Trade, Finance, Specialization and Synchronization

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Abstract

I investigate the determinants of business cycles synchronization, across regions and over time. I use both international and intranational data to evaluate the linkages between trade in goods, trade in financial assets, specialization and business cycles synchronization in the context of a system of simultaneous equations. In all specifications, the results are as follows. (i) Simultaneity is important, as both trade and financial openness have a direct and an indirect effect on cycles synchronization. (ii) Countries with liberalized capital accounts (and States with high degree of risk sharing) are significantly more synchronized, even though they are also more specialized. (iii) Specialization patterns have a sizeable effect on business cycles, above and beyond their reflection of intra-industry trade and of openness to goods and assets trade. (iv) The role of trade, in turn, is in line with existing models once intra-industry trade is controlled for. Furthermore, trade-induced specialization has virtually no effect on cycles synchronization. The results obtain in a variety of cross-sections and panels. They relate to a recent strand of International Business Cycles models with incomplete markets and transport costs, and on the empirical side, point to an important omission in the list of criteria defining an Optimal Currency Area, namely specialization patterns.

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1 Introduction

The theoretical interactions between trade openness, financial integration, specialization and business cycles synchronization are complex. It is well-known that openness to goods trade results in high degrees of specialization.[1] Similarly, financial liberalizations may result in specialization, as access to an increasing range of state-contingent securities unhinges domestic consumption patterns from domestic production, which then becomes free to specialize according to comparative advantage, for instance.[2] Both trade in goods and in financial assets, in turn, potentially affect the cross-country synchronization of business cycles. These mechanisms were exposited in a literature spawned by the work of Backus, Kehoe and Kydland (1992), that attempts to account for the observed high international correlation of business cycles, among others. In particular, intense bilateral trade will tend to accompany highly correlated business cycles in a wide range of theoretical models, ranging from multi-sector international models with intermediate goods trade, to one-sector versions with either technology or monetary shocks.[3]

The impact of financial integration on cycles synchronization is not unambiguous. On the one hand, a limited ability to borrow and lend internationally hampers the transfer of resources across countries and can increase GDP correlations. If however on the other hand, investors have imperfect information or face liquidity constraints, limiting capital flows can actually decrease GDP correlations, as investors herd, or withdraw capital from many destinations simultaneously.[4]

Specialization, in turn, is likely to affect the international synchronization of business cycles directly. This will naturally occur in the presence of sector-specific shocks, as two economies producing the same types of goods will then be subjected to similar stochastic

[1] Most classical trade models have this prediction. For instance, falling transport costs in Dornbusch, Fisher and Samuelson (1977) result in a narrowing non-traded sector, as it becomes cheaper to import goods rather than produce them domestically. Thus resources are freed up and used more intensely in fewer activities.

[2] For early models of this mechanism, see Helpman and Razin (1978), Grossman and Razin (1985) or Saint-Paul (1992).

[3] A non-exhaustive list includes Ambler, Cardia and Zimmermann (2002), Canova and Dellas (1993), Baxter (1995), Mazzenga and Ravn (2002), Kollman (2001) or Kose and Yi (2002). See Imbs (2001) for details.

[4] For the first line of argument, see Heathcote and Perri (2002a, 2002b). For the second one, see Calvo and Mendoza (2000) or Mendoza (2001). These latter models were written with the purpose of explaining sudden reversal of capital flows to emerging markets, but there is no reason why the logic they develop could not apply more generally.

developments. But it may also occur in the absence of any sector-specific shock. If sectors differ in their response to monetary shocks, say, for instance because of different market structures or labour market arrangements, countries with similar production patterns will be synchronized even though shocks are purely aggregate.[5]

To summarize, both goods and assets trade have potentially direct as well as indirect effects on business cycles synchronization. Furthermore, both have ambiguous overall impact. Classic Ricardian or Heckscher-Ohlin specialization may mitigate the direct impact of openness to goods trade, whereas financial integration may decrease (or increase) synchronization, but will also unambiguously induce specialization. This paper introduces a simultaneous equations methodology to assess empirically the magnitudes of these channels. Disentangling the relative contributions of trade, finance and specialization is crucial simply from the point of view of business cycles research. But it is also a relevant policy question, since the international correlation of business cycles is an important metric used to measure the desirability of a currency union. Giving up independent monetary policy can be very costly when business cycles are out of phase. More generally, the channels this paper proposes to identify are directly relevant to policymakers asking if, and why, they should be concerned with foreign developments affecting domestic fluctuations.

Most, but not all, of these linkages have been investigated empirically, but never simultaneously.[6] Most famously, the direct impact of trade on synchronization is documented in Frankel and Rose (1998), who estimate a strong and robust positive relationship between trade and cycle synchronization, taking particular care of the endogeneity of trade to the business cycle with appropriate instrumentation. They interpret their estimate as indicative that trade-induced specialization has but a small effect on business cycles, and is dominated by the direct positive link. Given the large evidence on the specialization effects of goods trade, it is of independent interest to quantify precisely the magnitude of this indirect effect of trade on business cycles correlations.[7] This is a first justification for the simultaneous

[5] For a recent theoretical development of this possibility, see Kraay and Ventura (2002).

[6] Otto, Voss and Willard (2001) estimate a reduced form equation where GDP correlations are regressed on bilateral trade, financial openness and an indicator of monetary policy. They also control for specialization. There are several differences between their approach and this paper: (i) they do not estimate a system as they do not propose to identify specific channels, (ii) they do not allow for the endogeneity of specialization patterns, (iii) they do not account for the possibly complex variance-covariance structure of the residuals, which is done here using GMM. Their results are on the whole consistent with those presented here.

[7] For instance, Harrigan (2001) or Harrigan and Zakrajsec (2000) show trade-induced specialization patterns to be significant, and consistent with theory.

estimation method implemented in this paper.[8]

The impact of financial integration on specialization is, in turn, well-documented too. For instance, Kalemli-Ozcan, Sorensen and Yosha (2002) show there is a significantly positive relationship between specialization and risk-sharing. Thus presumably financial integration should affect (negatively) cycles synchronization, via its effect on specialization. The evidence on a *direct* link between finance and the extent of co-fluctuations is, as suggested by theory, equivocal. Heathcote and Perri (2002b) argue the U.S. business cycle has become increasingly idiosyncratic over the past thirty years, and relate this to the increasing share of international assets held in the U.S.[9] However, a considerable amount of empirical work lends support to the claim that capital flows are correlated internationally, and that financial integration tends to synchronize business cycles.[10] Thus, the link between finance and cycle correlations is ambiguous for two reasons: firstly the sign of the direct link is unclear in general, secondly the indirect specialization effect could either mitigate or reinforce the direct link. This is the second justification for the simultaneous approach in this paper.

Finally, the direct effect of sectoral specialization on business cycles synchronization, although very intuitive, is perhaps the least researched empirical question amongst those addressed in this paper. Otto, Voss and Willard (2001), Kalemli-Ozcan, Sorensen and Yosha (2001) and Imbs (2001) all find a significantly positive role for an index of similarity in production structures. Clark and van Wincoop (2001) use a similar index to account for higher business cycle correlations within than between countries.[11] But although they all point to a sizeable direct impact of specialization on business cycles, none of these papers embed the possibility that specialization could be an indirect manifestation of trade or financial integration, and amend the estimated effects of trade, finance and specialization accordingly. This is the third justification for a simultaneous approach, that appears to be implicit in most of the existing empirical work.[12]

[8] As will become clearer, the procedure also estimates the share of the overall effect of trade that is due to intra-industry trade. This is akin to Gruben, Koo and Millis (2002) or to Shin and Wang (2003) for East Asian countries, although using different data and methodology.

[9] This, in turn, is endogenously caused by a stronger diversification motive, as shocks are argued to have become less correlated since the 70s.

[10] See for instance Claessens, Dornbusch and Park (2001), Calvo and Reinhart (1996) or Cashin, Kumar and McDermott (1995). Admittedly, most of this evidence concerns pathological cases experienced by emerging economies, but there is no a priori reason to dismiss similar, if milder, arguments between developed economies.

[11] Their reasoning is based on the premise that regions within countries have more similar production structures than regions in different countries.

[12] In a similar exercise applied to financial markets, Chinn and Forbes (2003) assess the relative magnitudes

This paper's estimates suggest simultaneity is important. The "reduced form" estimates of the effects of trade mask two distinct channels, in that a substantial share of the measured effect works through intra-industry trade. Furthermore, the evidence that trade-induced specialization affects cycles synchronization is weak at best. This suggests overall an estimated effect of *inter*-industry trade in line with existing models. By the same token, the effects of financial integration are two-fold. On the one hand it results in positively correlated cycles, but the correlation coefficient would be higher if finance-induced specialization were held constant. Finally, the direct effects of specialization are important economically, even once trade and financial integration are accounted for.

Results implied by cross-country and cross-state data are strikingly similar. This is important for three reasons. (i) The fact that financial integration appears to result in correlated business cycles is not an artefact of an international convergence of policy-making, most notably monetary. Similarly, we do not observe synchronized business cycles between trade partners only because they tend to follow the same monetary policy. Similar estimates obtain across U.S. states and across countries with substantially different monetary policies. (ii) The importance of specialization patterns in affecting cycles is not due to the arbitrary choice of a time-period or geographic coverage. In particular, the results cannot stem from the prevalence of one given type of shock in a given sample.[13] (iii) Trade treatment is constitutionally homogenized across the States of the Union. This legitimizes focusing on bilateral trade flows, since third party treatment is the same for all pairs of States.

The results in this paper suggest theories of the international business cycle should build on the following ingredients: some sectoral heterogeneity, e.g. in the responses of different sectors to a given macroeconomic shock, trade both within and between industries and some "herding" in international capital flows, e.g. through liquidity constraints or imperfect information.[14] The rest of the paper proceeds as follows. Section 2 describes the data, main econometric issues and general methodology. Section 3 illustrates the importance of simultaneity, comparing three-stage least squares and simple OLS estimates to the existing

of trade, banking and FDI linkages in explaining international correlations of financial returns.

[13] Furthermore, this paper uses altogether three different sources of sectoral data, measured at three different levels of aggregation (one-, two- and three-digit levels). The specialization variable is always significant, no matter the coarseness of the data. This makes it hard to ascribe the results to sampling.

[14] These results are based on a measure of business cycles synchronization that is simultaneous. Thus, channels with a lag of more than a year (the lowest frequency of the data used) are not the focus here. This centers the analysis onto relatively "fast" transmission channels. This is also done for the sake of comparison with a large existing literature, indeed concerned with the determinants of the *contemporaneous* correlations between business cycles.

literature. Section 4 explores the robustness of the conclusions to alternative specifications. Section 5 introduces non-parametric methods to describe the time dimension of the data, and establishes the robustness of the conclusions to panel data estimations. Section 6 concludes.

2 Methodology and Econometric Issues

This section introduces the system of equations estimated in the paper, and relates each individual specification in the system with the relevant literature. It then briefly describes the variables involved, their measurement and data sources, and closes with an account of the specific heteroscedasticity problem in a cross-section of bilateral correlations.

2.1 The System

This paper estimates the following system of equations simultaneously

$$\rho_{i,j} = \alpha_0 + \alpha_1 \ T_{i,j} + \alpha_2 \ S_{i,j} + \alpha_3 \ I_{1,i,j} + \varepsilon_{1,i,j} \tag{1}$$

$$T_{i,j} = \beta_0 + \beta_1 \ S_{i,j} + \beta_2 \ I_{2,i,j} + \varepsilon_{2,i,j} \tag{2}$$

$$S_{i,j} = \gamma_0 + \gamma_1 \ T_{i,j} + \gamma_2 \ I_{3,i,j} + \varepsilon_{3,i,j} \tag{3}$$

where i, j indexes country pairs, ρ denotes bilateral business cycles correlation, T is bilateral trade intensity and S is a specialization index capturing how different the sectoral allocations of resources are between countries i and j. Business cycles correlations, bilateral trade and specialization are all endogenous variables, while I_1, I_2 and I_3 contain the vectors of their exogenous determinants, respectively. Identification of the system requires differences between at least I_2 and I_3. Fortunately, a substantial literature is there to provide guidance on what variables to include in the I_i vectors. I next turn to this question.

The dependent variable in equation (1) is one of the most topical item in the list of Optimal Currency Area criteria.[15] It is therefore of interest in its own right, and indeed its determinants have been the object of intense scrutiny. Frankel and Rose (1998) have for instance focused on α_1, reasoning that if currency unions affect trade and then trade in turn

[15] It is for instance one of the five tests set by Gordon Brown, that the UK economy has to pass to enter EMU.

boosts cycle correlations, then currency areas can endogenously become optimal.[16] Imbs (2001) focused on α_2, arguing that measured bilateral trade may partly be a manifestation of differences in the degrees of specialization between the trading countries, which could affect ρ independently.[17] The estimates of α_1 can therefore be affected by inclusion of a specialization term.[18] Since specialization can very well be the result of trade intensity, however, accurate identification of α_1 and α_2 requires exogenous determinants for both trade and specialization, which equations (2) and (3) provide. Hence an added advantage to estimating (1)-(2)-(3) simultaneously.

The typically large estimates of α_1 pose a theoretical puzzle. While Baxter (1995) reviews the theories that imply a positive α_1, Canova and Dellas (1993), Schmitt-Grohé (1998) and Kose and Yi (2002) have used various methods to document the inability of existing models to reproduce the magnitude of standard estimates for α_1.[19] Imbs (2001) proposed to add the potentially omitted variable S to equation (1) and corrected the estimates accordingly. But an equally plausible explanation could be that we are not using the appropriate modelling strategy when attempting to reproduce the observed effects of trade. In particular, α_1 embeds the impact of both inter- and intra-industry trade, two dimensions that the models typically do not share. The simultaneous approach makes it possible to decompose the two effects, as β_1 in equation (2) captures the extent to which bilateral trade can be accounted for by the similarities in the two countries economic structures, i.e. an account of intra-industry trade. Thus, the total effects of trade in the simultaneous estimation equals $\alpha_1.\beta_1 + \alpha_1.\beta_2$, where the former term captures the importance of intra-industry trade. One sector models should seek to reproduce $\alpha_1.\beta_2$ only.[20]

[16] Alesina, Barro and Tenreyro (2002) use a slightly different methodology to answer a similar question. They investigate the impact of currency unions on both trade and co-movements. They instrument the advent of currency unions with gravity variables involving a third (anchor) country, rather than the bilateral characteristics used to explain bilateral trade intensity.

[17] Again, this could happen with or without sectoral shocks.

[18] Kalemli-Ozcan, Sorensen and Yosha (2001) estimate a variant of equation (1), but without a trade term. Then, Kalemli-Ozcan, Sorensen and Yosha (2002) estimate a variant of equation (3), and let specialization depend on financial integration. Implicitely, therefore, their two papers seek to document *one* of the channels in this paper , although not using simultaneous techniques. Their result that financially integrated regions specialize, and are less correlated as a result, obtains here as well.

[19] Or equivalent thereof. Canova and Dellas and Schmitt-Grohé, for instance, use structural VAR techniques. Kose and Yi actually argue standard models with technology shocks predict that $\alpha_1 < 0$, at least with complete markets. Kollmann (2001) argues nominal rigidities and demand shocks are crucial in reproducing international output correlations.

[20] A similar point is developed in Gruben, Koo and Millis (2002) who include a measure of both inter- and intra-industry trade on the right-hand side of (1). The coefficients on the two components are found to be significantly different.

This leaves open the question of what additional regressors to include in (1). Since this paper is concerned with the (direct and indirect) effects of financial integration, an important variable is one capturing the extent of impediments to capital flows between each pair of countries. This is done by including a variable capturing capital account restrictions in the international dataset, and an estimate of inter-state risk-sharing in the intranational data.[21] The preferred specification for (1) therefore contends that economic structure, and integration to financial and trade markets jointly explain a sufficient fraction of ρ to rule out omitted variable bias in the estimation of the coefficients α_i.[22] There are however a few additional explanations, including most prominently convergence in policies. In Section 4, I subject the specification to some sensitivity checks, introducing among others controls for monetary policy. More importantly, I implement the same estimations using information on U.S. States, which are subjected to a unique monetary policy, and find strikingly similar estimates.[23,24]

The specification of equation (2) is more straightforward, although also an object of debate. The empirical performance of so-called gravity variables in accounting for trade flows is a result going back at least to Tinbergen (1962), which has been used extensively subsequently.[25] The set of gravity variables customarily included in I_2 include measures of both countries' GDP levels, or sometimes of their populations, the geographic distance between their capitals, and binary variables capturing the presence of a common border and linguistic similarities between them. The list is usually argued to contain clearly ex-

[21] All variables are described in details in the next section.

[22] This is already more than what is usually included in this estimation, which typically focuses on the effects of trade, or those of specialization.

[23] The possibility that international economic fluctuations be caused by common shocks is also a prominent explanation to cycles correlations, and the object of a burgeoning literature. Leading candidates for global shocks are the sudden swings in the price of crude oil, witnessed throughout the 70s and some of the 80s. Loayza, Lopez and Ubide (2001) perform a decomposition of output fluctuations amongst the developing world into global, country and sectoral components, and find a dominant role for sectoral interdependences. Kose, Otrok and Whiteman (2002) perform a similar decomposition using Bayesian techniques. The sample analyzed here excludes the time periods commonly thought to correspond to global shocks, which suggests global shocks are not *particularly* prevalent in the data used. Furthermore, the results are almost identical across countries and across US states.

[24] Stockman (1988) documented the prevalence of country-specific shocks in European countries. While S could be an important determinant of ρ even in the absence of sectoral shocks, if S turns out to capture country-specific developments better than other variables, the international results can be interpreted differently. There is no particular reason to expect S to capture country-specific shocks; however, in (unreported) robustness analysis, I check that the results hold with country fixed-effects, i.e. that the channels identified in this paper continue to prevail for bilateral GDP correlations expressed in deviations from country-specific means. The analogue concern in the U.S. state data would entail the prevalence of state-specific shocks, a highly improbable possibilty given the constitutional restrictions on state-level fiscal policy, and no independent state Central Bank.

[25] See among many others Frankel and Rose (1998, 2002), Frankel and Romer (1999) or Rose (2000).

ogenous variables with high predictive power on trade flows, thus supplying an exceptional instrument set, used for instance to identify causality between trade and growth in Frankel and Romer (1999), or to control for other determinants of trade in Rose (2000), or both in Frankel and Rose (2002). This paper uses similar insights to isolate the exogenous impact of trade on cycles synchronization and specialization.[26]

The exogenous determinants of specialization, summarized in I_3, are empirically less established. Two variables do however spring to mind. Firstly, access to financial markets will influence specialization patterns, and how similar they are between countries. I thus include in the vector I_3 the measures of capital account restrictions and the extent of risk-sharing already used in I_1. Secondly, Imbs and Wacziarg (2003) show economies go through two stages of specialization as income per capita grows: they initially diversify but re-specialize once a (relatively high) level of income per capita is reached. This empirical fact suggests two additional components for I_3: GDP *per capita* levels in both economies, but also, because of the non-monotonicity, the gap between them.

In summary, since the intersection between I_2 and I_3 is empty, the system can be identified through a choice of instruments that is largely warranted by an existing literature. The main contribution of the present exercise is simultaneity. The main assumptions are the exogeneity of financial integration to ρ and S, and that of GDP per capita and relative GDP per capita to S.[27] I now turn to a detailed description of the data and measurement of the variables included in the I_i vectors.

2.2 Data and Measurement

Bilateral correlations in business cycles are computed on the basis of the cyclical component of quarterly GDP, isolated using the Band-Pass Filter introduced in Baxter and King

[26] The only role of the gravity variables in the present context is to isolate the exogenous component of T in the system estimated. Thus the methodology does not fall victim to the criticism due to Rodrik, Subramanian and Trebbi (2002) that gravity variables merely capture good institutions, in turn conducive of high growth, nor to Persson's (2001) critique that geography is inherently more conducive of trade within currency unions. The impact of currency unions on trade, or of trade on growth are not central to this paper.

[27] Capital account liberalization as a proxy of financial integration is probably preferable to a (non-existent) measure of gross bilateral capital flows, as the latter is certainly much more endogenous to ρ. The determinants of S, in turn, are poorly known beyond the role of trade. I simply interpret the evidence in Imbs and Wacziarg (2002) as suggestive that specialization is a manifestation of growth, rather than the opposite.

(1999).[28] The quarterly data cover 1983:1 to 1998:3 in 18 countries, and come from the International Financial Statistics issued by the IMF.[29] This gives rise to a cross-section of 153 bilateral correlations.[30] The annual data used for robustness in Section 4 is taken from the version 6.1 of the Penn-World Tables. The (annual) series on Gross State Product come from the Bureau of Economic Analysis, and run from 1977 to 2001.

Bilateral trade intensity is computed in two ways. The first one is standard, used in Frankel and Rose (1998) among others, and writes

$$T^1_{i,j} = \frac{1}{T}\sum_t \frac{X_{i,j,t} + M_{i,j,t}}{Y_{i,t} + Y_{j,t}}$$

where $X_{i,j,t}$ denotes total merchandise exports from country i to j in year t, $M_{i,j,t}$ represents imports to i from j, and Y_i denotes nominal GDP in country i. Bilateral trade data are from the IMF's Direction of Trade Statistics. I use this standard measure for the benchmark case. Clark and van Wincoop (2001) use an alternative measure of trade intensity, independent of size, based on Deardorff (1998) model, which can be constructed as

$$T^2_{i,j} = \frac{1}{2}\frac{1}{T}\sum_t \frac{(X_{i,j,t} + M_{i,j,t})\ Y^W_t}{Y_{i,t} * Y_{j,t}}$$

where Y^W_t is world GDP. T^2 differs from T^1 in that it depends only on trade barriers, and not on country size. In particular, Deardorff shows that T^2 equals 1 if preferences are homothetic and there are no trade barriers. I use T^2 in Section 4, dedicated to a sensitivity analysis.

There is no data available on bilateral trade flows between U.S. states. The main virtue of the gravity model, however, is that it provides a dependable predicting tool. Just as cross-country trade flows are well accounted by the gravity variables, with R^2 above 0.65, so cross-state trade flows can be simulated with reasonable reliability on the basis of each state's economic size, the distance separating each state's main business center and whether they share a common border. Thus, I use the estimated coefficients from a cross-country

[28] The parameters are set according to Baxter and King's recommendations. In particular the filter is set to preserve the components of the data with period between 6 and 32 quarters for quarterly data, and between 2 and 8 years for annual data. In Section 5, the Hodrick-Prescott filter is also applied to the data, with $\lambda = 1600$ or 100 in quarterly or annual data, respectively.

[29] This is the maximal uninterrupted coverage afforded by the November 2002 IFS CD-Rom where sectoral data are available. The countries included are Australia, Austria, Belgium, Canada, Finland, France, Israel, Italy, Japan, Mexico, the Netherlands, Norway, Peru, South Africa, Spain, Switzerland, UK, US.

[30] These are independent, since the time dimension is larger than the number of countries used to compute the correlations. The fact that the same country appears in different observations of the cross-section complicates the nature of heteroscedasticity, an issue that is addressed in the next section.

gravity estimation of $T^1_{i,j}$ regressed on distance (between capital cities, in statute miles), the product of each country's GDP, the product of each country's population, and binary variables capturing the presence of a common border or a common language. The estimates are used to fit a value for inter-state trade, $\hat{T}$, which is then used in estimating jointly equations (1) and (3).[31]

There are no standard measure of similarity in industry specialization. Krugman (1991) and Clark and van Wincoop (2001) favour a variable akin to a Herfindahl index of concentration, whereas Imbs (2001) uses a correlation coefficient between sectoral shares in aggregate output or employment. Here, I use sectoral real value added to compute

$$S_{i,j} = \frac{1}{T} \sum_t \sum_n^N |s_{n,i} - s_{n,j}|$$

where $s_{n,i}$ denotes the GDP share of industry n in country i. In words, $S_{i,j}$ is the time average of the discrepancies in the economic structures of countries i and j. Thus, S reaches it maximal value of two for two countries with no sector in common: we should therefore expect $\alpha_2 < 0$. For the international estimation, the sectoral shares s are computed using two alternative data sources: first the United Nations Statistical Yearbook sectoral data, which provides sectoral value added at the one-digit level, for all sectors in the economy and with (incomplete) coverage from 1960 to 1998. Second, for robustness, I also use two-digit value added data issued by the UNIDO, pertaining to manufacturing sectors only.[32] For the intranational estimation, I use real sectoral state value added series issued by the Bureau of Economic Analysis. These cover all economic activities, at the three-digit aggregation level.[33]

In the international dataset, financial integration is measured through a variable reporting the number of countries with capital account restrictions, as defined by the IMF, for each country pairs. The variable therefore takes values 0, 1 or 2.[34] For intranational

[31] In particular, $\hat{T} = -1.355 * \ln(\text{Distance}) + 1.057 * \ln(\text{GDP Product}) - 0.635 * \ln(\text{Population Product}) - 29.834$. The cross-country estimation controls for the (significant) effect of a common language, as well as the (insignificant) presence of a border.

[32] This is the main data limitation for the present exercise. The intersection between quarterly GDP IFS data and sectoral UN data is what is used in this paper. One-digit sectors are: 1. Agriculture, Hunting, Forestry, Fishing, 2. Mining & Quarrying, 3. Manufacturing, 4. Electricity, Gas & Water, 5. Construction, 6. Wholesale, Retail Trade, Restaurants & Hotels, 7. Transport & Communications, 8. Finance, Insurance, Real Estate & Business Services, 9. Community, Social & Personal Services. There are 28 two-digit manufacturing sectors.

[33] There are 61 sectors in each state.

[34] To avoid endogeneity issues, it is measured at the start of the sample, in 1970.

data, a state-specific index of risk-sharing is obtained following Kalemli-Ozcan, Sorensen and Yosha (2002). They propose to estimate

$$\ln gsp_t - \ln dy_t = \alpha + \beta \ln gsp_t + \varepsilon_t \tag{4}$$

where gsp denotes Gross State Product per capita and dy is state disposable income per capita. Kalemli-Ozcan, Sorensen and Yosha interpret β as an index of risk-sharing. Indeed, if inter-state risk sharing (in the guise of income insurance) is perfect, $\beta = 1$ as disposable income is unrelated with GSP per capita, and equation (4) is simply a regression of GSP on itself. Conversely, if there is no inter-state risk-sharing $\beta = 0$ since the dependent variable becomes essentially noise. A measure of cross-state financial integration is then given by pairwise sums of the state-specific estimates of β.

The gravity variables in I_2 are standard, and include the following: a measure of the (log mile) distance between the countries capitals, the (log) products of each country's GDP and binary variables indicating the presence of a common border and whether they share the same language. The vector I_3 is different from I_2, and includes: the proposed measure of financial integration, already in I_1, the (log) product of each country's GDP per capita, and the (log) GDP disparity, defined as $Max\left[\frac{Y_i}{Y_j}, \frac{Y_j}{Y_i}\right]$.[35]

Table 1 reports summary statistics for the three endogenous variables of the system, in both datasets. Table 2 reports the corresponding unconditional correlations. As usual, and particularly in the present context of simultaneity, unconditional correlations are only informative superficially. However, several points are worth noting. Firstly, the cross-sections of cycle synchronizations appear to be very similar regardless whether the cycles are computed on the basis of quarterly or annual data. ρ_Q and ρ_Y have similar moments and extreme values, and are very highly correlated. Cycle correlations between U.S states do not seem higher on average, although the cross-section tends to have more extreme values. Secondly, states are more specialized than countries, as S is on average larger than both S_{YB} and S_{Mfg}. This is a well-known result, first documented in Krugman (1991). Average specialization in manufactures is also higher than across all economic activities, and the correlation between the two cross-sections is only 0.36, which warrants some sensitivity analysis [36] Thirdly, both measures of trade intensity are very similar, with a correlation

[35] The gravity variables are taken from Andrew Rose's website, at http://faculty.haas.berkely.edu/arose.

[36] Some of these rankings could as well be due to different levels of aggregation. They are however not inconsistent with existing evidence, as described for instance in Imbs and Wacziarg (2003).

of 0.86. They both correlate positively with ρ, although T^1 does so more significantly. Fourthly, specialization is correlated negatively with cycle synchronization, no matter the combination of measures used. The evidence for a trade-induced specialization is a priori weak, since the correlation between specialization and trade measures in only positive with T^2, and very weakly. Unsurprisingly, this calls for appropriate conditioning, as well as a simultaneous approach.

Finally, Table 3 reports a few extreme values for the four main variables used in this study, namely cycles correlations, trade, specialization and financial integration. This is only illustrative, but has some interesting teachings. For instance, it is remarkable that the only country pair displaying both high business cycles correlation and high trade linkages be the U.S with Canada, precisely where Schmitt-Grohé (1998) showed the theoretical inability of trade per se to account for cycles synchronization. Thus, even between the two countries where the case for trade would be the strongest, the variable alone appears insufficient to account for observed synchronization. Similarly, low correlations between GSP tend to involve South Dakota, wherea low inter-state trade flows (admittedly, only as predicted by a gravity model) tend to involve Vermont, a rather remote and economically small state. Florida and Virginia display the most correlated GSP, yet there is no particular reason to expect strong trade linkages between the two states, at least not on the basis of a gravity model.

To summarize, both international and intranational data suggest trade may be important, but is probably insufficient to explain all the cross-section of cycle correlations. Turning to measures of specialization, the three most similar country-pairs (on the basis of one-digit data) are Australia - Canada, the UK - France and the Netherlands - Canada. The importance of sectoral specialization is therefore of special interest to inform the debate of Sterling's entry into the EMU. Across states, the District of Columbia unsurprisingly displays the most idiosyncratic sectoral composition of value added. Finally, financial integration as measured by capital account restrictions is highest between the North American countries and lowest when such countries as South Africa are included. Across states, the extent of risk-sharing seems to be related with specialization, as already demonstrated in Kalemli-Ozcan, Sorensen and Yosha (2002), since pairs involving Alaska display high risk-sharing, as measured by income insurance.[37]

[37] The pair Belgium - the Netherlands has very high values for both T^1 and T^2, and could thus be considered

2.3 Three-Stage Least Squares and Heteroscedasticity

As should be clear from the previous discussion, the proposed estimation method must combine the features of simultaneous equations procedures, *and* control for the possible endogeneity of the three dependent variables ρ, T, S. Three-Stage Least Squares (TSLS) does exactly that. The estimator combines insights from Instrumental Variable and Generalized Least Squares methods, achieving consistency through instrumentation and efficiency through appropriate weighting in the variance-covariance matrix. As is well-known, the procedure consists of the following steps: (i) estimate the system equation by equation using Two-Stage Least Squares, and retrieve the covariance matrix of the equations disturbances, then (ii) perform a type of Generalized Least Squares estimation on the stacked system, using the covariance matrix from the first step.[38]

It is also often useful to contrast the results obtained via Three-Stage Least Squares, to those generated by the partly similar Seemingly Unrelated Regression (SUR) technique. SUR focuses on the simultaneity, but does not account for possible endogeneity of the dependent variables. In other words, the system is estimated equation-by-equation under the assumption that the variance-covariance matrix is diagonale. Finally, the next section also reports simple equation-by-equation Least Squares estimates, for the sake of comparison with existing estimates. Comparisons between the OLS, SUR and TSLS estimates highlight the importance of simultaneity and endogeneity, respectively.

In addition, the correlations in business cycles ρ are measured with error, in a way that is likely to create a specific type of heteroscedasticity. In particular, following Clark and van Wincoop (2001), let $\hat{\rho} = \rho + \upsilon$ denote the estimated correlation coefficients, with υ the sampling error. It is then possible that the sampling error υ be correlated across observations in $\hat{\rho}$, since many correlation coefficients involve the GDP series for the same country or state.[39] This will create a kind of heteroscedasticity in the residuals of (1) that standard White corrections cannot account for.

an outlier. The subsequent results are however invariant to omitting this country pair. The estimations that follow do include the "outlier", and are run in logarithms. Estimations in levels yield virtually identical results, though with lower fits.

[38] See for instance Tavares and Wacziarg (2001) for an application of Three-Stage Least Squares to the effects of democracy on growth.

[39] Exactly 17 (50) of them do in the international (intranational) data, since there are 18 countries (51 states) in the sample.

Ignoring this heteroscedasticity is likely to result in understated standard errors for the estimates in (1), and since the estimation is simultaneous, in the rest of the system as well. It is however possible to account for this potential issue, at the cost of relatively mild assumptions. If the true vector of bilateral correlations ρ is assumed to be deterministic, (1) rewrites

$$\rho_{i,j} = \alpha_0 + \alpha_1\ T_{i,j} + \alpha_2\ S_{i,j} + \alpha_3\ I_{i,j,1} + \varepsilon_{i,j,1} + \upsilon \tag{5}$$

The variance-covariance matrix of equation (5) involves $\hat{\Sigma}_\upsilon = E\left(\upsilon\ \upsilon\right)$, which requires using a GMM estimator. As part of the robustness checks discussed in Section 4, I present results applying a GMM estimator to the system (1)-(2)-(3), that also accounts for both endogeneity and simultaneity.

3 Trade, Finance, Specialization and Synchronization

This section reports the results for four different procedures applied to the international data: Ordinary Least Squares, Two-Stage Least Squares, Seemingly Unrelated Regression and Three-Stage Least Square. It compares the Least Squares results with existing evidence, and investigates the impact of simultaneity and endogeneity. The section closes with the intranational results, and a comparison with the international evidence.

3.1 Equation-by-Equation Estimates

Table 4 reports the results of equation-by-equation estimations for the system (1)-(2)-(3), using the benchmark set of control variables described in Section 2.[40] The purpose of Table 4 is to confirm that the well-known results pertaining to each equation in the estimated system, taken in isolation, are present in the dataset used here.[41] Column (i) confirms the large and significant effect of trade in accounting for ρ in equation (1). The point estimate in column (i) means that doubling trade results in a correlation higher by 0.063, which is close to the estimate in Clark and van Wincoop (2001), and exactly equal to the revised estimates in Kose and Yi (2002). As in Frankel and Romer (1999), instrumenting trade with exogenous gravity variables results in an even higher point estimates. This probably

[40] K denotes the binary variable capturing capital account restrictions.

[41] Again, the necessity of having sectoral data constrains the sample relative to standard estimations of, say, (1) or (2).

happens because the endogeneity bias is negative, as non-synchronized economies tend to trade more. The point estimate for α_1 in column (ii) means doubling trade now results in a correlation coefficient higher by 0.10, comparable in magnitude with the estimates in Frankel and Rose (1998). We conclude that the dataset used here is perfectly standard from the point of view of the relationship between ρ and T.

Equation (2) in specification (i) is unsurprising: the gravity variables all have the expected signs, as is now completely standard in any empirical work concerned with explaining the geography of trade. The same is true of equation (3), with estimates of the γs in line with theory. In particular, pairs of rich countries tend to have significantly lower value of S, i.e. their economic structure are more similar, as would happen if growth resulted in diversification. But on the other hand, pairs of countries at different stages of development, as measured by the gap between their GDPs, have significantly higher S, i.e. tend to display different economic structures. Finally, the effect of trade on S is weakly significant, but with the "wrong" sign, i.e. more bilateral trade results in lower S, or in more similar economies. This last result is even stronger when trade is instrumented in column (ii), a puzzling fact, that is however later shown to depend on the measure of trade used.

Columns (iii) and (iv) add the two variables specific to the simultaneous approach, namely specialization S and financial integration K. Four results are of particular interest. (a) Financial integration results in (weakly) more correlated business cycles, as lowering K significantly increases ρ. (b) Financial integration has the predicted specialization effect, since a low value of K is significantly associated with high S, that is, financially integrated economies have different specialization patterns. (c) Country pairs with low S have significantly higher ρ: similarities in economic structure result in correlated business cycles. (d) Estimates for α_1 are now much smaller, with a point estimate such that a doubling of trade would result in a correlation higher by 0.036.[42] Column (iv) implements the corresponding instrument variables estimations, with the same instrument set as in (i) and (ii). This tends to magnify all four results (a) to (d), and adds a fifth interesting one: (e) β_1 becomes significantly negative once specialization is instrumented. This makes sense as the endogeneity of S to T would if anything tend to bias β_1 upwards, as trading partners specialize and thus have high S. A negative β_1 can be interpreted as meaning that countries with similar economic structures trade more, a quantification of the extent of intra-industry trade.

[42] This point is already in Imbs (2001).

Although they are largely consistent with existing work, all these results may alter once both endogeneity and simultaneity are controlled for. For instance in equation (1), the three regressors are theoretically related, and a proper account of the covariance term may very well result in different estimates throughout the system. I next turn to the simultaneous estimations.

3.2 Simultaneity and Channels

Table 5 is symmetric to Table 4, and presents SUR and TSLS estimates, where the former only account for simultaneity while the latter also instruments the three endogenous variables ρ, S and T. Table 5 can help answer two questions: 1) are the estimates sensitive to simultaneity? 2) can we quantify the direct and indirect channels relating trade, finance, specialization and business cycles synchronization?

The estimates in Table 5 are not dissimilar to the equation-by-equation approach, but some coefficients do change substantially in magnitude. Firstly, estimates of α_1 increase slightly in specifications (i) and (ii). Since T in equation (2) is only explained by the (exogenous) gravity variables, this may happen because the systems (i) and (ii) focus *de facto* on the geographic component of trade, and thus the attenuating effect of trade's endogeneity is neutralized. This however disappears once S in included in equations (1) and (2) in specifications (iii) and (iv). Then, estimates of α_1 revert to relatively low levels, roughly three times lower than the Frankel-Rose estimates. Of course, part of the overall effect of trade may now go through specialization S, as γ_1 captures in equation (3). Furthermore, trade itself is decomposed into two components: intra-industry trade, as captured by β_1 in equation (2), and the classic "geographic" component, as captured by β_2.

One word of comment is in order here. A number of authors have puzzled over the inability of standard one-sector models to reproduce the large effect trade has on cycle correlations.[43] Recently, Kose and Yi (2002) have calibrated and simulated an international business cycles model with transport costs and technology shocks. Depending on the parametrization, their model yield simulated values for α_1 ranging from 0.009 to 0.069. It is interesting to note that the simultaneous estimates in Table 5 are well within this range: thus, once focused on the link between *inter*-industry trade and business cycles correlations, the data is not inconsistent with elasticities predicted by one-sector models. The estimates

[43] For instance Canova and Dellas (1993) or Schmitt-Grohé (1998).

for α_1 in the last two columns of Table 5 are low for two reasons. Firstly, the presence of an adequate control for the influence of common sectors, where the sectoral pattern of production is in turn allowed to respond endogenously to trade intensity and other exogenous determinants. Secondly, an explicit account of the possibility that (at least part of) the high estimate for α_1 originates in the prevalence of intra-industry trade, something not typically part of international business cycles models.[44,45]

Secondly, estimates of the effect of S on ρ become larger in Table 5, now that S is allowed to depend on both trade and financial integration. The R^2 suggest S is a quantitatively important determinant of business cycles correlation. Furthermore, the estimates from equation (3) suggest its determinants are largely beyond the reach of policy makers. While financial integration does affect specialization patterns as predicted by theory, the bulk of the cross-section in S depends on the stages of diversification reached by both economies, largely a low frequency, long-run phenomenon. Finally, the (positive) impact of capital account liberalization on ρ is confirmed and slightly enhanced both statistically and economically. In other words, even though financial integration does result in specialization, a direct synchronizing effect is present in the data. I next turn to a quantification of these direct and indirect channels.

Panel A of Table 7 reports all direct and indirect channels in the system under study, as a function of the estimated parameters. Of interest is the decomposition of the coefficients αs in equation (1) into overall contributions from trade, specialization and financial integration. The direct effects of trade are either a reflection of intra-industry flows (α_1 β_1) or of standard Ricardian trade (α_1 β_2); the indirect effect of trade comes from the possibility that economies open to goods are also specialized, and may have a higher value of

[44] Both U.S states data, and the sensitivity analysis in Section 4 confirm lower estimates for the effects of trade, thus bringing them further in line with the simulations in Kose and Yi (2002). I will come back to the decomposition between inter and intra-industry trade when analyzing the channels through which T, S and K affect ρ. As noted, trade also affect ρ *indirectly*, through its effect on specialization, as captured in equation (3). This will add to the overall effect of trade, but evidence on this channel turns out to be non-robust.

[45] Kollmann (2001) suggests that models with nominal rigidities and demand shocks might be more appropriate from the standpoint of reproducing the high observed correlation between T and ρ. Kollmann describes three diffusion channels for demand shocks: (i) a substitution effect, whereby agents substitute (depreciated) domestic to foreign goods in response to a domestic monetary shock, (ii) a quantity effect, whereby foreign aggregate demand increases since part of domestic demand falls on foreign goods, and (iii) a price effect, whereby.the foreign price index decreases as it embeds prices of some domestic goods, now relatively cheaper. Only the quantity effect will be present in models with technology shocks. The evidence in this paper suggests nevertheless that the measured effects of *inter*-industry trade on ρ are compatible even with models based on technology shocks only.

S as a result ($\alpha_2\ \gamma_1$). The direct effects of specialization can, again, originate in trade ($\alpha_2\ \gamma_1$), or in financial integration ($\alpha_2\ \gamma_2$), or in exogenous stages of development reached by both economies ($\alpha_2\ \gamma_3$); the indirect effect of specialization may, once again, consist in the manifestation of intra-industry trade ($\alpha_1\ \beta_1$). The direct effect of financial integration is captured by α_3, and its indirect effect is going via specialization ($\alpha_2\ \gamma_2$).

Panel B of Table 7 reports the values for these channels as implied by the Three-Stage Least Squares estimates in Table 5.[46] A number of results are of interest. Firstly, the component of trade that affects business cycles synchronization most significantly, is that predicted by gravity variables. Thus, we confirm the existing result that trading partners are more synchronized, but not because they trade intra-industry.[47] Secondly, although this is just significant at the 10 percent confidence level, economies sharing similar economic structure trade substantially more, and are more synchronized as a result. Actually, the magnitude of this effect is almost three times larger than that of the "inter-industry" trade, based on point estimates.[48] We conclude that the puzzlingly high estimates for α_1 in standard single equation estimations is largely driven by intra-industry trade, an ingredient models seeking to reproduce these estimates should include. Models with inter-industry trade should only seek to reproduce the much smaller value of $\alpha_1 = 0.056$.

The indirect effect of trade, in turn, is estimated to *increase* business cycles correlations, if anything. This is a somewhat surprising result, as one would expect trading partners to specialize according to comparative advantage, and have higher S as a result. Here there is evidence for the opposite result. This may find an explanation in the fact that the sample includes a vast majority of developed economies. Perhaps specialization patterns amongst these countries may indeed follow standard trade theories, but the variable S does not capture it because it relies on one-digit sectoral data.[49] This result is also not robust: applying an alternative filter to the data, or measuring trade differently results in a coefficient with the opposite sign. The absence of much of an indirect effect of trade on ρ is consistent with existing evidence, for instance Frankel and Rose (1998).

[46] Estimates for β_2 and γ_3 were obtained from the TSLS fitted values for T on gravity variables and S on GDP variables, respectively. The fitted values were then used in estimating equation (1). All other P-values were obtained using the Delta Method.

[47] Although correcting for intra-industry trade still brings the estimates in line with one-sector models. These results are in line with Fidrmuc (2002), who documents an important channel going from intra-industry trade to output correlations.

[48] This is because there is a very strong effect of specialization patterns on trade intensity.

[49] Actually, the sensitivity analysis shows that γ_1 becomes insignificantly different from zero when specialization is measured using data on manufacturing sectors only.

Most of the direct effect of S on ρ works through the exogenous determinants of specialization, i.e. the degree of economic advancement of countries i and j. As mentioned above, trade does appear to result in less specialization (and higher ρ), while financial integration, in turn, does result in higher S, i.e. countries specialized in different range of activities, but this effect is only significant at the 16 percent confidence level. In other words, the bulk of the determinants of S are largely beyond the reach of short-term policymaking. In as much as the international correlation of business cycles is an important constraint to policy, e.g. through its relation with monetary union, this puts into perspective the significantly positive estimates for α_1 arising from single equation estimations. While it may be possible to manipulate T through trade policy, there is no immediate equivalent for S. Finally, most of the effect of financial integration is direct, as countries with liberalized capital account tend to be more synchronized, even though they are also (weakly) more specialized. I next investigate how these conclusions are affected by focussing on international as opposed to intranational data.

3.3 The Channels between U.S States

Table 6 reports three-stage least squares estimates for U.S states data. Since no data are available on direct trade flows between U.S states, equation (2) is subsumed in implementing a gravity model to predict inter-state trade. This does not come at zero cost. First of all, all results depend on the reliability of a gravity model for inter-state trade. Luckily, the descriptive statistics in Table 3 do not seem out of line, as indeed the route between California and New York is probably amongst the most heavily traded within the U.S. The gravity model has reached almost universal validity, and is probably particularly appropriate for intranational data given the absence of any tariffs: it is hard to think of any impediments to commerce between U.S states that are not related to geography. Second, not having any estimates for the coefficients β in equation (2) prevents a separate assessment of the effects of inter- and intra-industry trade on ρ.

On the upside, however, a dataset where trade treatment to all third parties can be taken as equal in the cross-section is a precious gift, since it helps quantifying the extent of a potentially important bias. Anderson and van Wincoop (2002) have shown that bilateral trade flows are heavily influenced by the trade treatment each party is imposing on the rest of the world. Correcting for this "multilateral resistance" effect is crucial when investigating the determinants, as well as the impact of bilateral trade. The previous estimates of α_1 in equation (1) may have suffered from this bias, to an extent that estimates based on intranational data can help evaluate. Finally, inter-state data provides an important robustness check. Indeed: the data is coming from completely different sources, the sectoral information is more disaggregated, the sample universe is more complete, as there is data on the whole of an economic entity, and the measure of financial integration is conceptually and practically different from an index of capital account restrictions.

Yet, as Table 6 reports, the results are largely unchanged. Perhaps the largest alteration in the results pertains to the estimates for α_1, which are still significantly positive but much smaller in magnitude. Recall that, given the manner in which inter-state trade was simulated, there is no way of discriminating between inter- and intra-industry trade. Estimates for α_1 are however almost half those implied by international data. Doubling inter-state trade (as predicted by a gravity model) results in GSP correlations being higher by 0.021, which is well into the range implied by standard (real) international business cycles models with plausible parameters. This suggests the bias demonstrated by Anderson and van Wincoop (2002) is prevalent in the international dataset.

The other coefficients, however, remain largely unaffected by the use of an alternate dataset. In particular: (i) states with similar specialization patterns do display significantly more synchronized GSP, and quite remarkably the estimates for α_2 in Table 6 are not significantly different from their equivalent in Table 5. Specialization patterns continue to be an economically and statistically important determinant of business cycles synchronization. (ii) States with high risk-sharing, as measured by an index of income insurance, tend also to be more synchronized. This result goes parallel to the negative effect of capital account restrictions in the international dataset. (iii) Inter-state trade seems to result in *less* specialized states, a somewhat surprising outcome that already obtains in the international data. It is however not robust, as the next section shows. (iv) States with high indices of risk-sharing tend to be more specialized, a confirmation of Kalemli-Ozcan, Sorensen and Yosha (2002).

The channels between trade, finance, specialization and synchronization are stronger between states than between countries, although not qualitatively different. Panel C in Table 7 presents the estimated direct and indirect linkages between the four variables of interest, although no channel involving an estimate of the βs can be obtained given the simulated trade data. The most remarkable difference with panel B has to do with the significant channel from risk-sharing to ρ: financial integration results in specialization, and thus less correlated cycles. The significance of this coefficient summarizes the results in Kalemli-Ozcan, Sorensen and Yosha (2001 and 2002). But the approach here also shows the presence of a direct link between financial integration to cycles synchronization, which in the intranational data is positive at the one percent confidence level. Indeed the estimates in panel C suggest that financial integration has an overall *positive* effect on business cycles synchronization.

Finally, the lower panel of Table 6 presents some robustness analysis for inter-state data. In particular, three checks are performed. First the possibility that the economic size of each state be independently and significantly affecting ρ is investigated, but without any sizeable changes. Second the Hodrick-Prescott filter is used to isolate the cyclical component of GSP when computing ρ (and the indices of risk-sharing), again without any sizeable effects. Third the GMM estimator described in section 2 is implemented instead of TSLS. This affects the estimates of financial integration's specialization effect, γ_2, which then becomes non-significantly different from zero. The next section extends this sensitivity analysis to the results pertaining to international data.

4 Robustness

In this section, I subject the estimation to seven robustness checks: (a) all estimations are run implementing the GMM simultaneous estimator described in Section 2. (b) I use the alternative measure for bilateral trade T^2, defined in Section 2. (c) I use the Hodrick-Prescott filter to isolate the cyclical component of GDP. (d) I use an alternative measure of specialization S_{Mfg}, based on two-digit manufacturing value added data issued by the UNIDO. (e) I use yearly rather than quarterly data to compute business cycles correlations. (f) I control for convergence in monetary policies. (g) I control for the size of countries in equation (1). All results are reported in Table 8.

4.1 GMM Estimates

The first specification in Table 8 implements the exact same specification as in section 3.2, but using a GMM estimator instead of Three-Stage Least Squares. The results are very similar, usually stronger both economically and statistically, with the notable exception of

α_1, which is not significantly different from zero. This does not appear to be a robust fact, though, as the next sub-section argues.

4.2 Alternative Measure of Trade

The second specification in Table 8 contains the alternative measure of trade T^2 introduced in Deardorff (1998). T^2 is not scale dependent, which manifests itself in the sudden reversal of the size variable in I_2 (namely GDP product). This measure of trade does once again affect directly cycles correlations, with an estimate for α_1 in line with earlier results. Results pertaining to other channels are unchanged: they are, if anything, once again stronger than in the TSLS case with T^1. Note also that T^2 does not appear to correlate at all with specialization patterns, confirming the sensitivity of the earlier negative point estimates.

4.3 Hodrick-Prescott Filter

Specification (iii) in Table 6 uses the Hodrick-Prescott filter to isolate the cyclical component of GDP fluctuations. None of the results change significantly, except for the correlation between trade and specialization (β_1), which becomes insignificant here as well.

4.4 Manufacturing Sectors

The last column in Table 8 reports estimates when S is computed using sectoral value added at the two-digit level, but for manufacturing sectors only, as issued by the UNIDO. The main difference has to do with the (much) larger magnitude of α_2, the effect of specialization on cycles correlation. The coefficient on K in equation (3) is also much larger, suggesting financial openness has much of an effect on specialization patterns in manufacturing sectors.

4.5 Yearly Data

The second panel of Table 8 reproduces the previous four checks, but using yearly data to compute cycles correlations. The estimates are virtually identical to those in the first panel.

4.6 Monetary Policy

The first two specifications in Table 8C report estimates where convergence in monetary policies is proxied and controlled for in equations (1) and (2). Identifying monetary policy is the object of an enormous literature, whose purpose is to track the effect of exogenous monetary policy decisions over time. There is fortunately no purpose in being that ambitious in the present context. Rather, this sub-section purports to ensure that the channels identified in the previous section are not but a manifestation of similar monetary policies. Note that this is unlikely, for, while converging monetary policies, manifested by a stable exchange rate for instance, are known to result in more trade and more synchronized business cycles, there is no obvious theoretical link with countries' specialization patterns.[50] In other words, these controls will most likely affect the estimates of α_1 only. Furthermore, the fact that intranational results are almost identical to international ones suggests monetary policy is not driving the results in this paper.

Specifications (ix) and (x) in Table 8 control for the volatility in the (growth rate of the) nominal exchange rate, and for five-year averages of inflation differentials, respectively. Once again, the results are unchanged. It is interesting to notice that the effects of a stable exchange rate and/or small inflation differentials seem to work through trade, as trade is estimated to significantly increase in the face of stable and similar monetary policies.

4.7 Size

Specifications (xi) and (xii) in Table 8C report estimates once the relative size of the two economies is controlled for in equation (1). The idea behind this control is to check whether country size continues to have a direct impact on business cycles correlation, beyond the indirect channels via trade or specialization, and to verify that the results carry through. Once again, the results are unchanged: large countries are indeed more synchronized, but it is happening indirectly because they tend to trade more.[51]

5 Business Cycles Over Time (incomplete)

In this section, I exploit the panel dimension of the data and compute period-averages of all variables to answer two questions: (i) how has the cross-section of cycles synchronization evolved over time? (ii) have its determinants changed accordingly? Two panel datasets are constructed, based on international datasets with uninterrupted observations since 1970: the first sample has more extensive coverage, and contains observations on ρ, S and T over two separate decades, 1980-1990 and 1990-2000. The second focuses on a reduced sample of 15 countries where longer time series are available, and constructs the variables

[50] See for instance Rose (2000) on the effects of monetary union.

[51] I also verified that another potential effect of relative size did not matter, namely the gap between the two countries' sizes. Indeed, very small economies could potentially be inherently highly correlated with a large neighbour, for reasons outside of the system estimated here. This does not happen either, as this alternative measure has no direct effect on ρ.

of interest over three sub-periods, 1970-1980, 1980-1990 and 1990-2000. The data thus obtained is supplemented with time-varying information on bilateral trade patterns, as the gravity variables are typically time-invariant.[52]

5.1 Non-Parametric Density Estimates

Figures 1 to 8 illustrate the result of kernel density estimations for the cross-sections in the three endogenous variables of interest, ρ, S and T, performed over each sub-period.[53] Density estimations are implemented for each cross-section as a whole; to gain further insight into the effects of the European Union, separate kernels are performed on the cross-section of within-Europe country pairs only, and, for contrast, on the complementary cross-section as well. These density estimates are reported in each figure's lower panels.[54] Each figure also reports mean comparison tests for each distribution over different time periods.

Several results are of interest. Firstly, the cross-section of bilateral correlations does not appear to have shifted upwards as a whole in the 90s as compared to the 80s. This apparent stability masks however dynamics specific to European countries. In particular, Figure 1 establishes that business cycles correlations in the EU are significantly higher on average in the 90s than in the 80s. Synchronization has increased, as a result of the whole cross-section shifting upwards. Outside of Europe, however, exactly the opposite happened. Synchronization has fallen on average, largely because the upper-tail of the distribution has thinned. In other words, while Europe was getting more synchronized, each aggregate cycle in the rest of the sample was getting more idiosyncratic.

[52] In particular, I supplement the gravity based measures of economic size with the Sachs-Warner index of trade liberalization, import duties as a percentage of total imports plus exports (from IMF), the coverage of non-tariff barriers (from UNCTAD), indices of contracts repudiation and corruption (from IRIS / ICRG) and a binary variable capturing the presence of local trade agreements. All variables are averaged over each sub-period.

[53] The density estimations reported in the Figures were performed using the Epanechnikov kernel function. Using alternative weighing functions did not change the distributions' shape nor any observed shifts over time. The bandwidth is chosen at half the value that would minimize the mean integrated square error if the data were Gaussian and a Gaussian kernel were used. Half this value was used since Silverman (1986) showed using the actual minimum tends to oversmooth the density. Once again, however, no results are overturned when using alternative bandwidths, within a reasonable range.

[54] The reduced sample with three time periods (decades) contains Australia, Austria, Canada, Finland, France, Germany, Italy, Japan, Korea, South Africa, Spain, Sweden, Switzerland, the UK and the US. The extended sample, covering the 1980-2000 period, adds Belgium, Chile, Israel, Mexico, Netherlands, Norway, Peru, Philippines and Portugal. Countries included in the "European" cross-section are: Austria, Belgium, Finland, France, Germany, Israel, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the UK.

When it comes to explaining these varied dynamics, Figures 2 to 4 suggest a multivariate approach is of the essence. Figure 2 points to a (univariate) explanation, as indices of risk-sharing between European countries appear to have significantly increased in the 90s, yet not outside of European pairs. Yet, Figure 3 implies European countries have specialized over the period, and the structures of production have diverged as a result. No comparable changes can be observed outside of European pairs.[55] These results are somewhat surprising, when compared with the dynamics in Figure 1. Finally, and perhaps most surprisingly, it is amongst non-European country pairs that bilateral trade is estimated to have increased significantly – precisely where cycles correlations have actually fallen.

The evidence based on a reduced sample of countries with observations over three decades is not dissimilar. European correlations still have increased between the 80s and the 90s, although this appears to have followed a (weakly significant) fall between the 70s and the 80s. Non-European pairs, on the other hand, appear to have become increasingly out of phase over both periods. Once again, the dynamics of risk-sharing between European countries has evolved hand in hand with cycles correlations: first a decrease, then a rise. The converse happened between non-European country pairs: first a rise, then a fall, thus not quite in line with the dynamics of cycles synchronization. There were no observable significant changes in indices of specialization, although the estimated densities in Figure 7 suggest weakly significant dynamics occurred mostly amongst European pairs. Finally, bilateral trade intensities hardly changed significantly over any sub-periods, except for increasing between the 70s and the 80s amongst non-European country pairs, once again a subset where the cross-section of cycle correlations has fallen on average.

These estimates illustrate the distinct possibility that the evolution of cycles correlations not be determined only by trade intensity, just as is the case in the cross-section. They also call attention on the possibility that bilateral correlations respond to period-specific changes in the nature of shocks. For instance, the 70s are customarily associated with global (oil) shocks, affecting indiscriminately all sectors in all countries, and thus resulting in higher ρ on average.[56] The panel estimation methods implemented in the next section make it possible to control for this possibility.

[55] An index of specialization based on manufactures only does show that non-European country pairs have specialized over the period. However, it does also confirm that European pairs have too.

[56] Notice however that the non-parametric evidence casts doubt on this possibility, since no universal upward (or downward) shifts in the cross-section of ρ is ever observed.

5.2 Panel Evidence

This section presents panel estimations of the simultaneous system (1)-(2)-(3), that achieve three objectives. Firstly, simultaneity within each period continues to be allowed. Secondly, period-specific effects can be included, and thus the prevalence of shocks of a particular nature over a given time period can be accounted for. Thirdly, it is possible to test for the presence of a time-invariant component specific to each country-pair, and perform the adequate estimation accordingly.

Table 9 presents the estimates of a random-effect estimation of the system (1)-(2)-(3) for both panels, where period-specific intercepts are included, and the coefficients on the exogenous variables are omitted for clarity. The first (last) two specifications focus on the extended two-period (reduced three-period) panel, respectively. For each sample, an equation-by-equation random-effect model is estimated, and contrasted with a TSLS simultaneous approach. The results are overall unchanged relative to the cross-sectional conclusions, albeit somewhat weaker. Firstly, in almost all instances Hausman tests fail to reject a random-effect specification at standard confidence levels, for each equation in the system taken individually as well as for the system as a whole.[57]

Random-effects estimates are roughly in line with cross-sectional ones. In almost all cases, bilateral trade enters with a positive and significant coefficient. The coefficient is still small enough in magnitude to be compatible with existing models, and for the same reasons as in the cross-section. In particular, the coefficient would be higher if S were not controlled for in equation (1), and if the combined impact of specialization and trade were not accounted for through equation (2). As before, countries with similar specialization patterns do trade more, a manifestation of the extent of intra-industry trade in the samples under study. In almost all cases too, countries with similar sectoral production patterns are more synchronized, everything else held constant. Finally, and as before as well, financial integration, as measured by (the lack of) capital account restrictions or the extent of risk-

[57] In the three instances where the Hausman test rejects a random-effect specification with more than a 10 percent confidence level, the difference in estimated coefficients is arising from either the period-specific binary variables or from the index of risk sharing. For instance, when risk-sharing is excluded from the independent variables in equation (1) of specification (iii), the P-value rises to 0.275. Given how they are constructed, the indices of risk-sharing are likely to embed susbtantial measurement error. This, in turn, is likely to magnify the discrepancy between fixed-effects and random-effects estimates, as first-differencing tends to exacerbate measurement error. As a result, rejection by the Hasuman test could be but a manifestation of measurement error in some of the independent variables in the system (1)-(2)-(3).

sharing, does result in synchronized cycles. The (indirect) specialization effects of financial integration are still present (in specifications (ii) and (iv)), although they are somewhat weaker than in the cross-section. In summary, using the panel dimension of the data simply confirms the conclusions based on cross-sections only.

6 Conclusion

This paper estimates a system of simultaneous equations to disentangle the complex interactions between trade, finance, sectoral specialization and business cycles synchronization. A large theoretical and empirical literature is referred to in choosing the sets of instruments necessary to achieve identification. Simultaneity, implicit in most theories, is also revealing empirically. The overall effect of trade on business cycles synchronization is confirmed to be strong, but a sizeable portion is found to actually work through intra-industry trade. Estimates of the link between *inter*-industry trade and cycles correlations, substantially smaller in magnitude, are consistent with existing models, thus arguably solving the trade-comovement anomaly. As previously documented, though never directly, trade-induced specialization has but a weak effect on cycles synchronization.

Patterns of specialization have a sizeable direct effect on business cycles correlation, as two economies with a similar economic structure are significantly more correlated *ceteris paribus*. This is shown to happen mostly because economies grow through evolving stages of diversification, and in spite of the specialization effects induced by financial integration. Finally, business cycles in financially integrated regions are significantly more synchronized, *ceteris paribus*. This remains true even though financial integration tends to result in more specialized economies, and less synchronized cycles as a consequence.

The results obtain across countries, over time and across U.S states. They hold for a variety of sectoral datasets, collected at different aggregation levels, for various measures of financial integration and trade linkages, and for various filtering methods. They suggest an additional item on the list of criteria characterizing Optimal Currency Areas, namely the economic structure of the putative member countries. They also provide some guidance on desirable strategies to model international business cycles, namely allowances for trade within the same industry, and international capital flows that are coordinated internationally.

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Table 1A: Summary Statistics across Countries (153 obs)				
	Mean	Min	Max	Std. Dev.
ρ_Q	0.227	-0.471	0.887	0.337
ρ_Y	0.226	-0.614	0.943	0.351
T^1	0.004	4.93×10^{-6}	0.074	0.008
T^2	0.237	0.001	5.149	0.482
S_{YB}	0.363	0.144	0.655	0.113
S_{Mfg}	0.472	0.149	0.842	0.127

Table 1B: Summary Statistics across States (1275 obs)				
	Mean	Min	Max	Std. Dev.
ρ	0.266	-0.896	0.968	0.387
S	0.577	0.201	1.339	0.200

Table 2A: Unconditional Correlations across Countries						
	ρ_Q	ρ_Y	T^1	T^2	S_{YB}	S_{Mfg}
ρ_Q	1.000					
ρ_Y	0.876	1.000				
T^1	0.324	0.329	1.000			
T^2	0.151	0.181	0.861	1.000		
S_{YB}	-0.451	-0.440	-0.145	0.051	1.000	
S_{Mfg}	-0.320	-0.335	-0.161	0.035	0.360	1.000

Table 2B: Unconditional Correlations across States		
	ρ	S
ρ	1.000	
S	-0.279	1.000

Table 3: Selected Minima and Maxima			
Correlation		Trade	
-0.471	US - Israel	4.93 x 10^{-6}	Mexico - S.Africa
-0.427	Austria - Peru	8.76 x 10^{-5}	Australia - Peru
-0.417	Norway - France	1.07 x 10^{-4}	Peru - S.Africa
0.882	US - Canada	0.029	France - Belgium
0.885	Switzerland - Nlds	0.031	US - Canada
0.887	Austria - Canada	0.074	Nlds - Belgium
-0.896	Texas - S. Dakota	17.06	Vermont - Wyoming
-0.894	Conn. - S.Dakota	17.94	Vermont - S.Dakota
-0.808	Rhode Isl. - S.Dakota	18.92	Vermont - Alaska
0.964	Mass. - Maine	64.36	New York - Penn.
0.967	Florida - Maine	66.95	California - Texas
0.968	Florida - Virginia	67.54	California - New York

Specialization		Financial Integration	
0.144	Australia - Canada	0	Mexico - US
0.158	UK - France	0	Canada - US
0.159	Netherlands - Canada	0	Mexico - Canada
0.591	Japan - Israel	2	Italy - S.Africa
0.621	Finland - Belgium	2	UK - S.Africa
0.655	Mexico - Israel	2	Nlds - Japan
0.201	Indiana - Ohio	0.247	Nebraska - Virginia
0.231	Arizona - Florida	0.287	Kentucky - S.Dakota
0.242	Minnesota - Wisconsin	0.319	California - Rhode Island
1.295	DC - S.Dakota	1.506	Alaska - Wyoming
1.331	DC - Wyoming	1.554	Alaska - Louisiana
1.339	DC - Delaware	1.638	Alaska - New Mexico

Notes: Correlations are based on Band-Pass filtered quarterly data. Trade is based on $T^1$for international data, and a fitted gravity model for intranational data. Specialization is based on UNYB international data, and BEA intranational data. Financial integration is K, a binary variable capturing capital account restrictions across-countries, and RS, the extent of income insurance across states.

Table 4: Equation-by-equation Estimations				
	(i) OLS	(ii) IV	(iii) OLS	(iv) IV
(1) Correlation ρ				
T	0.091 (5.09)	0.144 (6.75)	0.052 (2.80)	0.069 (2.20)
S			-0.373 (4.60)	-0.497 (2.62)
K			-0.077 (1.76)	-0.081 (1.75)
R^2	0.147	0.097	0.262	0.235
(2) Trade T				
Distance	-1.036 (14.46)		-1.074 (13.34)	-0.937 (8.72)
Border	-0.113 (0.35)		0.045 (0.12)	-0.124 (0.26)
Language	0.507 (2.53)		0.622 (2.54)	0.508 (1.65)
GDP Product	0.303 (7.58)		0.297 (6.39)	0.131 (1.78)
S			-0.277 (1.14)	-2.343 (3.62)
R^2	0.672		0.683	0.507
(3) Specialization S				
GDP per capita Product	-0.224 (4.27)	-0.160 (2.70)	-0.223 (3.85)	-0.154 (2.37)
GDP Gap	1.261 (2.73)	0.996 (2.07)	1.258 (2.61)	0.981 (1.96)
T	-0.033 (1.54)	-0.077 (2.70)	-0.031 (1.39)	-0.075 (2.63)
K			-0.100 (2.26)	-0.097 (2.15)
R^2	0.256	0.235	0.249	0.226

Notes: Intercepts are not reported. All variables are in logs, excepted binary ones and correlation coefficients. The instruments in the IV estimations are the gravity variables and K. t-statistics between parentheses.

Table 5: Simultaneous Estimations

	(i) SUR	(ii) TSLS	(iii) SUR	(iv) TSLS
(1) Correlation ρ				
T	0.117 (6.60)	0.159 (7.56)	0.065 (3.53)	0.056 (1.82)
S			-0.406 (5.11)	-0.602 (3.25)
K			-0.078 (1.85)	-0.093 (2.03)
R^2	0.135	0.064	0.257	0.207
(2) Trade T				
Distance	-1.019 (14.67)	-0.973 (14.15)	-1.000 (13.06)	-0.786 (8.29)
Border	-0.040 (0.13)	-0.017 (0.06)	0.086 (0.25)	0.118 (0.41)
Language	0.584 (3.04)	0.604 (3.28)	0.666 (2.93)	0.597 (3.05)
GDP Product	0.325 (8.47)	0.322 (8.67)	0.284 (6.50)	0.210 (3.22)
S			-0.872 (3.79)	-2.715 (4.35)
R^2	0.670	0.668	0.665	0.407
(3) Specialization S				
GDP per capita Product	-0.171 (3.45)	-0.160 (2.90)	-0.226 (4.14)	-0.197 (4.01)
GDP Gap	1.078 (2.47)	1.054 (2.36)	1.534 (3.38)	1.393 (3.48)
T	-0.065 (3.13)	-0.086 (3.15)	-0.058 (2.74)	-0.064 (2.41)
K			-0.100 (2.38)	-0.057 (1.53)
R^2	0.245	0.225	0.231	0.227

Notes: Intercepts are not reported. All variables are in logs, excepted binary ones and correlation coefficients. The instruments in the TSLS estimations are the gravity variables, GDP product, GDP gap and K. t-statistics between parentheses.

Table 6: US States			
	(i) TSLS	(ii) TSLS	(iii) TSLS
(1) Correlation ρ			
$\hat{T}$	0.031 (13.74)	0.032 (14.09)	0.031 (13.84)
S		-0.351 (8.49)	-0.326 (7.64)
Risk Sharing		0.063 (2.28)	0.051 (1.86)
Size			-0.049 (3.51)
R^2	0.176	0.267	0.277
(3) Specialization S			
GDP per capita Product	-0.185 (17.22)	-0.206 (18.21)	-0.206 (18.23)
GDP Gap	0.400 (9.55)	0.405 (9.09)	0.404 (9.08)
$\hat{T}$	-0.033 (17.66)	-0.035 (17.96)	-0.035 (17.97)
Risk Sharing		0.050 (2.81)	0.050 (2.81)
R^2	0.628	0.624	0.624

Table 6: US States (cont.)		
	(iv) HP	(v) GMM
(1) Correlation ρ		
$\hat{T}$	0.029 (12.65)	0.028 (7.44)
S	-0.571 (13.11)	-0.571 (8.52)
Risk Sharing	0.140 (4.95)	0.142 (4.60)
Size	-0.056 (3.94)	-0.042 (2.47)
R^2	0.338	0.341
(3) Specialization S		
GDP per capita Product	-0.205 (18.33)	-0.460 (8.03)
GDP Gap	0.406 (9.23)	-0.131 (0.99)
$\hat{T}$	-0.035 (17.98)	-0.103 (6.46)
Risk Sharing	0.050 (2.81)	0.014 (0.44)
R^2	0.624	0.471

Notes: Intercepts are not reported. All variables are in logs, excepted binary ones and correlation coefficients. Trade between states is a fitted value implied by a gravity model estimated on cross-country data; in particular, $\hat{T} = -1.355*$ ln(Distance) $+ 1.057*$ ln(GDP Product) $- 0.635*$ ln(Population Product) $- 29.834$. t-statistics between parentheses. Risk Sharing measures income insurance between US states, and reports the pairwise sum of β from the regression $\ln \mathrm{GSP}_t - \ln \mathrm{y}_t = \alpha + \beta \ln \mathrm{GSP}_t$, where the cyclical component of all variables is isolated using the Baxter-King filter (except in (iv) and (v)). Size is measured by the pairwise discrepancy in GSP.

Table 7A: Channels to Business Cycles Synchronization	Direct	Indirect
(1) Trade		
Intra-Industry Trade	$\alpha_1\ \beta_1$	
Geographic Trade	$\alpha_1\ \beta_2$	
via Specialization		$\alpha_2\ \gamma_1$
(2) Specialization		
Trade Induced	$\alpha_2\ \gamma_1$	
Finance Induced	$\alpha_2\ \gamma_2$	
Stages of Diversification	$\alpha_2\ \gamma_3$	
via Trade		$\alpha_1\ \beta_1$
(3) Finance		
Financial Integration	α_3	
via Specialization		$\alpha_2\ \gamma_2$

Table 7B: Channels to Business Cycles Synchronization - International Data	Direct	Indirect
(1) Trade		
Intra-Industry Trade	-0.152 (0.096)	
Geographic Trade	0.063 (0.019)	
via Specialization		0.038 (0.058)
(2) Specialization		
Trade Induced	0.038 (0.058)	
Finance Induced	0.034 (0.162)	
Stages of Diversification	-0.530 (0.004)	
via Trade		-0.152 (0.096)
(3) Finance		
Financial Integration	-0.093 (0.043)	
via Specialization		0.034 (0.162)

Table 7C: Channels to Business Cycles Synchronization - Intranational Data	Direct	Indirect
(1) Trade		
Intra-Industry Trade	N/A	
Geographic Trade	N/A	
via Specialization		0.020 (0.00)
(2) Specialization		
Trade Induced	0.020 (0.00)	
Finance Induced	-0.029 (0.01)	
Stages of Diversification	-0.694 (0.00)	
via Trade		N/A
(3) Finance		
Financial Integration	0.140 (0.00)	
via Specialization		-0.029 (0.01)

Notes: P-values between parentheses.

Table 8A: Sensitivity Analysis				
	(i) T^1	(ii) T^2	(iii) HP Filter	(iv) S_{Mfg}
(1) Correlation ρ				
T	0.012 (0.37)	0.069 (1.76)	0.054 (1.72)	0.022 (0.36)
S	-0.832 (4.72)	-1.462 (9.93)	-0.997 (8.87)	-2.920 (24.65)
K	-0.068 (1.61)	-0.169 (2.71)	-0.121 (2.67)	-0.488 (5.61)
R^2	0.221	0.228	0.195	0.103
(2) Trade T				
Distance	-0.576 (6.02)	-0.953 (14.53)	-0.966 (15.25)	-0.879 (13.90)
Border	0.160 (1.07)	-0.239 (0.95)	-0.211 (0.89)	0.159 (0.70)
Language	0.438 (3.70)	0.660 (3.82)	0.675 (3.91)	0.625 (3.77)
GDP Product	0.223 (4.02)	-0.085 (2.02)	-0.092 (2.19)	-0.119 (3.15)
S	-3.035 (5.32)	-0.581 (1.24)	-0.524 (1.12)	-0.567 (1.29)
R^2	0.415	0.601	0.609	0.621
(3) Specialization S				
GDP/cap Product	-0.127 (3.90)	-0.158 (5.07)	-0.183 (5.23)	-0.067 (5.33)
GDP Gap	0.986 (3.80)	0.826 (3.20)	1.172 (4.34)	0.442 (4.18)
T	-0.109 (4.39)	-0.002 (0.07)	0.010 (0.36)	0.002 (0.10)
K	-0.061 (2.51)	-0.120 (3.02)	-0.122 (3.15)	-0.174 (6.03)
R^2	0.208	0.214	0.227	0.147

Notes: All estimations are run using the GMM - Simultaneous Equation method described in Section 2. t-statistics reported between parentheses. Specification (ii), (iii) and (iv) use T^2. Specification (iii) and (iv) use HP-filtered series.

Table 8B: Sensitivity Analysis (cont.) - Yearly Data				
	(v) T^1	(vi) T^2	(vii) HP Filter	(viii) S_{Mfg}
(1) Correlation ρ				
T	0.020 (0.63)	0.091 (3.02)	-0.066 (0.64)	0.085 (1.15)
S	-0.772 (4.39)	-1.053 (7.47)	-3.940 (17.21)	-3.502 (19.17)
K	-0.054 (1.25)	-0.119 (2.24)	-0.326 (2.24)	-0.510 (5.21)
R^2	0.228	0.243	0.182	0.248
(2) Trade T				
Distance	-0.599 (6.11)	-0.977 (15.60)	-0.914 (12.02)	-0.913 (14.37)
Border	0.181 (1.24)	-0.184 (0.80)	-0.147 (0.72)	-0.308 (1.44)
Language	0.451 (3.72)	0.729 (4.22)	0.755 (4.57)	0.699 (3.94)
GDP Product	0.232 (4.30)	-0.111 (2.66)	-0.061 (1.40)	-0.106 (2.70)
S	-2.933 (5.21)	-0.264 (0.58)	-1.241 (2.63)	-0.410 (0.90)
R^2	0.430	0.631	0.503	0.626
(3) Specialization S				
GDP/cap Product	-0.137 (3.73)	-0.258 (6.10)	-0.072 (3.75)	-0.104 (5.51)
GDP Gap	1.022 (3.75)	1.221 (3.87)	0.335 (2.20)	0.534 (3.34)
T	-0.104 (4.01)	0.021 (0.79)	-0.034 (1.27)	0.010 (0.46)
K	-0.064 (2.64)	-0.127 (3.15)	-0.089 (2.49)	-0.174 (6.20)
R^2	0.213	0.243	0.109	0.202

Notes: All estimations are run using the GMM - Simultaneous Equation method described in Section 2. t-statistics reported between parentheses. Specification (ii), (iii) and (iv) use T^2. Specification (iii) and (iv) use HP-filtered series.

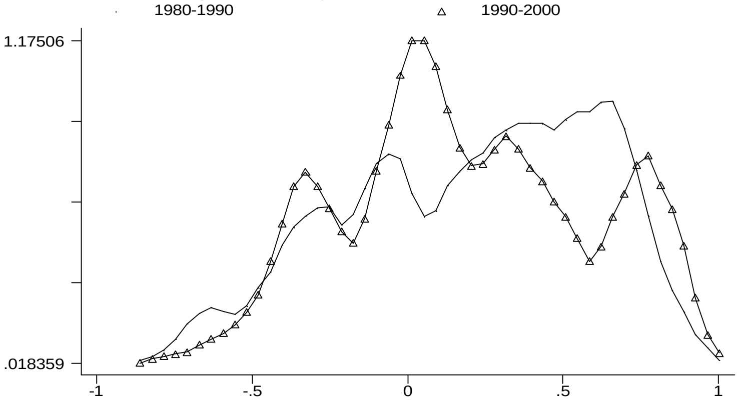
Table 8C: Sensitivity Analysis (cont.)				
	(ix) NER	(x) Inflation	(xi) T^1	(xii) T^2
(1) Correlation ρ				
T	-0.050 (1.29)	-0.041 (1.11)	-0.032 (0.73)	0.108 (3.08)
S	-1.317 (6.99)	-1.263 (6.90)	-1.114 (3.21)	-0.810 (3.18)
K	-0.120 (2.48)	-0.102 (2.14)	-0.084 (1.35)	-0.087 (1.49)
Monetary Policy	0.028 (1.76)	0.017 (1.49)		
Size			-0.609 (0.20)	0.031 (0.98)
R^2	0.168	0.171	0.179	0.241
(2) Trade T				
Distance	-0.548 (6.16)	-0.561 (6.71)	-0.527 (5.11)	-0.978 (15.30)
Border	0.162 (1.19)	0.172 (1.22)	0.151 (1.07)	-0.250 (0.97)
Language	0.445 (4.10)	0.409 (3.76)	0.400 (3.44)	0.677 (3.84)
GDP Product	0.200 (4.11)	0.216 (4.39)	0.212 (3.67)	-0.114 (2.64)
S	-3.050 (5.61)	-2.798 (5.19)	-3.185 (5.42)	-0.466 (0.99)
Monetary Policy	-0.071 (2.52)	-0.051 (2.22)		
R^2	0.416	0.444	0.389	0.618
(3) Specialization S				
GDP/cap Product	-0.100 (3.94)	-0.101 (3.76)	-0.109 (3.26)	-0.237 (5.76)
GDP Gap	0.813 (3.83)	0.900 (4.09)	0.852 (3.04)	1.338 (3.62)
T	-0.117 (5.07)	-0.119 (5.16)	-0.119 (4.55)	0.020 (0.71)
K	-0.067 (2.64)	-0.065 (2.55)	-0.057 (2.35)	-0.125 (3.11)
R^2	0.199	0.200	0.199	0.240

Notes: All estimations are run using the GMM - Simultaneous Equation method described in Section 2. t-statistics reported between parentheses. Size in equation (1) is measured by the (log) GDP product. GDP correlations are computed using quarterly data. Specifications (ix) and (x) use T^1.

Table 9: Panel Evidence				
	(i) RE	(ii) RE - TSLS	(iii) RE	(iv) RE - TSLS
(1) Correlation ρ				
T	0.059 (3.10)	0.096 (3.93)	0.021 (0.61)	0.047 (1.71)
S	-0.175 (2.45)	-0.048 (0.53)	-0.352 (3.07)	-0.581 (4.73)
K	-0.059 (1.71)	-0.081 (2.27)	0.006 (0.12)	0.050 (1.31)
Risk-Sharing	0.018 (0.51)	0.028 (0.77)	-0.002 (0.05)	0.091 (2.28)
R^2	0.152	0.156	0.160	0.180
Hausman Test	0.286		0.005	
(2) Trade T				
S	-0.047 (0.35)	-0.596 (2.92)	-0.227 (1.67)	-1.132 (4.90)
R^2	0.726	0.689	0.741	0.847
Hausman Test	0.900		0.180	
(3) Specialization S				
T	-0.028 (1.57)	-0.110 (5.20)	-0.081 (2.56)	-0.142 (5.40)
K	0.040 (1.44)	-0.032 (1.35)	0.013 (0.33)	0.018 (0.64)
Risk Sharing	0.000 (0.00)	0.035 (1.49)	0.001 (0.05)	0.052 (2.24)
R^2	0.218	0.241	0.195	0.270
Hausman Test	0.040	0.306	0.069	1.000

Notes: In specifications (i) and (ii), all variables are computed over two decades of quarterly data, 1980-1990 and 1990-2000, for a maximum of 276 observations per period (24 countries). In specifications (iii) and (iv), all variables are observed over three periods, corresponding to 1970-1980, 1980-1990 and 1990-2000, for a maximum of 105 observations per period (15 countries). Decades effects are controlled for. The cyclical component of GDP is isolated using the Baxter-King filter. Bilateral trade and specialization indices are decade averages of yearly values. The trade measure used is T_1 and specialization is based on all economic activities. All variables are in logs, except binary ones. In Equation (2), the (unreported) independent variables are the usual gravity measures (kilometric distance, and binary variables taking value one in the presence of a common language or border), as well as the time-varying following ones: economic size, measured by the product of each country-pair's GDPs, indices of contracts repudiation and corruption (on a scale of 1 to 10, as issued by IRIS), Sachs-Warner index of trade liberalization (averaged over each sub-period), import duties, non-tariff barriers and a binary variable taking value one in the presence of a local trade agreement. In Equation (3), the (unreported) exogenous variables are the (log) product of GDP per capita and the GDP gap. Hausman tests report the P-value associated to the null hypothesis that estimates based on fixed-effects and random-effects are not systematically different. A low value rejects the null, suggesting random-effects are not appropriate. Specification (ii) only reports the P-Value for the whole system.

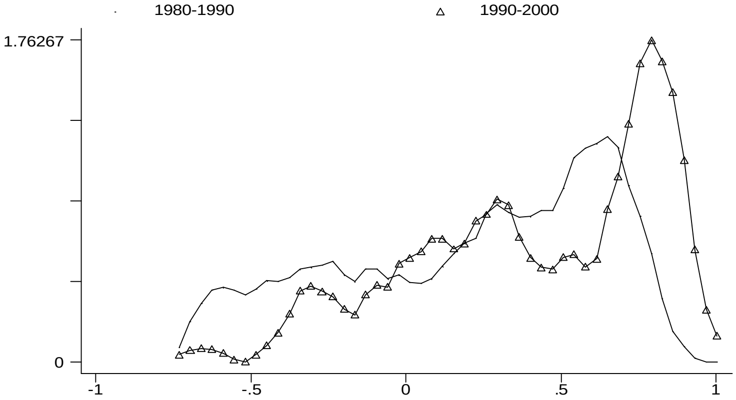
Figure 1: Cycles Correlations



All Correlations - 24 countries, 1980-2000

	1980-1990	1990-2000
Mean	0.2009 (0.024)	0.1858 (0.024)
Nobs	276	276

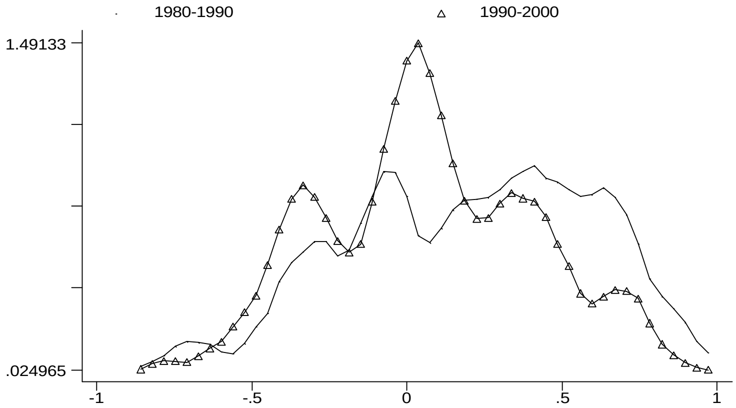
Ho: Equal Means (P-value)		
Ha: Mean Increased	Ha: Mean Unchanged	Ha: Mean Decreased
0.669	0.661	0.330



European Correlations - 24 countries, 1980-2000

	1980-1990	1990-2000
Mean	0.2113 (0.045)	0.4204 (0.041)
Nobs	91	91

Ho: Equal Means (P-value)		
Ha: Mean Increased	Ha: Mean Unchanged	Ha: Mean Decreased
0.000	0.000	0.999

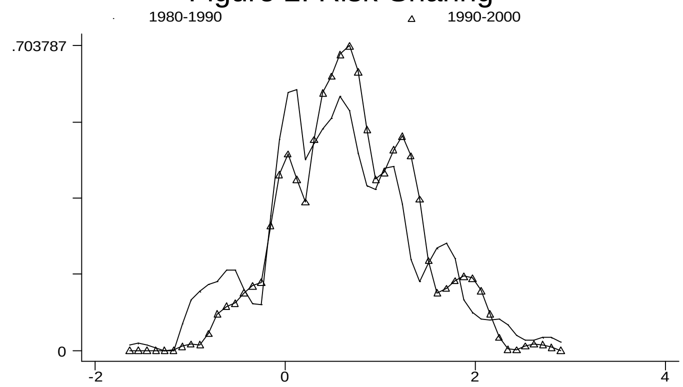


Non-European Correlations - 24 countries, 1980-2000

	1980-1990	1990-2000
Mean	0.196 (0.029)	0.070 (0.026)
Nobs	185	185

Ho: Equal Means (P-value)		
Ha: Mean Increased	Ha: Mean Unchanged	Ha: Mean Decreased
0.999	0.001	0.000

Figure 2: Risk-Sharing



All Risk-Sharing - 24 Countries, 1980-2000

<table>
<tr><td></td><td colspan="3">1980-1990</td><td colspan="3">1990-2000</td></tr>
<tr><td>Mean
Nobs</td><td colspan="3">0.5776 (0.054)
210</td><td colspan="3">0.7012 (0.043)
231</td></tr>
<tr><td colspan="7">Ho: Equal Means (P-value)</td></tr>
<tr><td colspan="2">Ha: Mean Increased
0.035</td><td colspan="3">Ha: Mean Unchanged
0.071</td><td colspan="2">Ha: Mean Decreased
0.965</td></tr>
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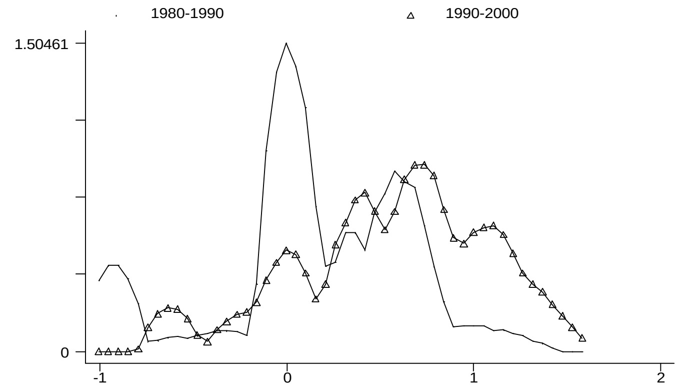

European Risk-Sharing - 24 Countries, 1980-2000

<table>
<tr><td></td><td colspan="3">1980-1990</td><td colspan="3">1990-2000</td></tr>
<tr><td>Mean
Nobs</td><td colspan="3">0.1582 (0.058)
78</td><td colspan="3">0.5610 (0.058)
78</td></tr>
<tr><td colspan="7">Ho: Equal Means (P-value)</td></tr>
<tr><td colspan="2">Ha: Mean Increased
0.000</td><td colspan="3">Ha: Mean Unchanged
0.000</td><td colspan="2">Ha: Mean Decreased
1.000</td></tr>
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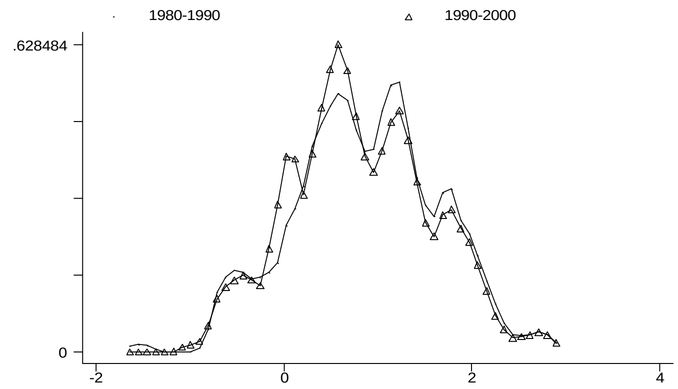
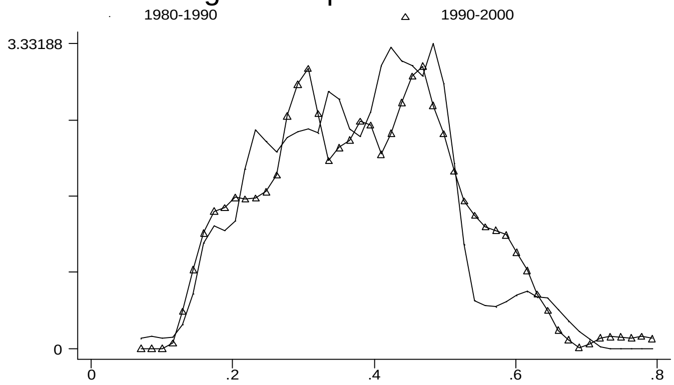


Non-European Risk-Sharing - 24 Countries, 1980-2000

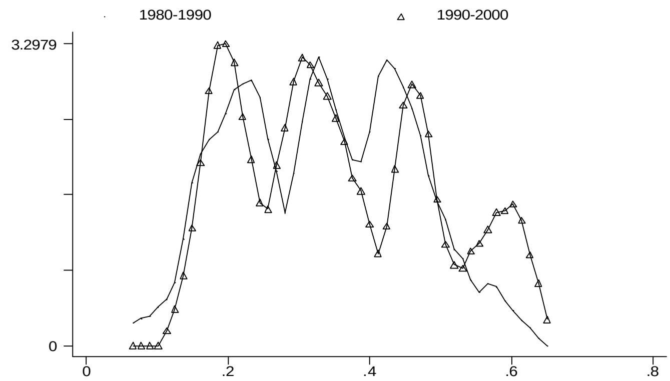
<table>
<tr><td></td><td colspan="3">1980-1990</td><td colspan="3">1990-2000</td></tr>
<tr><td>Mean
Nobs</td><td colspan="3">0.8254 (0.070)
132</td><td colspan="3">0.7727 (0.056)
153</td></tr>
<tr><td colspan="7">Ho: Equal Means (P-value)</td></tr>
<tr><td colspan="2">Ha: Mean Increased
0.722</td><td colspan="3">Ha: Mean Unchanged
0.555</td><td colspan="2">Ha: Mean Decreased
0.278</td></tr>
</table>

Figure 3: Specialization



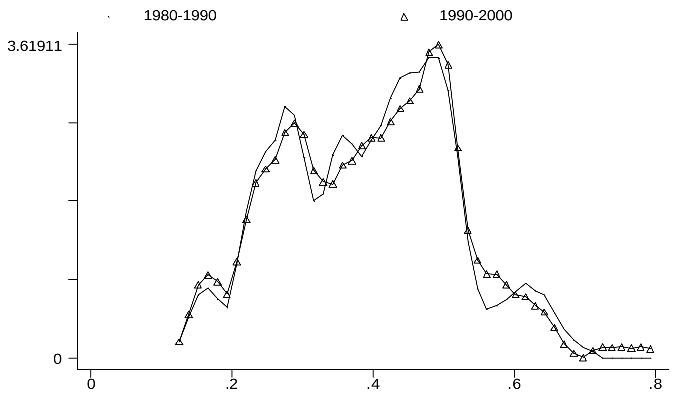
Specialization Indices - All 24 Countries, 1980-2000

	1980-1990	1990-2000
Mean	0.3755 (0.009)	0.3859 (0.010)
Nobs	171	171
Ho: Equal Means (P-value)		
Ha: Mean Increased	Ha: Mean Unchanged	Ha: Mean Decreased
0.226	0.452	0.774



Specialization Indices - European Countries, 1980-2000

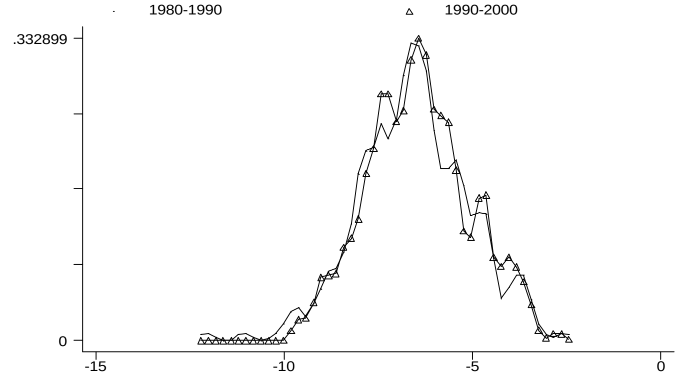
	1980-1990	1990-2000
Mean	0.3335 (0.017)	0.3570 (0.018)
Nobs	55	55
Ho: Equal Means (P-value)		
Ha: Mean Increased	Ha: Mean Unchanged	Ha: Mean Decreased
0.174	0.348	0.826



Specialization Indices - Non-European Countries, 1980-2000

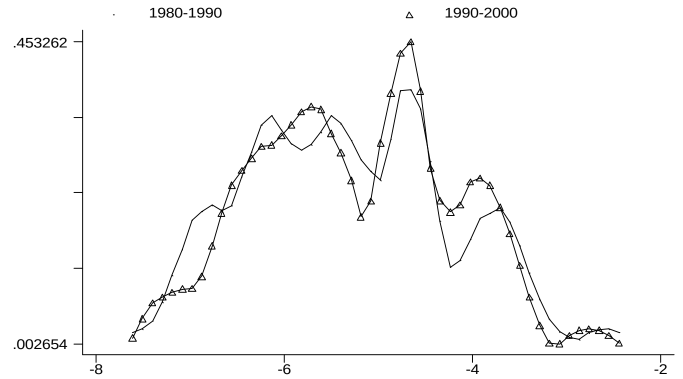
	1980-1990	1990-2000
Mean	0.3954 (0.011)	0.3995 (0.012)
Nobs	116	116
Ho: Equal Means (P-value)		
Ha: Mean Increased	Ha: Mean Unchanged	Ha: Mean Decreased
0.399	0.797	0.601

Figure 4: (Log) Bilateral Trade



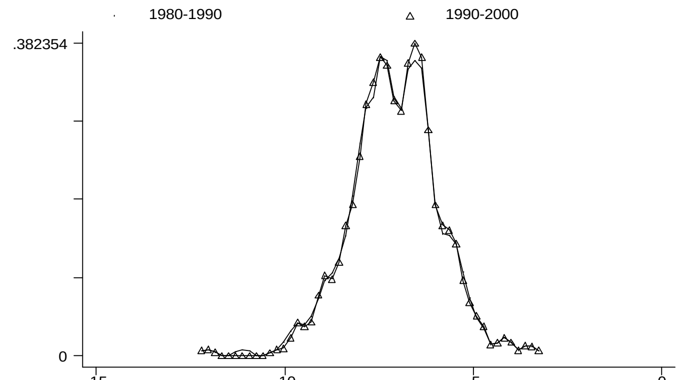
Bilateral Trade (log) - All 24 Countries, 1980-2000

	1980-1990	1990-2000
Mean	-6.562 (0.088)	-6.438 (0.081)
Nobs	276	276
Ho: Equal Means (P-value)		
Ha: Mean Increased	Ha: Mean Unchanged	Ha: Mean Decreased
0.151	0.302	0.849



Bilateral Trade (log) - European Countries, 1980-2000

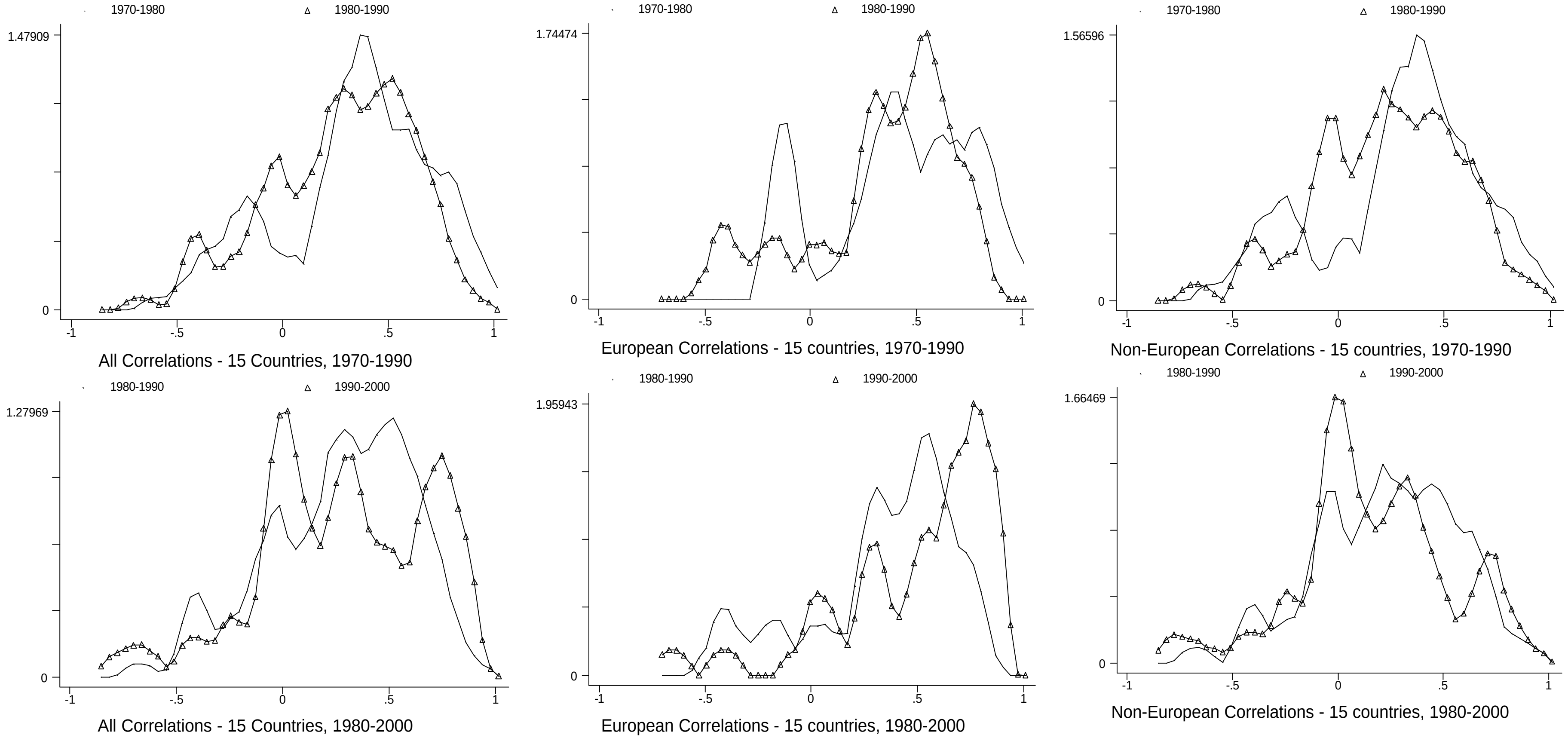
	1980-1990	1990-2000
Mean	-5.323 (0.112)	-5.252 (0.107)
Nobs	91	91
Ho: Equal Means (P-value)		
Ha: Mean Increased	Ha: Mean Unchanged	Ha: Mean Decreased
0.324	0.648	0.676



Bilateral Trade (log) - Non European Countries, 1980-2000

	1980-1990	1990-2000
Mean	-7.172 (0.091)	-7.021 (0.081)
Nobs	185	185
Ho: Equal Means (P-value)		
Ha: Mean Increased	Ha: Mean Unchanged	Ha: Mean Decreased
0.108	0.217	0.892

Figure 5: Cycles Correlations

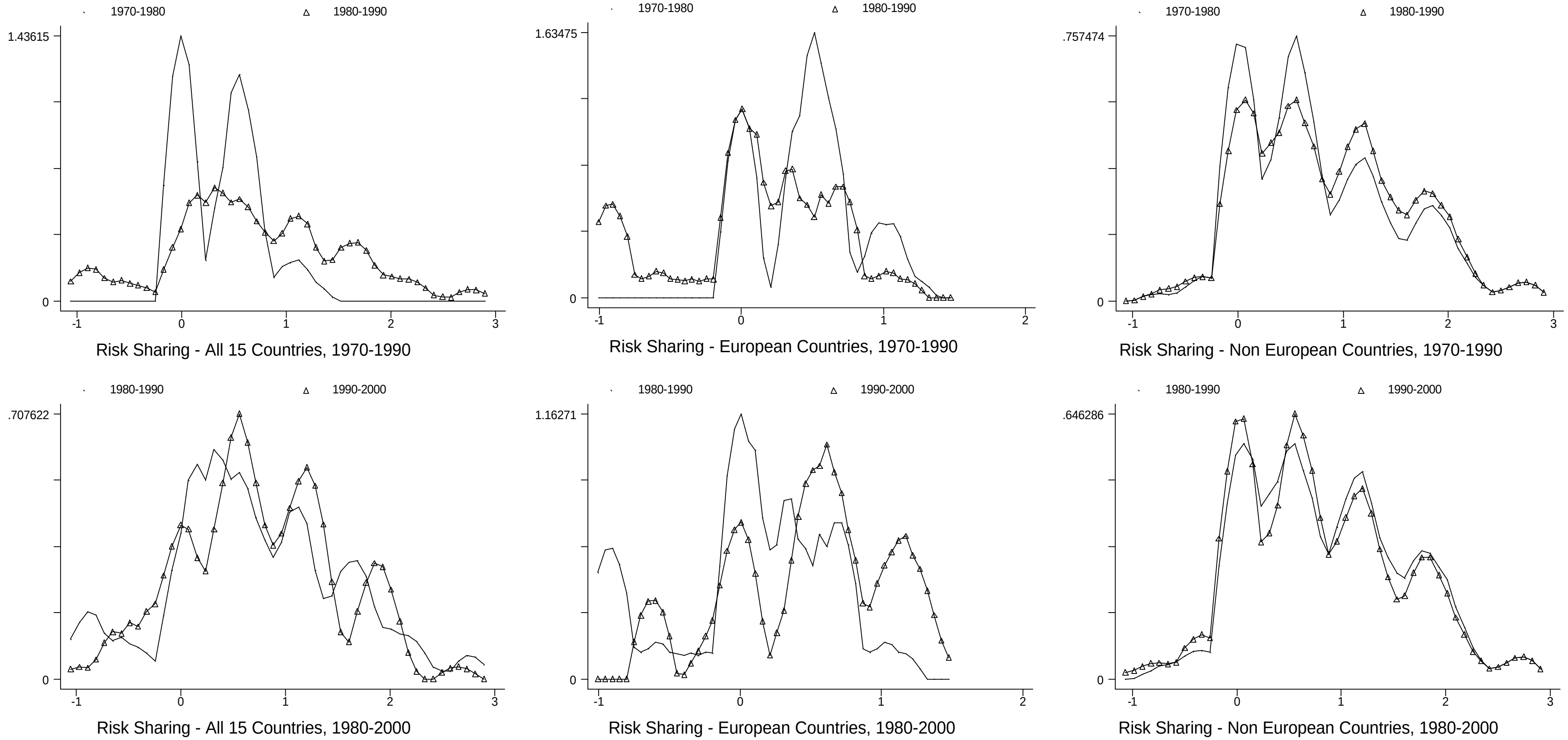


	1970-1980	1980-1990	1990-2000
Mean	0.3375 (0.035)	0.2700 (0.033)	0.2800 (0.038)
Nobs	105	105	105
	Ho: Unchanged Means 70-80 vs. 80-90 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.917	0.166	0.083
	Ho: Unchanged Means 80-90 vs. 90-00 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.426	0.851	0.574

	1970-1980	1980-1990	1990-2000
Mean	0.4223 (0.057)	0.3420 (0.057)	0.4948 (0.061)
Nobs	36	36	36
	Ho: Unchanged Means 70-80 vs. 80-90 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.839	0.322	0.161
	Ho: Unchanged Means 80-90 vs. 90-00 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.036	0.072	0.964

	1970-1980	1980-1990	1990-2000
Mean	0.2933 (0.044)	0.2331 (0.039)	0.1679 (0.044)
Nobs	69	69	69
	Ho: Unchanged Means 70-80 vs. 80-90 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.843	0.313	0.157
	Ho: Unchanged Means 80-90 vs. 90-00 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.864	0.272	0.136

Figure 6: Risk-Sharing

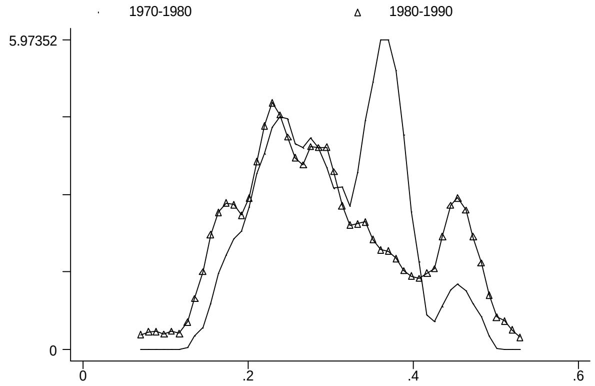


	1970-1980	1980-1990	1990-2000
Mean	0.358 (0.034)	0.711 (0.079)	0.742 (0.071)
Nobs	105	105	105
	Ho: Unchanged Means 70-80 vs. 80-90 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.000	0.000	1.000
	Ho: Unchanged Means 80-90 vs. 90-00 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.384	0.768	0.616

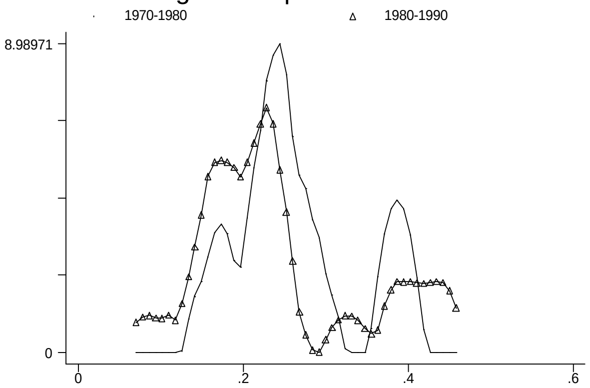
	1970-1980	1980-1990	1990-2000
Mean	0.451 (0.058)	0.099 (0.093)	0.492 (0.092)
Nobs	36	36	36
	Ho: Unchanged Means 70-80 vs. 80-90 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.999	0.002	0.001
	Ho: Unchanged Means 80-90 vs. 90-00 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.002	0.003	0.998

	1970-1980	1980-1990	1990-2000
Mean	0.309 (0.042)	1.031 (0.088)	0.873 (0.092)
Nobs	69	69	69
	Ho: Unchanged Means 70-80 vs. 80-90 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.000	0.000	1.000
	Ho: Unchanged Means 80-90 vs. 90-00 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.889	0.221	0.111

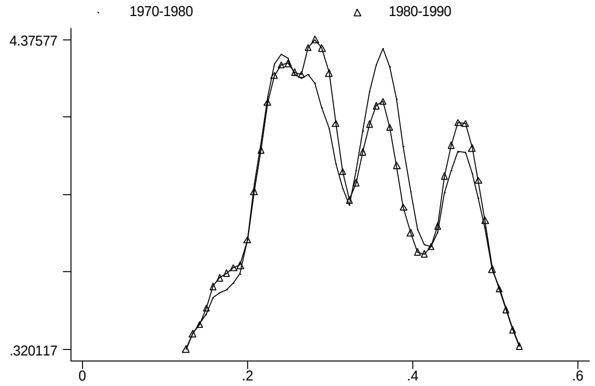
Figure 7: Specialization



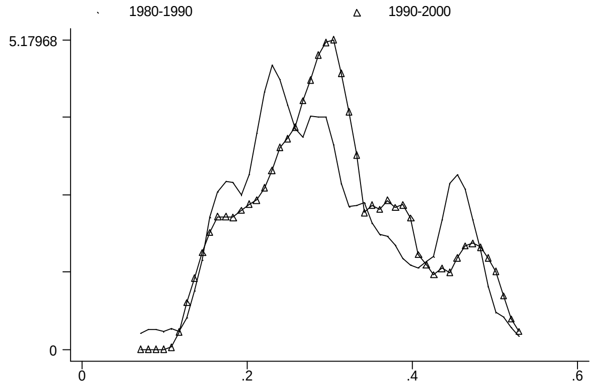
Specialization Indices - All 15 Countries, 1970-1990



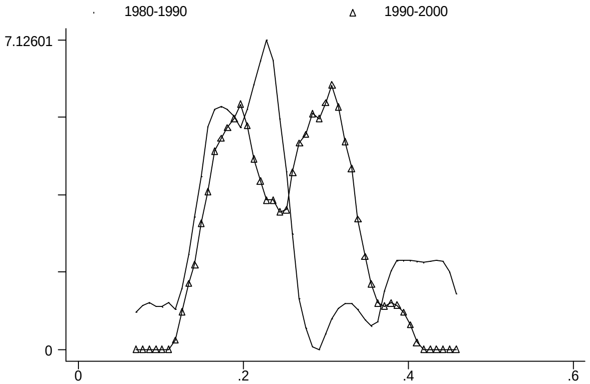
Specialization Indices - European Countries, 1970-1990



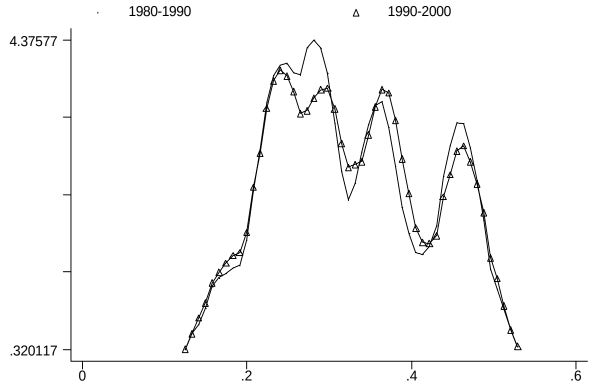
Specialization Indices - Non European Countries, 1970-1990



Specialization Indices - All 15 Countries, 1980-2000



Specialization Indices - European Countries, 1980-2000



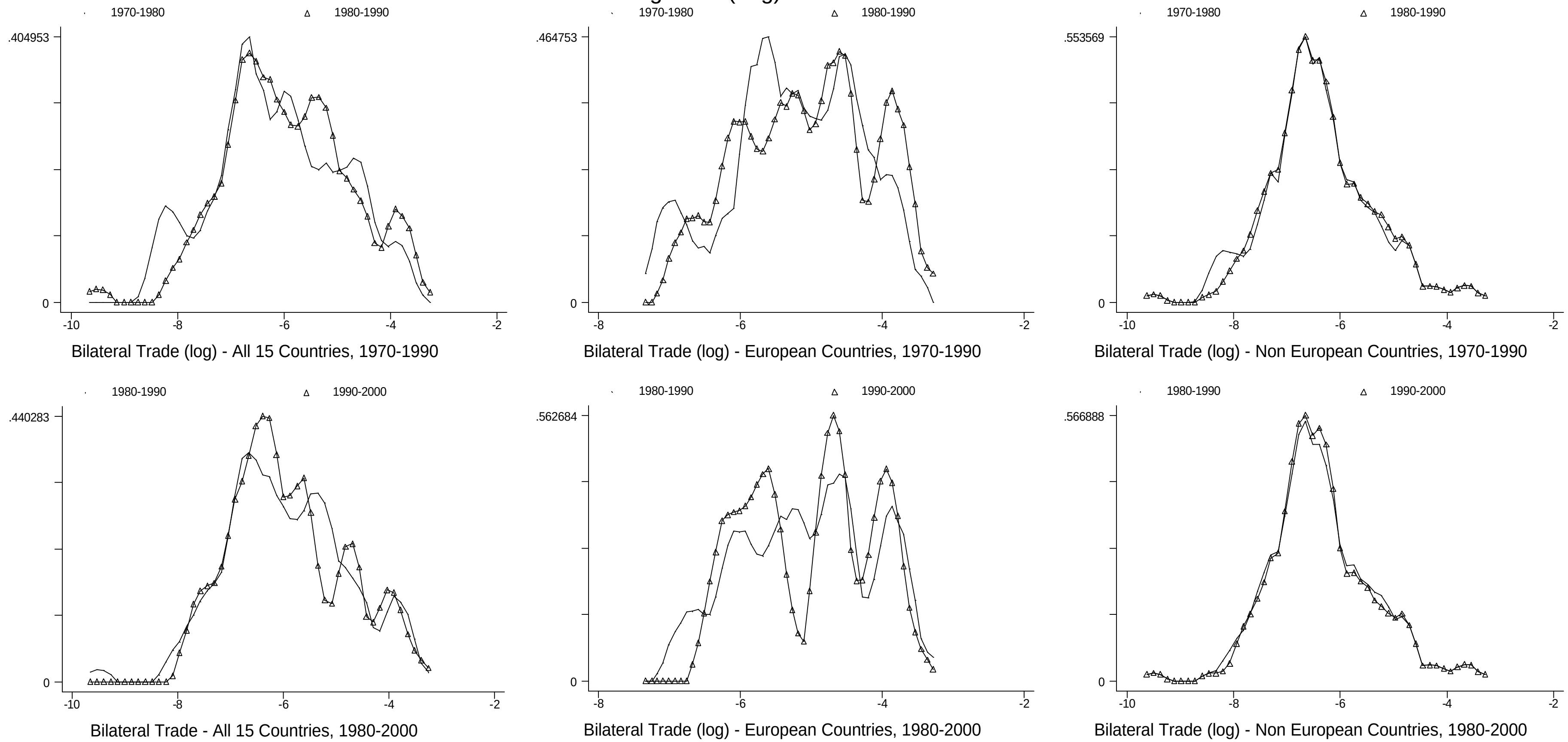
Specialization Indices - Non European Countries, 1980-2000

	1970-1980	1980-1990	1990-2000
Mean	0.3047 (0.011)	0.2967 (0.013)	0.3057 (0.012)
Nobs	45	66	66
	Ho: Unchanged Means 70-80 vs. 80-90 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.669	0.661	0.331
	Ho: Unchanged Means 80-90 vs. 90-00 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.302	0.604	0.698

	1970-1980	1980-1990	1990-2000
Mean	0.2622 (0.024)	0.2407 (0.022)	0.2156 (0.014)
Nobs	10	21	21
	Ho: Unchanged Means 70-80 vs. 80-90 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.725	0.55	0.275
	Ho: Unchanged Means 80-90 vs. 90-00 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.338	0.677	0.662

	1970-1980	1980-1990	1990-2000
Mean	0.3168 (0.012)	0.3229 (0.014)	0.3309 (0.014)
Nobs	35	45	45
	Ho: Unchanged Means 70-80 vs. 80-90 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.376	0.753	0.623
	Ho: Unchanged Means 80-90 vs. 90-00 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.345	0.691	0.654

Figure 8: (Log) Bilateral Trade



	1970-1980	1980-1990	1990-2000
Mean	-6.117 (0.115)	-5.932 (0.112)	-5.905 (0.104)
Nobs	105	105	105
	Ho: Unchanged Means 70-80 vs. 80-90 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.126	0.251	0.874
	Ho: Unchanged Means 80-90 vs. 90-00 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.431	0.862	0.569

	1970-1980	1980-1990	1990-2000
Mean	-5.242 (0.154)	-5.063 (0.156)	-5.025 (0.144)
Nobs	36	36	36
	Ho: Unchanged Means 70-80 vs. 80-90 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.209	0.418	0.791
	Ho: Unchanged Means 80-90 vs. 90-00 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.428	0.856	0.572

	1970-1980	1980-1990	1990-2000
Mean	-6.574 (0.124)	-6.386 (0.118)	-6.365 (0.104)
Nobs	69	69	69
	Ho: Unchanged Means 70-80 vs. 80-90 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.137	0.274	0.863
	Ho: Unchanged Means 80-90 vs. 90-00 (P values)		
	Ha: Mean Increased	Ha: Equal Means	Ha: Mean Decreased
	0.448	0.896	0.552