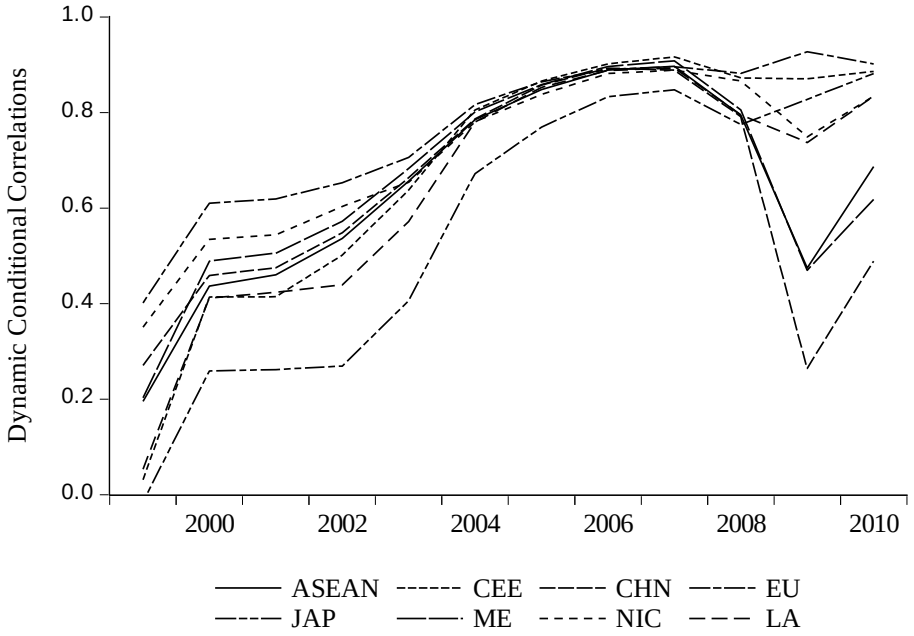
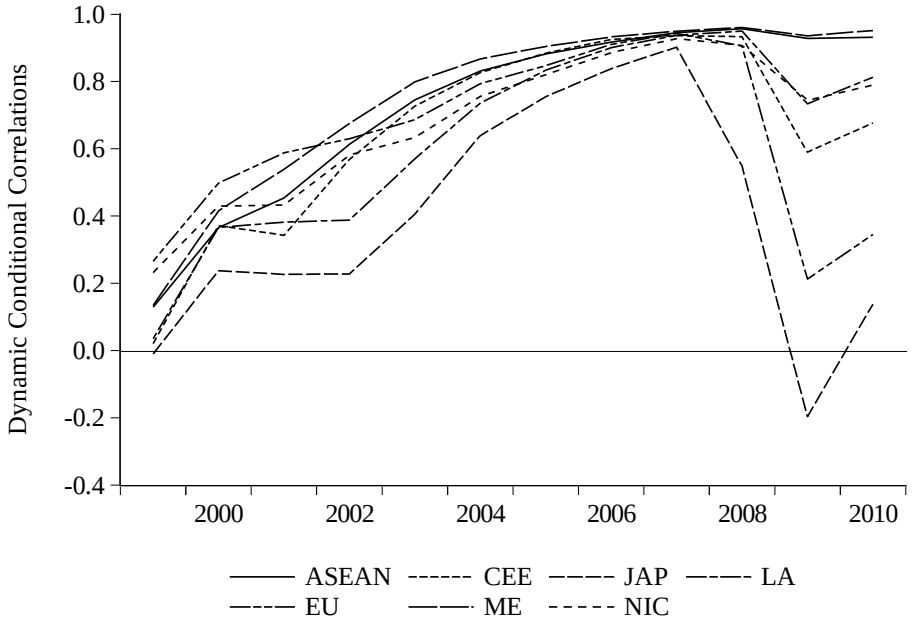


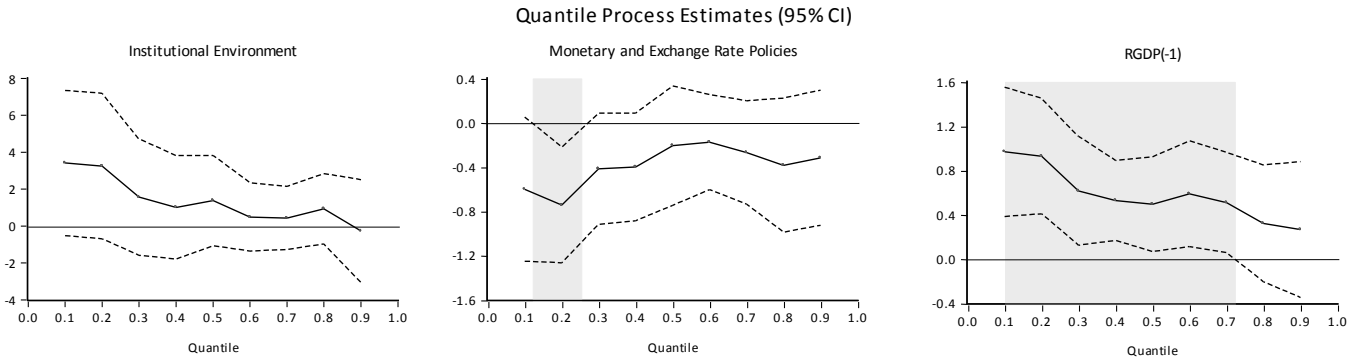
Figure 4 Dynamic conditional correlations, China versus other regions, 2000-2010



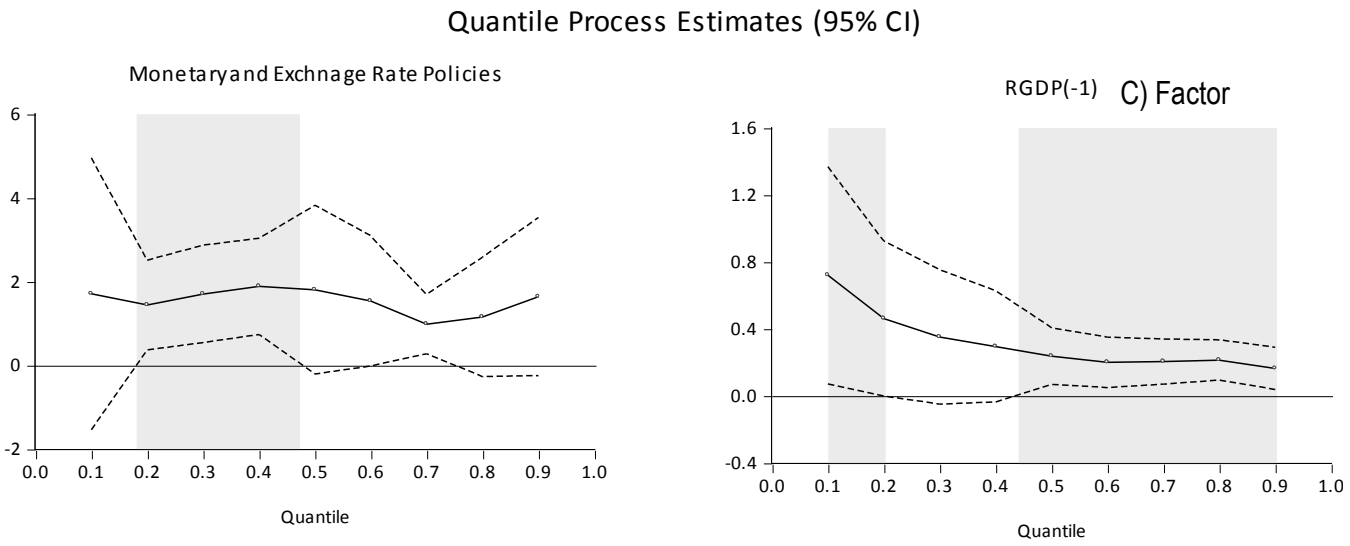
Notes to Figures 3 and 4: see the text for the explanation of the methodology and Figure 2 and the Appendix for the country/regional block definitions.

Figure 5 Quantile Process Estimates

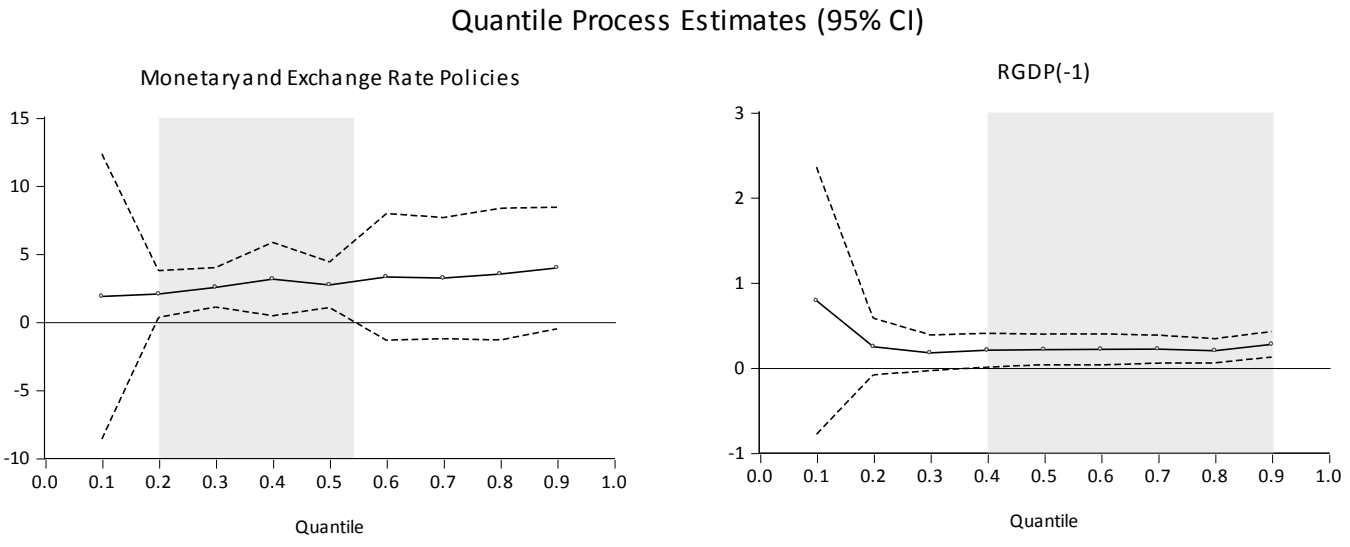
A) Full set of variables



B) Factor 1B (see Table 3 for details)



1C (see Table 3 for details)



[i] One way of establishing the degree of maturity of financial systems in a cross-country setting is to rely on proxies for the size of the financial sector. See, for example, Beck, Demigürç-Kunt and Levine (2010).

[ii] Eichengreen and Park (2008) suggest that the decoupling hypothesis does not apply to Asian economies.

[iii] A related literature asks whether levels of real GDP (possibly expressed in per capita terms) are converging or not. Here the question is whether there exist convergence clubs. These refer to groups of countries in close geographical proximity and who share common structural characteristics, including similar initial economic conditions. If these conditions hold then convergence in per capita real GDP is likely. Otherwise, convergence will not take place. Canova (2004), for example, finds that the European Union, and the OECD, do not represent a single convergence club. Indeed, in Europe, the Northern and Southern periphery countries constitute different convergence clubs. The series in question are typically highly non-stationary while the research question is geared toward whether incomes in some countries show signs of catching-up to incomes of other countries. Since this is considered to be a somewhat separate line of inquiry, although not entirely divorced from the problem of business cycle synchronization, the relevant literature is not considered further in what follows.

[iv] If growth rates are not stationary then levels possess two unit roots. The notion that cointegration in real GDP is akin to a form of convergence was first suggested by Bernard and Durlauf (1995).

[v] Kose, Otrok and Prasad (2010) include the year 2008 but Figure 1 assumes the period ends in 2007 since many observers would date the beginning of the 'global financial crisis' in that year.

[vi] The smoothing parameter of 100 was used.

[vii] A version of a panel test performs a standard Augmented Dickey-Fuller (ADF) test on each country individually, and Im, Pesaran and Shin (2003; IPS) provide the critical values. The test equation is written: $\Delta y_t = \alpha y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \varepsilon_t$ The ADF tests tend to have a downward bias, which is corrected for when a panel test is used. Generally, if all independent parameter estimates are unbiased, then the mean of these estimates is also unbiased (Enders 2004, p. 225). This version of the panel unit root test generates a test statistic for each cross-section, as well as a country specific lag augmentation term. In contrast, if the hypothesis that $\alpha_j = \alpha_{j'}$, where $j \neq j'$, represent the unit root test statistic for two different countries, and it cannot be rejected then an alternative formulation of the test specification $\Delta y_t^{\mu} = \alpha y_{t-1}^{\mu} + \sum_{i=1}^{k} \varphi_i \Delta y_{t-i}^{\mu} + u_t$, where α (as well as β in equation (1)) are fixed across all countries results in the more restrictive Levin, Lin, and Chu (2002; LLC) panel unit root test. LLC also advocate removing the overall mean of the series (i.e., $\bar{y}$) prior to running the test. All the results reported above were unaffected by this modification.

[viii] For the ASEAN they are: India, Malaysia, Philippines, and Thailand; the CEE: Hungary, Poland, and Turkey; the EU: France, Germany, and the UK; the Middle East: Algeria, Egypt, Iran, Iraq, and Saudi Arabia; the NIC economies: Hong Kong, Singapore, and Korea; and Latin America: Argentina, Brazil, Chile, and Mexico.

[ix] Given the span of the dataset and the timing of the 'global financial crisis' of 2008-9 it seems preferable under the circumstances to rely on sub-sample estimates as opposed to relying on some dummy variable approach to account for the impact of the crises years.

[x] The inspiration for the technique stems from the fact that multivariate GARCH models tend to be highly over-parameterized.

[xi] Where $h_{it} = E_{t-1}(r_{it}^2), \quad r_{it} = \sqrt{h_{it}}\varepsilon_{it}, \quad \varepsilon \sim N(0,1)$.

[xii] Estimates at the median are considered to be more robust than those for the mean. See Koenker (2005).

[xiii] Factor ladings are roughly equivalent to the weight in the linear combination of the series in the factor model that is then used to reduce the dimensionality of the problem considered. Communality is akin to a correlation coefficient as it refers to the fraction of the total variance each variable in the analysis shares with other variables in the model considered.

[xiv] One might ask why not include a role for interest rates. Except for a few cases (e.g., USA and the EU) interest rates are neither the only nor even the most important policy instrument over the period examined.

[xv] The orthogonal Varimax method is used.

[xvi] Note that for the Freedom House indexes, a lower value for the index translates into greater political rights or more civil liberties.

[xvii] Recall that in a panel setting the relevant series are I(0). Individually, however, there is a case to be made that for some countries, or regions (e.g., China) the change in foreign exchange reserves is I(1). Nevertheless, normalizing the series by nominal GDP did not change the results.

[xviii] The impact of persistence in initial conditions is not unlike the role of this structural characteristics found in the literature on convergence clubs (e.g., see Galor 1996, Canova 2004).

BOFIT Discussion Papers

A series devoted to academic studies by BOFIT economists and guest researchers. The focus is on works relevant for economic policy and economic developments in transition/ emerging economies by BOFIT economists and guest researchers.

2012

No 1 Walid Marrouch and Rima Turk-Ariss: Bank pricing under oligopsony-oligopoly: Evidence from 103 developing countries

No 2 Ying Fang, Shicheng Huang and Linlin Niu: De facto currency baskets of China and East Asian economies: The rising weights

No 3 Zuzana Fungáčová and Petr Jakubík: Bank stress tests as an information device for emerging markets: The case of Russia

No 4 Jan Babecký, Luboš Komárek and Zlatuše Komárková: Integration of Chinese and Russian Stock Markets with World Markets: National and Sectoral Perspectives

No 5 Risto Herrala and Yandong Jia: Has the Chinese Growth Model Changed? A View from the Credit Market

No 6 Sanna Kurronen: Financial sector in resource-dependent economies

No 7 Laurent Weill and Christophe Godlewski: Why do large firms go for Islamic loans?

No 8 Iftekhar Hasan and Ru Xie: A note on foreign bank entry and bank corporate governance in China

No 9 Yi Yao, Rong Yang, Zhiyuan Liu and Iftekhar Hasan: Government intervention and institutional trading strategy: Evidence from a transition country

No 10 Daniel Berkowitz, Mark Hoekstra and Koen Schoors: Does finance cause growth? Evidence from the origins of banking in Russia

No 11 Michael Funke and Michael Paetz: A DSGE-based assessment of nonlinear loan-to-Value policies: Evidence from Hong Kong

No 12 Irina Andrievskaya: Measuring systemic funding liquidity risk in the Russian banking system

No 13 Xi Chen and Michael Funke: The dynamics of catch-up and skill and technology upgrading in China

No 14 Yin-Wong Cheung, Menzie D. Chinn and XingWang Qian: Are Chinese trade flows different?

No 15 Niko Korte: Predictive power of confidence indicators for the russian economy

No 16 Qianying Chen, Michael Funke and Michael Paetz: Market and Non-Market Monetary Policy Tools in a Calibrated DSGE Model for Mainland China

No 17 Pierre L. Siklos: No coupling, no decoupling, only mutual inter-dependence: Business cycles in emerging vs. mature economies

BOFIT Discussion Papers
http://www.bof.fi/bofit_en • email: bofit@bof.fi
ISSN 1456-6184, online