What Happened to the East Asian Business Cycle?

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Abstract

I examine the dynamics of business cycle correlations within emerging East Asia, and draw comparisons with alternative regional samples. There is overwhelming evidence bilateral cycle correlations have significantly shifted upwards since the 1980's. In emerging East Asia, the shift corresponds to the late 1990's Asian crisis - but not elsewhere. A spike in business cycles synchronization is evident from 2008Q3. However, it is substantially more pronounced amongst developed countries than in emerging East Asia, or indeed Latin America. The ongoing crisis appears to affect East Asian economies in more differentiated ways than the rest of the developed world. The paper proposes a decomposition of the dynamics in cycle synchronization into changes in goods trade and in financial linkages. Interestingly, while the change in cycles synchronization corresponds to a fall in bilateral trade for emerging East Asia, it is associated with a fall in financial trade in the rest of the world.

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1 Introduction

The onset of the sub-prime crisis has triggered what has been labeled the first global recession in decades. According to virtually any definition, most countries have entered recession between 2008Q3 and 2009Q2. World trade has collapsed, though whether it happened as a cause or a consequence of the crisis is an open question. Far from dampening the effect on consumption of business cycle fluctuations, international financial linkages are often accused of having accelerated the international diffusion of the shock. International capital is being withdrawn as financial intermediaries de-leverage their balance sheets, which is often argued to have worsened the consequences of the crisis, especially in the developing world.

In this paper, I propose to examine these claims rigorously with a focus on emerging East Asia. I compute the cross-sectional distribution of bilateral cycle correlations for East Asian countries with recently available data. I consider its evolution over time, with focus on sub-periods of interest for emerging East Asia. Changes in the distribution around 1997Q2 capture the impact of the Asian crisis on cycle correlations. They are contrasted with changes over the late 2000's.

I also investigate the specificities of the East Asian business cycle by comparing the time properties of international cycle correlations in the region to what happened in two alternative samples. Comparisons are first drawn with a sample of 33 developed economies with available recent data, and second with a small sample of Latin American countries. Correlations are estimated over the same sub-periods as those considered for emerging East Asia. By definition, the Asian crisis of 1997 presumably had special consequences in emerging East Asia. Whether the same can be said of the more recent sub-prime crisis is an open question. It is also one that potentially informs the mechanics of the international diffusion of the ongoing shock.

The paper proposes to examine the joint dynamics of bilateral cycle correlations in various geographic samples and the observed changes in goods trade and financial linkages. Importantly, no causal inferences are drawn, for both trade and financial linkages have undoubtedly responded to the onset of the crisis. And time varying instruments for goods and assets trade are simply not available. The approach is therefore akin to an analysis of variance. The dynamics of cycle correlations around crises dates are systematically associated with changes in goods and assets trade. The association is informative in that it identifies hypothetical differences in the margins of adjustment that prevail in response to the current shock.

The results are as follows. There is overwhelming evidence that East Asian, Latin American and world cycles have all become more synchronized since the 1980's. However, the bulk of the increase in emerging East Asia corresponds to the 1997 Asian crisis. Cross-sections that exclude dates after 1997Q2 do not display a significant shift relative to the

early 1990's. In contrast, the rest of the world or Latin America did not become more correlated in the late 1990's. In fact, the most significant shift in world business cycles corresponds to the inclusion of the current crisis, from 2008Q3. This brings the focus onto a specificity of emerging East Asia. While 2008Q3 saw a sizeable upward shift in business cycles correlations in the developed world, such is not the case for emerging East Asia. First, the shock is smaller in relative magnitude, as cycles were already highly correlated prior to the 2000's. Second, and perhaps most interestingly, the current shock appears to have had differentiated effects on East Asian economies. The cross-sectional distribution of business cycles in emerging East Asia has shifted upwards with the inclusion of the post 2008Q3 period - but only partially. In the most recent period, the distribution has become bi-modal, with one mode at high correlation levels (above 0.75), and another insignificantly different from zero. In other words, some East Asian business cycles are left relatively unaffected by the sub-prime shock.

The last section of the paper seeks to account for this heterogeneous response. I consider two conventional determinants of business cycle correlations, or particular relevance in the current discussion. I compute the intensity of bilateral trade, and a measure of mutual openness to financial flows. Both are time varying measures, and their pattern over time are related with the changes in the cross-sectional distribution of cycle synchronization. I confirm the specificity of emerging East Asia as compared with the rest of the world. In the 2000's, but prior to the sub-prime crisis, the determinants of business cycle correlations are entirely conventional, both in emerging East Asia and in the rest of the world. Countries that engage in goods and financial trade tend to be more correlated in cross-section. With the onset of the sub-prime crisis, however, a striking difference arises. In emerging East Asia, the determinants of cycle correlations remain by and large unchanged. But in the rest of the world, financial trade falls, and the correlation between financial trade and cycle correlation becomes negative. In this cross-section, countries with lower financial openness tend to be more correlated.

The results are diametrically opposed in emerging East Asia and in the developed world when it comes to accounting for the change in business cycles correlations around the sub-prime crisis. In emerging East Asia, it is a fall in goods trade that seems to be significantly associated with the (heterogeneous) increase in bilateral correlations. In developed countries, it is mostly a fall in financial openness that correlates with cycle synchronization. These correlations should not be interpreted causally, for both kinds of trade are eminently endogenous to the cycle, and cannot be instrumented in this panel framework. That said, the results suggest a fundamentally different margin of adjustment in emerging East Asia in response to an exogenous shock. Perhaps because the region is less financially integrated to start with, a global recession translates mostly into a fall in goods trade. In the rest of the world, the global recession is associated with falling asset trade. Perhaps because the role for multinational banks is more advanced there to start with and de-leveraging is more prevalent. Thus, East Asian countries with relatively less

pronounced trade linkages with the developed world, suc as the Philippines, Vietnam or Indonesia, have remained relatively insulated from the real effects of the crisis.

The rest of the paper is structured as follows. Section 2 discusses the measurement of the variables of interest, i.e. the cross-section of cycles correlation, bilateral trade and openness to capital flows. The Section also describes the data used in computing all variables. Section 3 presents the time pattern in bilateral cycle correlations for East Asian countries and the rest of the world. Section 4 investigates the trade and financial determinants in a panel framework. Section 5 concludes.

2 Measurement Strategy

I first describe the procedure used to track the distribution of cycle correlations over time, and the data choices conditioned by the necessity to have observations on recent developments. I then describe how measures of bilateral trade intensity and financial openness are computed. Both approaches have become quite standard in the literature.

2.1 The Distribution of Bilateral Correlations

The paper takes inspiration from the seminal approach in Frankel and Rose (1998), followed by a vast literature interested in the determinants of the international synchronization of business cycles. I consider windows of arbitrary lengths over which I compute the lower triangular matrix of the Pearson correlation coefficients between all pairs of countries in a given sample. The window is rolled forward in time, the computations repeated, and the cross-sectional matrix saved. The result is a panel formed by repeated cross-sections of cycle synchronization. The approach entails several choices of a relatively arbitrary nature, which I now discuss.

First and foremost, the length of each window determines the significance of the coefficients that form each cross-section. We know that for an estimation of conventional Pearson correlation coefficients ρ computed on N observations,

$$t = \frac{\rho}{\sqrt{(1-\rho^2)\,(N-2)}}$$

approximately follows a t-distribution with $N-2$ degrees of freedom. This provides a convenient rule of thumb when assessing the significance of bilateral correlation coefficients. In most of the quarterly data used here, correlation coefficients are computed on a minimum of 25 quarters. For results based on quarterly data, therefore, correlations above 0.34 are significant at the 10% confidence level. Some results are also presented using yearly data, for which 15 years are used, and coefficients above 0.45 can be considered significant at 10% confidence level.

The window length is dictated by data availability. The longest available series on quarterly real GDP for East Asia is released by the World Economic Outlook (WEO). Data are available from 1984Q1, and run until 2009Q2. For emerging East Asia, however, no data are available prior to 1991Q1. Window length is also conditioned by the sub-periods that are relevant for economic reasons. In Asia, the date 1997Q2 is pivotal, and correlations must be computed before and after the date. For simplicity and convenience, I focus on up to three 25 quarters sub-periods, namely 1991Q1-1997Q2 (pre-crisis), 1997Q3-2003Q2 (post-crisis), and 2003Q3-2009Q2 (current crisis). Country coverage is not identical for all periods.

For each available cross-section of countries, the paper presents results that pertain to the three periods under consideration (pre-crisis, post-crisis and current crisis). For instance, I compute the distribution of bilateral correlations for 11 countries in the post-crisis and current crisis periods (since this cross section is available from 1999Q1). By the same token, I estimate the distribution for 10 countries in the pre-, post- and current crisis periods, bearing in mind the first period's distribution is only computed over 1995Q1-1997Q2. This ensures robustness in terms of the representativity of the cross-section of countries, and gives rise to four sets of figures - corresponding to the distributions between 7, 9, 10 and 11 emerging East Asian countries. Indeed, for the earliest period, only seven countries are available - China, Hong Kong, Japan, Malaysia, the Philippines, Singapore, and Taiwan. Indonesia and Thailand have data from 1993Q1, and Korea from 1995Q1. The most complete country coverage is available from 1999Q1, with the addition of Vietnam.

The same exercice is performed on a sample of 33 developed economies. There, data from the WEO are available from 1984Q1, and make it possible to estimate the distribution of cross-correlations over four periods of 25 quarters, namely 1984Q1-1990Q2, 1991Q1-1997Q2, 1997Q3-2003Q2, and 2003Q3-2009Q2. Comparison with the ASEAN sample is focused on the latter three sub-periods. Nine countries are available from 1984Q1, 17 from 1988Q1, 27 from 1995Q1 and all 33 from 1998Q1. Analogously, this gives rise to four sets of figures.[1] Note this is a heterogeneous set of countries, including advanced economies like the US or the UK, but also transition economies, like the Czech Republic, Slovakia or Slovenia.

For the sake of comparison, a sample of Latin American countries is also considered, focused on 7 developing economies: Argentina, Chile, Colombia, the Dominican Republic, Mexico, Peru and Venezuela. All these countries have data from 1997Q1.

[1]The nine countries are: Hong Kong, France, Germany, Italy, New Zealand, Singapore, Switzerland, the UK and the US. The extra eight that become available in 1988 are Australia, Austria, Canada, Denmark, Greece, Japan, Spain and Sweden. Ten more have data from 1995: Belgium, Cyprus, Finland, Israel, Korea, Luxembourg, Malta, the Netherlands, Portugal and Taiwan. Finally, six more become available from 1998, i.e. Czech Republic, Iceland, Ireland, Norway, Slovak Republic and Slovenia.

Data from the WEO are measured both in local currency and in US dollars. The results presented in the body of the paper correspond to local currency GDP numbers, but the same conclusions do obtain with USD data. By the same token, the correlation coefficients are computed between GDP (logarithm) fourth differences, simply because growth rates are the most widely used numbers in reference to the onset of or the exit from a recession. Taking fourth differences also accounts for the fact that the data are not seasinally adjusted, to maximize coverage. An alternative is to detrend GDP using a conventional filter to isolate its business cycle component. The body of the paper consist of results based on GDP growth rates, but similar conclusions obtain when the filter introduced by Baxter and King (1999) is implemented on the data instead.

2.2 Trade and Financial Linkages

The paper relates the cross-section of cycle correlations with two of its conventional determinants. Frankel and Rose (1998) forcefully established the relevance of trade intensity as a driver of the international business cycle. Cycles between trade partners are significantly more correlated, so much so that the estimated elasticity is in fact hard to reproduce in general equilibrium model of the business cycle. This was labeled a "trade - comovement" puzzle by Kose and Yi (2006). The conventional approach implements data from the IMF's Direction of Trade data to compute

$$T^1_{i,j} = \frac{X_{i,j} + X_{j,i}}{Y_i + Y_j}$$

where $X_{i,j}$ denotes total merchandise exports from country i to j and Y_i denotes nominal GDP in country i. Trade intensity is typically measured at the beginning of the period to assuage endogeneity concerns, and the same will be true here. Even so, external instruments are typically indispensable because trade patterns are persistent over time. Instruments for trade are based on gravity arguments, and include variables such as geographic proximity, the presence of a common border, or a common colonial history, languages or access to an open body of water. Most of these instruments are constant over time, and thus cannot be used in this paper, where the time dimension is of the essence. This conditions the interpretation of the results here, which should not be taken in a causal sense, but rather in a purely descriptive one. We seek to evaluate whether the time pattern of international correlations correlates with changes in trade intensity, bearing in mind the sub-prime shock may have conjointly increased cycle correlations, and decreased world trade.

The measure $T^1_{i,j}$ focuses on trade intensity relative to output. If both output and trade fall simultaneously because of an exogenous shock, however, $T^1_{i,j}$ will show no response, as the measure captures only the scale of trade. But the *allocation* of trade across destinations may also have altered in response to the recent shock. $T^1_{i,j}$ will not capture

such reallocation effect. I therefore construct an alternative measure that focuses on the allocation of trade across trade partners, defined as

$$T^2_{i,j} = \frac{X_{i,j} + X_{j,i}}{X_i + X_j}$$

where X_i denotes total exports from country i. $T^2_{i,j}$ will respond to changes in the allocation of goods trade between partners, rather than to a disproportionate change in trade relative to production.

A channel of shock diffusion that is especially relevant in the current context pertains to financial linkages. Unfortunately, bilateral data on financial flows do not yet cover the current crisis. The Country Portfolio Investment Survey (CPIS) supervised by the IMF, and released on a yearly basis stops in 2007 at time of writing. And the Bank of International Settlements (BIS) "locational bank statistics" are only available bilaterally for a reduced cross-section of lending economies, limited to OECD countries. In this paper therefore, I propose to construct an imperfect proxy for bilateral financial openness. I consider conventional measures of bank lending, taking inspiration from Lane and Milesi-Ferretti (2001, 2007, 2008). I construct the share of external lending by banks relative to the size of the lending economy. The data are available from the BIS's "locational banking statistics" for all countries in both samples, at least until 2008Q4.

The locational banking statistics gather quarterly data on international financial claims and liabilities of bank offices in the reporting countries. Both domestically owned and foreign-owned banking offices in the reporting countries record their positions on a gross (unconsolidated) basis, including those vis-à-vis own affiliates in other countries. This is consistent with the residency principle of national accounts, balance of payments and external debt statistics. The variable brings the focus on the role of banks' international linkages for the diffusion of the current crisis. An "entrenchment" argument is often heard to account for the global nature of the current crisis, and financial intermediaries are often accused of "deleveraging", thus contributing to the international diffusion of an originally US-based shock. BIS data are therefore directly relevant to the question at hand. I have also verified that data on capital account from the IMF's International Financial Statistics imply similar conclusions.[2]

The BIS data used here are not bilateral. This is a serious shortcoming, especially relative to information on goods trade. I propose an approximating shortcut, and compute

[2]One of the attractions of IMF data is they make it possible to decompose international positions into portfolio, direct investment, or financial derivatives. The importance of the latter in journalistic accounts of the current developments make IFS data an interesting alternative to those released by the BIS. On the other hand, IFS report flow data, as opposed to the stocks of assets and liabilities reported for banks in the locational banking statistics used here. Financial linkages are surely best captured by stock data.

a bilateralized version of the BIS data, given by

$$\phi_{i,j} = \frac{A_i + L_i}{Y_i} + \frac{A_j + L_j}{Y_j}$$

where A_i and L_i are measures of banks claims and liabilities in country i. The contention implicit in the interpretation of $\phi_{i,j}$ as a measure of bilateral financial linkage is that countries that are both open to capital flows will tend to be open to each other.

I consider an instrumentation of $\phi_{i,j}$ based on the corresponding variable implied by the CPIS data. I compute

$$CPIS_{i,j} = \frac{A_{ij} + L_{ij}}{A_i + L_i + A_j + L_j}$$

where A_{ij} and L_{ij} denote *bilateral* assets holdings between countries i and j in 2007, $A_i = \sum_j A_{ij}$ and $L_i = \sum_j L_{ij}$. The variable is only available before 2007, and can therefore not inform the *changes* in business cycles correlations around the crisis date. But it can serve several purposes. First, if such instrumentation confirms the cross-sectional results based on $\phi_{i,j}$, it brings support to the assumption that financially open countries are open to each other. Then using multilateral data is not what drives the paper's conclusions. This is particularly important for Asian countries, as it is often said they are more open financially to the rest of the world than to each other. Second, it is well known $CPIS$ data are persistent. Thus, if the instrumenation is satisfactory before the crisis, but gives different results afterwards, it is an indication that the current crisis has altered the international allocation of assets holdings in an unprecedented manner.

3 What Happened to the International Business Cycle?

This Section discusses the patterns observed in the cross-section of bilateral cycle correlations within emerging East Asia, and draw comparisons with what happened in an aggregate of the rest of the world, formed by 33 developed countries.

3.1 The East Asian Business Cycle

The first piece of evidence is based on yearly data, whose coverage includes several business cycles as it dates back to 1984. There are 25 years of observations, on which to evaluate the time pattern of (yearly) business cycles in emerging East Asia. Unlike quarterly data, yearly numbers on GDP are actually available for 15 countries.[3] These effectively comprise

[3]These are: Brunei Darussalam, Cambodia, China, Hong Kong, Indonesia, Japan, Korea, Lao, Malaysia, Myanmar, Philippines, Singapore, Taiwan, Thailand, and Vietnam.

the most representative cross-section available, as quarterly data are not available at all for four of these countries. To preserve significance, Figure 1 reports kernel estimates of the distribution of correlations for the periods 1984-1999 and 1994-2009. Thus, each correlation coefficient is estimated on 15 observations. All estimates are based on the Epanechnikov kernel distribution.

As is patent, the cross-sectional distribution of business cycles correlation has shifted upwards significantly. Between 1984 and 1999, correlation coefficients are roughly centered around zero, and take extreme values close to -1 and 1. The distribution is also virtually symmetric around zero. After 1994, on the other hand, the kernel shifts upwards sizeably, with a mode around 0.7 . Note this is significantly different from zero at the 1% confidence level. The distribution has also become asymmetric, with only positive values. The overall upwards shift is significant at any conventional confidence level. It may reflect Asian specific developments, such as the 1997 crisis, or indeed perhaps more recent developments. The Asian crisis year effectively belongs to both samples, but represents only two observations in the earlier sample. Its effect may therefore be only muted in the first kernel estimate on the Figure.

Figure 2 turns to quarterly data, and focuses on the cross-section formed by the seven countries with data from 1991Q1. The three kernel estimates correspond to three 25 quarters periods. The earlier, pre-crisis period, is characterized by a distribution centered around zero, slightly skewed to the right. The mode is around zero, which suggests a period with only a few extreme country pairs with large (and positive, in this instance) degrees of synchronization. The second, crisis period corresponds to a shift upwards of the distribution, which becomes heavily skewed to the right with few negative correlations. The mode continues to be barely significant, however, with values between 0.3 and 0.4, namely just at significance level given the number of observations. Still, the mass of significantly positive correlations augments sizeably in the crisis period. Interestingly, the current crisis period starting from 2003Q3 is characterized by a bimodal distribution of correlations. A first mode is indistinguishable from zero, but a second one takes high values around 0.8. This suggests a heterogeneous response of cycle correlations in emerging East Asia to the current global shock. While some economies seem to suffer the brunt of the crisis, others remain uncorrelated - decoupled, perhaps. While the 1997 crisis seems to have had a more homogeneous effect on emerging East Asia - perhaps by definition - such is not the case for the more recent shock.

This remarkable pattern is not an artefact of a sample focused on 7 countries only. Figures 3 and 4 consider the 9 and 10 countries with data since 1993 and 1995. The results are similar. The pre-crisis period is characterized by a distribution centered around zero. Admittedly, this may simply reflect the shorter time sries, since the data start later in both cases. But from this standpoint it is reassuring the pre-crisis distribution was already centered around zero in Figure 2. The post-crisis shifts to the right, with a mode around

the 10% significance level for quarterly data, i.e. 0.35. The distribution in the current period continues to be centered around zero, but with a second mode at 0.8.

The apparent heterogeneous effect of the current crisis on East Asian business cycles begs the question of the identity of the countries with increased synchronization - and those without much of a response. As a first pass at this question, I compute a multilateral correlation for each country in the sample, as a simple average of all bilateral correlation coefficients. Two groups clearly emerge from the data. Six countries have average correlations significantly different from zero, ranging between 0.406 and 0.485. They are Hong Kong, Japan, Korea, Malaysia, Singapore and Taiwan. In contrast, four countries have average correlations that are indistinguishable from zero, ranging between -0.073 and 0.133. They are China, Indonesia, the Philippines and Thailand. Heuristically, the former group comprises economies that are open to both goods and assets trade, and are slightly richer than the latter group.

Finally, Figure 5 presents kernel estimates of the cross-sectional distribution of interest for all 11 East Asian economies with data available since 1999Q1. The analysis is focused on the post-crisis sample, and purports to identify the shock that created the bimodal distributions apparent from Figures 2 to 4. To do so, the kernel continues to be estimated on a window of 25 quarters, but it is rolled forward in time by one year exactly. Thus, Figure 5 presents 7 kernel estimates, corresponding to seven periods of 25 quarters between 1999Q1-2003Q3 and 2005Q1-2009Q2. The onset of the subprime crisis is often dated after 2008Q3. Interestingly, the first five kernel estimates in Figure 5 concern periods that end prior to 2003Q8. All of them point to relatively symmetric unimodal distributions, centered around zero. In contrast, the last two kernel in the Figure point to bimodal distributions, akin in their shapes to the estimates in Figures 2 to 4. The second mode appears as soon as the period post-2008Q3 is included.[4]

3.2 Synchronization Elsewhere

This section draws comparisons between the dynamics we observe in emerging East Asia and in the rest of the world. I use a sample of 33 developed countries to estimate the kernel distribution of bilateral correlations, over the same sub-periods as the ones considered in emerging East Asia.[5] These data unambiguously confirm the average bilateral correlation in the rest of the world has increased significantly since the 1980's. Annual data are

[4]These results are similar to findings in Kim and Lee (2008) or Kim, Lee and Park (2009), who focus on linkages between the East Asian region and the rest of the world. The focus here is within regions, rather than between them.

[5]The countries are: Australia, Austria, Belgium, Canada, Hong Kong, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan, UK, and US.

available from 1980 for this sample, so that 30 years of data can be split half-way. Figure 6 plots both kernel densities, corresponding to the periods 1980-1994 and 1994-2009. The distribution in the earlier period is centered around zero, and very slightly skewed to the right. In contrast, the distribution in the more recent period shifts upwards, is heavily skewed to the right, with most of its mass at correlations above 0.8, and no negative correlation coefficients. Just as in emerging East Asia, the shift is significant at any conventional confidence level.

For nine developed countries, quarterly data are available from 1984Q1. Such coverage makes it possible to estimate distributions over four periods of 25 quarters each, whose kernel distributions are reported on Figure 7. Correlations are on average zero between 1984Q1 and 1990Q2, with values between -0.4 and 0.6. The distribution is slightly skewed to the right, but with most values barely significantly different from zero. The pre-crisis period 1991Q1-1997Q2 is rather similar, albeit perhaps slightly shifted to the right. But extrema take larger values, ranging from -0.7 to 0.8. Interestingly the post-crisis period does entail a significant shift upwards of the distribution, with a mode that now is significantly greater than zero at around 0.5. These dynamics are similar to what we observed in emerging East Asia in Figures 2 to 4. In contrast, the distribution of correlations for the current period is drastically different. The fourth panel in Figure 7 shows a very large shift of the distrbution towards high values of the correlation coefficients. The kernel is now bounded between 0.5 and 1, with a mode close to 0.9. All correlations in this panel are significantly different from zero at the 10% confidence level. The shift observed in the 2003Q3-2009 period is remarkable and has no equivalent in any earlier periods. It is also fundamentally different from what is observed in emerging East Asia, where the current crisis has heterogeneous effects across countries. Here, the effect seems universal, as all countries do become more synchronized.

The result is not an artefact of the fact the sample covers nine countries only. Similar patterns are evident from Figure 8 for the seventeen countries with data since 1988, and from Figure 9 for the 27 countries with data since 1995. In both cases, the latest period is characterized by a large shift of the whole distribution of bilateral correlations. Most correlations are in fact significantly higher in the current period than they were ever before, at least since the early 1980s. It is also worth noting the post-1997 shift upwards of the distribution is much less apparent in Figures 8 and 9 than it is in Figure 7. In a large sample of developed economies, there is not much of a shift in bilateral cycle correlations around the 1997 date that is so relevant for emerging East Asia. But there is a much larger - and more universal - shift in correlations after 2003. The heterogeneity observed in emerging East Asia is absent from this larger sample, even though more countries are included.

Finally, there are 33 countries with quarterly data from 1998Q1. On Figure 10, the 25-quarter window is rolled forward year-by-year, to identify a hypothetical time period

as the culprit for the upwards shift documented in Figures 7 to 9. As is patent from the Figure, the distibution becomes heavily skewed to the right only when observations posterior to 2008Q3 are included in the sample. This is remarkable, for it really points to a truly global shock, which appears to be unprecedented at least in available quarterly data. It points to the 2008Q3 sub-prime crisis as the driver for the shift documented in this section.

Even though it includes countries as different as the US and Slovakia, the sample of 33 countries is focused on developed economies. Such relative homogeneity may explain why the bimodal property prevalent in emerging East Asia is not present here. In Figure 11, I report distribution estimates that arise from 7 Latin American countries with data available from 1997. Two conclusions continue to obtain: distribution estimates are centered around zero for all time periods excluding the current crisis, and they shift rightwards once recent data are included. But they are not bimodal. This comparison suggests the sub-prime shock has had a heterogeneous effect in emerging East Asia that does not exist elsewhere. This is in fact a specificity of the region relative to the rest of the world. In the next section, two candidate explanatory variables are proposed to account for this specificity.

4 What Happened to Trade and Financial Linkages?

This section presents conventional regressions of the determinants of business cycles synchronization, in the tradition pioneered by Frankel and Rose (1998) or Frankel and Romer (1999), and followed subsequently in a vast literature. The focus is on the time changes in the cross-section of bilateral correlations, for emerging East Asia, and for a measure of the rest of the world. The previous sections have illustrated an intriguing difference between the two samples in terms of how both regions have responded to the sub-prime shock. This section examines rigorously the determinants of cycles synchronization over the early 2000's (from 2000Q1 to 2004Q3), and contrasts them with the most recent period, inclusive of the current recession (from 2005Q1 to 2009Q2). Then it asks how both trade and financial linkages contribute to explaining changes in cycles synchronization in both regions.

The focus is squarely on trade in goods and assets, assuming away alternative explanatory variables. Still, the literature has documented other determinants for cycle synchronization. For instance, Imbs (2001) argues the sectoral specialization of trade matters in the presence of sectoral shocks. Baxter and Kouparitsas (2005) consider gravity variables or the composition of trade. Rose (2000) argues exchange rate arrangements and particularly currency unions act to synchronize international business cycles. Here I focus on trade and financial linkages. The foremost reason is this paper is concerned with

the time pattern in $\rho_{i,j}$ over the past decade. Such focus immediately rules out correlates that are time invariant or persistent over time. This rules out gravity variables, but also the structure of production or of trade, which change over time at low frequencies. By the same token, currency unions or exchange rate regimes have not observably changed in the recent years. Inasmuch as we can observe them, goods and financial trade have altered drastically with the crisis. They are also at center stage of policy discussions about the international diffusion of a shock originally located in the U.S.

The specification of the estimated regressions takes inspiration from Frankel and Rose (1998), Imbs (2004, 2006), or Papaioannou, Peydro and Kalemli-Ozcan and (2009). I regress a given cross-section of bilateral correlations, denoted $\rho_{i,j}$, on the corresponding measure of financial openness $\phi_{i,j}$ and alternatively either measure of trade intensity, $T^1_{i,j}$ or $T^2_{i,j}$. The specification writes

$$\rho_{i,j} = \alpha_0 + \alpha_1 \phi_{i,j} + \alpha_2 T_{i,j} + \varepsilon_{i,j} \tag{1}$$

The paper focuses on Pearson correlation coefficients $\rho_{i,j}$ for the sake of comparability, and intelligibility. The metric captured by $\rho_{i,j}$ has an immediate intuitive interpretation, and has indeed been used in the vast majority of this empirical literature, starting with Backus, Kehoe and Kydland (1992) and Frankel and Rose (1998). There are exceptions, such as the residual measure used in Alesina and Barro (2002), or the coherence measure computed in the frequency domain proposed by Giannone and Reichlin (2006) for instance. For simplicity however, this paper makes use only of the Pearson correlation coefficient.[6]

The residual $\varepsilon_{i,j}$ is liable to have a heteroskedastic stucture corresponding to measurement error specific to a given country i. This may contaminate all pairs i is part of. I account for this possibility via clustering of the residual along the country dimension. The coefficients of interest are α_1 and α_2, but more as a check against standard results than for causal interpretation. In particular, Frankel and Rose (1998) famously established α_2 is positive and significant, for a wide range of country coverages and time periods. Imbs (2004, 2006) showed α_1 is also positive and significant, even when it is instrumented with institutional variables capturing the depth of financial markets.

Table 1 reports the results for simple OLS estimations of equation (1) performed on emerging East Asia. Both goods trade and financial openness have the conventional association with cycles correlation. As far as goods trade is concerned, it is the measure scaled by GDP, T^1, that appears to account best for the cross-sectional dispersion in cycles correlation. Across both periods and all four specifications, α_2 is estimated to be positive

[6]Forbes and Rigobon (2002) argue the correlation coefficient is an imperfect measure of contagion, for it does not hold constant the variance of shocks. Here however, I focus on business cycle correlations, rather than crisis contagion. In the current instance, the two happen to be closely related. This is unprecedented.

and significant at least at the 10% confidence level. Interestingly, instrumenting $\phi_{i,j}$ using the $CPIS$ data reinforces the finding that α_1 is positive and significant in emerging East Asia. In addition, the IV results are stable across sub-periods. These results are perfectly conventional and reminiscent of findings in Frankel and Rose (1998) or Imbs (2006).

Table 2 estimates equation (1) on the sample formed by 33 developed economies. In the period prior to the sub-prime crisis, all results are conventional and indeed similar to emerging East Asia. Estimates of α_1 and α_2 are positive and significant at least at the 10% confidence level. Both measures of trade intensity appear to have a significant association with $\rho_{i,j}$, and $\phi_{i,j}$ becomes more significant once instrumented with $CPIS$ bilateral data. Things are very different in the later sample starting in 2005Q1. While goods trade continues to display a positive association, irrespective of how it is measured, the association between cycle synchronization and financial linkages becomes significantly *negative*, at the 1% confidence level.

Remarkably, instrumenting $\phi_{i,j}$ with 2007 $CPIS$ data now *reverts* the sign of α_1. This could be happening for two reasons. Either the explanatory power of $CPIS$ data in explaining ϕ fell after 2008, or the negative estimates of α_1 in specifications (iv) and (v) of Table 2 were actually driven by the endogenous negative response of ϕ to the crisis. The answer rests ultimately on the explanatory power of $CPIS$ data after 2008. The first-stage R^2 in specification (iii) of Table 2 is 0.152. It falls to 0.093 in specification (vi) . This suggests $CPIS$ data become inadequate to explain international capital holdings after 2008. The shock altered fundamentally the pattern of $\phi_{i,j}$.

Some caution is therefore in order when it comes to interpreting this result. There is nothing causal in this correlation. Given the descriptive evidence presented earlier in this paper, negative estimates of α_1 in specifications (iii) and (iv) of Table 2 presumably reflect the fact $\rho_{i,j}$ increased in the more recent period, and financial openness conjointly fell as financial intermediaries "deleveraged". Both phenomena likely happened in response to the same (omitted) shock. The intepretation is drastically different from the similar result presented in Papaioannou et al (2009), for at least two reasons. First, the similarly negative coefficient they estimate arises from a fixed effect estimation, i.e. one that focuses on the change in synchronization - not unlike what is presented in Table 3 here below. Second and more important, they propose to instrument changes in financial integration using measures of regulatory change in the banking sector. Their intention is therefore to interpret estimates of α_1 causally. Unfortunately, the instruments they use are simply not available for the type of country coverage endeavoured in this paper.

Be that as it may, Tables 1 and 2 point to a specificity in emerging East Asia, where the determinants of cycles correlations continue to be conventional even in the current crisis. The same is not true in the rest of the world. Table 3 estimates a first-differenced version of equation (1), where differences are measured between the two periods considered

in this section. The results crystallize the specificity of emerging East Asia. In the developed world at large, the change in business cycle correlations (which we know is an overwhelming increase) is associated with a fall in financial linkages, but no observable response of goods trade. In emerging East Asia, in contrast, it is goods trade that falls. Financial integration, in contrast, tends to correlate positively with cycles correlations. The results point to the possibility that financial integration was actually not stopped by the sub-prime crisis in East Asia, at least not to the same extent as it was elsewhere. In emerging East Asia, it is goods trade that fell as the crisis hit. Such a specificity may reflect the fact that emerging East Asia is relatively less financially integrated than the rest of the developed world, perhaps because banks are less invested internationally there. As a result, the response of financial linkages remains muted there.

Finally, Table 4 confirms these findings in a dataset that pools both samples, and uses interacted binary variables to capture the differential importance of T and ϕ across sub-samples. This sets to rest the possibility some results draw from different sample sizes in Tables 1, 2 and 3. I estimate

$$\rho_{i,j} = \alpha_0 + \alpha_1 \phi_{i,j} + \alpha_2 \phi_{i,j} \cdot EA + \alpha_3 T_{i,j} + \alpha_4 T_{i,j} \cdot EA + \varepsilon_{i,j} \tag{2}$$

where EA takes value 1 for East Asian country pairs. As is patent from the Table, trade and finance correlate more weakly with $\rho_{i,j}$ in emerging East Asia, for both cross-sections, in 2000 and in the crisis period. But the correlations continue to be conventional across all samples. In panel estimations, it continues to be the case that goods trade fell most in synchronized East Asian economies, whereas it is financial trade that fell amongst developed countries.

5 Conclusion

This paper presents some descriptive evidence of the changes in the patterns of international business cycles correlations in emerging East Asia, and draws comparison with the rest of the world. The 1997 crisis had a sizeable effect on bilateral cycle correlations within East Asia, but not in the rest of the developed world. The current crisis, in contrast, has affected emerging East Asia in a differentiated manner. Some pairs of countries have seen their correlation increase observably. Typically these are open and relatively richer economies within East Asia. But others appear to have "decoupled" so far from the global cycle. Figure 12 plots yearly growth rates in emerging East Asia since 2007. As is patent, relatively closed economies maintained higher growth rates throughout the period, while the whole emerging East Asia zone recovered sooner and more sharply than the rest of the world in the early quarters of 2009

The sub-prime crisis has had a very different effect on the rest of the developed world, whose cycle correlations have shifted upwards in an unprecedented - and quite universal -

manner. An explanation is sought for this specificity of emerging East Asia, on the basis of the conventional explanations for international cycle correlations, namely goods and assets trade. In emerging East Asia, goods trade fell markedly as cycles became more synchronized with the current global recession. In stark contrast, in the rest of the world, it is assets trade that fells significantly as countries entered the global recession. This may be a reflection of different adjustment margins in the two regions. In particular, the difference may rest in the fact that banks contributed heavily to the diffusion of the sub-prime shock in the developed world, but not in emerging East Asia.

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Table 1: Period by Period Determinants of Cycles Synchronization - Emerging East Asia

	(i) 2000	(ii) 2000	(iii) IV 2000	(iv) Crisis	(v) Crisis	(vi) IV Crisis
T^1	1.661***			2.184*		
	(0.395)			(1.010)		
T^2		0.192	1.566*		−0.011	1.938
		(0.397)	(0.701)		(0.559)	(1.900)
ϕ	6.718	9.077*	18.651**	7.941*	1.132**	3.691***
	(4.575)	(4.358)	(5.943)	(3.821)	(0.396)	(0.935)
R^2	0.062	0.050	0.228	0.088	0.075	0.075
Obs.	45	45	28	45	45	28

Notes: The left-hand side is $\rho_{i,j}$ as defined in the text. The correlations are computed over 2000Q1-2004Q3 in specifications (i) and (ii), and over 2005Q1-2009Q2 in specifications (iii) and (iv). T^1 is the measure of trade intensity scaled by GDP, and T^2 denotes trade intensity normalized by total trade. Trade is measured in 2000Q1 for the early period, and in 2005Q1 for the later one. ϕ is a measure of bilateralized financial openness, measured by reporting banks total assets and liabilities relative to the reporting country's GDP. The ratios are summed pairwise to form a bilateral measure. ϕ is measured in 2000Q1 for the early period, and in 2005Q1 for the later one. Estimates of α_1 are multiplied by 1,000. Standard errors are clustered by country. Specifications (iii) and (vi) instrument ϕ with actual bilateral asset holdings measured in 2007 by the Coordinated Portfolio Investment Survey. *** (**, *) denote significance at the 1% (5%, 10%) confidence level.

Table 2: Period by Period Determinants of Cycles Synchronization - Rest of the World

	(i) 2000	(ii) 2000	(iii) IV 2000	(iv) Crisis	(v) Crisis	(vi) IV Crisis
T^1	5.553*** (0.981)			4.148*** (0.973)		
T^2		1.607*** (0.399)	1.714*** (0.407)		1.076*** (0.335)	1.522*** (0.488)
ϕ	0.167* (0.088)	0.284*** (0.088)	1.216** (0.498)	−0.275*** (0.096)	−0.218** (0.088)	1.054** (0.419)
R^2	0.054	0.065	0.065	0.069	0.070	0.070
Obs.	496	496	435	496	496	435

Notes: The left-hand side is $\rho_{i,j}$ as defined in the text. The correlations are computed over 2000Q1-2004Q3 in specifications (i) and (ii), and over 2005Q1-2009Q2 in specifications (iii) and (iv). T^1 is the measure of trade intensity scaled by GDP, and T^2 denotes trade intensity normalized by total trade. Trade is measured in 2000Q1 for the early period, and in 2005Q1 for the later one. ϕ is a measure of bilateralized financial openness, measured by reporting banks total assets and liabilities relative to the reporting country's GDP. The ratios are summed pairwise to form a biltateral measure. ϕ is measured in 2000Q1 for the early period, and in 2005Q1 for the later one. Estimates of α_1 are multiplied by 100. Standard errors are clustered by country. Specifications (iii) and (vi) instrument ϕ with actual bilateral asset holdings measured in 2007 by the Coordinated Portfolio Investment Survey. *** (**, *) denote significance at the 1% (5%, 10%) confidence level.

Table 3: Changes in Cycles Synchronization

	(i) East Asia	(ii) East Asia	(iii) Developed	(iv) Developed
ΔT^1	-2.835^{***}		-1.365	
	(0.817)		(3.717)	
ΔT^2		-1.067^{**}		-0.964
		(0.385)		(1.121)
$\Delta\phi$	4.234^{***}	3.236^{**}	-0.623^{***}	-0.628^{***}
	(1.316)	(1.301)	(0.163)	(0.163)
R^2	0.174	0.209	0.037	0.037
Obs.	45	45	496	496

Notes: The left-hand side is the change in $\rho_{i,j}$ over the two periods 2000Q1-2004Q3 and 2005Q1-2009Q2. T^1 is the measure of trade intensity scaled by GDP, and T^2 denotes trade intensity normalized by total trade. The change is measured between 2000Q1 and 2005Q1. ϕ is a measure of bilateralized financial openness, measured by reporting banks total assets and liabilities relative to the reporting country's GDP. The ratios are summed pairwise to form a biltateral measure. The change in ϕ is measured betwen 2000Q1 and 2005Q1. Estimates of α_1 are multiplied by 100. Standard errors are clustered by country. *** (**, *) denote significance at the 1% (5%, 10%) confidence level.

Table 4: Pooled Data

	(i) 2000	(ii) 2000	(iii) Crisis	(iv) Crisis	(v) Panel	(vi) Panel
T^1	5.657***		4.705***		7.568*	
	(1.006)		(1.067)		(4.595)	
$T^1 \cdot EA$	−4.006***		−3.928		−8.585*	
	(1.068)		(3.021)		(4.994)	
T^2		1.661***		1.360***		7.592**
		(0.402)		(0.397)		(2.401)
$T^2 \cdot EA$		−1.816***		−3.195***		−8.633***
		(0.456)		(0.530)		(2.549)
ϕ	2.145**	3.211***	−1.117	−0.095	−2.575***	−2.538***
	(0.915)	(0.912)	(1.184)	(0.106)	(0.159)	(0.156)
$\phi \cdot EA$	−1.338	2.161	−11.406***	−1.853	4.186***	3.485**
	(3.924)	(3.580)	(3.443)	(5.238)	(1.618)	(1.477)
R^2	0.053	0.062	0.056	0.112	0.316	0.328
Obs.	541	541	541	541	1,082	1,082

Notes: The left-hand side is the correlation $\rho_{i,j}$ over the two periods 2000Q1-2004Q3 and 2005Q1-2009Q2. T^1 is the measure of trade intensity scaled by GDP, and T^2 denotes trade intensity normalized by total trade. The change is measured between 2000Q1 and 2005Q1. ϕ is a measure of bilateralized financial openness, measured by reporting banks total assets and liabilities relative to the reporting country's GDP. The ratios are summed pairwise to form a biltateral measure. The change in ϕ is measured betwen 2000Q1 and 2005Q1. EA denotes a binary variable taking value 1 for country-pairs that belong to emerging East Asia. Estimates of α_1 are multiplied by 100. Standard errors are clustered by country. *** (**, *) denote significance at the 1% (5%, 10%) confidence level.

Figure 1: Distribution since 1984 (ANNUAL National Currencies)

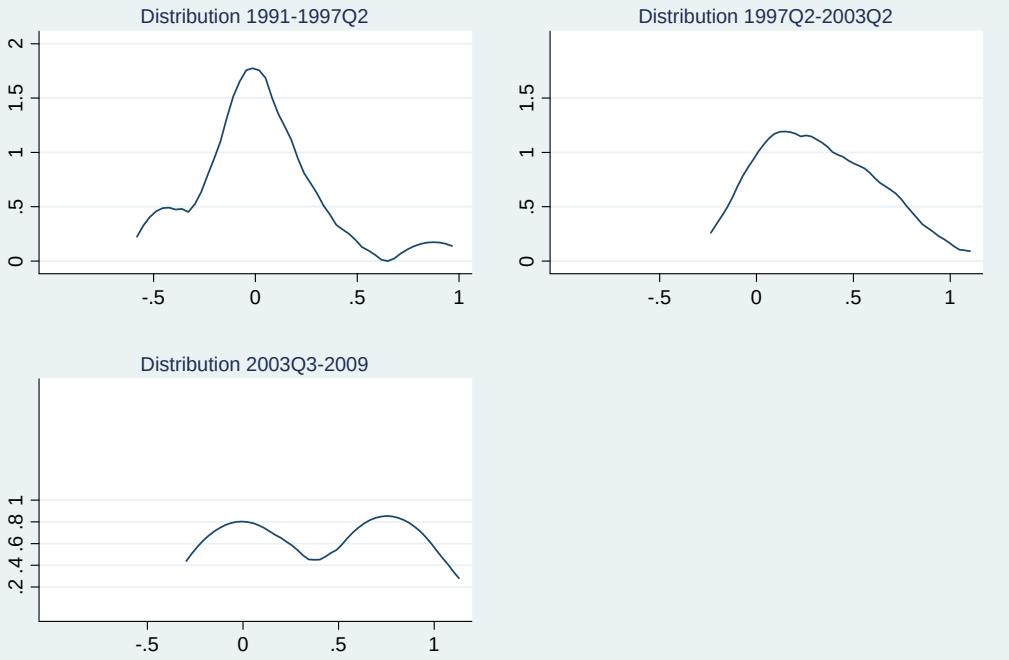

Figure 2: 7 Countries - Distribution since 1991 (National Currencies)

Figure 3: 9 Countries - Distribution since 1993 (National Currencies)

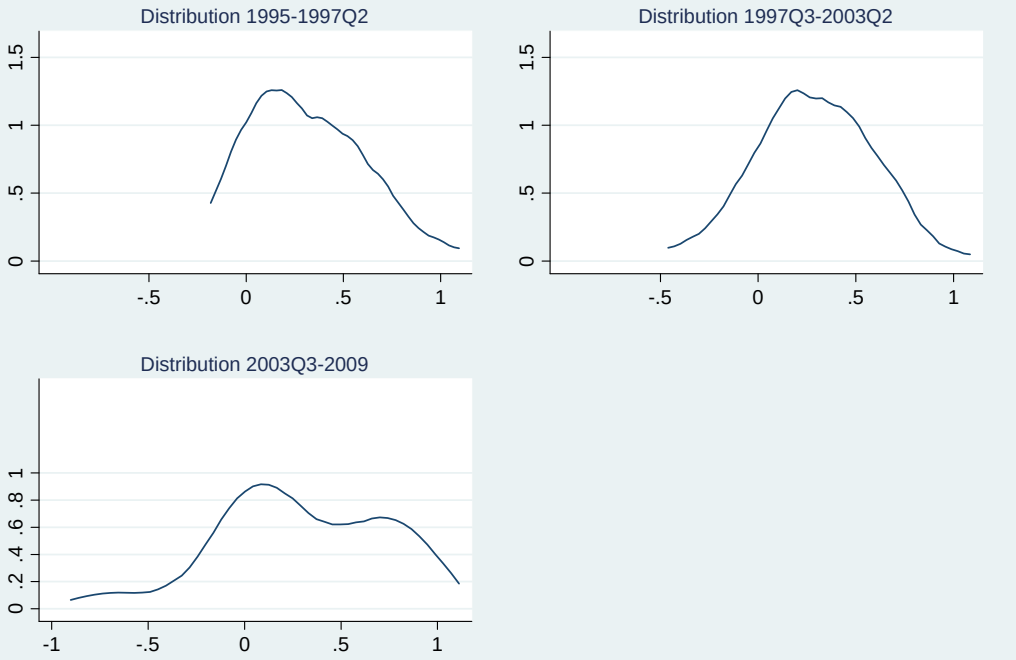

Figure 4: 10 Countries - Distribution since 1995 (National Currencies)

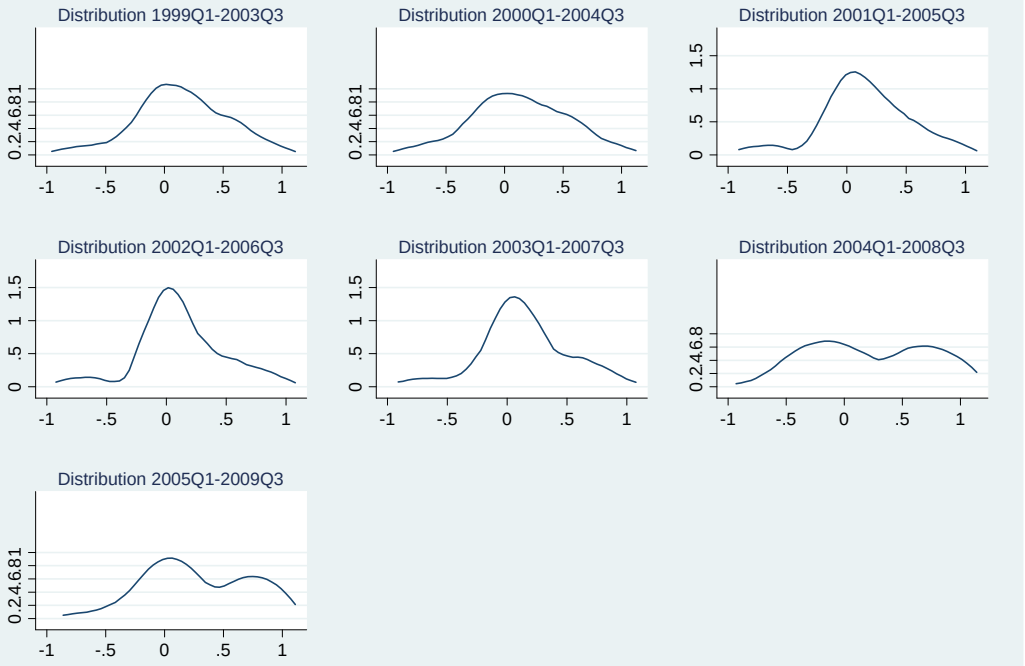

Figure 5: 11 countries - Distribution since 1999 (National Currencies)

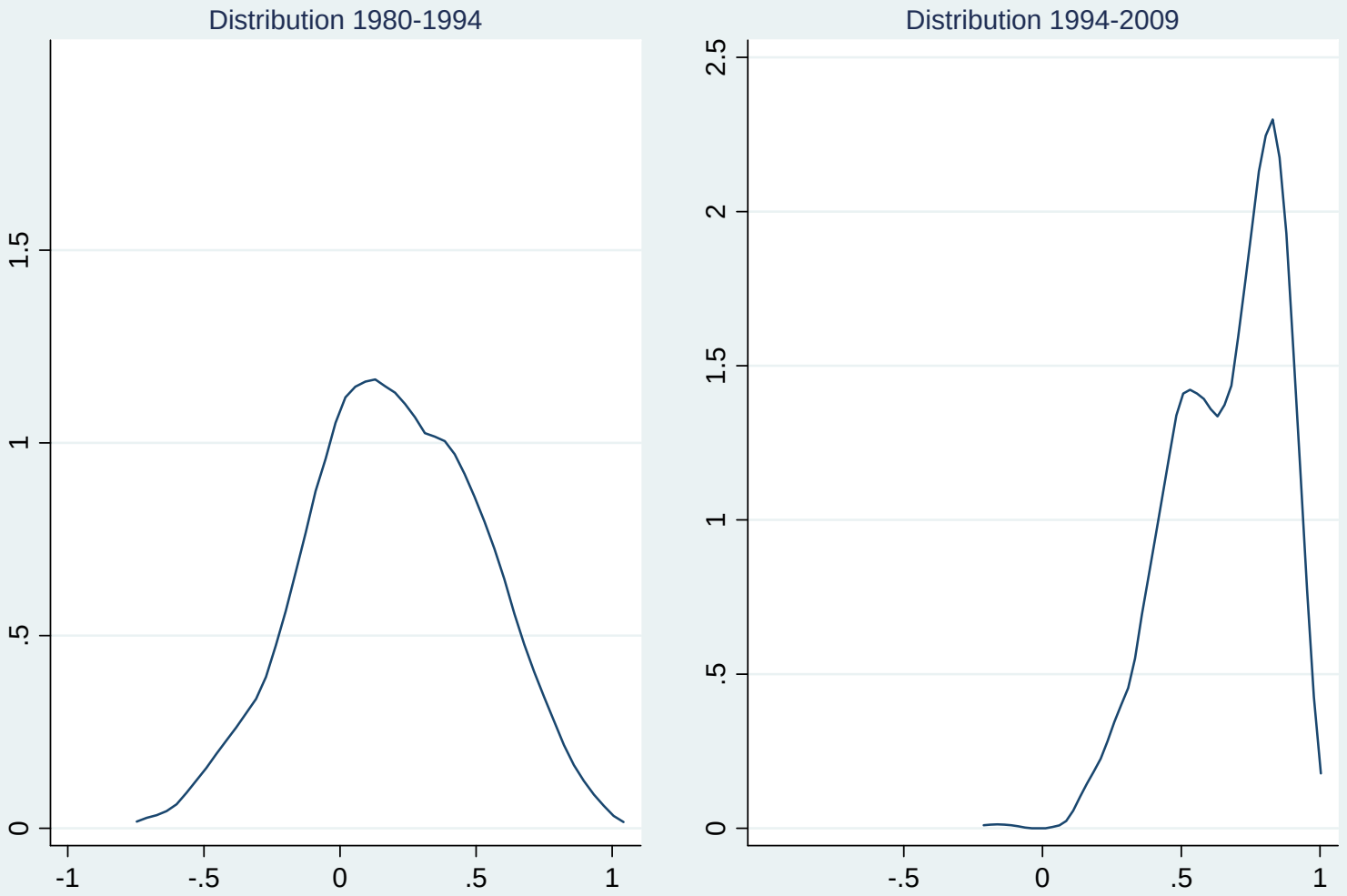

Figure 6: Distribution since 1980 (ANNUAL National Currencies)

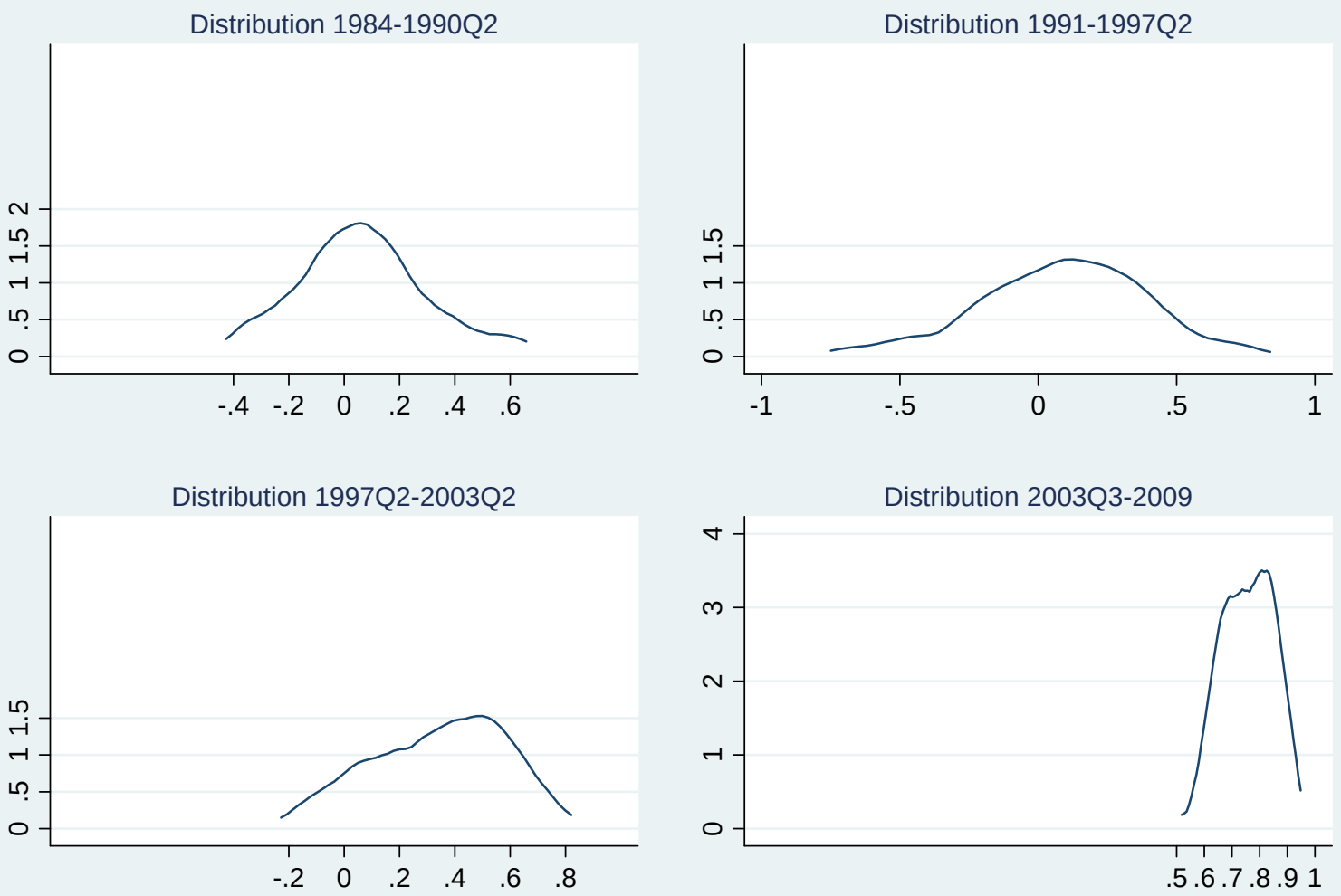

Figure 7: Nine Developed Countries - Distribution since 1984 (National Currencies)

Figure 8: Seventeen Developed Economies - Distribution since 1988 (National Currencies)

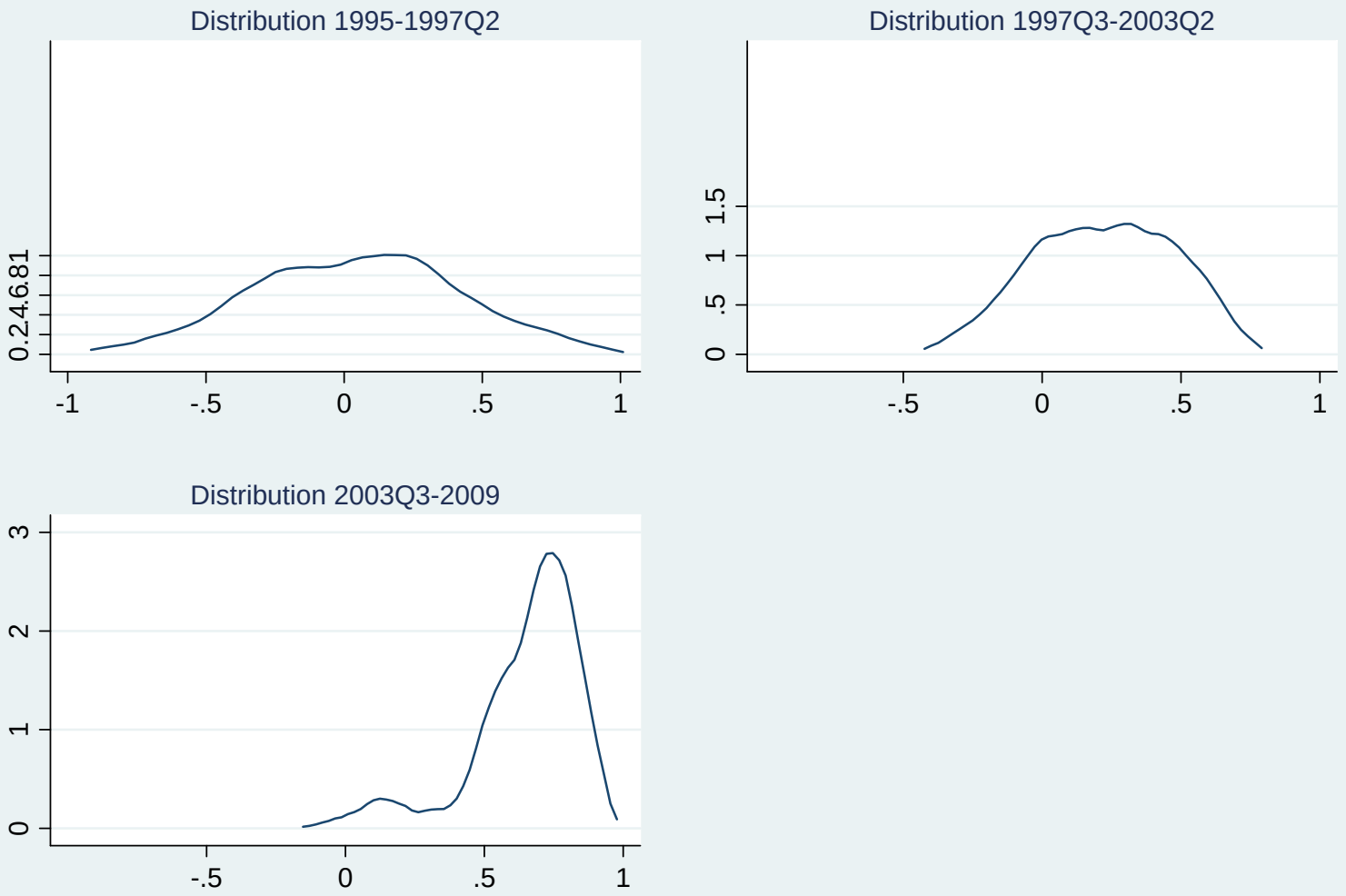

Figure 9: 27 Developed Economies - Distribution since 1995 (National Currencies)

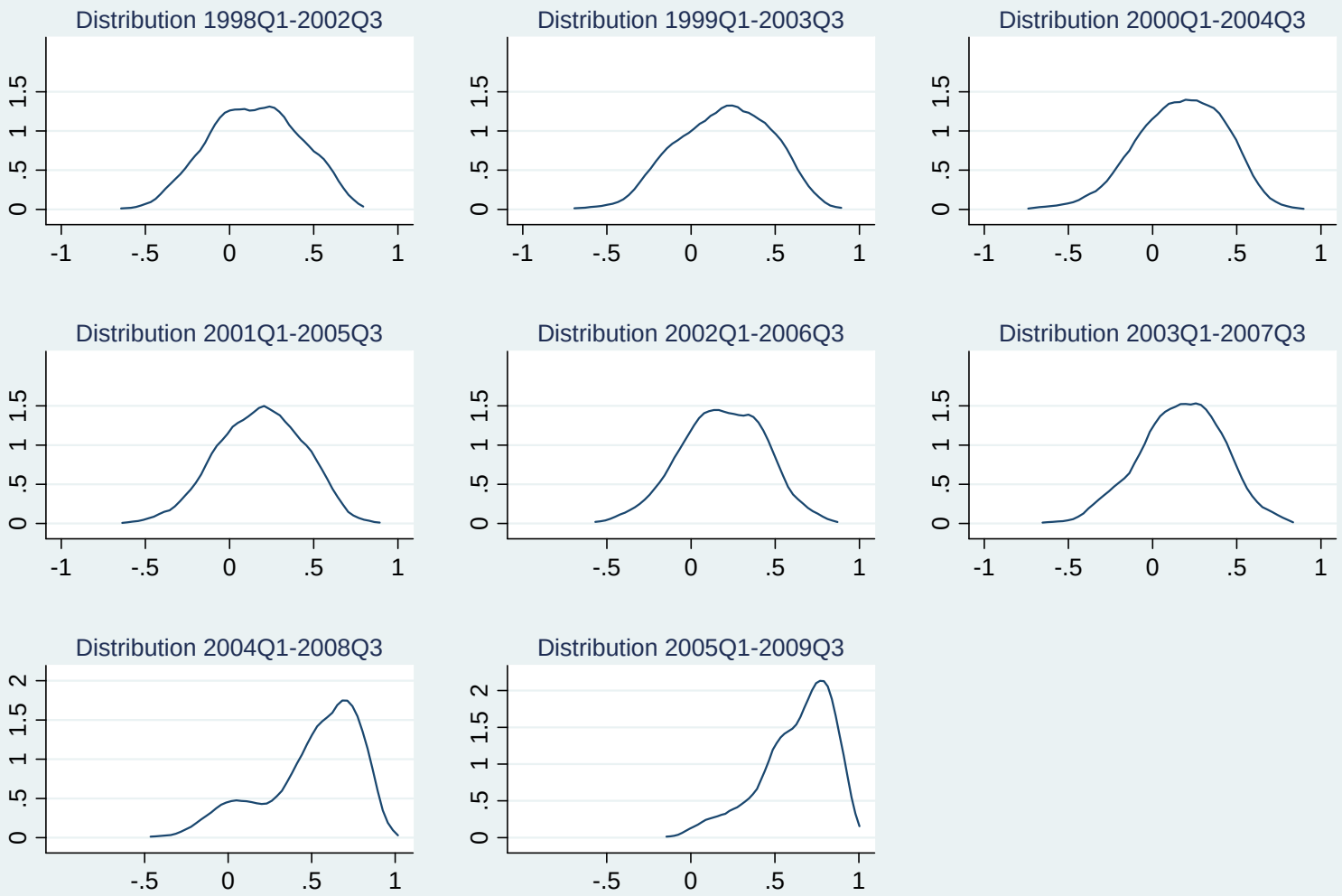

Figure 10: 33 Developed Countries - Distribution since 1998 (National Currencies)