An International Comparative Study on Housing Price and Property Tax Liabilties

preliminary

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Abstract:

The study tries to explore the factors affecting the relative house price movements in the last two decades for some selected OECD as well as East Asia countries with the dynamic factor model put forward by Otrok and Terrones (2005) with a particular aim to shed light on the relationship between the level of house prices and the user's cost that are lay on their owners. Our preliminary results show that the international common trend does have its effect on house price in each of the countries studied, be they in OECD or in East Asia countries, which attest the empirical findings of Chirinko et al.(2004) and Otrok and Terrones(2005), and mortgage interest rate and effective property tax rate do have negative effects on each country's house price, just as what the authors expected prior to the study. Yet the effect of per capita GDP on house price is undecided. As such, the objective of the study is attained with only limited satisfaction.

Keywords: house price, effective property tax rate, common trend, Kalmon filter

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I. Introduction

The financial deregulation since early 1980's has brought about a world-wide trend of increasing house prices concomitant with deceasing interest rates almost around the world up to the eruption of catastrophe two years ago.

The issue of the reason why there had been such a phenomenon has been addressed by Chirinko et al. (2004) and Otrok and Terrones (2005) with a structural VARs model and a three non-observable dynamic factor model respectively. The result of the latter study shows that "international comovement in house prices ….is explained mainly by develepments in housing market as captued by the housing factors". The factors explored in the study include some variable-specific factors, 13 country-specific factor for each country studied which is obtained through a sophisticated statistical process deemed appropriate by the author, and the so-called latent factors which are constructed from the money, oil, real (productivity) and equity shocks among the countries beside the common dynamic component in house price for the countries studied. While we regard the research framework and the results of their study quite inspiring and illuminating, it appears to us that the study is short of generality in terms of the composition of countries studied as well as the way that the the factors are formed.

The set of countries studied in the above study comprises some 13 industrial countries, the contruction of latent factors leave out one important institutional aspect of the housing markets that may play an important role in determining the level of house prices for various countries—the tax liabilities of their house owners. With these reasonings, we believe that it might be worthwhile to trying to construct a modified research framework that takes the composition of countries of different level

of development into account.

As it is well documented in the housing research literature that property values are indeed negatively affected by future property tax liabilities, a phenomenon that is often termed as *capitalization* in the literature. (e.g. Palm and smith, 1998; Krantz et al., 1982; and Lea, 1982). In viewing of these, we believe that there are some differences in relative house prices in terms of per capita income for countries with different statutory conditions on property tax collection or at different development stages. As a matter of fact, for countries at developing stage and/or with highly centralized government, as property taxes there are not the main source of local government's revenue, the property tax liabilities are usually low in relation to the value of the property if compared to that of more developed and/or decentralized countries. Taking Taiwan for example, the property tax that is paid annually by a representative house owner there is mostly no more than two or three hundred USD, a magnitude that is actually less than one tenth percent of the value of the house asset, far less than the magnitude that one may find from the statistics compiled for citizens in most cities in the U.S.. As a result, the house price there, especially in unban areas, have been relatively higher than those in developed countries such as the U.S. in terms of people's affordability. To put it in another words, we believe it might be more general to have some developing countreis included in the sample set and to add some institutional factors such as the real estate tax liabilities of the populace of the countries into the study framework to shed light on how the relative house price for those sampled countries are affected by their different levels of tax liabilities along with those factors prevailing in the previous studies.

That is, in this study, we would have the above mentioned factors augmented into the model already put forward by Otrok and Terrones with an object to have

relationslip between the level of house prices and their tax liability across different countries unveiled along with other important aspects already considered in previous studies.

In the following section, a brief explanation of the model specification will be given. Then, we would give a brief description to the data used in the study. Following that, some preliminary results of the study would be displayed and discussed. The summary remarks would be given in the final section.

Ⅱ、 Analytical Framework

To address this question we follow Otrok and Terrones（2005）and estimate a dynamic factor model (DFM) comprising one dependent variable—the house price index, one common state variable, and three country-specific variables—GDP per capita, interest rate of banking loan, and per-capita tax burden—for selected 3 OECD and 3 East-Asia countries during the 1991Q1 to 2009Q4 period. Then we use the estimated factors to decompose the variance of each series attributable to the latent factors and country-specific regressors.

Dynamic factor models are a generalization of the static factor models which are commonly used in finance and psychology.[1] The motivation underlying these models is that the covariance or comovement between a group of (observable) time series is the result of the relation between these variables and a small number of unobservable variables, called factors. Otrok and Terrones（2005）propose a model comprising three non-observable factors to address the question how the growth rate of real house price for 13 industrial countries moved together with these factors. They find that although housing is the quintessential nontraded asset, there is a high degree of synchronization

[1] Sargent and Sims (1977) developed the first dynamic factor model.

in the changes in the price of this asset across industrial countries. Howerer, Otrok and Terrones attribute all the changes in the price to the unobservable factors, ignoring any possibilities that price changes are resulted from some observable, espicially country-specific variables. In this paper, we combine dynamic factor model along with traditional regression approach—considering per-capita output, user's cost（mortgage interest rate）, and property tax burden—to explain house price fluctuations among these countries.

Let HP_t^i denote the i^{th} house price index in country i at time t. The dynamic factor model and country-specific regressors decompose each HP_t^i into the following components:

$$HP_t^i = c + \lambda^i f_t + b_y^i Y_t^i + b_{\text{int}}^i INT_t^i + b_{tax}^i Tax_t^i + \varepsilon_t^i \quad for\, i = 1...n \; and \; t = 1...T, \tag{1}$$

where f_t is the component common to all house price index and λ^i is the sensitivity of country i to the global common factor; Y_t^i, INT_t^i, Tax_t^i represents the per-capita output, the banking loan interest rate, and property tax burden of each housing unit for country i, respectively; b_y^i, b_{tax}^i, b_{int}^i are the corresponding sensitivity of the same variable. Finally, ε_t^i is an idiosyncratic component measuring movements in the house price index which can't be captured by the common or country-specific factors and ε_t^i is assumed to be distributed as i.i.d. $N(0, \sigma_i^2)$.

The global common factor evolves as an independent AR(p) process:

$$f_t = \beta(L) f_t + \mu_t \tag{2}$$

where $\beta(L)$ is a lag polynomial operator and μ_t is an i.i.d. $N(0,\sigma_f^2)$ variable. Following Otrok and Terrones（2005）, we fix the variance of μ_t to unity as a normalization of the model. That is, $\sigma_f^2 = 1$.

To estimate this model, we use the Kalmon filter procedure developed in Stock and Watson（1993, 1999）, which distinguish the model into observable measurement equation and unobservable transition equation. Then we use Kalmon smoother to extract the latent factor for each country studied.

3. Model Results and Discussion

3.1 Selected OECD countries – U.S., U.K., and Canada

Before embarking on the formal estimation, we first take a look into the movements of the original time series that are selected to be used in this study. The movement of these original time series are plotted in Figure 1 as follows:

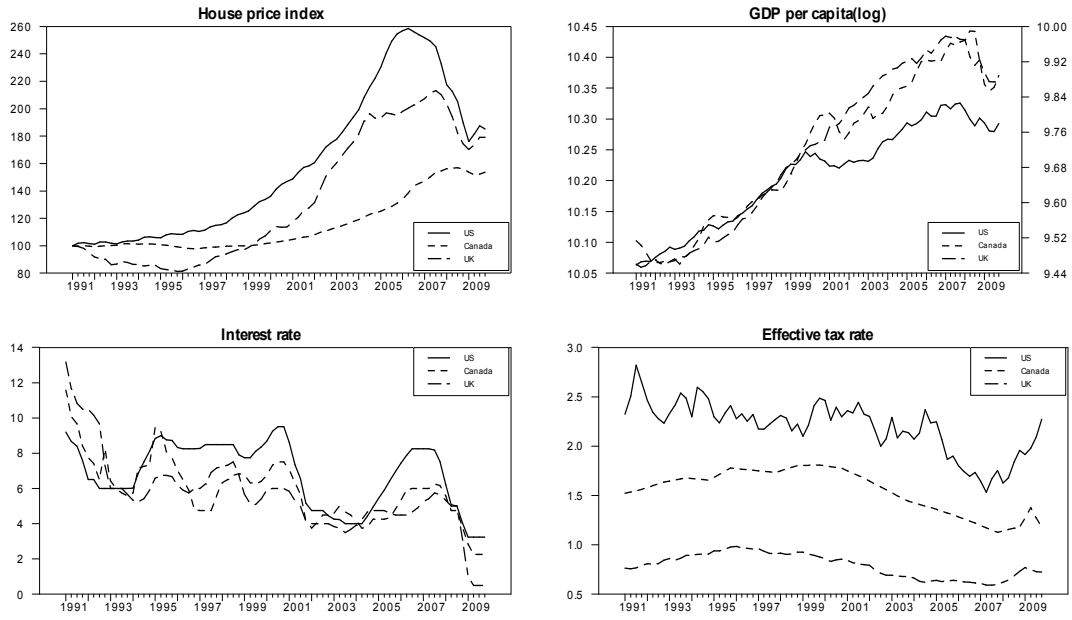

Figure 1: The movement of time series of selected OECD

From Figure 1 one can find that the trend for house prices in U.S., U.K. and Canada are pretty resembling to each other, indicating that there must be a common

trend among these selected OECD countries. As to the variables for per capita GDP and mortgage interest rate, the movements also look similar, implying that these countries are affected by the fluctuations of international business cycle, and cross-country capital movement has been so highly mobile among these countries that the interest rate parity seemed to holds and unavailable for arbitrage.

The behavior of the effective property tax rate, on the contrary, are quite different for those countries, with U.S. and U.K. having the highest and lowest value respectively, while Canada's was in between. During our observation period, the movement of this variable, by and large, exhibits a hunchbacked pattern except for the last two years, implying the property tax policy of individual authorities concerned might have been affected by the other countries'.

The formal estimation begins with the simplest conjecture that only the unobservable common factor is considered as the explanatory variable for each house price index among these selected OECD countries (called restricted model hereafter). That is, eq. (1) and (2) are reduced into

$$HP_t^i = c + \lambda^i f_t + \varepsilon_t^i \quad for\ i = 1...n\ and\ t = 1...T.$$

$$f_t = \beta(L) f_t + \mu_t$$

This means that all the country-specific factors which might affect the house price index among those countries are ignored in order to focus on the effect of the common trend on them. The estimated results are reported in Table 1 and the actual as well as fitted level of house prices based on the common trend for those OECD countries are depicted in Figure 2.

Table 1： Model results for selected OECD countries

	U.S.		U.K.		Canada	
	restricted model	full model	restricted model	full model	restricted model	full model
Common Factor（f_t）	0.525*** (0.006)	0.680*** (0.011)	0.707*** (0.010)	0.809*** (0.014)	0.533*** (0.007)	0.635*** (0.014)
GDP per capita（Y_t）		110.360*** (1.385)		-1.086 (1.219)		-7.730*** (1.286)
Interest Rate（Int_t）		-1.514*** (0.039)		-1.596*** (0.063)		-0.605*** (0.039)
Dewelling Tax（Tax_t）		-2.381*** (0.176)		-34.261*** (1.567)		-25.692*** (1.099)
	without country-specific factors		with country-specific factors			
State space model	$f_t = \underset{(0.017)}{0.905} f_{t-1} + \varepsilon_t$		$f_t = \underset{(0.063)}{0.863} f_{t-1} + \varepsilon_t$			

Note 1: Dependent variables are the house price index of selected countries.

Note 2: Constant terms are not reported.

Note 3:*, **, ***represents 10%, 5%, and 1% significance level, respectively.

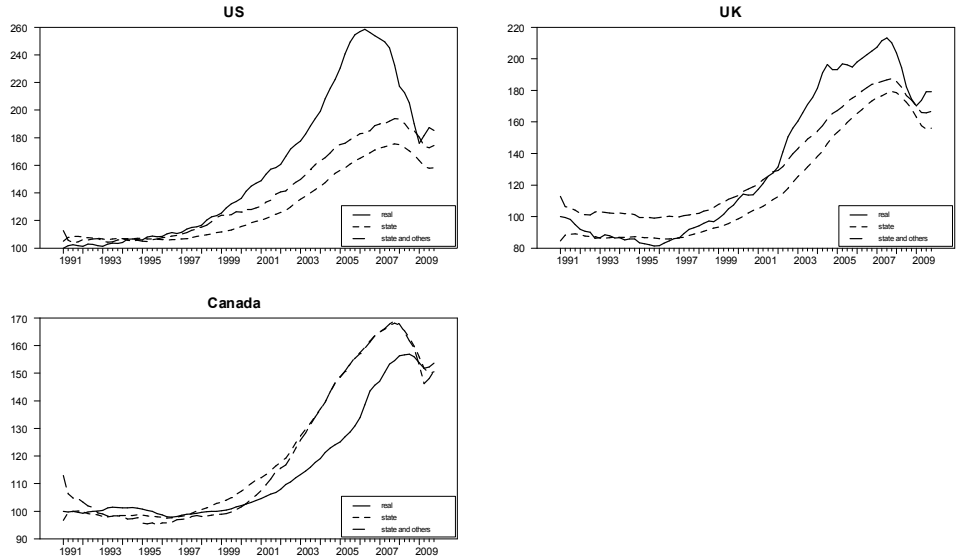

Figure 2: Real and fitted house price of selected OECD countries

There are a couple of points to be noted from the result. For one thing, the estimated common trend evolved as: $f_t = \underset{(0.017)}{0.905} f_{t-1} + \varepsilon_t$ which is highly persistent and significant. Besides, the estimated λ^i s for each selected OECD countries is and and significantly positive, implying the highly concomitant correlation among the house price trends. . From Figure 2, one can see that there does have a common trend

existed in the house price indices in the U.S., U.K. and Canada. That is, the house prices in the the U.S., U.K. and Canada are affected by the same fluctuation of international common trend. The fitted values for the U.S. and Canada deviate below and above their respective actual house prices, implying that the actual house price in the U.S. rose more rapidly than the common trend while that of Canada less rapidly than the common trend.

This result mimics the finding of Chirinko et al. (2004) and that of Otrok and Terrones (2005) and may be interpreted as reflecting the fact that the U.S., U.K. and Canada have high level of financial openness so that there exists an evident common trend even though real estates are quintessential non-tradable goods.

After going through the above-mentioned simple conjecture, we add the country-specific factors to the selected countries that might have affected each country's house price index besides their common trend in accordance with the specification of eq. (1) and (2) mentioned above (called full model hereafter). The result of the latter estimation and the fitted values for the full model are also included in Table 1 and Figure 2, respectively.

From Table 1, it is evident that house prices moved negatively with mortgage interest rate for those three countries, indicating that the decrease in user's cost in the decade observed did bring about the higher level of house prices in these countries. Similarly, the lowering of the effective property rates for the latter half periodin these countries also helped to boost their house prices. These results are consistent with that of Palm and smith (1998) and Krantz et al. (1982) in that the effecitve property tax is negatively related to their house price through the capitalization effect. The effect of per capita income on house price, howerer, is ambiguous. The effect is positive for the case of U.S. while negative for Canada. As to the case of U.K., the effect is not

statistically significant. The results are somewhat to our surprise since the level of personal income is widely believed to be positively related with the level of house price. We suspect that the surprising result might have to do with the adequency of the variable itself.[2]

From figure 2, one can see that the full model has a better fit to the house prices, although there are still deviations — lower for U.S. and higher for Canada. Clearly, the estimated coefficients of the country-specific factors, as indicated in Table 1, are quite significant while the autocorrelation coefficient of state space model decreased from 0.905 for the restricted model to 0.863 for the full model. This result implies that the effect of the common trend has been partaken by the country-specific factors. It seems that under perfect capital mobility, the country-specific factors in those countries might have been affected by their international counterparts. Otrok and Terrones (2005) estimated the common trend for 13 OECD countries with their GDP, consumption, residential investment and long-run as well as short-run interest rate. Their result reveals that both long-run and short-run interest rate of U.S had been affected by the common trend of interest rates in the other 12 countries. It seems our empirical finding here is consistent with theirs.

3.2 Selected East Asia countries – H.K., Taiwan, and Korea

As to the case of theselected East Asia countries, the story seems different. For one thing, our selected East Asia countries are still in developing stages. Taking Taiwan for an example, the country heavily relies on her foreign trade as the growth engine to its economy and the U.S. happens to be its greatest trade partners during most of the observation period of this study. As such, it is imaginable that the

[2] Most of the literature used the variable of personal disposable income which reflects the true consuming abilities. However, the time series for this variable are unavailable for most of the selected countries during our estimation period.

domestic economic conditions of the U.S would transmit their effect to Taiwan through the channel of trade which, in turn, affects the behavior of her house prices. Korea, as another example, being a country similar to Taiwan in its economy structure and economic development pattern but somewhat different in financial openness, heavily relies both on the domestic demand and foreign trade for growth. It is expected that the house price in Korea should be affected more by domestic conditions since her financial sector is less developed than the selected OECD countries.

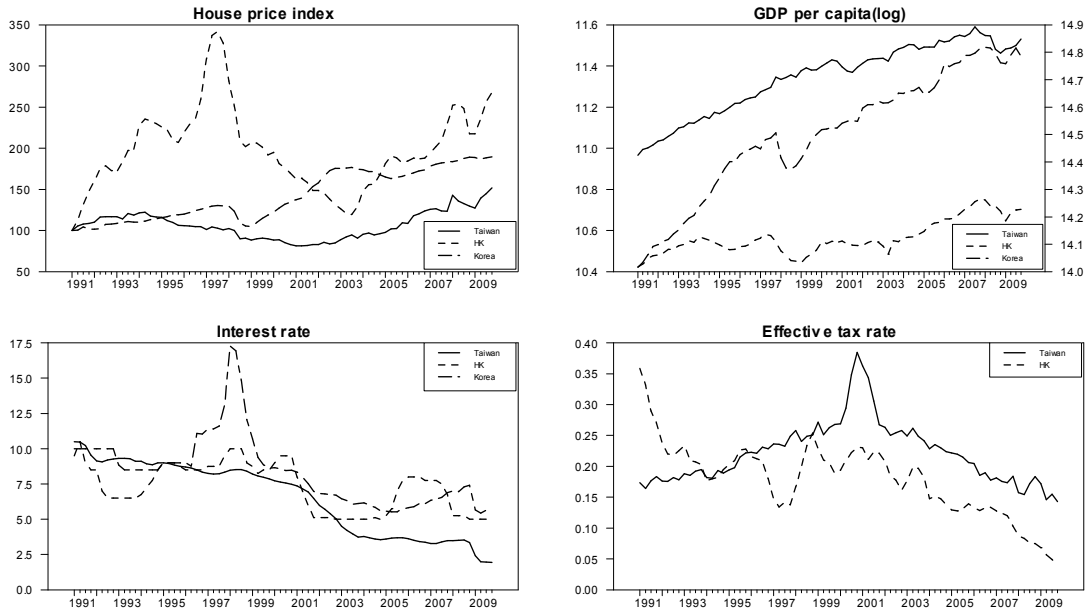

Figure 3: The movement of time series of selected East-Asia

Figure 3 depicts the movements of the various time series for H.K., Taiwan and Korea. It is discernible that the house price movement here is quite different for those three countries. In the case of H.K., house price moved abruptly upward before its reunion with China in 1997 and then bounced back for several years until 2003 when it rebounded back to a height less than its previous peak. The Korean house price had been increasing steadily for most of the observation period except for the financial crisis of 1997 and in 2001 when the whole world was in recession. For the case of

Taiwan, the movement had been relatively smooth with a couple of turnings occurred at 1993-94 and 2002. Before 2002, there was an upswing at the beginning for 2-3 years and then it reversed the swing. After 2002, the movement had been on the rise again. These different movement patterns implies that the house prices in these countries had been affected mainly by their country-specific factors or domestic shocks.

As to per capita GDP and mortgage interest rate, the trends here are similar to that of the U.S., U.K. and Canada. Namely, the per capita GDP has been on the rise while the interest rate on the fall by the large. However, the patterns of the trend are rather different for these East Asia countries, indicating that their country-specific factors have been more susceptible to their domestic conditions (or shocks). Finally, there is a difference discerned from the movement patterns of effective property tax rate for H.K. and Taiwan, indicating that they had adopted different tax policy with respect to their real estates. Specifically, the effective property tax rate had been decreasing for the observation period for H.K. while that of Taiwan had been on the rise for the first half period and then falled for the rest period. For Korea, the time series for this variabke is not available.

The estimation results for those East Asia countries are reported in Table 2. The result for the restricted model shows that the house price in each country had been affected by the common trend as is indicated by the estimated positive coefficients which are all statistically significant. Yet the estimated coefficient (0.721) for the common factor obtained here, obviously, is much lower than that of the selected OECD countries reported in Table 1 (0.905). This reveals that the common trend of house price in the East Asia countries has less stability than that of OECD countries.

Table 2： Model results for selected East-asia countries

	H.K.		Taiwan		Korea	
	restricted model	full model	restricted model	full model	restricted model	full model
Common Factor（f_t）	1.977*** (0.021)	0.733*** (0.004)	1.899*** (0.018)	0.732*** (0.004)	1.682*** (0.017)	-0.869*** (0.003)
GDP per capita（Y_t）		-3.663*** (0.420)		1.382*** (1.463)		17.773*** (0.309)
Interest Rate（Int_t）		-0.372*** (0.011)		-0.692*** (0.064)		-0.488*** (0.017)
Dewelling Tax（Tax_t）		-1.688*** (0.546)		-0.995* (0.586)		
	without country-specific factors		with country-specific factors			
State space model	$f_t = \underset{(0.007)}{0.721} f_{t-1} + \varepsilon_t$		$f_t = \underset{(0.049)}{0.962} f_{t-1} + \varepsilon_t$			

Note 1: Dependent variables are the house price index of selected countries.

Note 2: Constant terms are not reported.

Note 3:*, **, ***represents 10%, 5%, and 1% significance level, respectively.

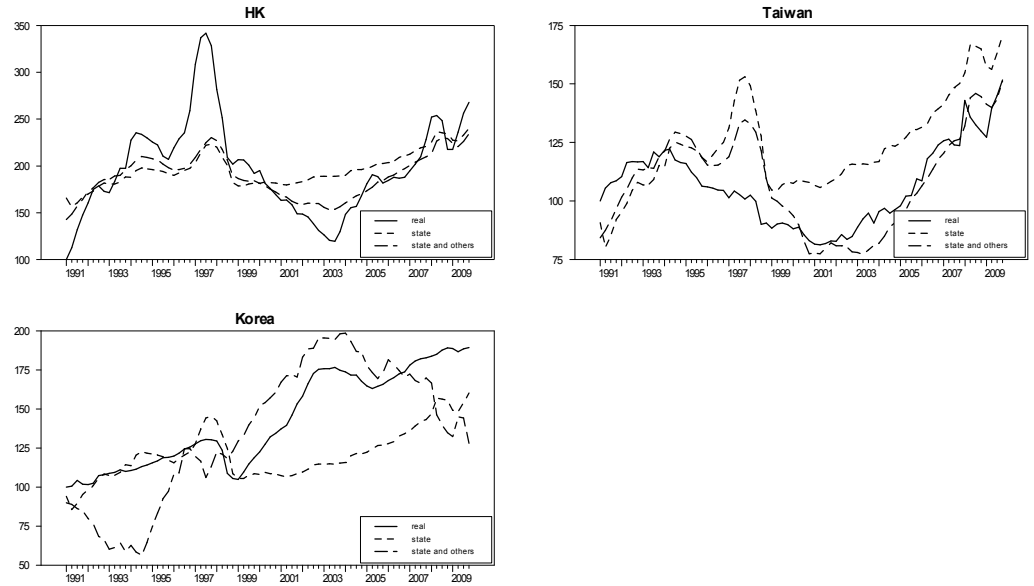

Figure 4: Real and fitted house price of selected East-asia countries

The comparison of the movements for the original house price series and their fitted common trend for those East Asia countries is depicted in Figure 4. From the figure, one can derive an understanding that, although there exhibits a common trend for house prices in those three countries, the common trend can not effectively

explain the house price movement in each specific country. As a matter of fact, the value of mean absolute error (MAE, defined as $(1/T)\sum\left|HP_{j,t}-\widehat{HP}_{j,t}\right|$) for those East Asia countries is much larger than that of the selected OECD countries.

Once again we add the country-specific factors to the selected East Asia countries that might have affected each country's house price index beyond the common trend in accordance with the specification of eq. (1) and (2) . The result of the latter estimation is also included in Table 2 and the real and fitted house with the estimated common trend as well as country-specific factors among the countries is depicted in Figure 4.

From the table, one can see that, after controlling those country-specific factors, the common trend among the selected East Asia countries studied still appears, and the autocorrelation of common factor rises apparently from 0.721 to 0.962. That is, the selected East Asia countries share a clear world common trend in house price movement after controlling all the other factors that may affect the estimation. As to the country-specific factors, similar to the result obtained in Table 1, the estimated coefficient for mortgage interest rate indicates that it has negative influence on house price, verifying that the house price boom over the decade was partly boosted by the falling of user's cost in the same period. The finding here is consistent with that of the selected OECD countries. This makes us confident to believe that the proposition we laid in Section 1 is applicable to developing countries as well as developed countries. The effect of per capita GDP on house price is found to be uncertain, just the same as what we obtained in the case of selected OECD countries. It is significantly positive in its effect on house prices in Taiwan and Korea. Nevertheless, the effect is negative for the case of H.K. and thus leaves us with an undecided result. Once more, it makes us to believe that the problem might have to do with the variable per se.

Finally, we found from Figure 4 that, after controlling those country-specific factors that might have influences on house prices, the fitted house price trend that is shaped by the important events happened among the countries and is well recognized to have influences on each country's house price movement resembles more closely to the real house price. In fact, the resulting MAE is significantly smaller than the restricted model for Taiwan and Korea. For the case of Korea, however, the fitted house price trend, after incorporating those country-specific factors, can only explain the house price movement for the period from 1997 till 2004 and goes in the opposite direction with the actual house price for rest of the period. Moreover, the estimated coefficient for the common trend variable is significantly negative in Korea, contrary to that of H.K. and Taiwan. We surmise that this might have been due to the inflence of the Asian financial crisis of 1997 in which only the Korean house market got its most hard hit while her corresponding income and interest variables did not reflect the same influence of these exogenous shocks and thus could hardly be relied upon to explain the house price movement in Korea.

VI. Concluding Remarks

The study tries to explore the factors affecting the relative house price movements across different countries with a particular aim to shed light on the relationship between the level of house prices and the tax burdens that are lay on their owners. To this we adopt the analytical model put forward by Otrok and Terrones (2005) in the first place but with some modifications in the specification of the estimation model, hoping that the empirical result will validate our hypothesis that the average national house prices are negatively related to the aggregate tax burdens of the home owners. Our preliminary results show that the international common trend does have its effect on house price in each of the countries studied, be they in OECD

or in East Asia countries, and mortgage interest rate and effective property tax do have negative effects on each country's house price, just as what the authors expected prior to the study. These results attest the empirical findings of Chirinko et al.(2004) and Otrok ND Terrones (2005). Yet the effect of per capita GDP on house price is found to undecided. As such, the objective of the study is attained with only satisfaction. We surmise that the disappointing performance of the income variable might have to do with the adequacy to the variable per se which we wish to solve in future.

Appendix: Sample Composition and Data Sources

This appendix provides details on the sample composition and data sources. The sample used in this paper includes the following 3 OECD countries: U.S., U.K., and Canada, and 3 East-Asia countries: H.K., Taiwan, and Korea. The data is quarterly and covers the 1991:1 to 2009:Q4 period.

Data was taken from a variety of sources, including the IMF International Sataistics, the OECD Analytical Database, Financial Department of relvant countries, and national authorities introduced by the Global Property Guide website.[3]

Main financial and housing series are:

(1) House prices. These are the nominal house price indexs which we normalized 1991Q1 as 100 for the selected countries. The house price is obtained from national sources (introduced by the Global Property Guide).

(2) Mortgage interest rate. The interest rate series were obtained from the IMF International Financial Statistic. We use bank prime loan rate as the primary mortgage rate.

(3) Effecitive tax rate. These are calculated as the sum of land tax and house tax in Taiwan, council tax in U.K., and property tax in U.S., Canada and H.K. while the data for Korea is unavailable. These were divided by respective total housing stocks to obtain the tax burdan of each housing unit. The data are obtained from respective government authorities of those countries.

(4) Income per capita. These are calculated as the Gross domestic product divided by the relvant total population. Original series are obtained from the OECD Analytical Database.

The X-11 method is appiled to obtain the seasonal adjusted series which we concerned.

[3] The address is: http://www.globalpropertyguide.com/

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