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Sheffield Economic Research Paper Series.

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ISSN 1749-8368

SERPS no. 2015003
January 2015

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19th January 2015

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Abstract:

Countries in the Asia and Pacific region have shown many macroeconomic similarities such as current account surpluses, exchange rate appreciation, export-oriented economies, growth success, etc. This paper argues that there may be one more macroeconomic feature to add to the list: strong tax convergence. Using data on the statutory corporate tax rate in 15 countries from 1980 to 2014, we identify (i) a significant dynamic tax convergence pattern, and (ii) three tax convergence clubs. The latter consist of the small tax haven economies of Hong Kong and Singapore, the East Asian countries (plus one), and the South and Southeast Asian and Oceania countries. These economies, within groups, have been reducing the tax gaps with their neighbours over time.

JEL classification: C22, E62

Key words: convergence clubs, tax policy, Asia and Pacific region

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Acknowledgments: Yang Chen and Paulo Regis were funded by the Lincoln Institute Center for Urban Development and Land Policy (Peking University) research grant FS-20130901. Juan Carlos Cuestas acknowledges the MINECO (Ministerio de Economía y Competitividad, Spain) research grant ECO2011-30260-C03-01. Simeon Coleman, Christoph Thoneissen and Karsten Staehr are gratefully acknowledged for comments on a previous draft. The usual disclaimer applies.

1. Introduction

The growing international exchange of products and factors has contributed to the strong integration in the Asia and Pacific region that includes countries such as Australia, China, Fiji, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, New Zealand, Pakistan, the Philippines, Singapore, Taiwan and Thailand. In particular, in 1967, Indonesia, Malaysia, the Philippines, Singapore and Thailand initiated the creation of the Association of Southeast Asian Nations (ASEAN), aiming to achieve a single common market by 2015 through gradual economic integration. Regional integration makes it hard for governments to set their own tax policies without taking the neighbouring countries' tax policies into account. Against this backdrop, this paper raises the question, for the first time, of whether tax policies are converging in the Asia and Pacific region.

With increasing capital mobility and foreign direct investment (FDI) across country borders, as well as the recognition that FDI may be an important force for economic growth, governments in Asia have extensively engaged in strategic tax policies designed to attract footloose firms from abroad. This can be a sensible approach in economies where sovereign debt is not a problem, and where the benefit of attracting foreign corporations might outweigh the reduction in corporate taxes. Stewart and Webb (2006) provide us with a thorough survey of theoretical contributions that justify the use of taxes by governments to attract corporations and FDI. As the tax competition model predicts, governments may strategically compete with each other to attract the footloose capital, *ceteris paribus*, resulting in a downward pressure on the corporate tax rate. In a recent contribution, Chen, Huang and Regis (2014) provide a theoretical model which, based on economies of agglomeration, explains tax competition amongst regions; see also Devereux (2012) and Liu (2014). Hence, the convergence of tax rates may well happen as a result of competition to attract foreign corporations, which, according to Velayos, Barreix and Villela (2008), is the first step on the fiscal harmonization pyramid.

Since the ignition of the 2008 Great Recession, it has been acknowledged that capital inflows may be an important source of credit creation, which may in turn boost economic growth, with this having been particularly true before 2008 (Carvalho, 2014). The rationale behind this is that foreign capital may be used to finance internal

spending, in particular in booming sectors, such as the housing market in some peripheral European countries. Given that foreign capital has clearly been a cheap source of funding for local economies, one way that governments can make it easier for foreign companies to establish themselves is to soften their tax burdens. FDI may have an important impact on the host economy by means of job creation and technology spillovers, which may boost aggregate demand. In a recent paper, Cuestas and Regis (2013) analyse the effect of capital inflows on the real exchange rates, and vice versa, in a number of East Asian countries, finding that capital mobility is significant, and that movements in competitiveness have an impact on capital inflows. Since taxes can affect final prices, tax policies may affect the competitiveness of a country in terms of attracting foreign capital.

Tax convergence may well be explained by globalization and economic integration. Since 1980, many countries have relaxed the restrictions on capital mobility and have tried to integrate themselves into the world economy. Bretschger and Hettich (2002) find a negative and significant impact of globalization on corporate taxes for fourteen OECD countries. This finding is also in line with the tax law convergence claimed by Avi-Yonah (2010). In the past thirty years, consumption value added tax (VAT) has been widely introduced by many countries, gradually replacing direct taxes on corporate benefits and labour income. This may have enhanced the corporate tax rate harmonization.

There is a large literature on tax competition, economic integration and tax regime shifts, all of which may lead to increasing pressure on tax policy harmonization and thus provide an explanation for the existence of tax convergence. However, studies on tax convergence itself are surprisingly rare. A few papers analyse tax convergence using a macro tax burden or fiscal pressure indicator such as the tax revenue. Additionally, most are in the EU context, where the process of economic integration has accelerated the discussion on fiscal harmonization. Delgado and Presno (2010) find little evidence of tax convergence (1965–2005) in the EU-15, using both the revenue to the GDP ratio and the tax mix ratios as benchmarks. Becker and Elsayyad's (2009) study, through the introduction of a bilateral similarity index to measure the similarity of tax systems conditional on country characteristics, implies a slight convergence in OECD tax systems. The main findings from the literature indicate that high tax rate countries have cut their taxes the most in the past years,

which has led tax rates to converge slightly over time. Recently, Apergis and Cooray (2013) show that there is no full convergence of total tax revenues and their composition across Asia and Pacific countries in the period 1990-2012; however, club convergence is identified, with three or four clubs identified depending on the type of revenue studied. However, corporate tax is aggregated together with income tax and other direct taxes.

The literature deals mostly with aggregate tax measures, while we contribute to the study of corporate tax specifically, since capital is the most mobile economic factor of interest for policy makers. Given the clear path taken by Asian countries towards a more integrated region, fiscal harmonization should be on their agenda. Moreover, according to Bettendorf et al. (2010), for fiscal harmonization, governments need to contemplate not only tax base consolidation, but also rate harmonization. In this study, the evidence concerning corporation tax rate convergence is directly tested using a sample of fifteen countries from the Asia and Pacific region. Not only is cluster analysis performed through the application of the new methodology of panel convergence testing proposed by Phillip and Sul (2007, 2009), but beta convergence and sigma convergence are also taken into consideration. The results support convergence in tax rates across Asian and Pacific countries.

The rest of the paper is organized as follows. Section 2 describes the tax data. Section 3 reviews the most commonly used concepts of beta and sigma convergence and presents the regional tax convergence result. This is followed by the identification of convergence clubs within the region in section 4. The last section concludes.

2. The data: statutory tax rates.

In order to assess tax convergence, we need to measure national tax levels that could be compared across countries and over time. However, there is no clear-cut way to summarize a country's complex corporate tax system that varies across countries and over time. Some countries adopt multiple-rate systems, with specific rates applied to certain sectors of the economy, while others may have graduated corporate tax rate structures. The problem of developing appropriate measures of taxation is an important reason for the lack of empirical evidence on corporate income tax

convergence. Three choices of corporate tax rates are generally considered in the literature: marginal effective tax rates, average tax rates and statutory tax rates. Fullerton (1999) was the first to develop the approach of assessing effective tax rates, which is a useful way to assess the micro-level decisions made by companies regarding the location of investment. Nonetheless, such estimates are project-specific and sensitive to assumptions about economic fundamentals and legislation. Moreover, this measure does not account for how a tax system is actually enforced. In the Asia and Pacific countries, the data needed to calculate this estimate are difficult to collect, making it unavailable for country-level comparisons and the assessment of tax convergence over time. Some other researchers, such as Baldwin and Krugman (2004), adopt the average corporate tax rate, defined as tax revenues over GDP. Criticisms of this measure mainly stem from two reasons. First, an increase in the average corporate tax rate may be due to a recession in the business cycle instead of an increase in the tax rate. Second, an increase in revenue may be due to the presence of more organizations instead of a rise in the corporate tax rate. This is by far the most commonly used measure in cross-country studies, including the literature on tax burden and the aforementioned tax burden convergence. The alternative choice is the statutory tax rate. Arguably, it this may be an inadequate value in that it may fail to comprehensively analyse the corporate tax base, including the inventory allowance system, inflation adjustment and depreciation schedules, holidays and availability of credits to investment, as summarized in Slemrod (2004). However, the legal tax is a highly transparent and clear measure of fiscal policy and tax schemes. Thus, we use it in this paper as the measure of corporate income taxes.

Hence, in this study, unlike in previous studies, the variable of interest is the statutory tax rate, rather than revenue, the aim being to use a proxy that is simple to interpret and independent of business cycle effects. The main source is the World Tax Database for the period 1980–2003, expanded when necessary with KPMG corporate tax rates (1993–1996) and KPMG's Corporate and Indirect Tax Rate Survey (1999–2014). The OECD tax statistics database (1981–2014) is also used, for the four OECD countries in our sample. Summary statistics by country in four different years can be found in Table 1.

3. Tax convergence

There is a long tradition of researchers studying economic convergence among countries, motivated by one of the most fundamental question in macroeconomics: Will poor countries catch up with rich countries? Alternative concepts of convergence have been developed, such as absolute beta convergence, sigma convergence, conditional beta convergence, stochastic convergence, club convergence, etc. The consensus is that there is conditional beta convergence across countries and regions, where convergence is defined as each economy converging to its own steady state. However, conditional convergence does not require convergence in the sense of poor countries growing more quickly than rich countries.

Absolute beta and sigma convergence are more directly related to the original ideas of the convergence literature. Also, it is relatively simple to produce graphical representations of them. Beta convergence has to do with the degree of convergence of a variable to its steady state, depending on its past values or initial value (Sala-i-Martin, 1996). In our case, it is given by

$$\Delta \text{tax}_{2014-1980} = \alpha - \beta \, \text{tax}_{1980} + \varepsilon \tag{1}$$

where ε is the error term. A significant β is indicative of beta convergence. Convergence in GDP usually is defined with variables in logs; however, our approach is to use the original variable since tax rates are measured in percentages making the economic interpretation of the results straightforward[1]. In Figure 1, changes in the tax rates are compared with the initial tax rate. The negative slope of the regression line shows the absolute beta convergence of corporate tax rates:

$$\begin{gathered} \Delta \hat{\text{tax}}_{2014-1980} = 7.784 - 0.706 \, \text{tax}_{1980} \\ (5.845) \quad (0.157) \end{gathered} \tag{2}$$

Standard errors are given in brackets. The beta convergence coefficient is negative and significant at 1%. However, as there are only 15 observations the results should be interpreted with caution. In this case, tax convergence has been achieved through cuts in statutory tax rates: countries with high tax rates converging to a lower tax rate.

[1] The beta convergence is often measured in a convergence equation in the log form. The study of beta-convergence speed in tax rates using logs is less intuitive. a growth rate in the tax rate of 1.8% where the average tax rate is 24%.

The countries with the highest tax rates in 1980 have cut their taxes the most (e.g. China and India), while countries with low tax rates in 1980 (e.g. Hong Kong) have barely changed their tax rates. The speed of convergence is around 3.4% per year[2] while the average annual (negative) change is 1.5%. This suggests that tax rates look more alike at the end of the period, with fast convergence.

Friedman (1992) and Quah (1993) argue that sigma convergence is of more interest since it looks directly at whether countries are becoming increasingly homogeneous. Beta convergence is a necessary but not sufficient condition for sigma convergence as can be seen in Furceri (2005) and Young, Higgins and Levy (2008). Sigma convergence provides a more accurate indication of convergence since it shows whether the dispersion of the distribution is declining over time. The thick line in Figure 2 shows the evolution of the standard deviation of tax rates. Since the line shows a clear negative trend, there is sigma convergence in the full period, with something of an upturn in the last 5–8 years. The standard deviation shrinks by almost half, which is quite an interesting evolution in the dynamic behaviour of tax rates. This result also suggests that countries are more alike at the end of the period, with similar statutory tax rates. In 2007, the average tax rate is 28.3% with a typical deviation in a country of ±5%. Both figures have decreased from the 1980 figures of 41% (mean) and 10.8% (standard deviation). The mean tax rate continues to decrease until 2014, ending up at 24.3%, while the standard deviation increases to 5.5%.

4. Cluster analysis and tax convergence

The overall picture in the previous section shows strong indications of convergence in tax rates. Although convergence has not been rejected, this is not inconsistent with the existence of convergence clubs and, if they do exist, it would be of interest to identify them. The general trend is down in terms of the dispersion of statutory tax rates; however, this can happen in many different ways, and clustering can be used to explore heterogeneity patterns across convergence clubs that occur at the same time as

[2] When transformed into logs, it is statistically significant and the speed of convergence is 1.8%.

homogeneity is increasing within the clubs. The cluster composition can help us to understand some of this heterogeneity.

4.1. Logt convergence: the logt test

In cases where convergence has been rejected, some have followed a clustering strategy to identify convergence clubs that may explain the overall non-convergence, exploring the heterogeneity in the inter-temporal behaviour within the sample. That is, the above definitions of convergence may be inadequate when economic fundamentals are different across the countries analysed. According to Phillips and Sul (2007, 2009), GDP dynamics need to be modeled under the assumption of heterogeneity. These authors develop a model whereby the traditional neoclassical growth model is modified so as to have different and time-varying technologies, i.e. the model incorporates nonlinearities[3]. This theoretical approach justifies the use of statistical methods that provide the ability to identify clusters or clubs of convergence, and are not based upon unit root and cointegration analysis. In the case of tax rates, the fundamentals behind the long-run differences across clusters could be related to the structural characteristics of the countries' tax systems.

Phillips and Sul (2007, 2009) argue that a panel can be decomposed into two main components,

$$Y_{it} = \{y_{1t}, y_{2t}, \dots, y_{Nt,}\} = \mu_t \delta_{it}, \tag{3}$$

namely, the common component μ_t and the idiosyncratic component δ_{it}. The fundamental idea behind the procedure is to test whether δ_{it} converges to a common value, δ. In order to test this hypothesis, the authors propose the analysis of the following semiparametric equation:

$$\delta_{it} = \delta_i + \frac{\sigma_i \xi_{it}}{[log(t)]t^{\alpha}} \tag{4}$$

where $\xi_{it} \approx \text{iid}(0,1)$ across i but weakly dependent over t and $\sigma_i > 0$. According to the formulation in equation (4), the key parameters for convergence are α and δ_i. Convergence of δ_{it} to δ happens when $\alpha \geq 0$, so $\delta_{it} \to \delta_i$ when $t \to \infty$, and at

[3] Nonlinear models are popular when analysing issues of economic integration; see Cuestas and Mourelle (2011) and Mourelle, Cuestas and Gil-Alana (2011), amongst many others.

the same time $\delta_i \rightarrow \delta$ for all i. The joint hypothesis $H_0: \delta_i = \delta \; and \; \alpha \geq 0$ can be empirically tested by means of the following auxiliary regression:

$$\log(\sigma_{h\,1}^2/\sigma_{h\,t}^2) - 2\log[log(t)] = c + b\log(t) + u_t \tag{5}$$

where

$$\sigma_{h\,t}^2 = \frac{1}{N}\sum_{i=1}^{N}(h_{it} - 1)^2 \tag{6}$$

is the squared average transition differential, and

$$h_{it} = \frac{\delta_{it}}{\frac{1}{N}\sum_{i=1}^{N}\delta_{it}} = \frac{Y_{it}}{\frac{1}{N}\sum_{i=1}^{N}Y_{it}} \tag{7}$$

is the relative transition path. Under the null hypothesis of convergence, $\sigma_{h\,t}^2 \rightarrow 0$. From equation (5) one can estimate the value of α as $\hat{\alpha} = \hat{b}/2$. For this estimate of α to be valid, it is required that $\delta_i = \delta$ since $\hat{b}$ is estimated to be constant across countries[4].

Therefore, the null hypothesis of convergence ($H_0: \delta_i = \delta \; and \; \alpha \geq 0$) is a one-sided test based on the t-statistic of $\hat{b}$, which focuses on the evolution over time of the individual transition path compared to the common growth component. This is a time series regression where a transformation of the cross-sectional variance of h_{it} is regressed against $\log(t)$, whose coefficient is the one of interest. If, for all economies in a convergence club, $h_{it} \rightarrow 1$ as time evolves, then the cross-sectional variance of h_{it} converges to zero and there is convergence. Note that, since the logt test is based on the variance of the logarithm of the variable of interest, this test is more related to sigma than beta convergence.

The alternative hypothesis includes two general cases: divergence and club convergence. If the null hypothesis of convergence is rejected, it may be because there is no convergence ($\alpha < 0$). Alternatively, there is one more interesting case of convergence: it may be that $\alpha \geq 0$ but not all δ_i converge to a single δ for all

[4] In addition, Phillips and Sul (2009) claim that, depending on the estimated values of $\hat{b}$, one can assess whether the processes present absolute convergence, i.e. level convergence, or conditional convergence, i.e. convergence in growth rates. Hence, if $\hat{b} \geq 2$ the processes converge in level, whereas if $0 \leq \hat{b} < 2$ the processes present conditional convergence. That is, stronger evidence in favour of convergence is required if we are to conclude that there is level convergence. However, note that because this is the analysis of a variable that can only assume values between 0 and 100, long-run growth may not be realistic. Within this framework, convergence in growth rates would eventually lead to either overall or cluster convergence in levels.

countries. Here, the variance of h_{it} converges to a constant rather than zero, which is consistent with having two or more convergence clubs in the sample. In other words, there are multiple equilibrium values, and different groups of countries converge to different ones. Identifying the composition of these groups would help to test whether there was within-group convergence. Phillips and Sul (2007) develop a four-step clustering algorithm whereby convergence clubs are identified by endogenized groupings. The cluster procedure is based on the logt test from equation (5), performed iteratively over country subsamples. In step 1, countries are sorted in descending order according to the last period of analysis. In step 2, a core of *k* countries of a convergence club is formed, by taking the first two countries in step 1, computing the logt-statistic and, if log(t)>-1.65, adding the remaining countries to the core one by one in descending order and computing the new logt-statistic until log(t)<-1.65. In step 3, the remaining countries are added one at a time and the logt-statistic is computed to check whether they can be added to the convergence club. In step 4, the logt-statistic is computed for the remaining countries to check whether they form a convergence club (i.e. logt-statistic>-1.65). Otherwise, steps 1–3 are repeated to check whether there is more than one club. The critical value at 5% is -1.65 because the statistic should be distributed as N(0,1) and the alternative is one-sided. See Phillips and Sul (2007) for further details.

4.2. Three clusters in the Asia and Pacific region

The results of our analysis are displayed in Table 2, in which the variable of interest (Y_{it}) is defined as the statutory tax rate[5]. The last column shows the logt-statistic, according to which the null of overall convergence among the 15 countries is rejected. This initial result may still be consistent with beta and sigma convergence if there is evidence of club convergence. Sigma convergence, for example, does not distinguish between overall convergence (long-run variance of 0, i.e. $\sigma_{Y\,t}^2 \to 0$) and club convergence (converging from above to a constant, i.e. $\sigma_{Y\,t}^2 \to \sigma_Y^2 > 0$). This implies that the clustering algorithm should be applied recursively until all clubs have been identified. Interestingly, the application of the Phillips and Sul (2007) cluster

[5] The variable has not been transformed into its logarithm because it is expressed as a percentage. No filter has been use since the business cycle is not a concern.

algorithm reveals that there are three clusters: convergence club A with nine countries, club B with four countries, and club C, a small cluster of two countries (see column 3 for their composition). The groups are organized according to their average tax rate in the last three years (column 2). Column 5 contains the logt test result, which shows that we cannot reject the null of convergence in any of the three cases. This means that there is evidence of tax convergence within each cluster.

Column 4 shows the t-statistic of sigma convergence, for which the null of no log time trend in the variance of tax rates (in logs) implies no convergence[6]. This test is based on the similarity of the concepts of logt convergence and sigma convergence. According to equation (5), logt convergence looks at whether there is a time trend in the time variance of the transition parameter h_{it}. This is the variance of the variable of interest Y_{it} normalized by its cross-sectional mean in each period. Other than the normalization to the cross-sectional sample average, logt convergence looks like the sigma convergence test[7] with a particular form of time trend. Since all t-statistics reject the null of no convergence at 1%, there is evidence of sigma convergence within the clusters. In Figure 2, the evidence of sigma convergence within these clubs is even stronger, if anything, than for the full sample. The general convergence trend of the full sample is quite similar to that of the largest convergence club A with nine countries, but within club A convergence seems to have accelerated since the early 1990s. Club convergence among the club B countries has been even faster than in club A, while club C's convergence has been the fastest.

Figure 3 presents the evolution of the relative transition functions h_{it}. The analysis of the transition curves provides an opportunity to explore the heterogeneity of the sample in more detail. Convergence would imply increasing homogeneity of h_{it} and the curves should concentrate around 1 (which is, by construction, the average value of h_{it}). In these graphs the convergence paths are clearly shown and the results confirm the results in Table 2. The last of the four graphs depicts the transition curves

[6] The same test for overall sigma convergence reports a t-statistic of -5.93. Tis would be consistent with both, convergence to a single tax rate for all countries and club convergence.

[7] The term $2\log[log(t)]$ on the left-hand side as a penalty function, which has not been included in this sigma convergence test, is another difference, which may be very important in practice. According to Phillips and Sul (2007), this improves the performance of the test. It helps the test to distinguish between overall convergence (not rejection of the null) and club convergence (rejection). Therefore, we do not expect this test to distinguish between sigma and cluster convergence. This would explain why overall convergence is rejected by the logt test but not by the sigma convergence test.

aggregated at the cluster level, and shows no sign of convergence. Clusters A and B are more similar to each other than to cluster C. However, the trend shows that, overall, the clusters are becoming more distinctive, if anything. The other three graphs show the dynamics within the clusters. The convergence is very fast within cluster C, and faster than in the others. One interesting point that can be highlighted from these graphs is that cluster convergence for the other two clubs seems to have been faster before 2008, and the Great Recession, than after. Clusters A and B show an increase in the dispersion after 2008, which may have been motivated by the financial crisis, namely through the cutting of rates to attract investment rather than the increasing of taxes to balance budgets. The general negative trend of the statutory rate continues, driven by countries with low rates, in each cluster. In cluster A, Thailand and Fiji reduced their rates from 28% and 30% in 2011 to 20% by 2013, while Taiwan had made an 8% tax cut even earlier, in 2010 (to 17%). Taiwan and Thailand, with the lowest tax rates in each of these two clusters for most of the period under study, could be considered the front runners of tax cuts.

To formally test convergence without the effect of the financial crisis, we run the Phillips and Sul (2007) algorithm for a subsample up until 2007, leaving the years of the crisis out of the analysis. The results, which are not reported here for the sake of brevity, point to the existence of only two clusters, with Hong Kong and Singapore in one cluster and the rest of the countries in the second cluster. The Phillips and Sul (2009) test of overall convergence is rejected, meaning that the two clusters cannot be merged. It is interesting that clusters A and B from the full sample period have merged.

Finally, to check the robustness of our analysis, we apply Robinson's (1995) multivariate test for fractional integration, based on a semi-parametric approach, which allows us both to estimate the differencing parameter and test for the hypothesis of their equality among countries. This analysis is based on fractional integration methods. A fractionally integrated process is a process whose order of integration is any non-integer number between 0 and 1, hence breaking the dichotomy of traditional tests for the order of integration of variables I(d), which classify variables as I(1) or I(0). We analyse the autoregressive, fractionally integrated, moving average *ARFIMA*(*p*, *d*, 0) of the form

$$\Phi_p(L)(1-L)^d x_t = \varepsilon_t, \quad t = 1,...T, \tag{8}$$

where $\Phi_p(L)$ is a polynomial of order *p*, with all zeros of $\Phi_p(L)$ outside the unit circle, and ε_t a white noise process. Table 3 displays the results of the estimations. The first point to notice is that the estimated parameters are well above 0.5, which is indicative of high persistence, meaning that the steady state has not yet been achieved. Second, the test for equality of the differencing parameter confirms the results obtained in Table 2; i.e. the speed of adjustment is similar within clusters.

The composition of the clubs is also quite interesting, especially when compared with a large international sample (Table 4). Hong Kong and Singapore, the two members of club C, are tax haven countries and are special cases[8]. The taxation policies in tax havens behave differently than in non-tax havens, so this must be recognized in our analysis. The average statutory tax rate in the last three years of the sample is 16.8%, quite low compared to the rest of our sample (6.2%, below club B's average) and at the lower end of international standards (see Table 4). China, Korea and Taiwan are the countries of East Asia, a region with important economic and cultural ties. The East Asian countries[9], together with Malaysia[10], make up convergence club B, which suggests that the tax convergence of East Asia within the Asia and Pacific region has been important, but that tax convergence within the East Asian countries has been even stronger and in fact happened earlier. The average tax rate is 23%, which is close to the international average[11]. It is more difficult to find the connection among the countries in group A, the largest cluster, since it is a mix of South and Southeast Asian countries and countries from Oceania. The 2012–2014 average tax rate of 27.6% is the largest among the three, and comparable to moderate to high corporate tax

[8] Low (or nil) corporate tax is a condition but not the essential element of a tax haven. Hong Kong and Singapore provide confidential financial and legal services to non-residents and corporations, preventing effective information exchange with other countries. The main aim of the tax structure is to attract foreign investment.

[9] Japan is also commonly designated to the East Asian region. However, in our analysis, Japan does not seem to behave similarly to the other East Asian countries. This may be because the corporate tax system in Japan is more complex than in the rest of the region.

[10] It should be noted that China has a strong influence in Malaysia, with 20-25% of the population having Chinese ancestors, especially from the Canton region. China and Malaysia have had strong commercial links for a long time. However, it may be argued that the cultural and commercial ties that Malaysia has with countries such as Indonesia are stronger.

[11] According to Table 4, the global average is around 22.1%, while the OECD (34 countries) and EU (28 countries) averages are 23.3% and 21.1%, respectively.

countries, such as Italy (27.5%), Norway (28%) and South Africa (28%). However, the convergence process here is almost as strong as in clubs B and C. Figure 2 shows that the standard deviations of the three groups in 2008 are quite similar, while there is a slight increase at the end of the period for clusters A and B.

With the clusters identified and club convergence confirmed, it is possible to test for convergence among the clusters. This is important, since Phillips and Sul (2009) recognize that their procedure/algorithm (Phillips and Sul, 2007) may overestimate the number of clusters. Hence, they propose a test for overall convergence, which allows us to test whether or not the clusters converge amongst themselves. This is the same test as was performed within the clusters separately, but now two clusters are grouped at the same time. If the logt test supports the hypothesis of overall convergence, this will suggest that the countries in the two clusters are also converging over time. Therefore, this test is usually considered to be a convergence club merging test, from which a larger cluster may emerge in the long run. In column 6 of Table 2, two logt-statistics of convergence, of clusters A with B and B with C, are reported. The overall logt test (column 7) and the cluster transition curves (Figure 3, panel 4) support the fact that the clusters do not convergence amongst themselves; however, the results imply that clusters A and B may be converging[12], while cluster C is clearly not doing. This suggests that, in the long run, tax rates may become homogeneous in the region, with the possible exception of the tax haven economies that have a distinctive dynamic from the rest.

Two strands of the literature may help to explain the existence of tax convergence. First, the tax competition literature has proposed that negative trends may be explained by the strategic behaviour of governments in competing for the location of corporations, such as in Slemrod (2004) and Devereux, Lockwood and Redoano (2008). In a recent study, Chen, Huang and Regis (2014), using an IV-GMM strategy to estimate the national-level tax reaction function, found evidence in favour of tax competition in fourteen Asia-Pacific countries, of the sort that would explain the negative slopes in Figures 1 and 2. These results, along with ours, suggest that tax

[12] At this point, note that the convergence of clusters A and B would be consistent with the analysis of the period 1980-2007 described earlier.

competition amongst regions indeed produces a Nash equilibrium (see Taugourdeau and Ziad, 2011, and the references therein).

Second, tax convergence may be part of globalization and economic integration in the Asia and Pacific region. Then, tax convergence could be explained as part of a cooperative game in which governments recognized the importance of transnational enterprises in an integrated world, which would promote a more homogeneous tax setting with countries with relatively high corporate taxes cutting their rates. Avi-Yonah (2010) identifies two general trends that may explain corporate tax convergence in OECD countries, which may equally apply to the Asia-Pacific region: the generalization of VAT, partially replacing corporate taxes, and the cross-country integration of corporate taxes (e.g. the elimination of double taxation), which may have created incentives to homogenize corporate tax regimes. Jogarajan (2012) presents a discussion of the network of bilateral tax treaties that has resulted from cooperation in the region.

5. Conclusions

The results show strong evidence of the convergence of corporate tax rates in terms of absolute beta and sigma convergence in the full sample of Asian and Pacific economies, and if anything even stronger sigma convergence within convergence clubs. Cluster analysis shows that there are three such clubs. Club convergence among the East Asian countries plus Malaysia has been much faster than within the club consisting of a mix of South and Southeast Asian and Oceania countries, while the club comprising the two tax havens has seen the fastest convergence. Convergence has pushed the statutory tax rate downwards significantly in the region. However, a sample of 122 countries in 2013 shows that there is still room for further tax cuts, especially in the South and Southeast Asian and Oceania countries (cluster A) but also within East Asia (cluster B). Since tax rates are capped from below at zero, further convergence can be expected in the near future.

It is usually the case that global measures of economic convergence fail to find any evidence of convergence, especially as defined by beta and sigma convergence. Therefore, the literature has developed the idea of convergence clubs, which suggests

that convergence within groups of similar countries is still possible even if overall convergence is not achieved. In the case of the corporate tax rate in the Asia and Pacific region, this is not the case. Every single piece of evidence analysed supports the hypothesis of convergence. This empirical regularity may be one more piece of evidence of economic integration in the region.

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Figure 1: Tax Rate Convergence – Beta Convergence

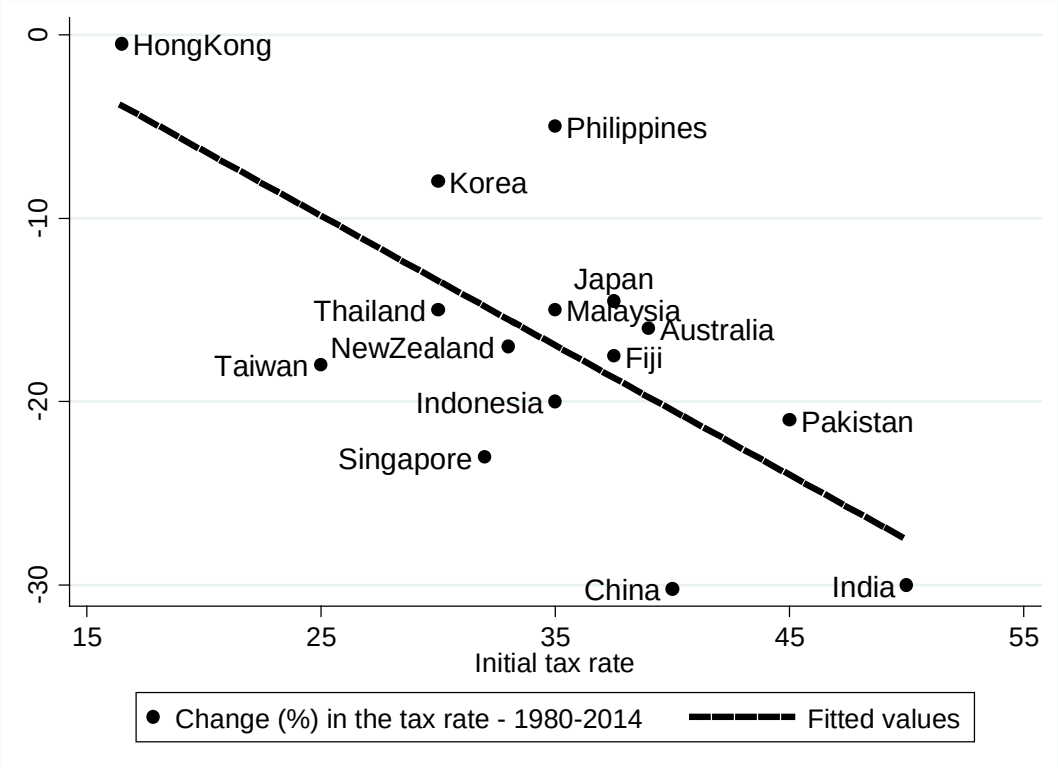


Figure 2: Tax Rate Convergence – Sigma Convergence

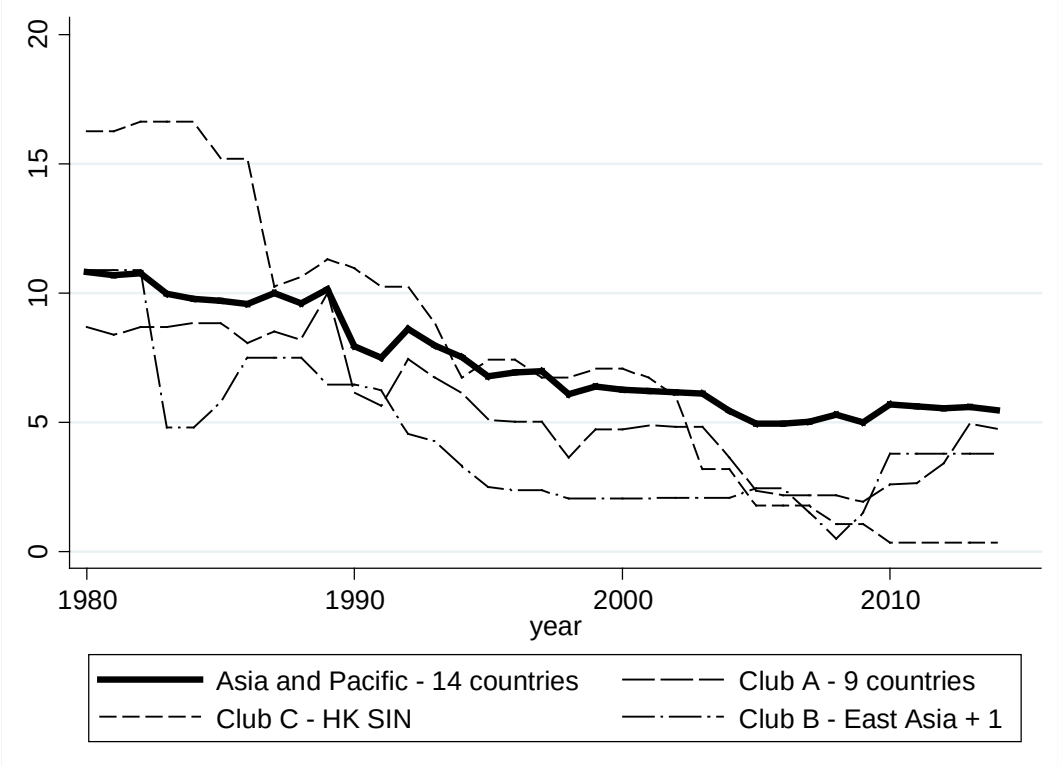
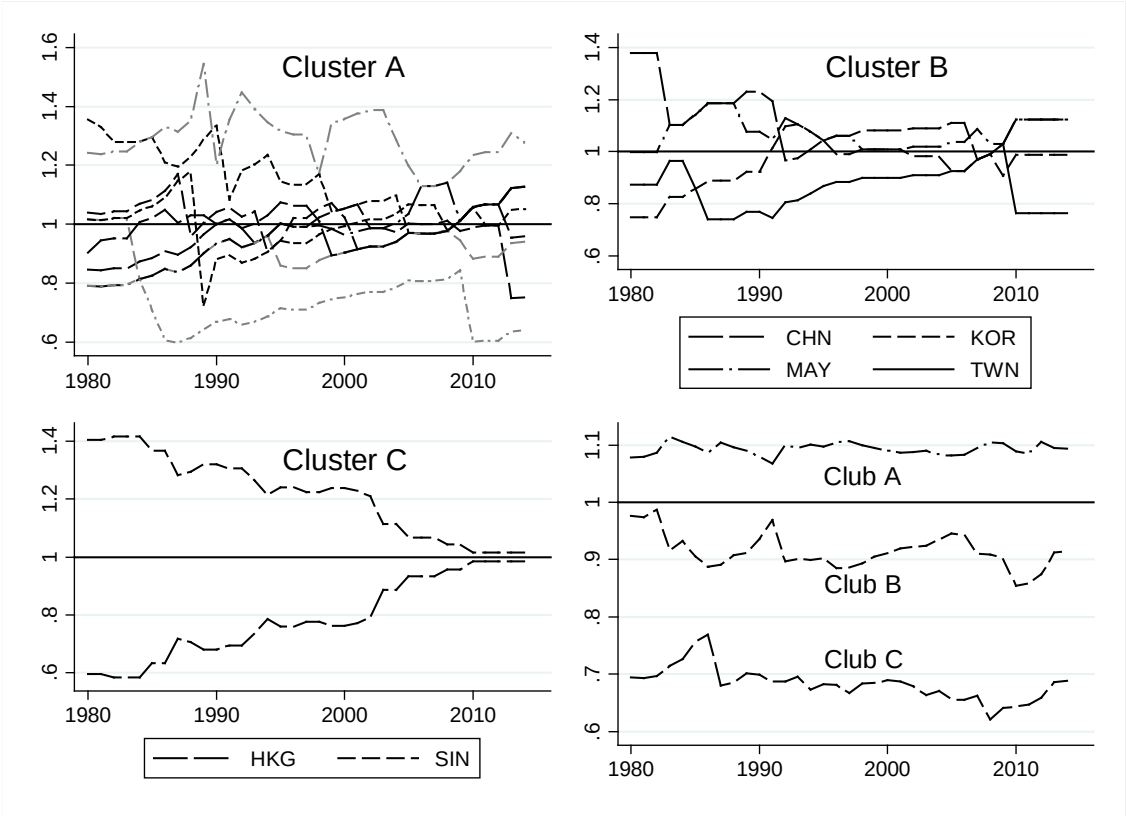


Figure 3: Relative Transition Curves (within and across clusters)



Notes: The lower right graph shows the transition parameters aggregated at the cluster level. The other three graphs show the transition parameter within each cluster separately. In clusters B and C, labels for each country are provided, while this is not possible for cluster A due to the large number of countries.

Table 1: Statutory Corporate Tax Rate -Summary Statistics

	1980	1991	2002	2014	Mean	St Dev
Australia	46.0	39.0	30.0	30.0	36.3	7.8
China	55.2	40.0	30.0	25.0	37.6	13.3
Fiji	37.5	37.5	32.0	20.0	31.8	8.3
Hong Kong	17.0	16.5	16.0	16.5	16.5	0.4
India	60.0	40.0	35.0	30.0	41.3	13.1
Indonesia	45.0	35.0	30.0	25.0	33.8	8.5
Japan	40.0	37.5	30.0	25.5	33.3	6.7
Korea, Rep	30.0	34.0	27.0	22.0	28.3	5.1
Malaysia	40.0	35.0	28.0	25.0	32.0	6.8
New Zealand	45.0	33.0	33.0	28.0	34.8	7.2
Pakistan	55.0	50.0	45.0	34.0	46.0	9.0
Philippines	35.0	35.0	32.0	30.0	33.0	2.4
Singapore	40.0	31.0	24.5	17.0	28.1	9.8
Taiwan	35.0	25.0	25.0	17.0	25.5	7.4
Thailand	35.0	30.0	30.0	20.0	28.8	6.3
Mean	41.0	34.6	29.8	24.3		
St Dev	10.8	7.5	6.2	5.5		

Sources: the World Tax Database (1980–2003), expanded by KPMG corporate tax rates (1993–1996) KPMG's Corporate and Indirect Tax Rate Survey (1999–2014) and the OECD tax statistics database (1981–2014) for the four OECD countries.

Table 2: Club Convergence

[1]	Tax rate mean [2]	Countries [3]	Sigma converg. test [4]	logt test: Cluster converg. [5]	logt test: Cluster merging [6]	logt test: Full sample converg. [7]
Cluster A	27.6%	Australia, Fiji, India, Indonesia, Japan, New Zealand, Pakistan, Philippines, Thailand	(-3.74)***	0.291		
				(1.191)	-0.155	
Cluster B	23%	China, South Korea, Malaysia, Taiwan	(-5.35)***	0.315	(-0.874)	-0.394
				(0.622)	-0.201	(-4.085)***
Cluster C	16.8%	Hong Kong, Singapore	(-3.25)***	2.889	(-2.141)***	
				(4.924)		

Notes: Columns have been numbered from [1] to [7]. In the second column, the club average tax rate across the last three years can be found. The last three columns contain the logt convergence test: (within) cluster convergence, cluster merging and overall convergence. In the logt test, a one-sided test with critical values of -2.33, -1.65 and -1.28 (at 1%, 5% and 10% significance levels, respectively), the null hypothesis implies convergence. Column 4 tests for within-cluster sigma convergence, where rejection of the null implies convergence. Sigma convergence is tested through the t-stat of $\hat{b}$ in the following linear regression: $\log(\sigma^2_{Y\,t}/\sigma^2_{Y\,1}) = c + b\log(t) + u_t$, mimicking the logt-statistic (however, note that this is the variance of Y_{it} rather than h_{it} and the log[$log(t)$] correction term is not included), where a significant negative trend implies convergence. All values in parentheses are t-statistics with Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors, of Newey-West type (truncation parameter of 3). ***, **, * stand for 1%, 5%, 10% significance levels.

Table 3: Estimated *d* parameters for each cluster

Cluster A:

Country	Estimated *d*	t-statistic
Australia	0.707	5.596
Fiji	0.709	5.611
India	0.692	5.477
Indonesia	0.692	5.167
Japan	0.827	6.545
New Zealand	0.630	4.990
Pakistan	0.631	4.996
Philippines	0.783	6.197
Thailand	0.511	4.045

Test for equality of *d* coefficients: F(8,207) = 0.53196 Prob > F = 0.8317

Cluster B:

Country	Estimated *d*	t-statistic
China	0.742	6.032
South Korea	0.865	7.029
Malaysia	0.772	6.273
Taiwan	0.615	4.997

Test for equality of *d* coefficients: F(3,92) = 0.70401 Prob > F = 0.5520

Cluster C:

Country	Estimated *d*	t-statistic
Hong Kong	0.609	4.770
Singapore	0.785	6.147

Test for equality of *d* coefficients: F(1,46) = 0.9483 Prob > F = 0.3352

Table 4: Corporate tax, statutory rates in 2013 (%)

Country	Rate	Country	Rate	Country	Rate	Country	Rate
Utd Arab Em	55.0	**New Zealand**	**28.0**	UK	23.0	**Hong Kong**	**16.5**
Angola	35.0	Norway	28.0	Botswana	22.0	Romania	16.0
Argentina	35.0	South Africa	28.0	Ecuador	22.0	Canada	15.0
Honduras	35.0	Sri Lanka	28.0	**South Korea**	**22.0**	Georgia	15.0
Malta	35.0	***AP-Club A***	**27.6**	Sweden	22.0	Germany	15.0
Pakistan	**35.0**	Bangladesh	27.5	Syria	22.0	Kuwait	15.0
Sudan	35.0	Italy	27.5	Estonia	21.0	Latvia	15.0
United States	35.0	Samoa	27.0	Luxembourg	21.0	Lithuania	15.0
Zambia	35.0	Greece	26.0	Afghanistan	20.0	Mauritius	15.0
France	34.4	Zimbabwe	25.8	Armenia	20.0	Serbia	15.0
Brazil	34.0	**Japan**	**25.5**	Cambodia	20.0	Jordan	14.0
Venezuela	34.0	Austria	25.0	Croatia	20.0	Cyprus	12.5
Belgium	33.0	Barbados	25.0	**Fiji**	**20.0**	Ireland	12.5
Namibia	33.0	Bolivia	25.0	Iceland	20.0	Liechtenstein	12.5
Mozambique	32.0	**China**	**25.0**	Kazakhstan	20.0	Macao	12.0
Guatemala	31.0	Colombia	25.0	Libya	20.0	Oman	12.0
Australia	**30.0**	Denmark	25.0	Russia	20.0	Albania	10.0
Costa Rica	30.0	Egypt	25.0	Saudi Arabia	20.0	Bosnia & Herz	10.0
El Salvador	30.0	**Indonesia**	**25.0**	**Thailand**	**20.0**	Bulgaria	10.0
India	**30.0**	Israel	25.0	Turkey	20.0	Gibraltar	10.0
Kenya	30.0	Jamaica	25.0	Yemen	20.0	Macedonia	10.0
Malawi	30.0	**Malaysia**	**25.0**	Czech Rep	19.0	Paraguay	10.0
Mexico	30.0	Netherlands	25.0	Hungary	19.0	Qatar	10.0
Nigeria	30.0	Panama	25.0	Poland	19.0	Montenegro	9.0
Papua New G	30.0	Portugal	25.0	Ukraine	19.0	Switzerland	8.5
Peru	30.0	Trinidad & T	25.0	Belarus	18.0	Bahamas	0.0
Philippines	**30.0**	Uruguay	25.0	Chile	17.0	Bahrain	0.0
Spain	30.0	Vietnam	25.0	**Singapore**	**17.0**	Bermuda	0.0
Tanzania	30.0	Finland	24.5	Slovenia	17.0	Cayman Is.	0.0
Tunisia	30.0	***AP-Club B***	23.0	**Taiwan**	**17.0**	Isle of Man	0.0
Uganda	30.0	Slovak Rep	23.0	***AP-Club B***	**16.8**	Vanuatu	0.0
Dominican R	29.0						

Notes: The sample has 122 countries. Countries in bold feature in our analysis. The average tax rates of the three convergence clubs from Table 2 have also been included.
Sources: OECD and KPMG.