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The *Intra*national Business Cycle: Evidence from Japan

by

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Abstract: This paper studies the *intra*national business cycle – that is the set of regional (prefecture) business cycles – in Japan. One reason for choosing to examine the Japanese case is that long time series and relatively detailed data are available. A Hodrick-Prescott filter is applied to identify the cycles in annual data from 1955 to 1995 and bilateral cross-correlation coefficients are calculated for all the pairs of prefectures. Comparisons are made with similar sets of bilateral cross correlation coefficients calculated for the States of the US and for the member countries of a "synthetic Euro Area". The paper then turns to an econometric explanation of the cross-correlation coefficients (using Fisher's *z*-transform), in a panel data GMM estimation framework. An augmented gravity model provides the basic model for the investigation, whilst the richness of the data base also allows for additional models to be represented.

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1. Introduction

The *intra*national business cycle is just the set of business cycles that characterize the regions of a country (or, as we shall also use the term, the constituent countries of a currency union). Although less commonly studied[1], analysis of the *intra*national business cycle offers a useful benchmark for comparison with the results obtained from international business cycle analysis. For example, issues of adjustment and of consumption-risk spreading, and more generally many of the predictions of Real Business Cycle (RBC) theory which have been investigated at the international level can also be analyzed at the *intra*national level – often with different results. Those differences provide a challenge for explanation. *Intra*national cycles have also been studied in the past in connection with propositions in the optimal currency area (OCA) literature, particularly with respect to risk-sharing mechanisms and the like.[2] In this last respect Wincoop (1995) and Iwamoto and Wincoop (2000) offer leading examples.

Naturally the OCA perspective is not the only one that should be important in studies of the *intra*national cycle. Indeed, as amplified below, many of the variables that determine or are alleged to determine the degree of international business cycle convergence, can have no salience in the study of the *intra*national context. We have chosen to investigate the *intra*national business cycle in Japan. An advantage of choosing Japan is that a relatively lengthy time series and reasonably comprehensive set of regional accounts and factor endowments exists for Japan's 47 prefectures.[3] Furthermore, the regional context of the *intra*national cycle draws attention to the need, instead, to take up some of the themes and insights contained in traditional (Heckscher-Ohlin) and new trade (the gravity model) theory, the new economic geography (Fujita, Krugman and Venables, 1999; Fujita and Thisse, 2002) and the factor basis for production and trade

[1] Of the handful of previous studies of the *intra*national business cycle among the better-known are those by Wynne and Koo (2000), Hess and Shin (1999 and 2001) Del Negro (2001) and HM Treasury (2003).

[2] Traditional OCA theory (as identified with Mundell ,1961) points towards a trade-off between trade and integration benefits against a loss of monetary sovereignty. The latter is assumed to imply a loss of regional stabilization policy benefits. A high correlation between regions' business cycles resolves the trade-off because the common monetary policy of a currency union then appears appropriate for all the regions.

[3] See Table E for 47 Japanese prefectures list for details.

(foreign direct investment (FDI), fragmentation and "task trade").[4] These literatures in recent years have seen greater attention paid to regional aspects.

In the next section we discuss ways to extract the cycle and provide some comparisons with other *intra*national cycles; we show that the cohesion of the Japanese *intra*national cycle, whilst pronounced for the recent period and in comparison with other countries, exhibits some effects of the dramatic changes that the Japanese industrial structure has undergone. In the subsequent section we move on to an attempt to explain the set of bilateral cross-correlations in the cyclical deviates (and their variation through time) that we identify for each of the regions. We recall that another purpose of an *intra*national cycle investigation such as this is to measure and identify the extent and nature of the risk-sharing mechanisms that exist. Whilst further investigation of this is the topic of a further paper we shall note some graphical evidence of the extent of consumption risk-sharing in Japan, which appears considerable.

Our main findings are that 1) Japanese prefectures have fairly high positive business cycle correlations over several decades, although the imbalance of economic growth across regions and factor movements in earlier years exacted a toll in reducing the synchronicity of the regional cycles then. The high cross-correlations reflect the homogeneity of Japanese society (law, political and economic institutions, culture, and language) and support an optimal currency area. 2) Augmented gravity model variables have considerable explanatory power in explaining the cross-correlations. Higher GDPs, greater openness in trade and smaller distance between prefectures increase the correlations. Market potential has a U-shaped relationship with the business cycle correlation measure: pairs of low or high market potentials have higher correlations. 3) The most recent decades (1980s-1990s) see more explanatory power in the capital-labor ratio gap: a larger capital-labor factor endowment gap synchronizes the *intra*national business cycle. These findings might be explained by the impact of globalization and fragmentation of production processes across regions.

The paper is organized into 7 sections. The next section seeks to identify business cycles and correlations across prefectures. Section 3 reviews Japanese economic history in the post-war period and Section 4 conducts an econometric analysis. Section 5 provides some interpretations using previous studies, linked with several literatures. Then

[4] Bergstrand (1985) explained the gravity model in new trade theory. Grossman and Rossi-Hansberg (2006) proposed "task trade" to explain the fragmentation of production processes.

Section 6 touches on the linkage to consumption-risk sharing. Finally, Section 7 sets out some conclusions.

2. Identifying the Business Cycle

Traditional business cycle analysis recognizes two types of cycle. There is the "classical" cycle, which can be recognized from the fact that it involves an *absolute* decline in economic activity from the peak and an *absolute* rise in activity from the trough. The NBER for the US and the CEPR for the Euro Area provide chronologies of such cycles. Clearly such cycles do not exist in growth economies and they are relatively rare for European economies and for Japan. The other type of cycle is a deviation or growth (occasionally growth *rate*) cycle where the underlying idea is that the business cycle can be identified as a cycle relative to a trend. It is the concept of the deviation cycle that we work with here. Consequently we need to use some kind of filter to provide a measure of the trend, so that the cycle can be identified as the deviation from this trend. In our case, where the original data are annual, there is a reasonable presumption that high-frequency noise (seasonal and the like) is already filtered out. On this basis we use a Hodrick-Prescott (HP) filter with a *lambda* value (dampening factor) set at 6.25, following the suggestion of Ravn and Uhlig (2002): this corresponds to a maximum periodicity of the cycle of 10 years just as the popular *lambda* value of 1600 does for data at a quarterly frequency.[5] The filter has been applied to the log of the GDP series for each prefecture and for Japan as a whole. Figure 1 shows the national Japanese cycle identified in this way and, alongside it the cycles for Tokyo, for Osaka (the second largest city) and for Aichi (the capital city of which is Nagoya, the third largest city in Japan). Perhaps not surprisingly the cycle for Tokyo follows that for Japan very closely: Tokyo itself accounts for 15 to 20 per cent of Japanese GDP and the Tokyo Area for 30 per cent over recent decades.[6] It is clear from the Figure that Osaka and Aichi (Nagoya) follow the national cycle less closely, with more volatility being evident.[7]

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[5] There remains a degree of controversy about the procedure, as exemplified most recently in the paper by Meyers and Winker (2005), following earlier papers by Harvey and Jaeger (1993), Burnside (1998) and Canova (1998) among others. However, an effective countercriticism can be found in Kaiser and Maravall (2001, 2002).

[6] The Tokyo Area is defined in our paper as Tokyo, plus its adjacent prefectures of Kanagawa, Saitama and Chiba. In population size, Tokyo accounts for less than 10 per cent in total over recent decades, but the Tokyo Area has 30 per cent.

[7] Generally, the more localized regional business cycle might be expected to be more volatile than the aggregate national cycle to the extent that more localization implies more specialization.

Our basic tool of analysis from here on is the bilateral cross correlation between the cyclical deviates for any (and all) pairs of prefectures *i* and *j*. When econometric explanation is attempted we use Fisher's *z*-transformation of this cross-correlation of HP-filtered GDPs to remove the potential limited dependent variable problem.[8] The bilateral cross correlation tools can be used to compare the Japanese *intra*national cycle with that for the US (US gross state product (GSP) data being used) and with that for a synthetic Euro Area (the data are just the data on the national business cycles for the countries that eventually formed the EuroArea-12, i.e. prior to the entry of Slovenia into the Euro Area)[9]. US *intra*national data have been used before, as providing a presumptive benchmark for a currency area to reach (see Hess and Shin, 1998; Wynne and Koo, 2000; HM Treasury 2003), whilst the countries forming the Euro Area have indeed formed a new currency union. Figure 2 shows the distribution of the bilateral cross correlations of the cyclical deviates for the 50 States over the periods 1990-1997 and 1997-2005 whilst Figure 3 does the same for the EuroArea-12 countries over the period 1975-1995. Turning to our discussion of the GDP correlation across Japanese prefectures, Figures 4-7 provide the same information for Japan, taken over 4 separate sub-periods (1955-1964, 1965-1974, 1975-1984, and 1985-1995).[10] It is clear that the Japanese distribution changed shape over the period considerably, reflecting what we know to be some turbulent periods of structural change. The more recent of the distributions suggests a greater degree of cohesion (fewer or no negative values and a bunching around quite high values) than can be found in the earlier periods or for the other countries. Figure 8 shows a time series generated as the 10-year moving average of the (unweighted) mean (the upper panel of the Figure) and variance of the cross correlations (the middle panel of the Figure) which indicate quite a lot of movement, especially in the earlier years. The average and the variance are likely to be related, as for example when common shocks dominate –yielding both high mean and small variance. The upper and middle panels of Figure 8 indeed show a striking negative relationship between the two: when the mean is high, the variance is low and vice-versa. The middle terms around from period 12 to 18, i.e. the 1970s, as well as the latest terms (period 31), i.e. 1990s, experienced nearly zero

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[8] See the section "definitions" in the Data Appendix for Fisher's *z* transformation.

[9] Euro-12 countries are composed of Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain. See Data Appendix for data source.

[10] See Tables A-D for HP filtered GDP cross-correlations, correspondent to the histograms of Figures 4-7. We have done the same for the full period as well as the two sub-periods. As a result, we can find similar results to the four-sub-sample case.

variance and nearly unity in mean.[11] The bottom panel of Figure 8 shows the scatter-plot of variance against mean and the time-dated combinations of these variables. The figure shows how the Japanese experience has involved over time an oscillation between high-variance-low-mean and high-mean-low-variance attractors. Over the last two decades the latter has been the dominant attractor. These results suggest that the Japanese GDP correlations are high and convergent in most periods and stated differently, Japan is composed of highly correlated prefectures.

Next, Moran's I and Geary's C statistics, which test for *spatial autocorrelation* (Moran, 1948, 1950; Geary, 1954), indicate an absence of this phenomenon throughout the sample period: values of these indices are shown in Appendix 1. Almost zero in Moran's I and almost one in Geary's C imply that GDP fluctuations are spatially random and thus have no positive nor negative correlations with neighboring prefectures (Figure A).[12] [13] Finally, Figure B marks the geographical distribution of the cyclical correlation of each prefecture with total Japan. The dense (bright) colors indicate higher (lower) correlation with the Japanese national cycle. Central prefectures are likely to have high values. However, it is quite difficult to see any spatial correlation; rather the maps seem to agree with the "no spatial autocorrelation" outcome provided by the Moran's I and Geary's C statistics. The correlation seems to be spatially random over time. As explained briefly below, the economic history of Japan from the 1950's on has reflected considerable structural change.

3. The Japanese Economy over Decades

Before contemplating a factor analysis of the business cycle correlations across the prefectures, we review the development in the Japanese economy over the post war years to support our discussion.

The Japanese economy in the post-war period (in the 1960s and 70s before the first oil shock) experienced a dramatically high growth rate. At the same time, Japan experienced a notable convergence in income across regions. Many studies concerning the Japanese prefectures observed the convergence of income (GDP per capita) and

[11] Obviously the concept of business cycle convergence should be distinguished from that of income convergence, studied in the Japanese context by, among others, Barro and Sala-i-Martin (1992b) and Shioji (1991).
[12] The fact of the absence of spatial autocorrelation, as shown in Figure A in the Appendix, tells us that we need not use spatial econometrics concepts to explain the cross-correlations.
[13] See sectoral HP filtered employment cross-correlations for Appendix 2 and Table C.

economic growth across the prefectures in the post-World War period, although we note that our main focus is business cycle correlation. Barro and Sala-i-Martin (1992a) (1992b) explained regional convergence as a result of technological progress and growth in factor endowments appealing to the Solow growth model (Solow, 1956).[14] Yue (1995), focusing on factor endowments and mobility across prefectures, showed that public capital accumulation as a result of government policy played a role in the convergence of GDP per capita. In particular, public capital moved toward low labor productivity prefectures, while private capital tended to flow to high labor productivity prefectures. Barro and Sala-i-Martin (1992b) and Shioji (1991) by contrast showed that labor mobility contributed to the convergence of GDP per capita across Japanese prefectures. Because labor moved to higher income prefectures, the income distribution across prefectures converged. Fukao and Yue (2000) suggested that larger public capital accumulation and higher human capital growth in poor prefectures contributed to the catch-up on the high income prefectures from 1955 to 1973. However, technological improvement and growth in the working force contributed to income convergence after 1973.

Turning from economic growth to change in the industrial and urban structure, the middle of the 1970s is generally recognized by students of Japanese history as an important turning point, the oil crisis bringing to an end the period of rapid economic growth. Many changes occurred inside Japan during the period of rapid economic growth – the period of the 1960s and the early 1970s. As shown in Fujita and Tabuchi (1997), industrial structure changed from a concentration on heavy industries to high-technology and service sectors. In the 1980s, the electronics sectors expanded dramatically. Japan also experienced a regional transformation, which shifted from a bipolar urban system centered on Tokyo and Osaka to a mono-polar system centered on Tokyo. According to Fujita and Tabuchi (1997, Figure 6), the major metropolitan areas (Tokyo, Osaka and Nagoya) witnessed labor inflow (net migration) until the early 1970s continuing from a peak in the previous decade. After the mid-1970s, the Osaka and the Nagoya areas declined considerably and experienced zero or negative net migration, while Tokyo retained a positive net migration (positive labor inflow). This led to the predominance of Tokyo as a population and economic center in Japan.

Then we turn to geographical aspects. The Taiheiyou (Pacific Ocean) Belt manufacturing area, the belt shaped area from Tokyo through Osaka to Fukuoka (South

[14] Kawagoe (1999) re-estimated their regressions in Japanese prefectures using a Markov chain model.

West Japan), was created during the phase of Japanese industrialization before World War II, in which Keihin area (Tokyo and Kanagawa), Chukyou area (Aichi, Mie and Gifu), Hanshin area (Osaka and Hyougo) and Kita-Kyushu area (Fukuoka) are central clustering areas of major heavy and light industries. The dramatic development of railway and highway networks after the mid-1960s created various kinds of manufacturing clusters in many other areas -if mainly in the Taiheiyou (Pacific Ocean) Belt areas in early periods then subsequently in other areas as Japan acquired a good transportation network access in later periods. After the 1980s, together with the completion of the spread of transport network systems all over Japan, the Japanese economy saw a large-scale unbundling of tasks and fragmentation across the Japanese regions, and then firm location was split by the characteristics of tasks, i.e. production process, correspondent to regional factor endowments. In detail, the spread of the highway and high-speed train networks all over Japan promoted the relocation of mass production points to rural areas, leading to the unbundling of tasks (Fukao and Yue, 1997).[15] Furthermore, since the late 1980s the Japanese manufacturing has increased FDI toward Asia in labor intensive production processes and increased re-imports of parts and components (Fukao, et al. 2003).[16] Together with these changes, headquarter services and business points, i.e. human capital intensive production processes, have concentrated heavily in Tokyo area and other big cities. Together with globalization, many manufacturing and non-manufacturing (particularly, service) sectors inside Japan have franchised, merged or spread firm/establishment networks across Japanese regions owing to the development of telecommunications and transportation networks and this causes the exit of local/ regional firms and business. This history of structural change needs to be reflected in our estimation procedures as indicated below.

4. Explaining the Cross-correlations

In this section of the paper we turn to the study of the pattern of cross-correlations that we found in the regional business cycle data in Section 2. Such studies, using panel data estimation techniques, have become common in the international business cycle

[15] Fukao and Yue (1997) examined the relocation of electronics machinery production in the period.
[16] Japan steadily reduced tariff rates and trade barriers. Japan saw a large increase in both exports and imports with a reduction in the national "border effect" (Okubo, 2004) over recent decades. In addition, volumes of FDI and service trades greatly increased in the 1980s and 1990s.

literature, particularly since the papers by Frankel and Rose (e.g., Frankel and Rose 1997, 1998) which initiated the use of large scale panels in this field. The principal object of this literature (see Gruben et al (2002) for a conspectus) was to establish the relationship between trade between countries and the synchronization of their business cycles. The development of the subsequent literature in the field has exploited the notion of a business cycle as a product of a shock followed by a transmission mechanism; intra-industry trade (or at least, horizontal intra-industry trade) – e.g., Fidrmuc (2004), Fontagné (1999) - has been treated as evidence of a common vulnerability to shocks and thus as predisposing to a high cross-correlation in business cycle experience whilst inter-industry trade (and vertical intra-industry trade) suggest a degree of specialization likely to result in a high frequency of idiosyncratic shocks, ultimately reflected in low business cycle cross-correlations. Albeit Kenen (2000) has reminded us that “thick” trade connections are liable to produce a shared business cycle fate regardless. The study of the international business cycle has led also to the reflection that differences in the propagation mechanism (including differences in policy response and even linguistic and genetic differences (e.g. Spolaore and Wacziarg, 2006)) are liable to produce a different business cycle. It is clear that many of these elements can have no salience in the setting of the *intra*national cycle, where institutions and markets important to the propagation mechanism are “national” in character and scope. This seems especially true in the case of Japan which is ethnically homogeneous and benefits from institutions, markets and welfare and taxation systems which are national in their scope and character. At the same time, for the prefecture system we are dealing with here trade data (though some can be retrieved for an alternative level of localization) simply do not exist.[17] Nevertheless, as will become clear below, the basic idea of choosing as explanatory variables those that might reasonably proxy a common – or an idiosyncratic – vulnerability to shocks (and hence predispose towards high or low cross correlations respectively) are ones with some potential salience for the problem in hand. At the same time, the notion that any thick flow of trade is likely to imply a common fate in the face of external shocks suggests that any variables that might proxy trade (as those suggested by the gravity model for example) will prove useful explanators.

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[17] Japan has regional trade data sets in the Inter-regional input-output (IO) Table assembled by METI (Ministry of Economy and International Trade of Japan). However, the data are published every five years (not annual data) and are not at prefecture level (47 prefectures) but regional level (9 regions). For these reasons, the data sets are out of our scope. There are a few studies measuring the direct impact of regional trade (Clark and van Wincoop, 2001; Chen 2004; Martincus and Molinari, 2007).

Data issues on one side there are some other important considerations to be taken account of here. First, as already mentioned above, the incidence of structural change reflected in other studies suggests that it will be unreasonable to treat the period as homogeneous.[18] Instead, we have broken the sample into four sub-periods of ten years each, averaging the variables over these decades and applying panel data estimation techniques. We also have to expect that as a result of structural change some variables identified as significant in some periods may not be so important in others. Second, general considerations suggest that there will be a substantial amount of endogeneity in the data, which requires the use of an appropriate estimation technique: here, after some (unreported) experimentation with OLS and GLS we decided to use GMM, nominating as instruments the lagged values of our independent variables[19]. Third, the left hand side dependent variable, the set of bilateral cross-correlation coefficients, is potentially a limited dependent variable as the values are bounded between -1 and +1; to overcome the potential bias involved in not recognizing this we applied the Fisher "z" transformation to the data. This implies that the estimating equation takes the following general form:

(1)
$$\frac{1}{2}\log\left(\frac{1+\rho_{ijt}}{1-\rho_{ijt}}\right) = \beta_t\left[X_{ijt}\ldots\right] + D_t + D_i + D_j + \varepsilon_{ijt}$$

where *i j* denote prefecture pairs, *i* and *j*, and *t* is a time subscript. ρ_{ijt} is the HP filtered GDP cross-correlation between prefectures *i* and *j* at time *t*. D_t and D_i, D_j denote time and prefecture dummies respectively, whilst X_{ijt} denotes the explanatory variables employed in the estimation. Following the argument above we consider as independent variables (generally expressed as the product of the values for prefectures *i* and *j*) all of the following: market potential, squared market potential, GDP, private sector capital stock, public sector capital stock, infrastructure, labor, human capital, openness, area, geographical distance, a dummy for adjacency, manufacturing ratio, and specialization index. Note that all factor endowment variables are expressed as a per-capita basis. These

[18] The reason of taking such 4 sub-samples is that almost every ten years from 1955 Japan experienced critical changes. For instance, the high-speed transport system and highway networks were first developed in the middle 1960s, and then a rapid economic growth period provided until the middle of the 1970s, but main manufacturing sectors shifted to machinery after the oil crisis after the middle 1970s, and then the Plaza Accord of 1985, which appreciated Japanese yen, promoted the Japanese FDI and international trade. The highway networks and transport system were spread all over Japan and were completed in the middle of the 1980s. This affected firm location together with globalization.
[19] Using these same instruments IV (instrumental variables) estimation produces the same point estimates of coefficient values though significance levels differ.

are all more or less self-explanatory but a detailed definition of each appears in the Data Appendix.

Before discussing the estimation results in any detail we briefly consider what signs we might associate with these variables. For distance, we would expect that a negative sign would be obtained as is the gravity model. For openness, we expect a positive sign. Measures of industrial structure seem attractive because they should proxy vulnerability to common shocks if similar and to idiosyncratic shocks if different. Measures of GDP are often employed as the "mass" variable in gravity trade models and to that extent should be expected to have a positive coefficient here. Market potential is a composite distance-weighted GDP variable which might be regarded as an alternative measure of mass, and hence also could be expected to carry a positive sign.[20] However, this expectation is not as clear-cut as first appears. Figure 9 plots the median spline of HP filtered GDP cross-correlations in terms of market potential from period 2 to 4. The market potential (given that the variable is entered as a product) will have high values when two large regions are considered and low values when two small regions are considered. Considering these limiting values a positive sign would be anticipated but the intermediate range combines large and small regions and medium-size and medium-size regions and across these the sign is less obvious. In consideration of this the variable has been entered in quadratic form, with results that vindicate the choice (see the discussion of the results below)[21].

While implicit trade in the gravity equation is intra-industry trade between two regions with similar productions (GDPs) (Helpman and Krugman, 1985), the one explained by the Heckscher Ohlin theorem is inter-industry trade or task trade due to fragmentation in production processes between two regions with different productions and different factor endowments (Grossman and Rossi-Hansberg, 2006). The Heckscher Ohlin theorem suggests that labor abundant regions export labor intensive products and capital abundant regions export capital intensive products. We use a measure of the capital labor ratio gap in the estimation when this is significantly positive, we obtain a confirmation of the hypothesis. The variable "public sector capital" (per capita) turns out to be quite significant, possibly because the practice of successive Japanese governments has been to reward lagging areas with substantial public sector infrastructure investment (per capita), so that the variable acts as a "branding" or for other reasons. The paper

[20] See Data Appendix for more detail on market potential.
[21] We owe to George Chouliarakis a valuable discussion of these points.

proceeds from here by first considering in brief the estimation results, then in Section 6 expanding on the interpretation of the results.

Let us see how these presumptions are borne out in the estimation. Given the historical association in the literature between trade and business cycle synchronization we can start with a simple model which predominantly reflects the gravity model of trade. In many of the papers mentioned above (including the "foundation" papers of Frankel and Rose (1997, 1998) the authors instrumented trade by the predictions of a simple gravity model. Here we can look to variables measuring "mass" and distance as in the simple model, supplemented by measures of openness and a dummy for a shared border. Mass can be represented (as usual) by GDP and accompanied by distance. Or the distance-weighted measure of market potential can be used, with (here) a negative effect on the level of the variable but a positive effect on the squared value. Table 1 shows the results of starting from such a model; as in the remaining estimations to be discussed, constant term and prefecture dummies are also included with the latter not shown in the interests of saving space (they are, commonly, significant). Starting from the classical gravity model, the first set of results (the first and second columns of Table 1) yields the expected positive sign on GDP products and the expected negative sign on distance.[22] Similarly, measures of area and the border dummy, though themselves not changing with time, could have time-varying effects but allowing for time-varying coefficients on these variables also proved an unprofitable exercise. The second set of results shown in Table 1 (the third to the fourth columns) brings into play an additional variable – market potential – alongside GDP and also introduces openness. As we predicted, squared market potential terms are significantly positive whilst market potential terms are significantly negative for periods 2 and 3. In period 4 we cannot see any significant relationships. This implies that the market potentials have the U-shaped relationship with HP-filtered GDP correlations except period 4, consistent with Figure 9. In the third set of estimates reported in Table 1 (the fifth column) a further measure, "gap", is introduced: this is the absolute difference in GDP per capita between prefectures i and j. As can be seen, this is significant, but to an extent and with a sign that varies between the periods. The variable, "openness", is mainly significantly positive. Two prefectures with high openness are highly correlated with each other due to high interdependencies through more trade flows.

[22] In principle, the effect of distance could vary through time but when we made allowance for this the result was often to produce insignificant values of the coefficient.

In Table 2, the "gravity model" variables are supplemented by others relating to factor endowments. Human capital is likely to be significantly positive. The variable relating to public sector capital stock and infrastructure have a negative sign, perhaps reflecting the "branding" argument that we mentioned above. As we expected, capital-labor ratio gap between two prefectures have positive relations with GDP cross-correlations. In particular, whilst market potential becomes insignificant the capital labor ratio gap becomes significantly positive in period 4. Interestingly, we can say that GDP correlations in period 4 can definitely be explained by the Heckscher-Ohlin theorem rather than the Gravity equation.

In Table 3 the bank of explanatory variables is further augmented by variables relating to the role of manufacturing in the prefecture. Though it is not so obvious, in some cases the manufacturing percentage of the prefecture in total manufacturing of Japan, *CL*, has a significantly positive sign. Prefectures with a high percentage of manufacturing are likely to be more correlated in GDP. The vertical linkage through intermediate good transactions within and across sectors might promote the correlation. The coefficient on the manufacturing specialization index, *CV*, changes sign over the periods. Period 2 is significantly positive, period 3 is significantly negative, and then period 4 is indeterminate. This implies that manufacturing substantially contributed to business cycle correlation in period 2, i.e. 1965-1974, whereas other sectors such as service and non-manufacturing played a role in leading business cycle correlation in period 3, i.e. 1975-1984. This seems to reflect what we know about the Japanese economy.

There is a noticeable sensitivity of the results to changes through time. But the arguments of a simple gravity-style trade model - as represented here by GDP and simple distance – New Economic Geography- as represented market potential, and the Heckscher-Ohlin model – as represented capital-labor ratio gap— and public capital or infrastructure investments demonstrate the most reliable explanators business cycle differences across the prefectures. We elaborate on this in the next section.

5. Discussion and Interpretations

The rich data base that we are able to exploit together with the structural change documented for the Japanese economy enable us to incorporate several hypotheses in our choice of explanatory variables. The results obtained confirm the salience of different hypotheses at different times, even whilst strongly supporting the relevance through out of the basic gravity model explanation.

5.1 Gravity Model Explanations and the Optimal Currency Area Literature

Our results see fairly good fits to augmented gravity equations and the openness of trade. Higher GDPs and smaller geographical distance increase the correlation between prefectures. The salience of the gravity equation in explaining business cycle convergence was initially highlighted in the empirical OCA literature: active (intra-industry) trade between countries (Frankel and Rose, 1997; 1998) and a high openness of trade (McKinnon, 1963) synchronize business cycles. Our results show that these hypotheses in international business cycle studies are applicable to the *intra*national business cycle. They confirm to this extent that the set of Japanese prefectures constitutes an optimal currency area

5.2 Explanations from Globalization and New Economic Geography

Market potential is one of the keys to firm location (Head and Mayer, 2002; Head et al, 1995). Firms are likely to locate in high market potential regions. Trade costs (distance) and market size are in trade-off. Even in small markets when they are far from big cities, firms may have incentive to locate there. In periods 2 and 3 in our sample (Figure 9), GDP cross-correlations have a U-shape with respect to market potential, in which two regions with low market potentials as well as those with high market potentials have higher correlations. Here, we can interpret two lower market potential regions as belonging to the periphery while two higher potential regions are big cities or manufacturing cluster areas. However, this explanation loses explanatory power in period 4. The U-shape finally weakens and fades out in period 4. Consistently, the market potentials in our estimations are not significant any more in period 4. This might come from the development of transport networks and the impact of globalization. Indeed, as we discussed in Section 3, the periods after the 1980s saw the dramatic development of transport networks and firm network all over Japan.

As currently discussed in the context of the heterogeneous firm trade model (Melitz, 2003) and many empirical papers (Bernard and Jensen, 1999a, 1999b, 2001) in the international trade literature, trade cost reductions and trade liberalization cause a shift of profits from low productivity local firms (non-exporters) to high productivity export firms (profit shift effect) and the most efficient local firms may start exporting but some least efficient local firms will exit the market (selection effect). Applying this idea to our case, as international and interregional (domestic) trade costs decrease due to globalization, severe competition expels the local firms in the periphery. Local firms in the periphery produce and sell locally, i.e. only in peripheral prefectures. Indeed, Japan saw a drastic decline of trade costs and on the other hand the 1980s and 1990s saw the development of firm networks and franchises and excluded local/regional firms and business. As a result, low market potential regions in the periphery definitely reduce the correlation with one another and instead they are more correlated with core regions.

5.3 Task trade and Fragmentation within Japan

So, what factors are crucial in the 1980s and 1990s? Our estimation results point to the capital-labor ratio gap rather than market potential. This might be affected by the evidence that Japan saw fragmentation across regions and an unbundling of tasks in the production process since the 1980s. The machinery sectors in particular have experienced fragmentation and task trade within Japan, later expanding to Asia. The development of the transport system has allowed the production process to be split up geographically. As Grossman and Rossi-Hansberg (2006) suggest, the production process can be split according to the Heckscher Ohlin theorem, in which the tasks in production are split over regions and more mass production processes (tasks) locate in labor abundant regions and human capital abundant regions specialize more in human capital intensive production processes. This implies that factor endowments difference is a big factor in unbundling. As a result, the unbundling of task will synchronize the business cycle between two regions through a specialization of production process in each prefecture and then a drastic increase in intra-firm and inter-firm trades due to fragmentation, which is triggered by the Heckscher Ohlin theorem. Our estimation tells us that only period 4 observes a significantly negative capital-labor ratio gap whilst the U-shape relationship of market potentials in cyclical correlation fades away and market potential terms are not significant. This might indicate that task trades across Japanese prefectures from the 1980s occur between different factor-endowment regions and consequently the Heckscher-Ohlin type trade may synchronize business cycle between them.

5.4 Public Capital Investment and Business Cycle Synchronization

Our results involve public capital per capita and infrastructure investments. The coefficients on these variables are significantly negative, i.e. there is a negative impact of public investments on business cycle synchronization. That is, two regions with higher public capital or infrastructure per capita have lower correlation, whilst two regions with lower public capital have a higher correlation. In Japan the public capital / infrastructure per capita is higher in rural areas and lower in cities. Over decades Japanese governments have invested in public capital through fiscal policy. This implies that the development of industrial infrastructure, highway, road networks, ports and airports in rural areas does not greatly contribute to business cycle synchronization with neighboring rural prefectures. Rather than that, this investment fortifies the connection to cities and boosts the correlation with them. By contrast with rural area, inter-city correlations are higher. The highway between cities is the most utilized for economic activity. This suggests a paradox that more public capital investment by central government reduces or does not increase business cycle synchronization. If we transferred our evidence on this point to Europe, it could be inferred that EU Structural Funds, in particular public investments in poor peripheral regions, are not appropriate and might actually be vicious in the sense of reducing business cycle synchronization, which is an essential criterion for an optimal common currency.

6. Additional Discussion-- consumption risk-sharing

A stylized fact that comes strongly out of these data is that institutions in Japan do appear to permit a high degree of consumption risk-sharing. We took the consumption data for the 47 prefectures is our working sample and filtered them in the same way as the GDP data.[23] In the same way we also calculated bilateral cross-correlations of the cyclical deviates of consumption for each pair of prefectures. Figure 10 plots these consumption cross-correlations against the GDP cross correlations. RBC theory predicts that (in the presence of complete asset markets) consumption-smoothing should result in consumption cross-correlations which are higher than the corresponding output correlations at business cycle frequency. In terms of the graphical evidence displayed in Figure 10, this would lead as to expect that a majority of the observations would lie below the 45 degree line, as they appear to do. This provides a counter-example to the well-known "consumption/output" anomaly first uncovered by Backus et al. (1993). In their (and many subsequent) studies the international evidence points to consumption correlations being lower than output correlations. The contrary finding leads weight to the presumption that the Japanese prefectures constitute a standard for an optimal currency area, but leaves open the question of the quantification of the channels through which this is achieved, which will be the subject of another paper. Iwamoto and Wincoop (2000) is a precursor study. The fact that the channels (and degree) of consumption risk-sharing may vary across countries needs documentation and provides a natural complement to the resolution of the puzzle that international capital mobility seems to have increased drastically without affecting conventional measures of risk-sharing between countries (see Artis and Hoffmann, 2006)

7. Conclusions

In this paper we have identified the *intra*national business cycle in Japan using GDP data for prefectures over the period 1955-1995. In the first section of the paper we compared it with those for the US and for the Euro Area. A high degree of business cycle synchronization within a prospective currency union has often been regarded as a *sine qua non* of that union's viability and ultimate survival; at the same time many observers have assumed that the formation of a currency union can itself lead to an increase in business cycle synchronization. In the Japanese case examined in this paper, the degree of business cycle synchronization within the country emerges as strikingly high by comparison with that in the US and the Euro Area for the periods considered. But this is only clearly so for the more recent decades of Japanese history. Earlier, the

[23] The consumption data are taken from Fukao and Yue's Japanese prefecture data set.

well-documented and drastic changes that occurred in Japan's industrial structure find a reflection in the appearance of a much lower degree of business cycle synchronization. We devote a short section of the paper to summarizing the empirical evidence on Japan's industrial development. This excursus provides as with valuable material, we believe, for the interpretation of the estimation results we subsequently obtain. The paper then moves on to explain the patterns of business cycle synchronization summarized in the set of bilateral cross-correlations. There is a large literature which explains the pattern of international business cycle cross-correlations, the later versions of which have increasingly drawn on explanatory factors which are irrelevant to the explanation of the *intra*national cycle – differences in labor markets, monetary policy, financial markets and the like which play an important role in explaining international business cycle differences are irrelevant in the setting of a single country. Our econometric explanation of the pattern of bilateral cross-correlations between the prefectures of Japan draws heavily, though, on a feature of earlier international cross-correlation work and that is the idea that trade models – specifically the gravity model and the Heckscher Ohlin trade model – and inspired by the new economic geography can help to explain business cycle associations. We find that variables that can be associated with gravity model explanators – GDP, distance, with economic geography represented as market potential supplemented by openness, and with Heckscher Ohlin explanators--capital labor ratio gap supplemented by endowment variables such as human capital and public capital investment are highly significant in explaining the bilateral business cycle cross-correlation coefficients in a GMM panel data estimation (fixed effects) framework. This is gratifying from several points of view: it underscores the remarkable versatility of use of the gravity model and allows us to integrate our knowledge of the development of the Japanese economy with modern trade theory. A feature of working currency unions is that some mechanisms usually exist to facilitate consumption risk-sharing; we find that overall risk-sharing between the prefectures is a marked phenomenon but its precise measurement and explanation remain a project for a future paper.

Data Appendix

The number of Japanese prefectures became 47 after the Okinawa prefecture was returned from the United States in 1972. Due to data availability problems for Okinawa Prefecture before 1972 and its position as both a geographical and economic outlier our estimation sample is restricted to the 46 mainland prefectures from 1955 to 1995. Many prefecture data sets for factor endowments and flow data are taken from Fukao and Yue's "Japanese prefecture data base"(Hitotsubashi University, Tokyo, Japan) (http://www.ier.hit-u.ac.jp/~fukao/japanese/data/index.html) and Fukao and Yue (2000) and Yue (1995).

The GDP data set for 12 EU nations for the HP-filtered GDP cross-correlations in Figure 3 is taken from World Development Indicator (Edition September 2006, World Bank). GDP is constant 2000 US dollars. The US GSP (gross state product) data sets for the autocorrelation in Figure 2 are taken from Bureau of Economic Analysis, US Department of Commerce (http://www.bea.gov/regional/index.htm#gsp). The unit of real GSP is millions of chained 2000 dollars.

Definitions

The dependent variable

The bilateral cross-correlation of cyclical deviates from HP-filtered real GDPs in two prefectures (prefectures *i* and *j*) in four sub-sample periods, transformed by Fisher's z transformation. The transformation is aimed at expanding the limited variation (from -1 to 1) in the cross correlation measure. Fisher's *z* transformation is a one-by-one mapping from a certain variable, ρ , to a variable υ, utilizing a uniformly increasing monotone function, defined as $\nu = 0.5\ln\left(\frac{1+\rho}{1-\rho}\right)$ for -1< ρ <+1

The independent variables

All the variables are related to two prefectures A and B, corresponding to the correlation of the dependent variables. The variables are the average values in each sub-sample period. These are period 1: 1955-1964; period 2: 1965-1974; period 3: 1975-1984; and period 4: 1985-1995.

GDP (time period 1-4): GDP denotes the logarithm of the product of GDPs in prefecture *i* and *j*. Real GDP is taken from Fukao and Yue's "Japanese prefecture data base" and Fukao and Yue (2000) and Yue (1995).

MKT (time period 1-4): Market refers to the logarithm of the product of Market Potential in prefectures *i* and *j*. The market potential for prefecture *i* is defined as the summation of GDPs weighted by geographical distance for all prefectures including the home market of prefecture *i*, i.e. $M_i = \sum_j \frac{GDP_j}{D_{ij}}$ where D stands for the distance between prefectures *i* and *j*. The distance between prefectures is that between the locations of central city offices in the prefecture capitals. The distance for the home market itself, D_{ii}, can be derived as $D_{ii} = (2/3)\sqrt{Area_i / \pi}$, in which Area is the geographical area (km2) of prefecture *i*. (See Keeble, et al. 1982). (This formula implies one third of the radius of a circle of the area.) The market potential variable has the largest values in Tokyo and Tokyo Area over four periods. By and large, values for the Northern prefectures tend to fall over time whilst those for the Southern and Western prefectures tend to increase.

MKT_square (time period 1-4): Square term of MKT.

Gap (time period 1-4): Absolute difference of GDP per capita.

CapLabor (time period 1-4): This is the variable of logarithm of capital labor ratio gap between prefectures *i* and *j*. Capital stands for capital per capita in prefectures *i* and *j*. This is private sector capital. Labor denotes working force ratio in total population. Both capital and labor are taken from Fukao and Yue data sets and Yue (1995).

CapPub (time period 1-4): This is variable stands for public capital per capita. The variable takes logarithm of the product of public capital in both prefectures. Fukao and Yue data sets.

Infra (time period 1-4): This variable is the logarithm of the product of industrial infrastructure per capita in two prefectures. Industrial infrastructure is a part of public capital formation. Fukao and Yue data sets.

Human (time period 1-4): this stands for the human capital index calculated by Fukao and Yue and then controlled by population size. The indices are derived from relative wages conditioned on gender and educational level. The index is normalized to be one for the male workers with less than the junior high school level education. Higher values express more human capital endowment.

Openness (time period 1-4): This stands for the summation of the openness to trade in two prefectures. Openness is derived as the value of net-exports divided by GDP. In the estimation these data are summed across the two prefectures involved in each pair. A higher value of the openness to trade means that prefectures export more to the other prefectures and foreign countries. Thus, "Openness" is higher, both prefectures are open each other and economically tied each other.

CL (time period 1-4): this is the summation of the manufacturing ratios of two prefectures. The ratio is defined as the manufacturing worker population ratio of prefecture *i* in Japanese total manufacturing workers, defined as $CL_i = \dfrac{Manufacturing_i}{\sum_i Manufacturing}$. This represents for percentage of manufacturing of prefecture *i* in Japan. The data are taken from Manufacturing Census (Ministry of Economy and International Trade of Japan (METI).

CV (time period 1-4): This index stands for the summation of two prefectures' manufacturing specialization index. The index is defined as the deviation of manufacturing worker in all working force (e.g. agriculture, manufacturing and service sectors) in prefecture *i* from the average in Japan, i.e. $CV_i = \dfrac{Manufacturing_i}{\sum_i Manufacturing} - \dfrac{WorkForce_i}{\sum_i WorkForce}$. When the value takes a higher positive number, the prefecture *i* is relatively specialized in manufacturing. Otherwise, the prefecture *i* is relatively specialized in service and agriculture. This reflects comparative advantage of manufacturing. The data are taken from Manufacturing Census (Ministry of Economy and International Trade of Japan (METI).

AREA: Area is the logarithm of the product of two areas (km^2).

Distance: Distance is the logarithm of the geographical distance between two prefectures. The distance is measured between the capitals of the prefectures (*km*).

Neighbor: Dummy for share border between two prefectures.

Appendix 1: Moran's I and Geary's C statistics (Spatial Autocorrelation)

These statistics are aimed at studying (global) spatial autocorrelation in terms of GDPs across prefectures (Moran, 1948, 1950; Geary, 1954). Figure A shows two sorts of spatial autocorrelation statistic in logarithm of the first difference of GDP for 47 prefectures from 1955 to 1995, i.e. Moran's I (the left panel) and Geary's C (the right panel) statistics. I-statistics are bounded in value between -1 and +1. We used geographical distance as weight matrix, *W*. The formula of Moran's I is given as

$$I = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}(X_i - \overline{X})(X_j - \overline{X})}{\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij} \frac{1}{n}\sum_{i=1}^{n}(X_i - \overline{X})^2}$$

Values for the I-statistics value closer to 1 indicate clustered (spatially concentrated) data points with similar characteristics, whilst the values close to -1 imply gathering data points with totally different characteristics. When the value is zero, it is randomly distributed in space: no spatial pattern in distribution of characteristics. Likewise, C-statistics take from 0 to 2, which is given as

$$C = \frac{(n-1)[\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}(X_i - X_j)^2]}{2\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}(X_i - \overline{X})^2}$$

A value of 1 means no spatial autocorrelation. As shown two panels of Figure A, the first difference of GDP (growth) is not spatially correlated over time. GDP growth is sporadic: some Metropolitan areas-Tokyo Area, Osaka and Nagoya--have predecessors of economic growth (as shown in Figure 1) and experienced high growth.

Appendix 2: HP-filtered Cross-correlations

Figure B shows the HP-filtered GDP cross-correlations of each prefecture with total Japan over four periods. The dark colors indicate higher cross-correlations with total Japan. Consistently with the verdict of Moran's I and Geary's C statistics discussed in Appendix 1, we cannot see a clear pattern of spatial correlations and see somewhat random patterns, although central prefectures are likely to have high correlations.

Figure C shows the histogram of HP-filtered employment cross-correlations at 2 digit-level industries for two periods (1975-1984 and 1985-1995) for pairs of prefectures. The data for the number of employees are taken from *Manufacturing Census* (METI). As shown in Figures, almost all sectors experienced a convergence from the 1970s through the 1990s. While the precision machinery, electronics machinery and food sector have a little change, other sectors experienced the convergence.

All sectors see an increase in the average with a positive. In particular, general machinery, transport machinery and textiles skew the correlation toward one. These outcomes might be related to the Japanese FDI after 1985. After the mid-1980s, the machinery and textile sectors relocated their own production points to Asian countries. Japanese FDI greatly increased. FDI in Asia is mainly for the labor intensive production process due to lower wage rates and re-imports to Japan have drastically increased. This causes off shoring and reduces employment in Japan. Textiles for instance reduce the number of employment in Japan, and as a result, the correlation becomes largely biased toward one.

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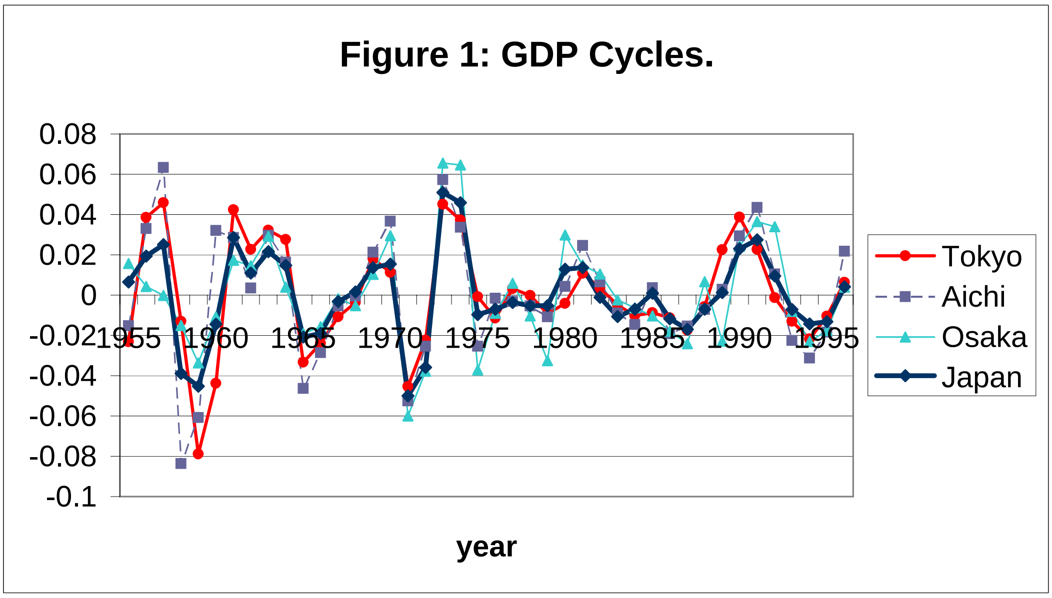


Figure 1: GDP Cycles.
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
1955
1960
1965
1970
1975
1980
1985
1990
1995
year
Tokyo
Aichi
Osaka
Japan

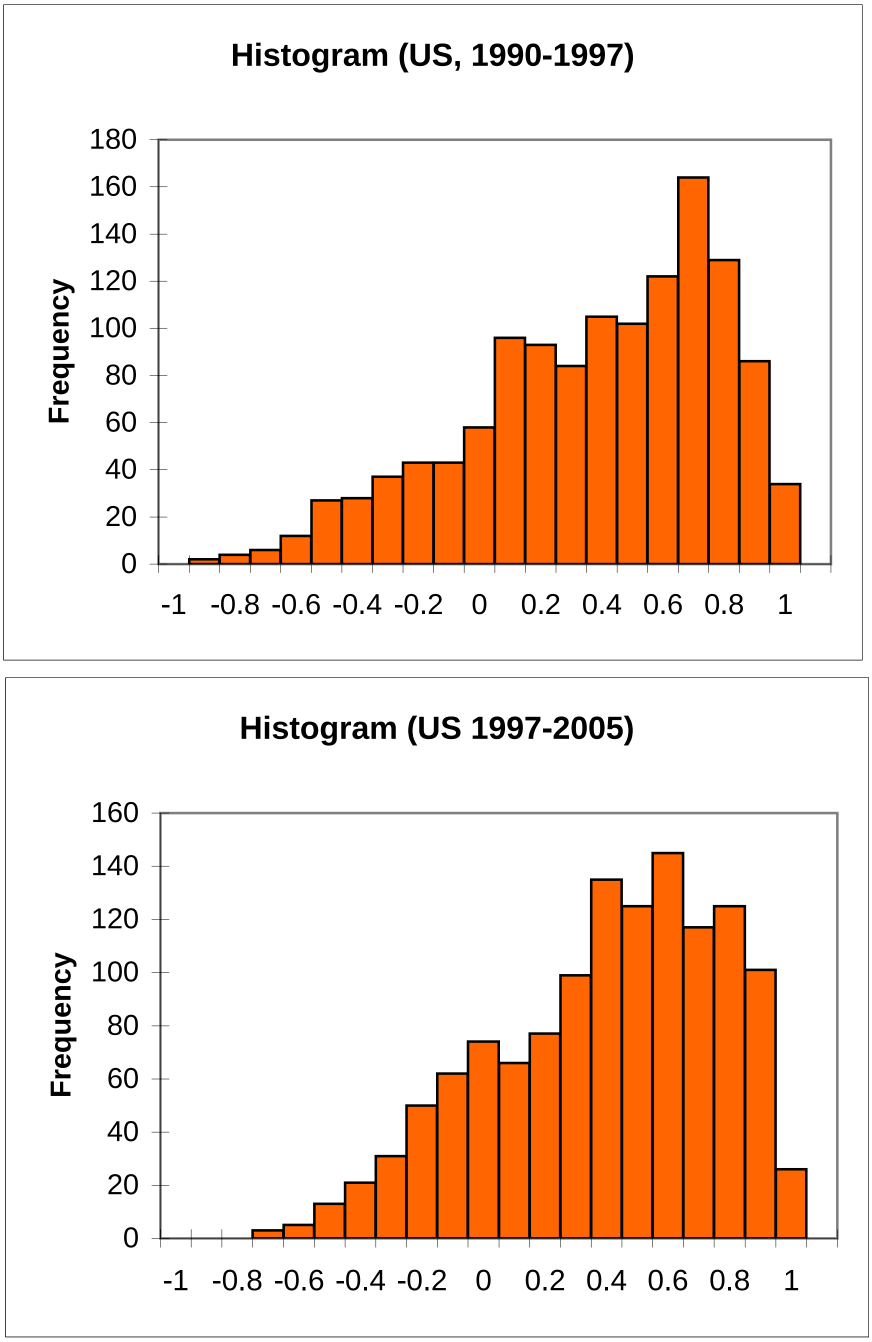
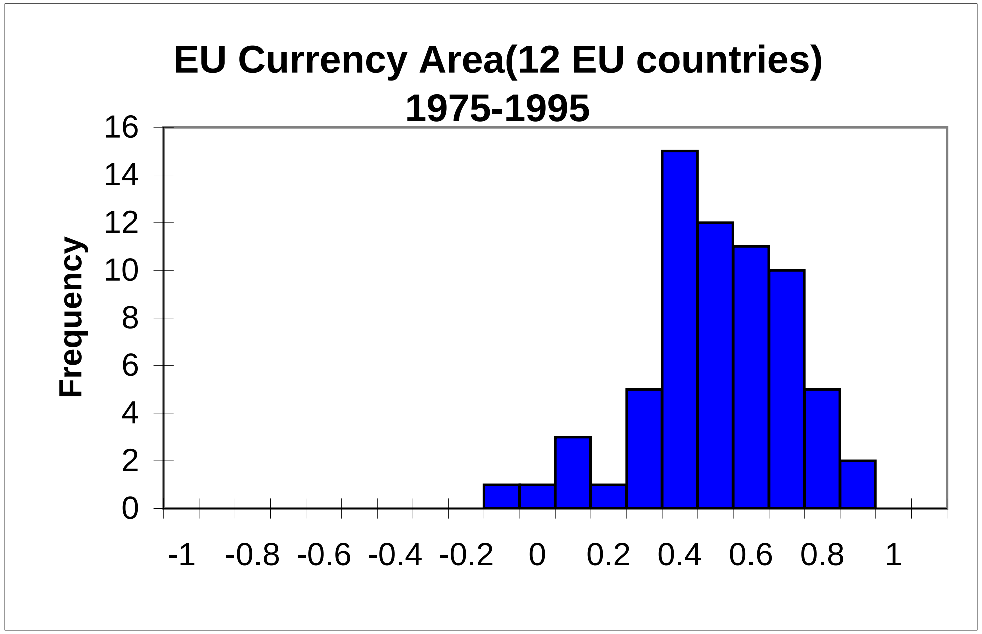


Figure 2: US Inter-state GSP Cross-correlations.



	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal
Austria											
Belgium	0.3767										
Finland	-0.012	0.4724									
France	0.5386	0.6557	0.443								
Germany	0.6752	0.5731	-0.1079	0.4836							
Greece	0.3072	0.5862	0.1309	0.5574	0.7059						
Ireland	0.07	0.3317	0.4726	0.5365	0.2963	0.3652					
Italy	0.4114	0.8681	0.5385	0.5975	0.5957	0.6609	0.3168				
Luxembou	0.2891	0.3527	0.034	0.3424	0.5983	0.6389	0.0713	0.3824			
Netherland	0.4784	0.6649	0.2122	0.4998	0.801	0.7594	0.4012	0.7211	0.6096		
Portugal	0.4974	0.634	0.3797	0.6972	0.3474	0.2711	0.3346	0.6334	0.2217	0.3084	
Spain	0.432	0.6821	0.3752	0.7689	0.4226	0.3646	0.4996	0.5965	0.3331	0.568	0.7727

Figure 3: EU 12 Countries GDP Cross-correlations.

Figure 4: Japanese GDP Cross-correlations (1955-1964)

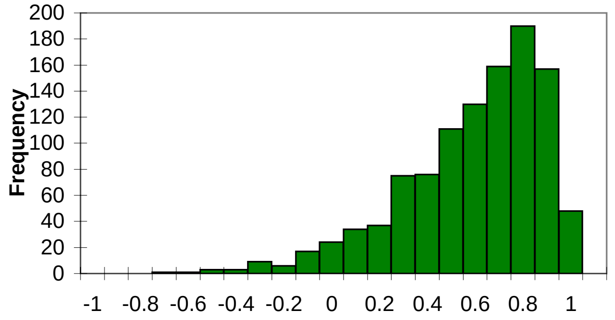


Figure 5: Japanese GDP Cross-correlations (1965-1974)

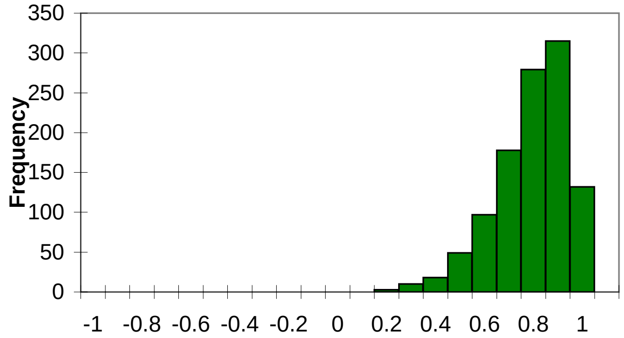


Figure 6:Japanese GDP Cross-correlations (1975-1984)

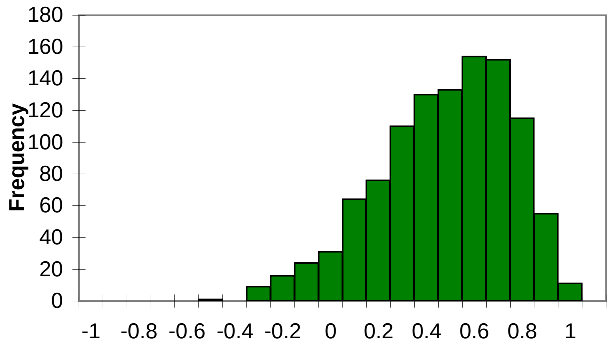
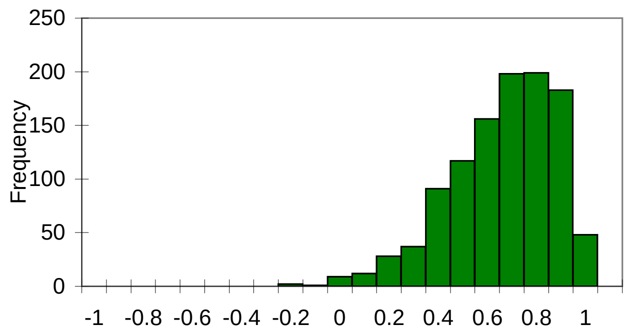


Figure 7: Japanese GDP Cross-orrelations (1985-1996)



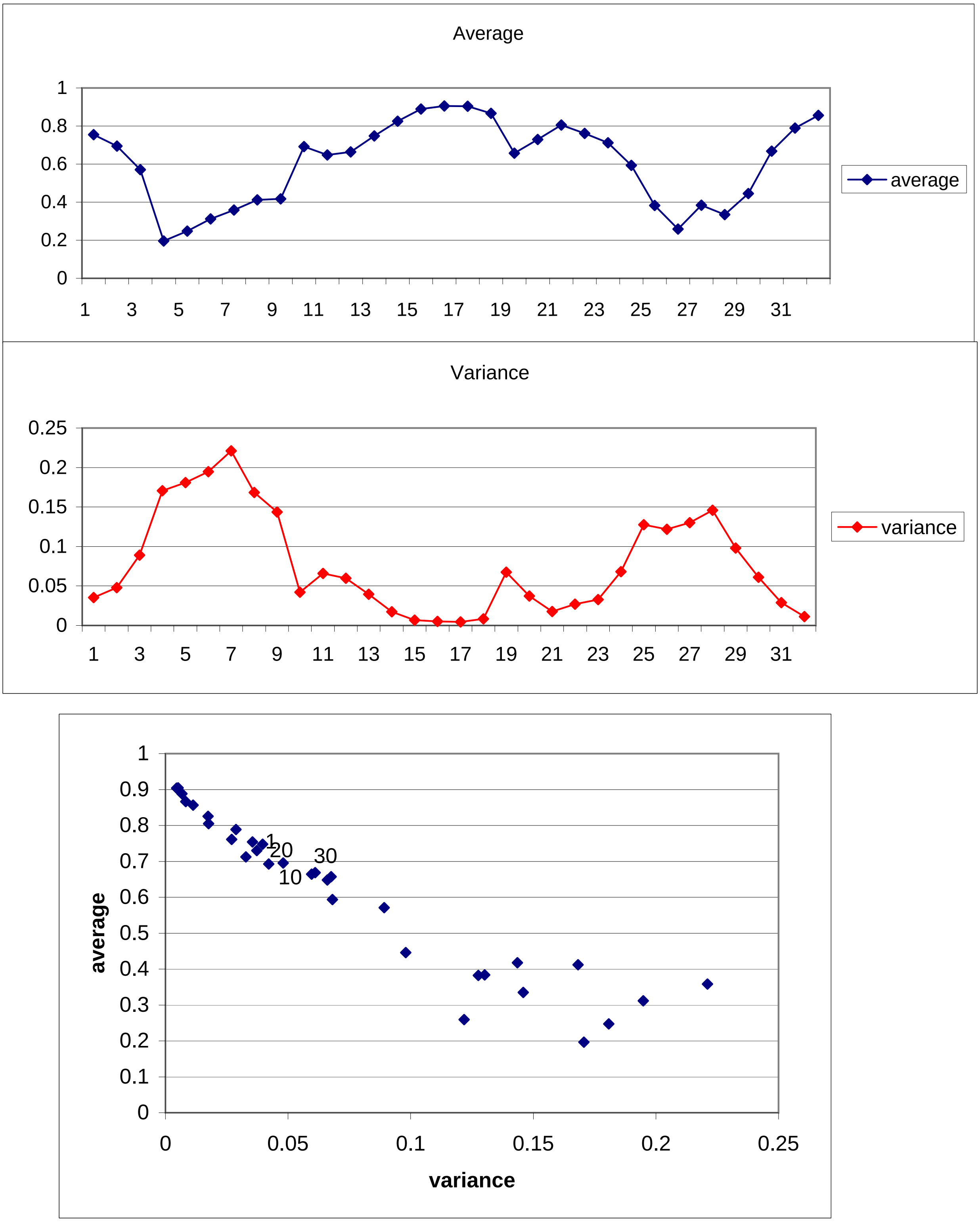
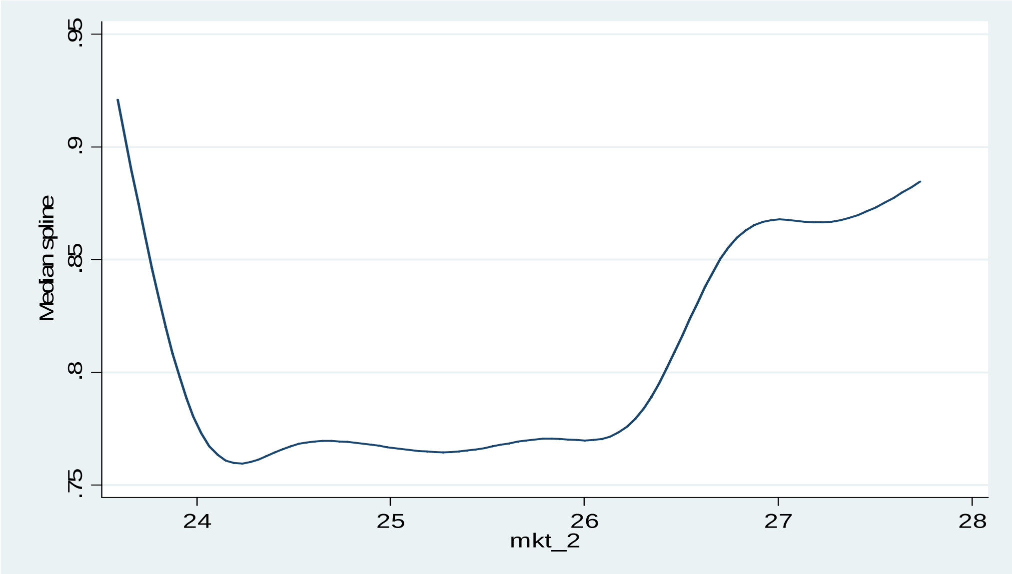
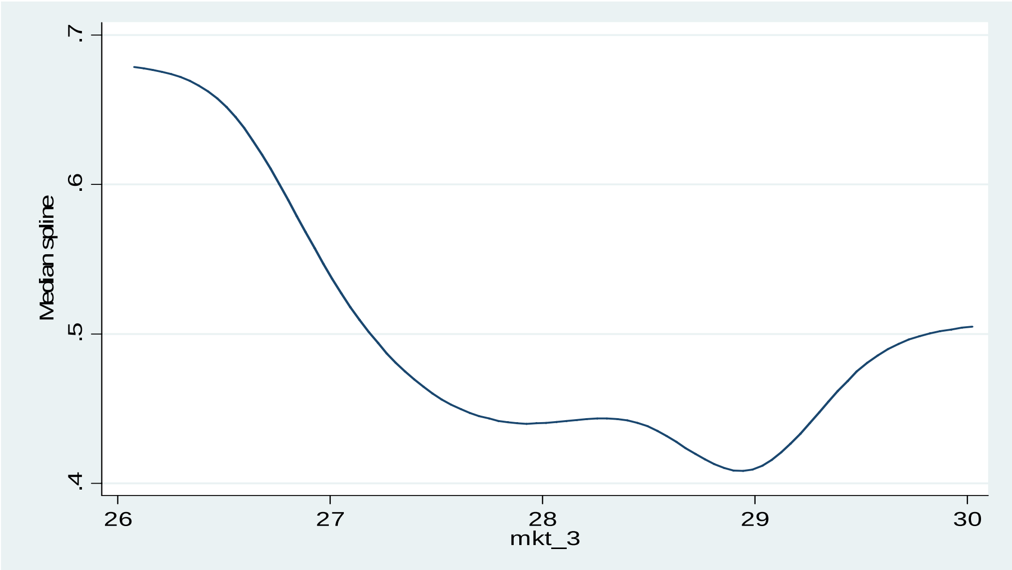


Figure 8: Means and Variance of HP-filtered GDP Cross-correlations.
Note: Each sample is 10-year moving average.
The first period (number "1") is from 1955 to 1964. The last period (number "32") is from 1986-1995.





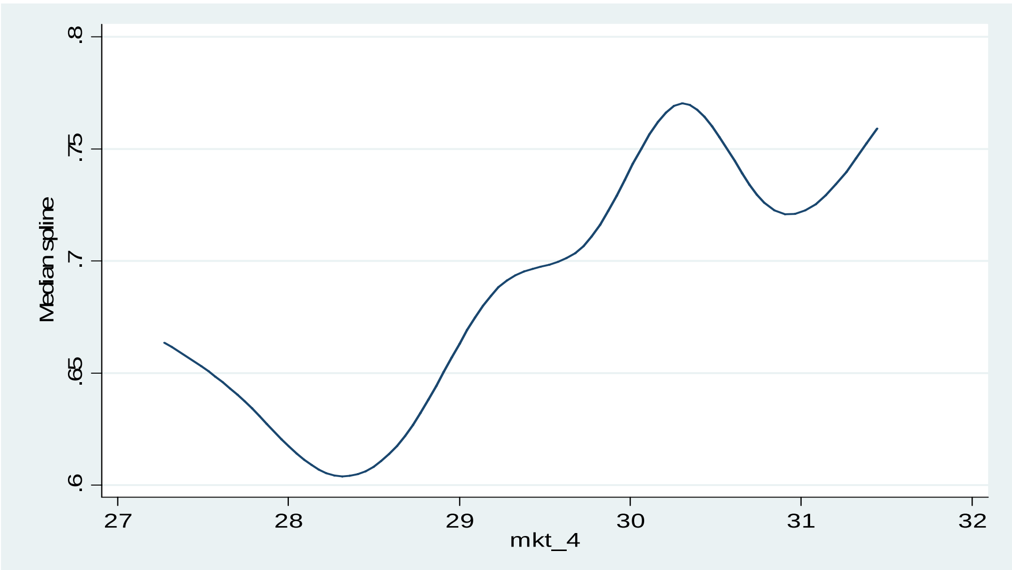


Figure 9: The Spline of Independent Variables in terms of Market Potentials.

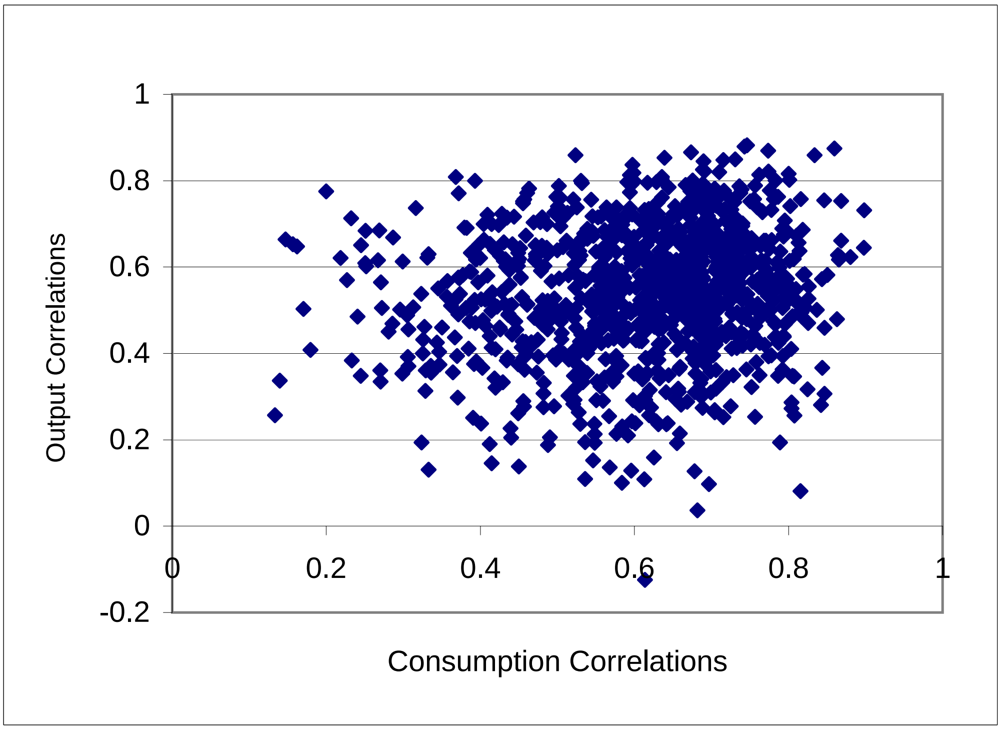


Figure10: Consumption Risk Sharing.

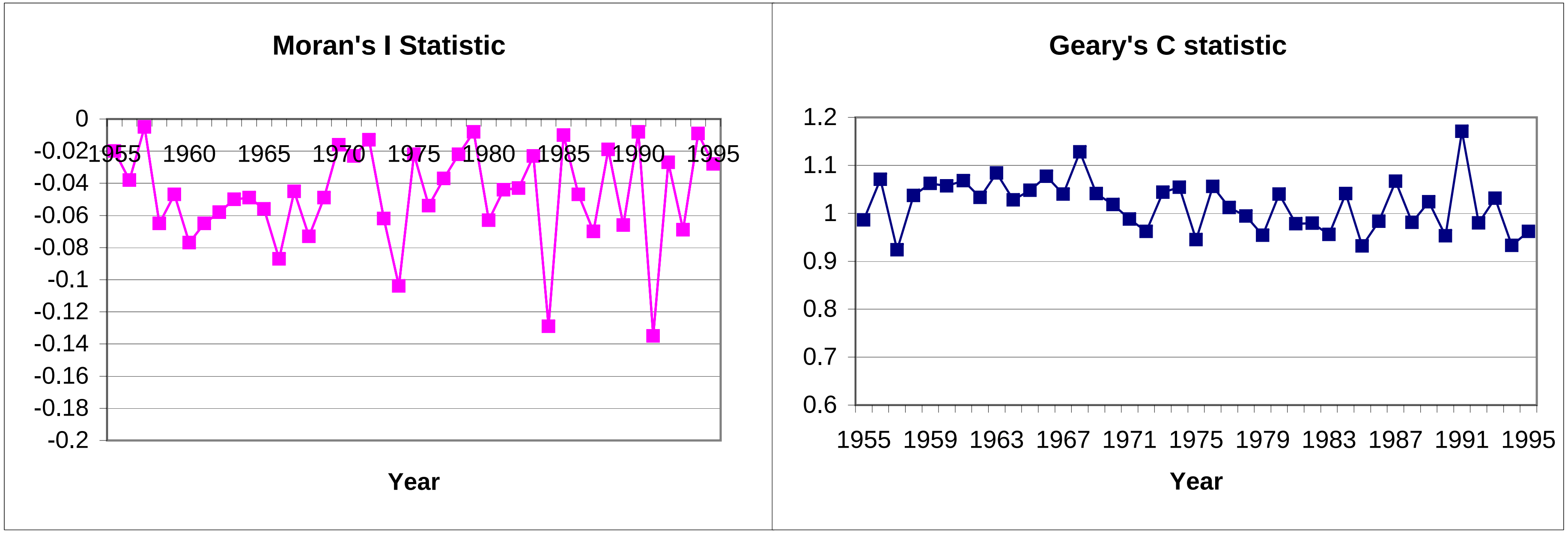


Figure A: Spatial Autocorrelations.

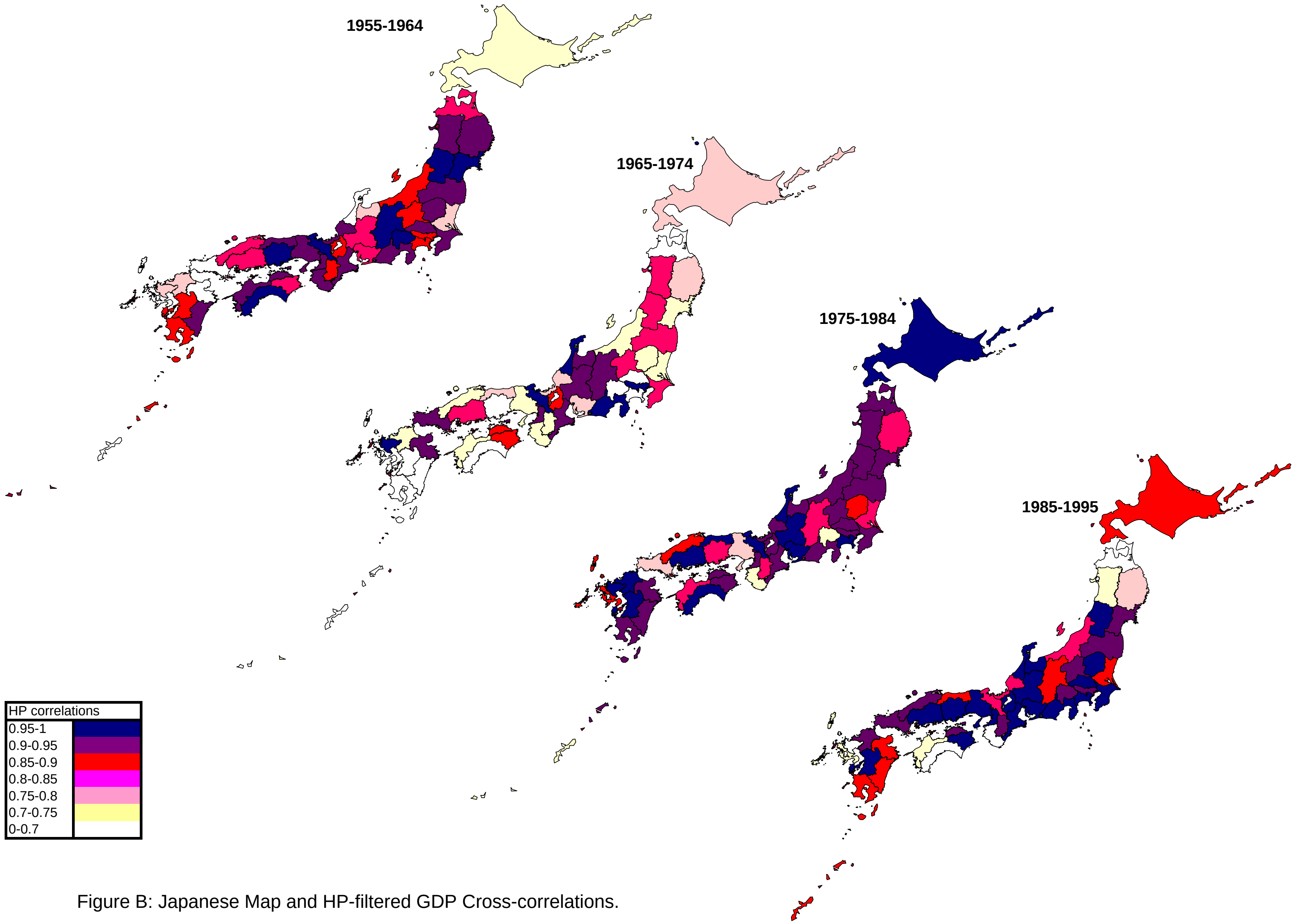
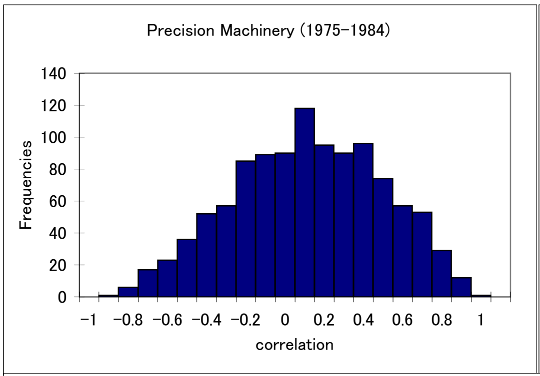
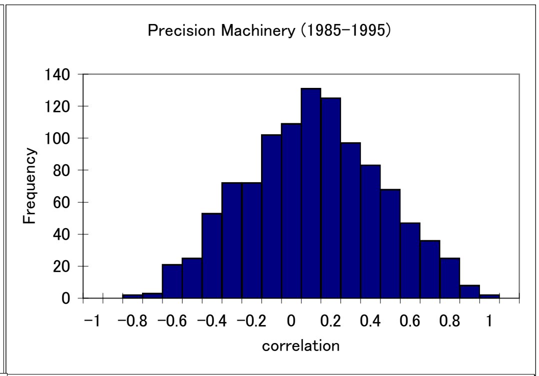
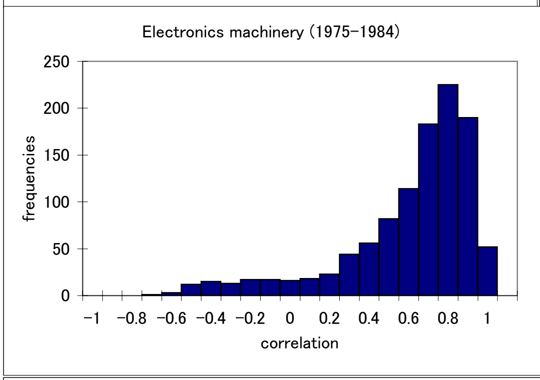
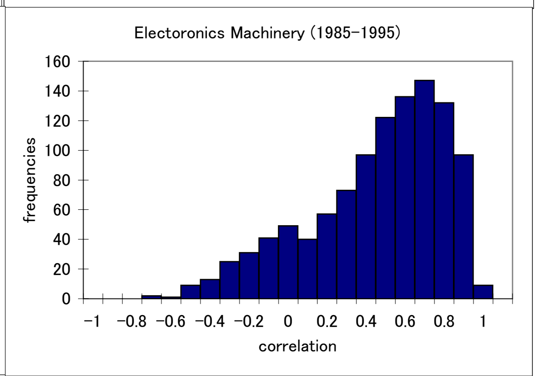


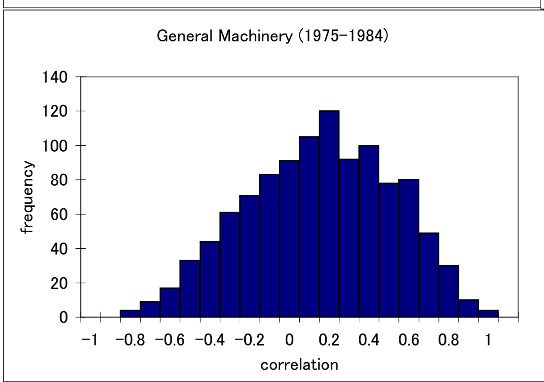
Figure B: Japanese Map and HP-filtered GDP Cross-correlations.

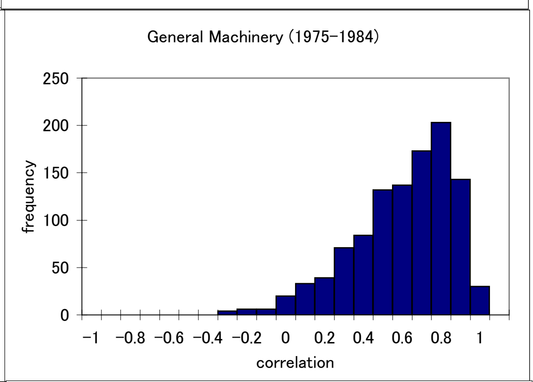

Precision Machinery (1975-1984)
Frequencies
correlation

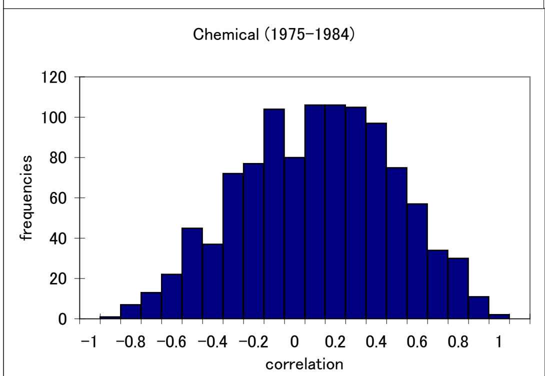

Precision Machinery (1985-1995)
Frequency
correlation

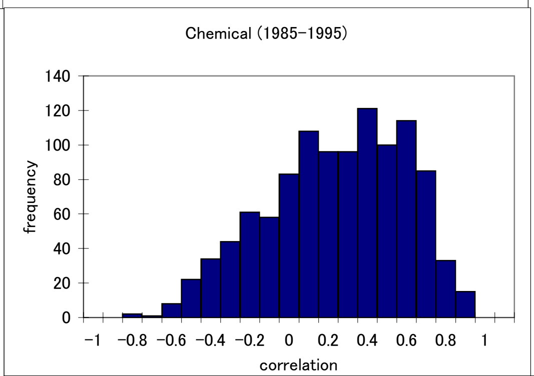

Electronics machinery (1975-1984)
frequencies
correlation

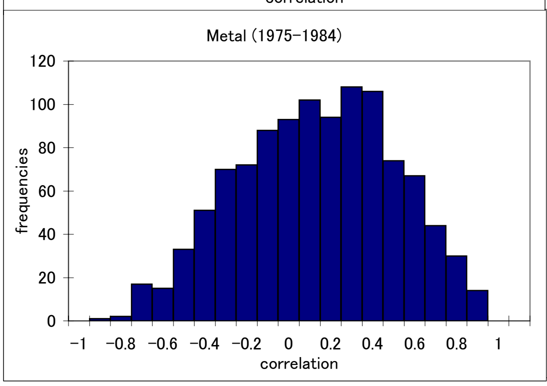

Electoronics Machinery (1985-1995)
frequencies
correlation

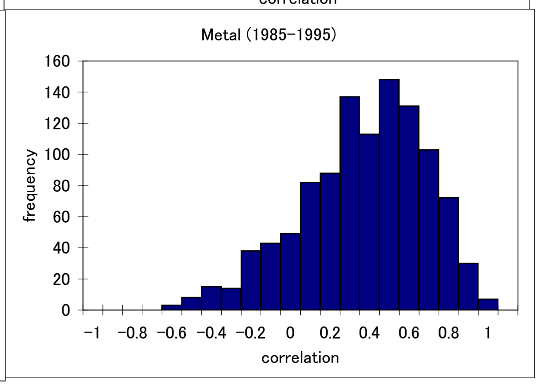

General Machinery (1975-1984)
frequency
correlation


General Machinery (1975-1984)
frequency
correlation


Chemical (1975-1984)
frequencies
correlation


Chemical (1985-1995)
frequency
correlation


Metal (1975-1984)
frequencies
correlation


Metal (1985-1995)
frequency
correlation

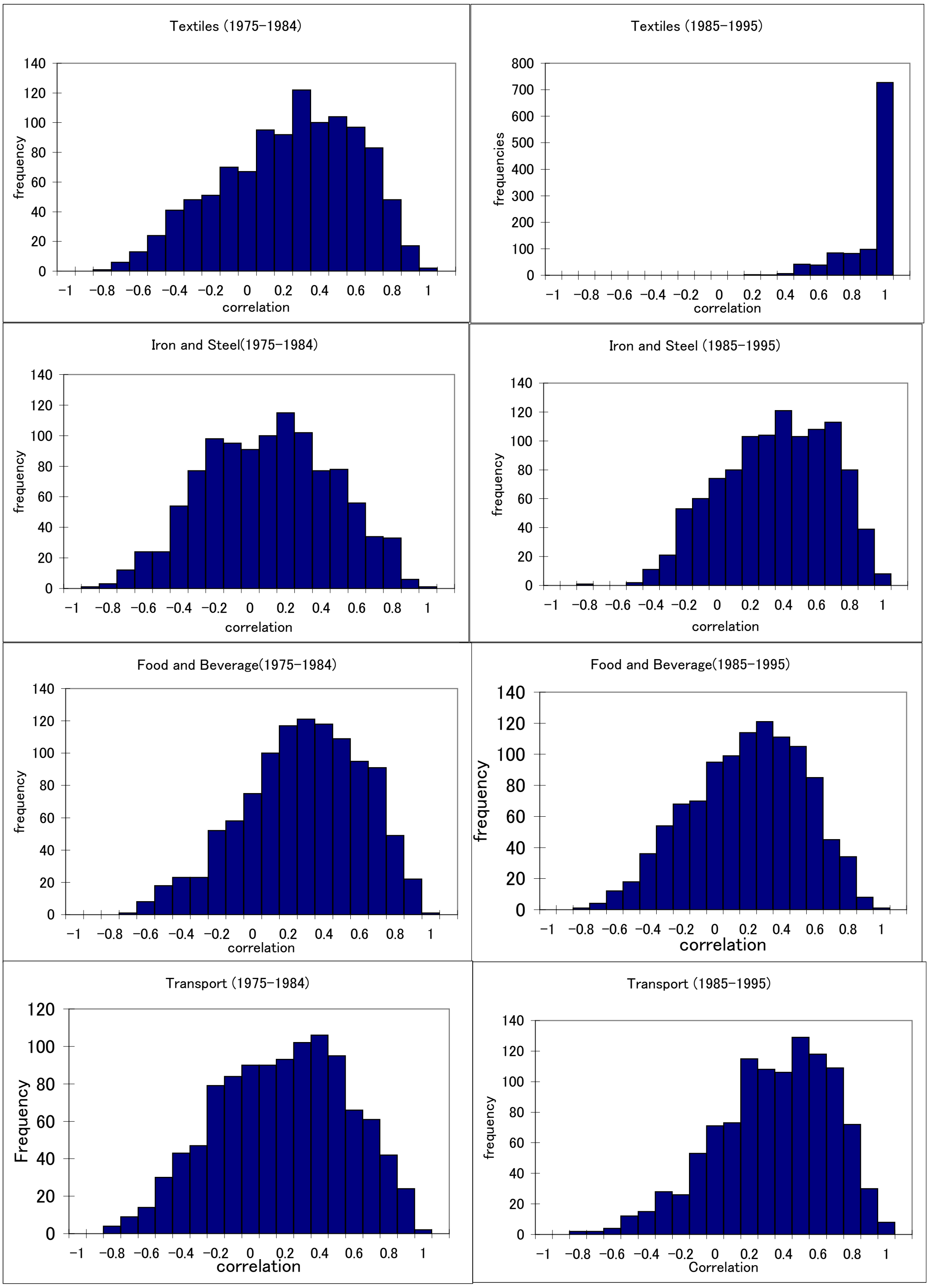


Figure C: Employment Cross-correlations in Manufacturing Sectors.

GMM	1		2		3		4		5	
Dependent Var	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value
MKT2					-6.719861	-7.27 **	-6.4068	-6.91 **	-6.173886	-6.11 **
MKT3					-6.806309	-5.97 **	-5.5361	-4.82 **	-5.006397	-3.77 **
MKT4					-4.179615	-0.87	2.0342	0.32	12.69678	1.03
MKT2_square					0.129754	7.14 **	0.1230	6.73 **	0.11838	5.93 **
MKT3_square					0.118255	5.75 **	0.0942	4.53 **	0.084463	3.50 **
MKT4_square					0.069849	0.84	-0.0390	-0.35	-0.225113	-1.05
GDP2	0.0696	5.00 **	0.087905	5.51 **	0.074504	4.69 **	0.0771	4.86 **	0.088127	4.89 **
GDP3	0.0214	1.48	0.011729	0.69	0.078803	4.53 **	0.0881	5.08 **	0.075673	4.15 **
GDP4	0.1076	7.97 **	0.062794	1.79 *	0.128032	4.56 **	0.1711	4.27 **	0.162967	3.89 **
gap2			-0.308365	-3.14 **					-0.188058	-1.83 *
gap3			0.163116	1.08					0.282288	1.69 *
gap4			0.791276	1.41					1.418171	1.60
Openness2							0.6744	1.77 *	0.682926	1.69 *
Openness3							0.8313	3.17 **	0.916838	3.27 **
Openness4							0.9002	1.55	1.557971	1.79 *
AREA	0.0299	5.24 **	0.048508	8.72 **	9.907115	1556.7 **	0.7091	0.04	2.85344	226.99 **
Neighbour	0.0117	0.46	0.010123	0.39	0.010231	0.42	0.0106	0.43	0.009386	0.36
Distance	-0.0296	-2.83 **	-0.031714	-2.83 **	-0.004879	-0.36	81.4828	6.84 **	-0.039166	-1.49
time2	-1.5838	-4.09 **	-2.017874	-4.67 **	85.1763	7.16 **	78.0722	4.87 **	78.2632	6.04 **
time3	-0.8257	-1.89 *	-0.564491	-1.12	95.1725	5.96 **	-31.5091	-0.34	71.22408	3.87 **
time4	-3.2655	-7.70 **	-2.017026	-2.02 **	58.50611	0.83	-0.0164	-1.09	-184.2017	-1.04
	Hansen's J 0.0000		Hansen's J 0.0000		Hansen's J 0.0044		Hansen's J 0.004		Hansen's J 0.0177	
	Root MSE = 0.3585		Root MSE = 0.3678		Root MSE = 0.3493		Root MSE = 0.348		Root MSE = 0.3791	

Table 1: Estimation Results 1 (GDP, Market Potential and Oppenness).

Independent var: HP-filtered GDP correlations

Notes:
The number of sample 4140
Constant terms are omitted.
* Significant at the 10 per cent level.
** Significant at the 5 per cent level.

GMM	1		2		3		4	
Dependent Var	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value
MKT2	-6.10561	-6.03 **	-9.3556	-9.30 **	-8.3441	-8.19 **	-8.88276	-8.14 **
MKT3	-4.93781	-4.07 **	-6.5866	-5.36 **	-5.4514	-4.41 **	-5.55741	-4.14 **
MKT4	10.672	1.13	-4.6398	-0.59	4.02841	0.50	-1.83143	-0.19
MKT2_square	0.11657	5.83 **	0.17227	8.75 **	0.15513	7.72 **	0.16327	7.65 **
MKT3_square	0.08302	3.77 **	0.10635	4.77 **	0.08999	4.00 **	0.08878	3.69 **
MKT4_square	-0.18946	-1.16	0.06225	0.45	-0.0739	-0.53	0.01598	0.09
GDP2	0.07694	4.29 **	1.31542	9.63 **	1.01951	8.04 **	1.30935	9.27 **
GDP3	0.09049	5.03 **	0.89626	4.41 **	0.29423	1.57	0.66254	2.63 **
GDP4	0.24247	3.51 **	0.94706	1.35	-0.7088	-0.95	0.52821	0.55
Human2			1.50264	9.21 **	1.14776	7.55 **	1.49913	8.87 **
Human3			0.95084	4.04 **	0.28192	1.30	0.71057	2.47 **
Human4			0.95862	1.22	-0.9572	-1.16	0.47064	0.44
CapLabour2	0.0595	0.36	0.02458	0.20	0.02778	0.21	0.07332	0.55
CapLabour3	0.05389	0.23	0.07049	0.43	0.10744	0.60	0.16284	0.91
CapLabour4	5.75913	1.86 *	5.61579	2.65 **	6.04598	2.46 **	6.66098	2.68 **
Cappub2			-0.5132	-4.11 **			-0.29911	-1.97 **
Cappub3			-0.853	-6.02 **			-0.35005	-1.65 *
Cappub4			-2.3061	-6.34 **			-2.14495	-2.95 **
Infra2					-0.2179	-1.95 *	-0.24188	-2.10 **
Infra3					-0.4774	-3.59 **	-0.4944	-3.00 **
Infra4					-0.8537	-1.95 *	-0.10087	-0.15
Openness2	1.1988	2.27 **	3.17283	5.92 **	2.65876	4.88 **	3.15952	5.80 **
Openness3	1.15198	3.40 **	2.23116	4.35 **	1.04671	2.13 **	1.74757	2.94 **
Openness4	1.44708	1.78 *	1.83394	1.07	-0.7988	-0.43	1.00616	0.48
AREA	3.08892	0.26	0.0362	0.00	22.7944	2472.70 **	1.99863	204.73 **
Neighbour	0.0073	0.20	0.00636	0.18	0.00671	0.19	0.00622	0.16
Distance	-0.04138	-1.72 *	-0.0139	-0.70	-0.0292	-1.39	-0.02199	-0.93
time2	77.9043	6.00 **	133.043	10.04 **	115.893	8.78 **	126.145	8.73 **
time3	70.0056	4.14 **	102.251	5.90 **	80.1782	4.65 **	85.8069	4.45 **
time4	-158.731	-1.15	85.257	0.75	-61.136	-0.53	41.2006	0.28
	Hansen's J 0.0021		Hansen's J 0.005		Hansen's J 0.1269		Hansen's J 0.0052	
	Root MSE = 0.5144		Root MSE = 0.5003		Root MSE = 0.5129		Root MSE = 0.5455	

Table 2: Estimation Results 2 (Factor Endowments).

Independent var: HP-filtered GDP correlations

Notes:
The number of sample 4140
Constant terms are omitted.
* Significant at the 10 per cent level.
** Significant at the 5 per cent level.

GMM	1		2		3		4		5	
Dependent Var	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value
MKT2	-8.1932	-8.29 **	-9.1435	-8.60 **	-9.8948	-9.13 **	-9.1314	-8.44 **	-9.3514	-7.76 **
MKT3	-5.4928	-4.48 **	-5.082	-3.88 **	-5.8203	-4.59 **	-5.1579	-4.02 **	-5.3127	-3.69 **
MKT4	-12.5851	-1.54	9.73802	0.57	-0.3228	-0.02	14.5888	0.94	9.00097	0.49
MKT2_square	0.1547	8.03 **	0.17099	8.32 **	0.18222	8.75 **	0.1704	8.11 **	0.17191	7.41 **
MKT3_square	0.0951	4.31 **	0.08552	3.71 **	0.09378	4.19 **	0.08575	3.77 **	0.08483	3.34 **
MKT4_square	0.2121	1.50	-0.1697	-0.59	-0.0122	-0.05	-0.2539	-0.97	-0.1691	-0.54
GDP2	0.0536	3.21 **	0.74734	6.10 **	1.19894	8.10 **	0.76526	4.71 **	1.19031	7.91 **
GDP3	0.1066	5.85 **	0.45189	1.49	1.27214	4.56 **	0.4719	1.59	1.05529	3.63 **
GDP4	0.1857	4.85 **	-2.0277	-0.83	0.2674	0.13	-2.6567	-1.20	-0.8875	-0.39
Human2			0.83604	5.89 **	1.37693	7.88 **	0.86167	4.50 **	1.37073	7.65 **
Human3			0.41356	1.22	1.37185	4.37 **	0.4596	1.37	1.14559	3.49 **
Human4			-2.547	-0.93	0.20249	0.09	-3.2074	-1.30	-1.0982	-0.44
CapLabour2			0.01416	0.10	0.01179	0.08	0.06426	0.46	0.07294	0.49
CapLabour3			-0.0407	-0.20	-0.0514	-0.27	0.06666	0.35	0.06274	0.31
CapLabour4			5.8485	1.71 *	5.50119	1.72 *	7.46542	2.27 **	7.28699	2.03 **
Cappub2					-0.4481	-3.90 **			-0.2359	-1.65 *
Cappub3					-0.7753	-6.34 **			-0.4032	-1.98 **
Cappub4					-2.3448	-5.24 **			-2.8079	-4.39 **
Infra2							-0.0469	-0.39	-0.2319	-2.05 **
Infra3							-0.2184	-1.64 *	-0.365	-2.36 **
Infra4							-0.5142	-1.33	0.28597	0.60
Openness2	1.4423	3.30 **	2.35711	4.61 **	3.26581	5.97 **	2.5556	4.48 **	3.23176	5.66 **
Openness3	0.5686	1.94 *	1.51744	2.07 **	2.53607	3.68 **	1.48179	2.06 **	2.24347	3.10 **
Openness4	0.7612	1.30	-0.779	-0.20	1.38284	0.39	-1.9138	-0.52	-0.43	-0.11
CV2	1.2822	2.94 **	1.17808	2.13 **	0.65704	1.21	1.2535	2.14 **	0.64187	1.20
CV3	-2.3634	-4.10 **	-1.5403	-2.03 **	-2.7533	-3.92 **	-1.1793	-1.65 *	-2.1422	-3.27 **
CV4	0.6198	0.54	7.229	1.89 *	3.42152	1.03	8.79369	2.41 **	4.97852	1.47
CL2	2.5866	0.83	-2.4896	-0.69	0.36097	0.11	-2.9362	-0.81	0.34419	0.10
CL3	12.0914	4.22 **	7.10655	1.47	11.1432	2.59 **	5.46303	1.26	9.4764	2.25 **
CL4	11.8518	2.70 **	-29.994	-1.01	-17.877	-0.66	-40.917	-1.51	-34.594	-1.19
AREA	0.0045	0.00	0.02293	0.00	1.40269	0.06	0.02426	0.00	0.32325	0.01
Neighbour	0.0100	0.41	0.00649	0.19	0.00649	0.19	0.00596	0.15	0.0058	0.15
Distance	0.0072	0.42	-0.0353	-1.03	-0.02	-0.66	-0.0458	-1.40	-0.0381	-1.02
time2	106.4864	8.30 **	124.875	8.86 **	139.704	9.64 **	124.965	8.78 **	131.884	8.16 **
time3	76.5540	4.45 **	73.7125	3.86 **	92.4228	5.02 **	75.8882	4.08 **	83.8577	3.97 **
time4	180.3838	1.52	-153.3	-0.60	21.0529	0.10	-223.33	-0.96	-118.22	-0.43 **
	Hansen's J 0.0083		Hansen's J 0.0102		Hansen's J 0.0287		Hansen's J 0.0224		Hansen's J 0.0128	
	Root MSE = 0.3471		Root MSE = 0.5044		Root MSE = 0.4885		Root MSE = 0.5806		Root MSE = 0.572	

Table 3: Estimation Results 3 (Industrial Structure and Factor Endowments).

Independent var: HP-filtered GDP correlations

Note The number of sample 4140
Constant terms are omitted.
* Significant at the 10 per cent level.
** Significant at the 5 per cent level.

Prefecture	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1																											
2	0.2014																										
3	0.3005	0.6519																									
4	0.3709	0.615	0.8142																								
5	0.0713	0.4483	0.6531	0.8144																							
6	0.53	0.5633	0.7885	0.9116	0.8065																						
7	0.4677	0.511	0.8902	0.877	0.7368	0.9146																					
8	0.3032	0.3538	0.3914	0.7051	0.5991	0.585	0.4153																				
9	0.2158	0.394	0.6992	0.9193	0.7451	0.8271	0.7975	0.7333																			
10	0.41	0.356	0.342	0.7282	0.4815	0.6364	0.5513	0.8084	0.8047																		
11	0.7297	0.6744	0.7967	0.836	0.5143	0.8228	0.8281	0.5041	0.6231	0.5587																	
12	0.6919	0.4654	0.5877	0.8822	0.5721	0.8608	0.7772	0.6644	0.796	0.8151	0.8727																
13	0.3389	0.5482	0.3895	0.6344	0.6309	0.7767	0.4701	0.5653	0.5759	0.5102	0.4947	0.6299															
14	0.1592	0.4485	0.6801	0.7702	0.853	0.8366	0.6924	0.4302	0.6746	0.2771	0.5528	0.577	0.7736														
15	0.5134	0.8593	0.7499	0.6681	0.5839	0.7761	0.7363	0.3679	0.4398	0.3895	0.8051	0.5955	0.621	0.5606													
16	0.4504	0.1467	0.5645	0.7679	0.7448	0.7966	0.6612	0.7904	0.7819	0.6004	0.5887	0.7289	0.6229	0.7359	0.3867												
17	-0.1554	-0.2375	0.2317	0.1417	-0.0351	-0.0853	0.2598	-0.0033	0.2922	0.1969	0.0393	0.046	-0.6062	-0.2723	-0.2569	-0.0129											
18	0.4683	0.6933	0.6901	0.9008	0.7482	0.8573	0.8236	0.7117	0.799	0.8297	0.8188	0.857	0.6115	0.5581	0.7899	0.6285	0.0817										
19	0.3667	0.5307	0.7915	0.9143	0.7191	0.8911	0.7929	0.7666	0.9267	0.7056	0.7332	0.8006	0.721	0.7645	0.6052	0.8416	0.0438	0.7816									
20	0.5061	0.4494	0.7969	0.9249	0.743	0.9237	0.8538	0.7655	0.907	0.7115	0.8002	0.8589	0.6627	0.7516	0.6192	0.9086	0.0934	0.8118	0.9711								
21	0.2815	0.2878	0.807	0.8207	0.7439	0.7017	0.7808	0.6204	0.7552	0.4427	0.6865	0.6297	0.2605	0.6516	0.432	0.807	0.382	0.6415	0.7573	0.8353							
22	0.6616	0.526	0.6857	0.832	0.5666	0.8444	0.716	0.8221	0.7783	0.7508	0.8331	0.8658	0.691	0.5899	0.6684	0.8308	-0.0632	0.8032	0.9134	0.9368	0.6839						
23	0.4428	0.4299	0.8276	0.7086	0.726	0.8603	0.8023	0.4087	0.5985	0.2358	0.6905	0.5684	0.6336	0.8535	0.7075	0.7709	-0.1624	0.5678	0.7761	0.8204	0.7302	0.7187					
24	0.3424	0.5003	0.8546	0.8899	0.7056	0.8182	0.8097	0.7784	0.8951	0.6689	0.739	0.7288	0.5211	0.6555	0.5927	0.824	0.2389	0.7774	0.9541	0.9538	0.8675	0.8877	0.7592				
25	0.2007	0.5484	0.9116	0.7878	0.742	0.7201	0.8335	0.2961	0.6025	0.1952	0.7366	0.5335	0.2996	0.7449	0.6412	0.5448	0.2195	0.6156	0.644	0.69	0.8562	0.515	0.7791	0.7134			
26	0.3528	0.7548	0.8478	0.9243	0.78	0.9212	0.8132	0.631	0.8076	0.5623	0.8116	0.7723	0.7917	0.8579	0.7943	0.7122	-0.1465	0.8177	0.9242	0.8888	0.6976	0.8385	0.822	0.8565	0.7667		
27	0.4963	0.4196	0.5439	0.8032	0.4233	0.7487	0.605	0.7148	0.8337	0.777	0.703	0.8708	0.6737	0.5562	0.4153	0.7115	0.0128	0.6741	0.886	0.8508	0.5373	0.8773	0.5126	0.7777	0.379	0.7723	
28	0.4095	0.2474	0.3056	0.7372	0.7606	0.7257	0.5211	0.8433	0.7099	0.7719	0.5245	0.7729	0.6964	0.6117	0.4022	0.8437	-0.1585	0.7533	0.6866	0.7479	0.5827	0.7305	0.489	0.6209	0.3486	0.628	0.6412
29	0.6543	0.2717	0.1307	0.4091	0.1729	0.5462	0.4176	0.4639	0.4611	0.7908	0.4672	0.6808	0.5415	0.0942	0.4537	0.3605	-0.117	0.6351	0.456	0.4826	0.0286	0.6171	0.1917	0.3489	-0.1003	0.3631	0.5996
30	0.478	0.5458	0.9039	0.8478	0.7167	0.8547	0.9335	0.5927	0.778	0.5986	0.8209	0.7194	0.4237	0.5888	0.7649	0.7108	0.2768	0.8471	0.8219	0.8817	0.8352	0.8074	0.7963	0.9054	0.7885	0.7989	0.5869
31	0.265	0.4683	0.8508	0.8804	0.8293	0.8283	0.9125	0.6318	0.8657	0.6445	0.697	0.6836	0.4042	0.6332	0.6368	0.7313	0.3733	0.8482	0.8208	0.8648	0.8706	0.7195	0.7217	0.9006	0.7915	0.775	0.5597
32	0.1078	0.0491	0.4961	0.6525	0.7356	0.585	0.62	0.7317	0.778	0.6581	0.3414	0.4958	0.2642	0.4351	0.2459	0.7791	0.4224	0.6349	0.6637	0.7252	0.7693	0.579	0.4912	0.7634	0.461	0.4739	0.4288
33	0.2821	0.4371	0.7693	0.9391	0.9359	0.9124	0.8628	0.6924	0.8942	0.6279	0.6958	0.7721	0.6407	0.858	0.5935	0.8723	0.1002	0.8206	0.8813	0.9177	0.8671	0.7618	0.7998	0.8677	0.7924	0.8686	0.6695
34	0.4009	0.3811	0.5369	0.4941	0.7031	0.7649	0.6413	0.3546	0.4177	0.274	0.4606	0.4184	0.7007	0.6812	0.7365	0.6135	-0.3812	0.5689	0.5625	0.6112	0.4008	0.5629	0.8244	0.514	0.4606	0.633	0.2722
35	0.0001	-0.154	0.5714	0.4831	0.3441	0.3791	0.5964	0.2227	0.6529	0.2899	0.2713	0.3241	-0.1198	0.3021	-0.0375	0.4873	0.7681	0.2504	0.5155	0.5519	0.7019	0.3156	0.4002	0.6205	0.5236	0.3	0.3863
36	-0.0439	0.0872	0.6549	0.7509	0.7589	0.6157	0.719	0.4832	0.827	0.4509	0.405	0.5096	0.2075	0.6379	0.1771	0.7034	0.5292	0.5311	0.6827	0.7174	0.8684	0.4525	0.557	0.7437	0.7267	0.57	0.4724
37	0.3777	0.5671	0.5997	0.8727	0.8945	0.8919	0.7921	0.6653	0.7718	0.7272	0.6985	0.8043	0.7262	0.7308	0.7245	0.712	-0.0889	0.9295	0.7432	0.7862	0.628	0.7129	0.6417	0.69	0.6203	0.8076	0.5865
38	0.2239	0.3217	0.7553	0.8977	0.9092	0.8279	0.8414	0.6521	0.8641	0.5702	0.6458	0.7083	0.4701	0.788	0.4834	0.853	0.2607	0.755	0.8118	0.8718	0.93	0.6823	0.7472	0.8469	0.8196	0.7732	0.5836
39	0.3525	0.3906	0.6661	0.9046	0.9168	0.8844	0.7847	0.7996	0.8624	0.6946	0.6748	0.7904	0.6715	0.8007	0.5678	0.9218	0.0239	0.8316	0.8625	0.914	0.8359	0.8069	0.7539	0.8492	0.6855	0.8247	0.6779
40	0.1537	0.2264	0.2761	0.5595	0.7602	0.6794	0.4177	0.7135	0.6286	0.5723	0.2509	0.4839	0.8243	0.6816	0.3994	0.7667	-0.3702	0.5718	0.6718	0.6566	0.3857	0.6111	0.5761	0.5628	0.2181	0.6106	0.5012
41	0.4531	-0.0069	0.3429	0.2735	0.2033	0.5261	0.5693	0.1295	0.4275	0.4179	0.285	0.3789	0.2924	0.1742	0.3555	0.3656	0.1611	0.3785	0.4194	0.4668	0.1675	0.4233	0.4462	0.3927	0.0884	0.2675	0.3391
42	0.2866	0.388	0.1071	0.2459	0.5492	0.4368	0.2247	0.1965	0.0036	0.0631	0.2878	0.249	0.6043	0.499	0.5835	0.2876	-0.7003	0.3927	0.1301	0.192	0.0831	0.2273	0.4259	0.0408	0.2479	0.3709	-0.0337
43	0.2696	0.1417	0.1824	0.6771	0.5184	0.5563	0.4819	0.6763	0.7635	0.9128	0.4153	0.7691	0.4224	0.3096	0.1686	0.5662	0.2492	0.7154	0.5634	0.5942	0.4189	0.5454	0.1203	0.4985	0.1803	0.4311	0.6666
44	0.3386	0.2533	-0.2102	-0.1663	-0.3179	-0.0934	-0.098	0.0696	-0.1737	0.3472	0.0748	0.0637	-0.0141	-0.5357	0.2784	-0.3173	-0.077	0.2404	-0.1643	-0.1612	-0.4266	0.088	-0.3337	-0.1456	-0.4398	-0.1632	-0.04
45	0.2271	0.4282	0.9116	0.7966	0.7835	0.8386	0.942	0.3652	0.7715	0.3897	0.6505	0.5705	0.4123	0.7385	0.644	0.656	0.2889	0.6857	0.7736	0.8066	0.8059	0.607	0.847	0.8173	0.8567	0.7747	0.4752
46	0.3948	0.6302	0.4036	0.7623	0.4375	0.675	0.5429	0.4905	0.6604	0.7218	0.6945	0.8454	0.6607	0.4982	0.5205	0.3855	-0.1142	0.7466	0.6334	0.5942	0.3056	0.6249	0.2804	0.4795	0.3702	0.7081	0.7913
47	-0.1339	0.0983	0.6989	0.5327	0.505	0.4381	0.612	0.3828	0.6914	0.3108	0.2645	0.2359	0.0305	0.3885	0.1767	0.5186	0.6241	0.3647	0.6252	0.6103	0.7314	0.4034	0.5166	0.7565	0.5819	0.4503	0.3494
Toatl	0.5005	0.5534	0.721	0.9048	0.8142	0.9725	0.8155	0.7224	0.8371	0.678	0.7761	0.8528	0.8531	0.8493	0.7266	0.8657	-0.1867	0.8398	0.9298	0.9437	0.6944	0.8992	0.8396	0.8443	0.6437	0.9343	0.8032

Table A: Hp-filtered GDP Cross-correlations in Japan (1955-1964).

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
0.5414																			
0.5473	0.4151																		
0.6181	0.3363	0.9541																	
0.7011	0.2963	0.7291	0.8495																
0.7977	0.3104	0.8392	0.9096	0.785															
0.5369	0.4207	0.6569	0.5962	0.4707	0.6477														
0.142	-0.0286	0.5656	0.6513	0.6533	0.5321	0.0658													
0.5256	-0.0072	0.6745	0.8302	0.8177	0.8419	0.2897	0.8437												
0.8594	0.547	0.757	0.8084	0.6588	0.8935	0.7018	0.196	0.5876											
0.7451	0.1878	0.827	0.9189	0.8338	0.9773	0.549	0.6388	0.9164	0.8225										
0.8981	0.3892	0.805	0.8678	0.8179	0.9763	0.6594	0.433	0.7704	0.9092	0.9472									
0.828	0.4727	0.4613	0.5376	0.6524	0.7117	0.7504	0.0798	0.4227	0.7435	0.6102	0.7873								
0.2099	0.6823	0.5403	0.4695	0.4311	0.3305	0.5999	0.4179	0.2375	0.3452	0.2751	0.3121	0.3822							
0.5162	0.2081	0.2005	0.1677	0.0654	0.3587	0.6979	-0.5104	-0.0804	0.5998	0.2581	0.4252	0.5505	-0.0088						
0.8002	0.6441	0.4276	0.5568	0.6357	0.6262	0.1485	0.3242	0.5509	0.7152	0.6047	0.6797	0.5317	0.2787	0.0812					
-0.0367	0.6489	0.0264	-0.0968	-0.1237	-0.3155	0.0393	-0.4422	-0.5439	0.0371	-0.3954	-0.2255	-0.0641	0.316	0.0783	0.1209				
0.419	0.2022	0.9039	0.9213	0.6825	0.8582	0.6747	0.6892	0.7995	0.696	0.8568	0.758	0.4576	0.5462	0.1664	0.3211	-0.2716			
0.5948	0.588	0.4154	0.4245	0.1629	0.5638	0.1755	0.0409	0.2908	0.6932	0.4553	0.5515	0.351	0.0975	0.2325	0.7174	0.1158	0.3226		
0.1814	-0.0437	0.689	0.7722	0.7569	0.6079	0.274	0.8878	0.8201	0.2984	0.6794	0.5208	0.2771	0.4136	-0.3523	0.2243	-0.3347	0.7813	-0.0207	
0.8121	0.5436	0.8022	0.7849	0.6109	0.914	0.7491	0.3067	0.5859	0.8854	0.8175	0.9206	0.7822	0.4368	0.46	0.5808	-0.1084	0.7515	0.6772	0.4062

Prefecture	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1																											
2	0.8498																										
3	0.9664	0.8016																									
4	0.8521	0.7351	0.8905																								
5	0.9403	0.8804	0.8597	0.8031																							
6	0.9163	0.8444	0.8774	0.8383	0.9523																						
7	0.9294	0.8254	0.924	0.7251	0.8986	0.8957																					
8	0.604	0.5893	0.6001	0.8074	0.6514	0.5661	0.4187																				
9	0.6707	0.2905	0.7456	0.7139	0.5205	0.6293	0.5884	0.3861																			
10	0.6938	0.6013	0.742	0.8044	0.7335	0.7172	0.6704	0.815	0.6518																		
11	0.6868	0.297	0.7522	0.6406	0.6027	0.628	0.7113	0.4396	0.8082	0.7133																	
12	0.7253	0.4975	0.8085	0.7776	0.6799	0.783	0.73	0.5689	0.8469	0.8585	0.8657																
13	0.7737	0.5622	0.8692	0.8276	0.7226	0.7839	0.8145	0.6	0.7997	0.8847	0.8959	0.9518															
14	0.5562	0.3153	0.6228	0.6924	0.5756	0.5744	0.5426	0.6929	0.7364	0.9341	0.824	0.857	0.8733														
15	0.7336	0.915	0.7017	0.7634	0.842	0.7829	0.7075	0.7799	0.2567	0.7813	0.3121	0.5443	0.6163	0.5259													
16	0.7354	0.642	0.7911	0.8711	0.7452	0.7301	0.6932	0.8213	0.6836	0.9793	0.6888	0.8232	0.8859	0.9021	0.7983												
17	0.8652	0.7298	0.8838	0.9098	0.8761	0.9052	0.8146	0.7557	0.767	0.9328	0.757	0.9144	0.9166	0.8446	0.7935	0.9348											
18	0.9306	0.8121	0.9588	0.8866	0.8826	0.8978	0.9434	0.5746	0.6664	0.7445	0.7247	0.7617	0.8754	0.6295	0.7523	0.8081	0.876										
19	0.6573	0.433	0.7747	0.5828	0.5077	0.5021	0.7648	0.2946	0.6581	0.6273	0.7735	0.6554	0.8162	0.6386	0.3919	0.6851	0.6249	0.7899									
20	0.8135	0.7924	0.8614	0.8571	0.8082	0.7974	0.7946	0.7739	0.6293	0.9461	0.6351	0.8223	0.8714	0.7931	0.873	0.9586	0.9369	0.849	0.6922								
21	0.7152	0.4485	0.7762	0.8076	0.6999	0.7938	0.7056	0.5721	0.8816	0.8564	0.8681	0.9583	0.9397	0.8963	0.5278	0.8487	0.9226	0.7824	0.6492	0.7864							
22	0.6923	0.5451	0.7827	0.8309	0.6747	0.726	0.6949	0.6765	0.7924	0.9512	0.7559	0.9032	0.9376	0.9218	0.678	0.965	0.9289	0.7971	0.7343	0.9197	0.9256						
23	0.7099	0.4592	0.7904	0.727	0.6712	0.6663	0.745	0.6348	0.7331	0.8976	0.9311	0.9035	0.9574	0.9239	0.5592	0.8691	0.86	0.7781	0.8067	0.834	0.8811	0.8911					
24	0.694	0.6674	0.736	0.8767	0.7397	0.7351	0.6177	0.8937	0.5994	0.9689	0.5917	0.8006	0.8244	0.8554	0.848	0.9724	0.9266	0.7424	0.5191	0.9421	0.807	0.9172	0.7984				
25	0.8125	0.4832	0.8766	0.7855	0.7012	0.7724	0.7962	0.462	0.9485	0.7682	0.9033	0.9174	0.9246	0.8027	0.4489	0.7898	0.8744	0.8359	0.7989	0.7708	0.9346	0.8711	0.8705	0.6951			
26	0.8072	0.6374	0.8527	0.8817	0.8225	0.8365	0.8127	0.7227	0.7263	0.9259	0.8357	0.8882	0.96	0.8905	0.7378	0.9378	0.9536	0.9	0.7356	0.8958	0.9274	0.9363	0.9257	0.8947	0.869		
27	0.7919	0.6013	0.85	0.8004	0.7706	0.7453	0.8102	0.7024	0.7205	0.9432	0.8673	0.8827	0.9559	0.9134	0.6961	0.9371	0.9179	0.8523	0.8171	0.918	0.8766	0.9297	0.9772	0.8696	0.8726	0.9602	
28	0.4789	0.3158	0.6127	0.6781	0.427	0.4623	0.4712	0.6487	0.727	0.9045	0.6981	0.8222	0.843	0.9245	0.5101	0.8992	0.7816	0.5859	0.69	0.8263	0.8122	0.9367	0.8582	0.8496	0.7598	0.8032	0.8604
29	0.8641	0.6808	0.8278	0.6283	0.8667	0.7759	0.9033	0.5296	0.5457	0.741	0.8029	0.719	0.7883	0.6775	0.6492	0.7118	0.7925	0.816	0.7203	0.7684	0.689	0.6714	0.842	0.637	0.7592	0.81	0.8731
30	0.9511	0.847	0.9731	0.9183	0.8814	0.912	0.9046	0.6139	0.7354	0.7645	0.6564	0.783	0.8427	0.6194	0.7738	0.8302	0.9098	0.9635	0.7212	0.8901	0.7862	0.8199	0.7284	0.7851	0.853	0.8596	0.8226
31	0.6874	0.7502	0.7448	0.6856	0.7147	0.6932	0.7976	0.5342	0.4503	0.8161	0.514	0.6446	0.7836	0.6641	0.8231	0.8551	0.7799	0.8278	0.7715	0.8992	0.6487	0.8337	0.7279	0.7844	0.6486	0.8153	0.8316
32	0.7807	0.7828	0.7744	0.7939	0.8215	0.8245	0.7811	0.5742	0.6001	0.792	0.4754	0.6541	0.7326	0.6486	0.8235	0.8568	0.8576	0.8461	0.6174	0.8696	0.7305	0.8361	0.6261	0.8077	0.7181	0.8187	0.7636
33	0.6872	0.5023	0.7652	0.7163	0.6687	0.6506	0.7149	0.6952	0.6736	0.9387	0.8609	0.8923	0.9313	0.9262	0.631	0.897	0.8677	0.7396	0.7549	0.8804	0.8448	0.8989	0.9844	0.8495	0.8159	0.9062	0.9749
34	0.7634	0.4642	0.8382	0.7037	0.6597	0.7747	0.7863	0.3766	0.8795	0.701	0.8987	0.9527	0.9082	0.7236	0.3975	0.6785	0.8288	0.7724	0.7073	0.7077	0.9035	0.7885	0.8464	0.619	0.947	0.8056	0.8103
35	0.7802	0.7441	0.8194	0.8979	0.8139	0.7942	0.7456	0.8461	0.6046	0.9631	0.6493	0.8013	0.8743	0.8408	0.8811	0.9838	0.9435	0.8514	0.6483	0.97	0.8162	0.9284	0.8411	0.9768	0.7458	0.9435	0.9216
36	0.6879	0.5104	0.7454	0.9133	0.6962	0.7491	0.5908	0.8271	0.7249	0.8797	0.7469	0.8657	0.873	0.863	0.6573	0.8873	0.9086	0.7545	0.5092	0.8057	0.9032	0.8789	0.8269	0.9098	0.7808	0.9196	0.8395
37	0.8855	0.8744	0.8509	0.8498	0.943	0.9438	0.8303	0.7541	0.5449	0.828	0.5939	0.7921	0.7796	0.6475	0.8887	0.8112	0.9321	0.8364	0.4484	0.8858	0.7555	0.7558	0.7181	0.8546	0.7008	0.8442	0.7981
38	0.4203	0.4029	0.4948	0.6868	0.4897	0.4844	0.3836	0.785	0.5206	0.9234	0.4918	0.6888	0.7189	0.8814	0.6841	0.9185	0.776	0.5308	0.4654	0.8248	0.7276	0.8882	0.7283	0.9267	0.5736	0.7841	0.7814
39	0.6348	0.7234	0.623	0.693	0.6709	0.6619	0.5559	0.624	0.5073	0.7535	0.2454	0.5476	0.5499	0.5646	0.7996	0.7992	0.7638	0.6186	0.3963	0.8353	0.5747	0.7508	0.466	0.8026	0.5529	0.6309	0.6204
40	0.924	0.8429	0.9494	0.8936	0.8737	0.8543	0.8863	0.7009	0.6885	0.8575	0.6655	0.7805	0.8583	0.7079	0.8322	0.907	0.9239	0.937	0.7624	0.9586	0.7714	0.8675	0.7976	0.8568	0.8292	0.8865	0.8957
41	0.7365	0.689	0.7815	0.7997	0.7733	0.8587	0.8222	0.455	0.5997	0.7153	0.6204	0.7378	0.8371	0.6319	0.7087	0.7701	0.8276	0.9056	0.6664	0.7662	0.8107	0.811	0.6896	0.7216	0.7524	0.8781	0.7593
42	0.5568	0.6701	0.5917	0.8263	0.6301	0.636	0.4844	0.7869	0.3972	0.7761	0.2836	0.5282	0.6182	0.6155	0.8458	0.8497	0.7554	0.6823	0.3916	0.8032	0.6063	0.7726	0.5159	0.8825	0.4767	0.7459	0.6439
43	0.8833	0.6949	0.8446	0.8603	0.8725	0.9348	0.8023	0.5169	0.7148	0.599	0.6515	0.7159	0.7318	0.5319	0.6094	0.6536	0.8342	0.8725	0.4824	0.6562	0.7926	0.6617	0.5982	0.637	0.7932	0.7956	0.6624
44	0.7303	0.5497	0.8363	0.7176	0.6479	0.6669	0.8135	0.4888	0.7484	0.8448	0.8189	0.8409	0.9377	0.8212	0.5858	0.8676	0.8282	0.8446	0.9341	0.8724	0.8265	0.9149	0.9166	0.7528	0.8859	0.8826	0.9411
45	0.921	0.8197	0.8751	0.8712	0.9307	0.8929	0.8627	0.6332	0.6081	0.7148	0.5939	0.6302	0.7363	0.5916	0.7887	0.7921	0.8548	0.9337	0.6279	0.7997	0.7174	0.7318	0.6519	0.741	0.7493	0.8454	0.7704
46	0.8864	0.7988	0.8544	0.694	0.7983	0.8254	0.8757	0.2601	0.539	0.3794	0.4652	0.4911	0.5766	0.2281	0.5663	0.4747	0.6355	0.8688	0.6011	0.5842	0.5129	0.473	0.4251	0.4036	0.6665	0.5923	0.5276
47	0.8796	0.7626	0.8649	0.6904	0.8055	0.867	0.9132	0.2229	0.6104	0.4372	0.5594	0.5983	0.6643	0.3173	0.5484	0.5104	0.6889	0.8894	0.6453	0.6116	0.6173	0.5488	0.5083	0.4327	0.7435	0.6568	0.5884
Japan	0.839	0.6514	0.8976	0.8774	0.8101	0.8279	0.8329	0.7105	0.7893	0.941	0.8566	0.93	0.9774	0.8954	0.7202	0.947	0.9676	0.8957	0.781	0.9345	0.9304	0.9561	0.9502	0.8966	0.9164	0.9802	0.9816

Table B: Hp-filtered GDP Cross-correlations in Japan (1965-1974).

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
0.5292																			
0.6221	0.7622																		
0.7145	0.7065	0.8035																	
0.6416	0.652	0.8859	0.8931																
0.8873	0.8274	0.7137	0.7577	0.6379															
0.6771	0.7408	0.7809	0.5537	0.575	0.7989														
0.8231	0.738	0.8595	0.8749	0.8695	0.873	0.6578													
0.7896	0.5994	0.7559	0.6014	0.6735	0.8178	0.7377	0.8872												
0.5607	0.7964	0.8712	0.7168	0.7881	0.7508	0.7139	0.8766	0.7969											
0.9101	0.4488	0.5683	0.7312	0.7141	0.7894	0.4599	0.8771	0.8047	0.6209										
0.6414	0.466	0.7554	0.769	0.9023	0.5391	0.4122	0.7925	0.569	0.7196	0.7491									
0.7203	0.8169	0.9706	0.8781	0.9008	0.8088	0.7364	0.9245	0.7608	0.8758	0.6834	0.8075								
0.5804	0.6335	0.8493	0.8283	0.8661	0.6486	0.6996	0.8109	0.7492	0.7533	0.5983	0.6109	0.8024							
0.657	0.3726	0.7162	0.7673	0.839	0.5599	0.3348	0.8782	0.7667	0.6982	0.8384	0.8179	0.753	0.7503						
0.3913	0.6667	0.8762	0.5362	0.7526	0.5343	0.7467	0.6982	0.7617	0.8143	0.3895	0.5417	0.7736	0.8293	0.5906					
0.8564	0.7855	0.8194	0.8769	0.7702	0.9012	0.8146	0.8335	0.7038	0.6624	0.7007	0.6112	0.875	0.777	0.5796	0.5867				
0.4907	0.7705	0.9272	0.7668	0.9037	0.6212	0.6155	0.8337	0.7182	0.8318	0.54	0.718	0.9069	0.8469	0.7416	0.9003	0.7093			
0.1946	0.6507	0.8721	0.5956	0.7178	0.366	0.6127	0.5383	0.4227	0.673	0.1219	0.5075	0.7717	0.7349	0.4307	0.8438	0.5777	0.853		
0.2689	0.6894	0.8805	0.6318	0.738	0.4428	0.7175	0.5647	0.4746	0.699	0.1718	0.4995	0.7764	0.8039	0.4182	0.8686	0.6487	0.841	0.9804	
0.8508	0.8356	0.8895	0.8207	0.8126	0.9421	0.8631	0.9388	0.8943	0.8525	0.7781	0.6721	0.9248	0.8252	0.6984	0.7653	0.9277	0.8187	0.6065	0.6692

Prefecture	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1																											
2	0.706																										
3	0.3497	0.6005																									
4	0.6377	0.7542	0.4497																								
5	0.8448	0.2956	0.2894	0.3551																							
6	0.7954	0.76	0.554	0.8973	0.6457																						
7	0.6467	0.6816	0.724	0.483	0.4996	0.5797																					
8	0.6992	0.1856	-0.0082	0.1648	0.7593	0.3474	0.5737																				
9	0.2757	0.2859	0.4774	-0.0024	0.2169	0.003	0.5263	0.1217																			
10	0.6163	0.4841	0.4456	0.3804	0.4797	0.4213	0.5347	0.5011	0.2037																		
11	0.4558	0.3374	0.3495	0.0764	0.314	0.0746	0.7064	0.6106	0.5303	0.7524																	
12	0.5047	0.5171	0.1927	0.2194	0.1704	0.1069	0.4388	0.3382	0.5399	0.7331	0.8011																
13	0.6453	0.6036	0.2897	0.8596	0.4186	0.8196	0.2792	0.2122	-0.2781	0.5264	0.092	0.2288															
14	0.6442	0.2612	-0.0333	0.4194	0.4938	0.3054	0.3814	0.5992	0.3463	0.5091	0.6095	0.6543	0.4561														
15	0.6618	0.2881	0.2018	0.6362	0.692	0.6959	0.5009	0.724	-0.1874	0.5606	0.3445	0.122	0.6955	0.5676													
16	0.3834	0.5071	0.5534	0.2978	0.1971	0.2652	0.5394	-0.024	0.8532	0.0887	0.3542	0.4382	0.0546	0.393	-0.1294												
17	0.7569	0.7519	0.8111	0.689	0.5861	0.751	0.7789	0.3372	0.4705	0.7395	0.5753	0.5451	0.642	0.5006	0.5311	0.5985											
18	0.5536	0.0992	-0.5098	0.2187	0.4311	0.1905	0.0366	0.6953	-0.2021	0.3731	0.3256	0.4299	0.4036	0.7238	0.553	-0.2115	0.0547										
19	0.3021	0.1353	0.5303	0.2174	0.3935	0.233	0.6139	0.488	0.3415	0.7472	0.7184	0.4089	0.1711	0.379	0.58	0.0863	0.5893	0.0591									
20	0.4685	0.1503	0.5789	0.4251	0.6594	0.5635	0.405	0.343	0.0701	0.6227	0.3058	0.0735	0.5607	0.3393	0.6994	0.0936	0.7029	0.0347	0.6991								
21	0.7369	0.2434	-0.02	0.4371	0.6927	0.4259	0.4135	0.7911	0.21	0.6492	0.581	0.5676	0.4751	0.8869	0.7675	0.1176	0.4938	0.7912	0.5541	0.4782							
22	0.4061	0.588	0.7871	0.3603	0.1996	0.3121	0.6938	0.0693	0.7574	0.6046	0.6887	0.6824	0.233	0.4045	0.0958	0.7764	0.8346	-0.2012	0.5681	0.4204	0.2552						
23	0.7007	0.4793	-0.0051	0.5873	0.4273	0.4716	0.2409	0.4463	0.0669	0.7222	0.4748	0.7296	0.7208	0.8175	0.5731	0.1413	0.5522	0.7572	0.3127	0.3511	0.8205	0.3427					
24	0.5547	0.205	0.1921	-0.08	0.5393	0.0347	0.6021	0.6752	0.7248	0.4469	0.8109	0.6544	-0.1039	0.6612	0.2004	0.5635	0.4544	0.3643	0.4312	0.1912	0.589	0.5515	0.3469				
25	0.4772	0.728	0.387	0.8309	0.1418	0.6495	0.3704	-0.0267	0.2922	0.308	0.0682	0.3972	0.5318	0.3267	0.2833	0.4174	0.5525	0.0891	0.1764	0.1297	0.3498	0.4384	0.5225	-0.0429			
26	0.6987	0.3767	0.2452	0.6036	0.6141	0.5704	0.5962	0.7354	0.1016	0.7645	0.6485	0.5098	0.6354	0.7825	0.9021	0.0792	0.6557	0.6176	0.7316	0.6479	0.9029	0.3858	0.767	0.4494	0.3947		
27	0.7662	0.184	-0.1548	0.4412	0.7966	0.525	0.2206	0.7639	-0.0449	0.4875	0.2708	0.303	0.5538	0.7354	0.7868	-0.0622	0.3617	0.8318	0.3049	0.4669	0.9137	-0.035	0.7496	0.3888	0.2699	0.7717	
28	0.2684	0.2894	0.3668	0.0748	0.1646	0.0548	0.0834	-0.1791	0.6764	0.4277	0.2881	0.6204	0.0524	0.2721	-0.2484	0.5841	0.4836	-0.1114	0.2005	0.2126	0.1879	0.6675	0.3752	0.3749	0.3848	0.0458	0.0552
29	0.302	0.564	0.6031	0.6001	0.1402	0.5505	0.2025	-0.3889	0.4293	0.0779	-0.1864	0.1254	0.3734	0.039	-0.0593	0.6398	0.5656	-0.3786	-0.0221	0.2562	-0.0435	0.529	0.1675	-0.1043	0.7416	-0.016	-0.0411
30	0.537	0.5819	0.0167	0.423	0.2285	0.4375	0.4288	0.5583	-0.287	0.576	0.436	0.4458	0.5093	0.2716	0.5263	-0.2543	0.297	0.5952	0.2156	0.0245	0.4314	0.0375	0.5534	0.1278	0.2662	0.5546	0.4145
31	0.7625	0.6905	0.6308	0.452	0.5926	0.5491	0.6036	0.2926	0.688	0.6657	0.541	0.6975	0.3929	0.4996	0.2296	0.7035	0.8623	0.1099	0.3985	0.4602	0.4843	0.8057	0.5622	0.6114	0.5355	0.4444	0.3711
32	0.6396	0.4493	0.5585	0.3893	0.6452	0.5472	0.6583	0.6228	0.1751	0.8977	0.641	0.4627	0.4381	0.3252	0.6834	0.0028	0.7191	0.2415	0.8287	0.7141	0.6051	0.4832	0.4894	0.392	0.2805	0.7547	0.5069
33	0.2244	0.3817	0.7907	0.0896	0.1831	0.1383	0.7917	0.1971	0.7817	0.4374	0.697	0.4449	-0.1431	0.1467	0.053	0.6289	0.6293	-0.3778	0.6775	0.3277	0.1143	0.8456	-0.0475	0.5851	0.1998	0.2695	-0.1892
34	0.8332	0.6819	0.6454	0.521	0.6725	0.6161	0.8047	0.5694	0.5332	0.8273	0.773	0.7122	0.5268	0.6481	0.5471	0.5591	0.9369	0.2824	0.6326	0.6221	0.6568	0.8014	0.6445	0.6982	0.4107	0.7347	0.4954
35	0.3367	-0.3007	0.0174	-0.145	0.6621	0.0126	0.2453	0.577	0.4516	0.1252	0.3472	0.0732	-0.1266	0.5489	0.3535	0.297	0.2123	0.2643	0.3926	0.4625	0.5616	0.1625	0.1191	0.6893	-0.2346	0.3869	0.5198
36	0.3936	0.232	0.1566	0.578	0.2785	0.3477	0.3592	0.345	0.3159	0.4998	0.4432	0.4941	0.4142	0.7457	0.5931	0.2484	0.4832	0.3989	0.6294	0.4249	0.7717	0.4251	0.671	0.2917	0.6388	0.7889	0.5596
37	0.7489	0.3429	0.1079	0.1942	0.6812	0.3434	0.628	0.8174	0.3451	0.4023	0.6605	0.469	0.2673	0.7247	0.5019	0.4055	0.4863	0.5933	0.2561	0.2634	0.6574	0.3296	0.4659	0.8361	-0.0394	0.587	0.5946
38	0.2233	0.2851	0.2945	-0.1933	0.0402	-0.2154	0.4769	0.2271	0.7826	0.4723	0.8153	0.8215	-0.2568	0.3781	-0.2163	0.5804	0.3844	0.0418	0.3821	-0.0624	0.2341	0.7279	0.2418	0.7874	0.0532	0.1706	-0.0813
39	0.9149	0.7399	0.4104	0.8029	0.6841	0.8169	0.574	0.5048	0.2556	0.7264	0.4508	0.6032	0.7984	0.7104	0.685	0.3893	0.8409	0.5069	0.4108	0.5591	0.7681	0.5327	0.8534	0.3987	0.688	0.7893	0.7311
40	0.7551	0.6024	0.4121	0.3424	0.5566	0.4547	0.79	0.6529	0.4124	0.5667	0.7658	0.6046	0.393	0.6338	0.4465	0.5355	0.7087	0.3877	0.3505	0.3264	0.525	0.6038	0.4871	0.773	0.1156	0.5861	0.3916
41	0.8433	0.6544	0.5002	0.8429	0.7637	0.9612	0.6439	0.5128	0.0924	0.4009	0.1723	0.1085	0.7578	0.4616	0.7875	0.3234	0.7491	0.2871	0.3097	0.618	0.5641	0.3131	0.4799	0.2127	0.5592	0.6692	0.6399
42	0.6788	0.3271	-0.0039	0.5991	0.6072	0.6435	0.0511	0.3968	-0.3101	0.584	0.0879	0.2619	0.8572	0.5376	0.7061	-0.1543	0.4666	0.6525	0.183	0.5789	0.6696	0.0229	0.8117	0.0243	0.3387	0.6567	0.8127
43	0.8573	0.6558	0.7132	0.6346	0.7969	0.7779	0.836	0.5743	0.5066	0.6484	0.5639	0.4381	0.544	0.5654	0.6503	0.5751	0.9323	0.1746	0.601	0.7101	0.6265	0.6954	0.4955	0.5887	0.4773	0.7138	0.5405
44	0.7244	0.3466	0.6144	0.3889	0.8868	0.6501	0.7447	0.691	0.3416	0.5518	0.4771	0.1551	0.3638	0.3936	0.712	0.3021	0.7385	0.1337	0.6639	0.7972	0.5719	0.4465	0.2585	0.5441	0.1513	0.6596	0.5541
45	0.6669	0.7646	0.7755	0.8422	0.54	0.937	0.73	0.2551	0.1762	0.391	0.1566	0.0774	0.6636	0.1825	0.5996	0.3976	0.8088	-0.0875	0.3701	0.5838	0.2773	0.4856	0.2675	0.0658	0.6374	0.5018	0.2892
46	0.741	0.4463	0.3376	0.7635	0.723	0.8137	0.3738	0.4682	-0.0224	0.6383	0.1888	0.241	0.7851	0.5172	0.8346	0.036	0.6744	0.4234	0.5081	0.7498	0.7355	0.2504	0.698	0.1029	0.5912	0.7927	0.7897
47	0.1338	0.393	0.3849	0.098	-0.0603	0.1143	0.6864	0.2428	0.2459	0.0259	0.478	0.1509	-0.0334	0.0695	0.0651	0.3904	0.2736	-0.1327	0.1269	-0.1103	-0.1095	0.3762	-0.1765	0.367	-0.0843	0.1072	-0.2849
Japan	0.9034	0.6009	0.3906	0.6186	0.7474	0.6628	0.6758	0.6923	0.3717	0.8031	0.689	0.6884	0.6486	0.8262	0.7251	0.4077	0.8374	0.5689	0.5846	0.6123	0.8716	0.5981	0.8289	0.6468	0.4793	0.8822	0.7607

Table C: Hp-filtered GDP Cross-correlations in Japan (1975-1984).

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
0.6207																			
-0.2497	-0.265																		
0.7841	0.6177	0.161																	
0.2316	0.0654	0.5441	0.5887																
0.3929	0.2654	-0.0189	0.5753	0.5065															
0.4857	0.3282	0.411	0.8836	0.7752	0.6355														
0.1593	-0.1126	-0.3317	0.2837	0.2195	0.2598	0.3595													
0.2705	0.2574	0.1652	0.3798	0.4327	0.2661	0.486	0.3268												
0.0172	-0.1817	0.3944	0.4803	0.3757	0.2906	0.6952	0.5944	0.2198											
0.594	0.0167	0.1066	0.5907	0.2884	0.7115	0.571	0.2183	0.184	0.4363										
0.4062	0.4682	0.5044	0.7903	0.6616	0.2269	0.845	0.2003	0.632	0.5467	0.2035									
0.1469	0.0095	0.4902	0.6318	0.4941	0.5045	0.8451	0.3452	0.2098	0.9104	0.5664	0.6298								
0.0065	0.448	0.3734	0.5443	0.5478	0.1852	0.6634	0.2611	0.4335	0.5178	-0.1672	0.8219	0.5513							
0.1538	0.1701	0.4563	0.3866	0.4961	-0.3304	0.4703	0.1249	0.4086	0.3183	-0.2456	0.7722	0.2844	0.6266						
0.3552	0.4528	0.2739	0.8249	0.7354	0.6038	0.924	0.4588	0.4978	0.648	0.3223	0.8364	0.7448	0.8487	0.4575					
0.1216	0.18	0.1838	0.5938	0.7689	0.5325	0.7616	0.6245	0.337	0.6158	0.1492	0.6126	0.6135	0.7662	0.3875	0.8984				
0.0718	0.6072	0.3148	0.5572	0.5662	0.4148	0.6348	0.0098	0.3345	0.2716	-0.095	0.6989	0.456	0.901	0.385	0.8152	0.6976			
0.2092	0.3887	0.3688	0.5327	0.71	0.0469	0.6154	0.2523	0.6553	0.2771	-0.1828	0.8584	0.2827	0.821	0.8429	0.7205	0.6649	0.6886		
-0.3302	-0.1675	0.3099	0.053	0.0613	0.5379	0.3069	-0.05	-0.131	0.4841	0.3768	-0.0041	0.6447	0.1692	-0.3905	0.2721	0.2086	0.2962	-0.2958	
0.3767	0.2448	0.4885	0.7837	0.7382	0.3793	0.9281	0.4284	0.66	0.7329	0.3932	0.9374	0.7744	0.7407	0.6777	0.878	0.7229	0.5805	0.7731	0.1266

Prefecture	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1																											
2	0.508																										
3	0.5949	0.7473																									
4	0.8327	0.6597	0.7678																								
5	0.8505	0.519	0.6072	0.8111																							
6	0.7425	0.5983	0.5415	0.8665	0.8131																						
7	0.6938	0.7551	0.6627	0.8892	0.6285	0.7915																					
8	0.6493	0.6699	0.4094	0.7598	0.8009	0.8219	0.7322																				
9	0.6046	0.5645	0.4291	0.7206	0.6546	0.8304	0.8353	0.7158																			
10	0.6336	0.4653	0.2632	0.5395	0.5075	0.677	0.6683	0.5769	0.5868																		
11	0.7711	0.5853	0.5246	0.7807	0.5985	0.8478	0.7842	0.627	0.6839	0.8692																	
12	0.8496	0.6775	0.6381	0.9362	0.7614	0.8801	0.8838	0.8241	0.7257	0.7351	0.9075																
13	0.3935	0.567	0.4155	0.5888	0.443	0.7256	0.7356	0.5946	0.9215	0.4927	0.6441	0.6301															
14	0.7082	0.5631	0.6506	0.8116	0.7684	0.8993	0.7585	0.6575	0.8723	0.5427	0.7591	0.7835	0.8034														
15	0.901	0.4855	0.4737	0.8802	0.8405	0.8864	0.7388	0.7709	0.6764	0.6221	0.7814	0.877	0.4477	0.7438													
16	0.6716	0.4932	0.4222	0.8086	0.6657	0.9421	0.8275	0.7199	0.9116	0.6707	0.8324	0.8327	0.8162	0.9041	0.825												
17	0.7031	0.4606	0.39	0.6284	0.6341	0.8051	0.722	0.5555	0.8673	0.8155	0.8375	0.7169	0.7759	0.8513	0.6825	0.8657											
18	0.8002	0.352	0.5991	0.6643	0.5933	0.5595	0.4046	0.3327	0.1771	0.5102	0.7231	0.6891	0.079	0.4751	0.6985	0.4096	0.4269										
19	0.6135	0.6879	0.5923	0.6614	0.6396	0.7884	0.783	0.5754	0.8527	0.7347	0.7669	0.6803	0.8046	0.8119	0.5927	0.7794	0.9007	0.3695									
20	0.6501	0.7363	0.4912	0.7502	0.6618	0.8817	0.8726	0.7897	0.8778	0.7662	0.8141	0.821	0.7738	0.842	0.7518	0.8994	0.8558	0.3468	0.8494								
21	0.787	0.3227	0.3531	0.6836	0.5988	0.816	0.6485	0.4773	0.722	0.7582	0.8971	0.7634	0.6134	0.7932	0.8049	0.8634	0.9038	0.6609	0.7304	0.7383							
22	0.6516	0.496	0.4335	0.823	0.646	0.8047	0.9061	0.7585	0.8647	0.7091	0.7643	0.8535	0.7664	0.7295	0.7301	0.862	0.7548	0.3273	0.7295	0.7933	0.689						
23	0.5938	0.5199	0.4984	0.7814	0.5912	0.8695	0.8753	0.6229	0.909	0.6907	0.805	0.7845	0.8313	0.8916	0.7085	0.9578	0.8755	0.3348	0.8359	0.9004	0.8035	0.8773					
24	0.7004	0.6767	0.5465	0.8566	0.6942	0.9328	0.9217	0.7829	0.9339	0.719	0.8576	0.8814	0.8596	0.8706	0.8037	0.9545	0.857	0.4197	0.8736	0.9265	0.8012	0.9128	0.9385				
25	0.6902	0.5211	0.4046	0.8385	0.6273	0.8779	0.9036	0.7361	0.8429	0.7546	0.8415	0.8694	0.7123	0.7398	0.8375	0.9255	0.7864	0.4326	0.7505	0.8545	0.7989	0.9431	0.9061	0.948			
26	0.8632	0.16	0.3299	0.7313	0.6426	0.6056	0.5738	0.4817	0.4087	0.5857	0.6876	0.7566	0.1621	0.5095	0.8528	0.6045	0.5371	0.7566	0.3242	0.4745	0.7415	0.6204	0.5277	0.5453	0.6821		
27	0.6807	0.4241	0.3422	0.7614	0.5504	0.8396	0.7233	0.6622	0.6308	0.7058	0.8636	0.8578	0.5186	0.7259	0.8408	0.8694	0.6927	0.5922	0.5196	0.8024	0.8212	0.7133	0.7964	0.786	0.8348	0.7558	
28	0.6148	0.3821	0.2068	0.5647	0.4027	0.7319	0.671	0.4396	0.7801	0.6618	0.7779	0.6431	0.6806	0.7114	0.7069	0.8597	0.855	0.3744	0.7085	0.7915	0.9006	0.6454	0.8082	0.8048	0.7973	0.5575	0.7757
29	0.4773	0.6101	0.5326	0.526	0.6114	0.7529	0.5825	0.5549	0.7451	0.6607	0.7011	0.5862	0.7868	0.7945	0.4526	0.6882	0.828	0.3358	0.9182	0.7518	0.6384	0.5829	0.7191	0.7554	0.5703	0.149	0.4372
30	0.8547	0.2967	0.2492	0.6139	0.7154	0.688	0.5022	0.5287	0.5109	0.6429	0.6735	0.6439	0.2491	0.5216	0.8726	0.6215	0.6658	0.6807	0.5601	0.5694	0.7939	0.5223	0.4973	0.6149	0.6734	0.7875	0.6176
31	0.3569	0.1528	0.5413	0.5862	0.4859	0.4494	0.4694	0.3532	0.481	0.1149	0.3212	0.4901	0.4739	0.666	0.3299	0.4961	0.363	0.2212	0.2862	0.3502	0.3104	0.5315	0.5616	0.4252	0.361	0.3661	0.3979
32	0.7799	0.5883	0.5581	0.8661	0.7168	0.8678	0.8087	0.7405	0.6129	0.8237	0.9137	0.9275	0.4964	0.6733	0.8563	0.7807	0.6909	0.733	0.6931	0.7652	0.7628	0.81	0.7483	0.8351	0.879	0.746	0.8269
33	0.6718	0.5322	0.4236	0.8611	0.589	0.7556	0.8451	0.7875	0.722	0.4586	0.6719	0.8668	0.6084	0.6413	0.8111	0.7961	0.5119	0.3901	0.4534	0.7087	0.5905	0.8418	0.7165	0.8132	0.8558	0.6803	0.79
34	0.7053	0.6834	0.4894	0.8434	0.5822	0.8643	0.932	0.7519	0.8571	0.7074	0.8662	0.9002	0.7756	0.7773	0.8153	0.9181	0.7803	0.4431	0.7538	0.9074	0.7874	0.8748	0.8858	0.9565	0.945	0.6138	0.8561
35	0.6423	0.3046	0.4012	0.6307	0.3599	0.6203	0.6036	0.295	0.3785	0.7453	0.8592	0.7191	0.2876	0.5446	0.6704	0.6507	0.635	0.7556	0.4903	0.5937	0.8112	0.5447	0.6615	0.5989	0.6884	0.7649	0.8429
36	0.5747	0.7324	0.4822	0.6794	0.4619	0.7397	0.8896	0.6362	0.8552	0.7802	0.8339	0.7802	0.8556	0.707	0.5859	0.8033	0.8336	0.3074	0.8814	0.8761	0.7106	0.8341	0.844	0.9132	0.8467	0.3801	0.6465
37	0.7287	0.6234	0.4278	0.8268	0.6716	0.7413	0.8249	0.8476	0.7579	0.4433	0.6181	0.8351	0.6126	0.637	0.8211	0.7514	0.5344	0.3521	0.5073	0.733	0.5568	0.7913	0.6507	0.8041	0.8012	0.623	0.6923
38	0.4946	0.8004	0.4294	0.594	0.6133	0.6427	0.6532	0.8268	0.6804	0.3811	0.4596	0.6157	0.6397	0.5047	0.5568	0.5393	0.4478	0.1579	0.6286	0.6664	0.3124	0.5845	0.4552	0.7061	0.58	0.1504	0.3365
39	0.6945	0.416	0.3811	0.3571	0.5103	0.224	0.1964	0.3781	0.0068	0.377	0.4054	0.4737	-0.1043	0.1507	0.4529	0.038	0.1992	0.7059	0.1643	0.1877	0.2863	0.0887	-0.0654	0.1397	0.1009	0.5034	0.2309
40	0.8512	0.6493	0.6061	0.8728	0.7275	0.8938	0.7535	0.7164	0.6243	0.6879	0.9134	0.9227	0.5217	0.7568	0.9137	0.8052	0.695	0.8091	0.6641	0.7766	0.8288	0.6723	0.7079	0.8251	0.8016	0.7365	0.8652
41	0.4446	0.368	0.2265	0.3678	0.1422	0.1915	0.2345	0.2407	-0.0254	0.0472	0.3001	0.3877	-0.0852	0.003	0.4591	0.1117	-0.0628	0.5259	-0.0553	0.1093	0.2181	0.0506	-0.0514	0.1746	0.2194	0.4151	0.3319
42	0.6823	0.787	0.7572	0.7278	0.5437	0.6068	0.6433	0.4813	0.4952	0.2492	0.574	0.655	0.4318	0.6168	0.6574	0.5282	0.4275	0.5979	0.5431	0.589	0.506	0.3614	0.4674	0.613	0.4869	0.4047	0.5025
43	0.7225	0.6682	0.6466	0.9086	0.7901	0.9777	0.8513	0.7902	0.8328	0.6399	0.8338	0.8809	0.7463	0.8821	0.8525	0.9162	0.7685	0.5538	0.826	0.8608	0.7669	0.8313	0.8767	0.9509	0.8922	0.5633	0.7762
44	0.6002	0.6281	0.3711	0.6066	0.4275	0.4528	0.7801	0.6145	0.5989	0.6057	0.5828	0.6878	0.5177	0.3335	0.5251	0.4755	0.4956	0.2741	0.5682	0.572	0.4175	0.7501	0.4857	0.6666	0.6943	0.4619	0.3888
45	0.5908	0.4892	0.7909	0.7927	0.5288	0.6272	0.5306	0.3885	0.3228	0.1615	0.5845	0.6814	0.3188	0.6347	0.6251	0.5244	0.2883	0.7485	0.3356	0.3983	0.4892	0.3811	0.4743	0.5171	0.455	0.5213	0.596
46	0.8578	0.6636	0.6794	0.9092	0.9254	0.8177	0.7397	0.8767	0.6541	0.4607	0.652	0.8746	0.4972	0.7341	0.8683	0.6808	0.5387	0.6223	0.5721	0.6773	0.5582	0.7036	0.5845	0.7474	0.687	0.6604	0.6261
47	0.5606	0.3547	0.528	0.6359	0.3424	0.3426	0.5408	0.2707	0.4379	-0.0146	0.347	0.5153	0.4054	0.4094	0.4829	0.3948	0.2347	0.3902	0.2561	0.228	0.3752	0.4559	0.3398	0.4608	0.4355	0.4651	0.289
Japan	0.7504	0.6488	0.555	0.8672	0.7057	0.9397	0.9053	0.7709	0.9184	0.7345	0.8976	0.9131	0.8438	0.9096	0.8293	0.9699	0.8832	0.4901	0.8426	0.9321	0.8547	0.8922	0.9439	0.9848	0.9289	0.613	0.8499

Table D: Hp-filtered GDP Cross-correlation in Japan (1985-1995).

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
0.5439																			
0.6947	0.3977																		
0.1308	0.3319	-0.0349																	
0.6053	0.596	0.7142	0.3169																
0.6181	0.281	0.5121	0.458	0.7311															
0.8442	0.5841	0.6125	0.3395	0.8243	0.8901														
0.6847	0.3658	0.5976	0.2619	0.7921	0.5105	0.6753													
0.7757	0.7447	0.4752	0.2432	0.7294	0.6725	0.9058	0.564												
0.6146	0.3304	0.5862	0.345	0.6719	0.9558	0.8668	0.3737	0.6831											
0.4003	0.5661	0.4353	0.0369	0.5229	0.6227	0.6668	0.0233	0.6762	0.7733										
0.0871	0.1558	0.5364	-0.0743	0.41	0.2098	0.202	0.2933	0.1667	0.3418	0.3386									
0.7178	0.5832	0.7697	0.2759	0.9094	0.7522	0.8511	0.7758	0.6945	0.7373	0.5744	0.5151								
0.2666	-0.2086	0.4422	-0.2958	0.3239	0.4696	0.3693	0.305	0.1549	0.5109	0.3621	0.5704	0.5411							
0.5392	0.4051	0.519	0.1607	0.5304	0.588	0.6686	0.4303	0.5479	0.6643	0.6224	0.4819	0.7703	0.6754						
0.6915	0.7549	0.643	0.4552	0.879	0.7659	0.8759	0.6015	0.7788	0.7453	0.6792	0.1883	0.8812	0.2118	0.6604					
0.4626	0.338	0.4818	0.0634	0.6199	0.69	0.7219	0.3296	0.7806	0.7548	0.7044	0.415	0.5253	0.3932	0.4551	0.5228				
0.322	0.3156	0.3378	0.5377	0.6093	0.579	0.532	0.5729	0.3175	0.4865	0.2666	0.3082	0.7522	0.4827	0.7521	0.6742	0.1556			
0.4147	0.5092	0.6474	0.4814	0.7679	0.7862	0.7115	0.3895	0.5474	0.8463	0.7351	0.5625	0.8161	0.4044	0.6985	0.822	0.5883	0.6704		
0.3806	0.0546	0.3353	0.3483	0.3186	0.6668	0.5307	0.2314	0.393	0.6733	0.4074	0.2595	0.4729	0.5915	0.6805	0.4309	0.5519	0.6085	0.5587	
0.8321	0.7434	0.6254	0.4894	0.8373	0.8213	0.9589	0.6677	0.8914	0.8017	0.6376	0.2027	0.8599	0.1934	0.6283	0.9351	0.6194	0.5676	0.7585	0.4679

Table E: Japanese Prefectures.

Prefecture Code	Name
1	Hokkaido
2	Aomori
3	Iwate
4	Miyagi
5	Akita
6	Yamagata
7	Fukushima
8	Ibaraki
9	Tochigi
10	Gunma
11	Saitama
12	Chiba
13	Tokyo
14	Kanagawa
15	Niigata
16	Toyama
17	Ishikawa
18	Fukui
19	Yamanashi
20	Nagano
21	Gifu
22	Sizuoka
23	Aichi
24	Mie
25	Shiga
26	Kyoto
27	Osaka
28	Hyougo
29	Nara
30	Wakayama
31	Tottori
32	Shimane
33	Okayama
34	Hiroshima
35	Yamaguchi
36	Tokushima
37	Kagawa
38	Ehime
39	Kouchi
40	Fukuoka
41	Saga
42	Nagasaki
43	Kumamoto
44	Oita
45	Miyazaki
46	Kagoshima
47	Okinawa