Journal of Urban Economics 66 (2009) 75–89

Contents lists available at ScienceDirect

Journal of Urban Economics

www.elsevier.com/locate/jue

Current account patterns and national real estate markets ☆

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ARTICLE INFO

Article history:
Received 28 September 2008
Revised 18 May 2009
Available online 27 May 2009

JEL classification:
F15
F21
F32
R21
R31

Keywords:
Current account
Real estate
Appreciation
Financial depth

ABSTRACT

This paper studies the association between current account and real estate valuation across countries. We find a robust and strong positive association between current account deficits and the appreciation of the real estate prices/(GDP deflator). Controlling for lagged GDP/capita growth, inflation, financial depth, institution, urban population growth and the real interest rate; a one standard deviation increase of the lagged current account deficits is associated with an appreciation of the real estate prices by 10%. This real appreciation is magnified by financial depth, and mitigated by the quality of institutions. Intriguingly, the economic importance of current account variations in accounting for the real estate valuation exceeds that of the other variables, including the real interest rate and inflation. Among the OECD countries, we find evidence of a decline over time in the cross country variation of the real estate/(GDP deflator), consistent with the growing globalization of national real estate markets. Weaker patterns apply to the non-OECD countries in the aftermath of the East Asian crisis.

1. Introduction and overview

The financial liberalization wave in emerging markets during the 1990s has frequently led to boom–bust cycles, particularly when the initial boom been followed by a financial crisis. A significant literature has focused on the dynamics of financial liberalization in emerging markets, where financial liberalization has led to large inflows of capital, which bankroll growing current account deficits and magnifying economic booms. Frequently, these booms were manifested in sizable real estate and real exchange rate appreciations, and in the buildup of balance sheet vulnerabilities, leading ultimately to financial crises. Observers noted that the real estate market played a key role in the propagation of the boom and bust cycle, magnifying the welfare costs of preexisting distortions (like moral hazard).[1]

The literature concerned with boom–bust cycles induced by financial inflows dealt mostly with East Asia and Latin America, implicitly presuming that the US and Europe are less exposed to the vulnerabilities that come with such cycles. The ability of OECD countries to borrow in their currency, the greater reliance on flexible exchange rate regimes, and the presumption of better institutions suggests that the potential volatility induced by real estate boom/bust cycles is indeed larger in developing countries. Yet, there is little evidence regarding the degree to which countries share similar qualitative links between current account patterns and national real estate markets. The purpose of our paper is to provide evidence on the robustness of the current account/real estate channel across availability wide spectrum of countries. Our

☆ Financial support from the College of Humanities, Arts, and Social Sciences at NTU is gratefully acknowledged. We thank Jess Moyer (Investment Property Databank), Ong Qiyan, Francis Ng, and Jiang Zhimin for their helps with real estate data. We would like to thank Marty Feldstein, Steve Sheffrin, and two anonymous referees for very useful comments. Any errors are ours.
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[1] See McKinnon and Pill (1996). Further discussion of the association between capital inflows, asset valuation and financial fragility can be found in Calvo et al. (1996), Krugman (1998), Edison et al. (1998), Quigley (2001), and Kim and Lee (2002). See Aizenman (2004) for an overview of the policy challenges facing financial opening, and the magnification of domestic distortions associated with capital inflows. See Debelle and Galati (2007), Edwards (2004), Chinn and Ito (2005), Freund (2005) and Faruqee and Lee (2008) for overviews of current account patterns in recent decades. See Kiyotaki and Moore (1997) and Aghion et al. (2004) for models of credit cycles in the closed and open economy, respectively.

0094-1190/$ - see front matter
doi:10.1016/j.jue.2009.05.002

main finding is that, indeed, this channel is potent across all countries, subject to interactions with other domestic variables.

Another recent literature has focused on the volatility of real estate prices relative to the observable changes in fundamentals. These studies frequently used the variation in the experience of municipalities in the USA, studying the factors accounting for the incidence of boom–bust cycles over time. Glaeser et al. (2008) pointed out the role of the supply side in accounting for recent boom–bust cycles. Other studies focused on the impact of the nature of financing [see the papers in the September 2008 JUE symposium on Mortgages and the Housing Crash]. An issue deserving further investigation is the degree to which international factors affect the patterns of the boom–bust cycles across countries and time. For example, the US, the UK, Spain and Ireland have shared similar trends in recent years – all running sizable current account deficits and experiencing prolonged spells of real estate appreciation. These patterns are consistent with the notion that international factors, including financial integration and financial flows, are among the factors accounting for the real estate boom–bust cycles in the OECD. We examine these assertions, assessing the impact of the cross country variation in current account patterns on the real estate valuation.

In this paper, we take the view that current real estate valuation has a sizable dependence on lagged macroeconomic variables. This is consistent with the notion that adjustment to changing macro conditions is more protracted in real estate markets than in stock markets [see Glaeser and Gyourko (2007) and Case and Shiller (1989)].[2] We provide evidence consistent with the view that the price adjustment of equities (assets traded in well organized liquid markets, subject to low trading costs) is faster than that of real estate (less liquid assets, subject to high trading costs).

We analyze regressions that account for the real appreciation of the housing stock, controlling for lagged variables, including GDP per capita, real interest rate, inflation, and the current account. We find that lagged current account patterns are important in accounting for the real appreciation of the real estate market. In addition, the current account changes interacting with other macro variables are important in accounting for future real valuation of housing. Specifically, a one standard deviation increase of the lagged current account deficits [by 4% in our sample] is associated with real appreciation of real estate prices by about 10%. This real appreciation is magnified by financial depth [about 2%], and mitigated by the quality of institutions [about 3%]. Intriguingly, the economic importance of current account variations in accounting for the real appreciation of real estate prices exceeds that of the other variables. This includes the real interest rate – a one standard deviation drop of the lagged real interest rate [by 2.5% in our sample] is associated with real appreciation of real estate prices by about 7%. Among the OECD we find evidence of decline over time in the cross country variation of the relative real estate prices, consistent with the deeper globalization of national real estate markets. Weaker patterns apply to the non-OECD countries in the aftermath of the East Asian crisis. Finally, we subject our analysis to various robustness checks.

Sections 2 and 3 review the methodology and the data, respectively. The estimation and results are summarized in Section 4. Section 5 offers concluding remarks.

2. Methodology

The possibility that financial flows are a contributing factor explaining real estate dynamics have been discussed recently by Reinhart and Rogoff (2008):

> "... a large chunk of money has effectively been recycled to a developing economy that exists within the United States' own borders. Over a trillion dollars was channeled into the subprime mortgage market, which is comprised of the poorest and least credit worth borrowers within the United States. ...we note that although this paper has concentrated on the United States, many of the same parallels hold for other countries that began experiencing housing price duress during the 2007, including Spain, the United Kingdom and Ireland."

The purpose of our paper is to investigate empirically the merits of the linkages between capital inflows and real estate valuation in all countries for which data is available. Our empirical analysis is inspired by models that focused on credit market imperfections, including Kiyotaki and Moore (1997) in a closed economy, and Aghion et al. (2004) in the open economy. Specifically, agency and moral hazard considerations imply that agents can borrow today up to a fraction μ of their wealth, W. This fraction may depend negatively on the real interest rate, r. Assuming lags in processing mortgages and closing transactions in the housing market, housing prices today P_H would reflect the lagged borrowing capacityμW_{-1}, and the lagged foreign demand for domestic houses,$H^{*,d}_{-1}$. The supply of housing, H^s, impacts negatively the equilibrium housing prices. In the Appendix we outline an inter-temporal model of the housing market in the open economy. This leads to a reduced form equation where the demand for housing depends on scale variables like wealth (W), income (Y) and demography (the number of households, N), and negatively on the rental rate. The rental rate increases with the interest rate r, and the risk premium (ϕ) associated with housing financing. Inflows of foreign capital (equivalently, current account deficits), S^f, tend to induce the appreciation of the real estate by several channels. First, it tends to increase liquidity and the pool of aggregate savings financing the investment in the economy, thereby reducing the interest rate and the housing risk premium. Next, inflows of foreign capital may target domestic real estate as a means of diversification. Due to a multitude of reasons, we presume that real estate price adjustment is protracted.[3] All these considerations suggests a specification where the real estate relative price is

$$P_H = P_H\left[\overset{+}{W}_{-1},\ \overset{+}{Y}_{-1},\ \overset{-}{r}_{-1},\ \overset{-}{\varphi}_{-1},\ \overset{+}{S^f_{-1}},\ \overset{+}{N}_{-1};\ \overset{+}{H^{*,d}_{-1}};\ \overset{-}{H^s_{-1}},\ \overset{-}{\mu}_{-1}\right].$$

Consequently, our empirical specification aims at explaining the real estate relative price by lagged variables including income growth, population, inflation, financial depth, the real interest rate, and capital inflows. Other variables that may impact collateral constraints (like quality of institutions, loan to value, etc.) are used in the robustness checks.

The above methodology presumes that the short/intermediate run dynamics of real estate prices differs from that of stocks. These dynamics may reflect differential adjustment and financing costs, the greater heterogeneity of real estate, and the different market structure underlying the housing and stock market. In the next

[2] Adjustments in the real estate markets are subject to significant transaction costs on behalf of consumers, and time consuming installation costs on behalf of producers. These features imply that demand-side factors play important and persistent roles in explaining protracted adjustment in the real estate market. See Brock (1988) for an open economy analysis of these issues. For empirical studies of the determinants of the real estate prices see Englund and Ioannides (1997), Case et al. (2000), Case et al. (2005), da Mata et al. (2007), and Shiller (2007).

[3] Housing transactions occur through time consuming bilateral negotiations associated with heterogonous assets; the liquidity of the housing market is constrained because of the existence of high transaction costs and agency considerations; borrowers rely heavily on external finance; real estate is widely used as collateral; and the supply of houses is adjusting slowly to market conditions. All these factors suggest that the adjustment of real estate valuations to shocks is much more time consuming than that of equity valuations.

sections, we provide evidence consistent with the above presumptions. We find that real estate relative prices are more persistent and less volatile than equity relative prices, and more correlated with the lagged current account. We also apply univariate and multivariate regression analysis, and find a much weaker association between lagged current accounts and equities than between lagged current accounts and real estate valuations.

Our focus is on the impact of past current accounts on the present real estate relative prices. Yet the life cycle model of consumption implies that real estate appreciation may be associated with higher wealth, triggering higher consumption, thereby increasing the current account deficit. Hence, there may be a two-way causality between housing wealth and the current account. We examine the possibility of such a two-way feedback and the importance of the "housing wealth" channel using three different tests.[4] We find that the case for "reverse causality," from real estate prices to current account deficits, is not supported in our 43 countries, 1990–2005 sample. We also apply the simultaneous-equations and instrumental-variables estimation to deal with potential endogeneity. Based on the 3SLS estimates, the effect of current account deficits on the real estate appreciation is positive and significant, but not significant in the other direction. Finally, we use Granger causality tests on quarterly data of current account deficits and various real estate indices in the US and the UK. Using this relatively long (30 years) and high frequency data, we find that the Granger causality can run in both directions, varying across locations and types of national real estate markets. Our inference from these tests is mixed – there may be a two way feedback. Yet, one may need longer and more frequent data to validate it, something that is not available at present for a large panel of countries.

Our reduced-form house price equation is related to the standard approach (e.g. the DiPasquale and Wheaton model). The standard approach makes a distinction between the market for housing services, which sets (implicit) rents, and the market for housing assets that puts a value on the stream of future rents generated by the housing stock. In these circumstances, prices adjust gradually towards the long-run equilibrium. This view has led to the common use of error-correction models (see e.g. Girouard et al., 2006). Our approach differences an equilibrium model, thereby not distinguishing between short-run reactions to disturbances and long-run adjustment towards equilibrium. This allows us to focus on the impact of systematic current account fluctuations, which are mostly medium-run by nature.

3. Data description

We obtained price indices of national real estate markets from the Datastream and the Global Property Guide. The data Appendix provides a description and the primary sources of these indices.

3.1. Sample and sources

We gathered the real estate data from 1978 to 2008 for all countries, subject to data availability. Using the national real estate indices is subject to important limitations. 'National indices' cover diverse and potentially different sectors of real estate markets for different countries; some residential, others industrial, office or retail.[5] To get a broader perspective, we also collect indices tracking real estate returns in several countries using 'investable indices' compiled by companies that invest in real estate markets internationally. The indices reflect the investable portion of the national real estate markets and offer detailed information at the sectoral level, in a consistent manner across countries. However, the coverage of these investable indices is limited, and they are subject to sample selection. The lack of data in any country is a result of the lack of interest and investment opportunities in the real estate markets there. For country-level data at an annual frequency, the investable indices cover 12 countries from 1998 to 2007. For city-level data at a quarterly frequency, the investable indices cover 6 cities from 1998:01 to 2007:04. Because of the short span and limited country coverage of the investable indices, our estimation focuses on the annual national indices. Other sources include quarterly indices kept by the UK and the US spanning back to the 1980s. We also included the investable indices for the UK, and the NCREIF indices and the Case and Shiller indices for the US.

The data on the current account deficits and relevant macroeconomic variables are taken from the World Development Indicators (WDI) and the International Financial Statistics (IFS). Following the literature, we control the annual growth of population in the urban areas (Urban Population Growth), the annual growth of real GDP per capita (Capita GDP Growth), GDP deflator inflation (Inflation), domestic credit provided by the banking sector as a percentage of GDP (Financial Depth), and the domestic real interest rate. We use the real interest rate from WDI, which is constructed from the bank's one year lending interest rate, adjusted for inflation by the GDP deflator. While the mortgage rates will allow testing both the prime and sub-prime real estate loans, to our knowledge a panel data on the mortgage rates at that level of disaggregation is not publicly available across the OECD and Non-OECD countries. We use the International Country Risk Guide (ICRG) scores on law and order as a proxy for quality of institutions. Though the loan-to-value ratio is available only as a cross-section variable, we include it as potentially an important financial factor explaining real estate valuations.[6] After combining the national real estate series with the current account deficits and macroeconomic variables, our sample covers the period of 1990–2005 for 43 countries, of which 25 are OECD countries. We deflate the real estate indices in nominal terms with the country GDP deflator, and call the resultant series "appreciation of real estate prices" or "real estate/(GDP deflator) appreciation." The GDP deflator is chosen over the consumer price index to maximize the sample size.[7]

3.2. Unit root issues

Table 1 provides the number of observations, sample averages, standard deviations, and the Mackinnon approximate p-value of the Dickey–Fuller test under the null hypothesis of a unit root. In testing the unit root, we note that the real estate prices/(GDP Deflator) appreciation series span from 1990–2005, while the Current Account Deficits/GDP series go back to 1980 for most of the

[4] The detailed discussion dealing with causality tests and other robustness checks is available as Aizenman and Jinjarak (2008) NBER Working Papers No. 13921.

[5] Another problem with the national indices is their accuracy. For example, consider the March 2008 figure in China for Shenzhen: the National Development and Reform Commission (NDRC) reported that real estate prices dropped by 4.9%, but the Shenzhen Bureau of Land and Housing Management reported a drop of 16.5% (Economist, 2008).

[6] Warnock and Warnock (2008) find that countries with stronger legal rights for borrowers and lenders, deeper credit information systems, and a more stable macroeconomic environment have a deeper housing finance system. There are several important financial variables which we lack in the cross-country data, including loan-to-value ratios, credit restrictions, and securitization of housing loans (see also BIS, 2006). Due to limited data availability, these figures also miss the recent market turbulences; the credit shock hitting the financial markets in 2007 has generated a decline in securitization of mortgages, which sharply reduces the demand for housing (Deutsche Bank, 2008).

[7] This is due to missing data in CPI series for a number of developing countries at the beginning of the sample period. Another side benefit of using the GDP deflator is that it is more consistent in terms of the changing basket and expenditure patterns across countries.

Table 1
Summary statistics and unit root tests. The statistics are for the period 1980–2005 for the current account deficits/GDP, and 1990–2005 for the real estate/GDP deflator appreciation, % per year. Local GDP deflator is chosen over the consumer price index to maximize the sample size and allow for the changing expenditure patterns across countries. The Mackinnon approximate *p*-value is from the Augmented Dickey–Fuller test under the null of unit-root with trend. The cumulative appreciation sums for the period 2001–2005 the real estate/GDP deflator appreciation for each country.

Country	Current Account Deficits/GDP (%)				Cumulative Deficits (%) from 2001 to 2005	Real Estate/GDP Deflator Appreciation (%)				Cumulative Appreciation (%) from 2001 to 2005
	Obs.	Avg.	s.d.	*p*-Value		Obs.	Avg.	s.d.	*p*-Value	
Australia	26	4.3	1.0	.031	25.8	16	4.7	7.6	.153	37.3
Austria	26	.8	1.8	.573	−5.1	16	2.6	8.0	.295	15.0
Belgium	25	−2.5	2.9	.977	−14.8	15	4.2	4.3	.866	42.9
Bulgaria	26	3.0	4.8	.266	41.8	12	−20.1	101.3	.010	90.1
Canada	26	1.0	2.3	.433	−9.2	16	.1	4.3	.000	19.6
China	23	−1.4	2.4	.098	−16.0	7	−1.8	3.1	.678	−13.1
Colombia	26	2.1	3.2	.356	7.5	9	−4.5	7.8	.001	5.5
Croatia	13	5.2	5.0	.164	34.7	11	−1.0	6.6	.022	−10.6
Czech Republic	13	4.0	2.3	.182	24.9	10	.5	7.8	.013	9.5
Denmark	25	−.2	2.7	.516	−13.9	13	6.4	5.0	.883	39.3
Estonia	14	7.4	4.7	.506	60.2	9	15.2	22.5	.009	108.9
Finland	25	−1.5	5.0	.866	−30.0	16	−.3	11.2	.207	32.9
France	26	−.2	1.3	.949	1.7	16	2.7	8.9	.002	50.3
Germany	26	−1.1	2.3	.929	−17.9	16	−1.0	1.5	.303	−4.6
Greece	24	4.8	2.8	.913	41.0	12	3.6	4.9	.017	24.6
Hong Kong	8	−7.5	3.4	.004	−49.7	12	−.1	16.5	.178	38.0
Hungary	24	4.5	3.6	.080	35.7	5	7.5	8.1	.100	35.9
Indonesia	24	.9	3.4	.092	−8.4	12	−9.5	18.4	.100	−10.9
Ireland	25	1.6	4.2	.967	4.1	16	7.0	5.8	.311	38.1
Israel	25	2.1	3.6	.348	−6.3	8	.0	8.3	.009	−2.4
Italy	25	.3	1.6	.840	4.5	16	1.3	5.6	.377	26.8
Japan	26	−2.5	1.2	.132	−17.4	16	−3.5	4.5	.000	−26.3
Korea	26	−.6	4.3	.191	−9.7	16	−1.8	8.9	.001	25.9
Lithuania	13	7.1	3.3	.641	37.7	7	14.4	16.3	.275	96.4
Luxembourg	11	−10.2	1.7	.001	−53.1	13	1.7	3.0	.347	7.8
Malaysia	25	−.8	8.9	.364	−48.3	5	−.1	2.6	.986	−4.3
Malta	25	2.6	5.1	.106	15.9	15	6.8	5.8	.177	30.0
The Netherlands	26	−3.9	2.2	.407	−33.3	16	5.4	5.3	.111	10.6
New Zealand	26	5.7	2.7	.403	33.0	14	5.0	6.0	.663	48.0
Norway	26	−5.5	6.4	.406	−71.9	16	1.0	5.0	.030	8.7
Phillipines	25	2.7	3.2	.145	−4.3	10	−6.9	9.4	.000	3.9
Portugal	26	4.6	4.7	.657	41.4	4	.0	2.2	.000	.1
Russia	12	−7.3	5.6	.718	−47.2	8	−22.8	30.2	.001	−68.4
Serbia	6	6.1	2.1	.081	8.8	6	−14.6	31.0	.439	−11.5
Singapore	25	−9.2	11.0	.153	−90.7	16	4.1	17.8	.027	8.5
South Africa	26	.3	2.9	.279	13.7	6	11.8	8.7	.950	74.2
Spain	26	2.3	2.4	.948	28.1	10	6.0	5.1	.982	49.0
Sweden	25	−.9	3.3	.754	−27.2	16	2.8	7.5	.148	36.3
Switzerland	26	−7.3	4.7	.185	−72.1	16	−2.1	4.0	.162	7.3
Taiwan	21	−5.7	3.7	.777	−34.0	14	−2.0	5.3	.023	10.9
Thailand	26	1.8	5.8	.449	−5.9	14	−.7	4.9	.012	6.1
United Kingdom	26	1.3	1.9	.759	10.4	16	3.0	9.6	.355	49.6
United States	26	2.6	1.9	.954	27.9	16	2.8	3.5	.018	31.3

countries in the sample. Non-OECD countries also have many missing observations for both the real estate and current account series, particularly the Eastern European countries. In our sample, the average number of observations (years available) for Real Estate/(GDP deflator) appreciation is 12 for the whole sample, 10 for the Non-OECD countries, and 14 for the OECD countries. We can see from Table 1 that the average appreciation of real estate prices in some countries is extreme: for the 7–12 year period, the appreciation exceeds 14% in Estonia and Lithuania whereas the depreciation exceeds 20% in Bulgaria and Russia.

During 1990–2005, the average Real Estate/(GDP deflator) appreciation is .64% per year for the whole sample, −1.35% per year for the Non-OECD, and 2.08% per year for the OECD countries. The real estate markets in Non-OECD tend to be more volatile: the average standard deviation of the real estate appreciation deflated by GDP deflator is 17.57, compared to 5.90 for the OECD countries. Using the Dickey–Fuller test for unit root with a trend term, most of the Real Estate/(GDP deflator) appreciation series are found to be non-stationary: the Mackinnon approximate *p*-value of 35 countries is larger than.005. As for the Current Account Deficits/GDP, some of the outlier observations are countries running large current account surpluses: for example Singapore and Switzerland run an average 10% surplus over a 25-year period. The average Current Account Deficits/GDP is.25 for the whole sample,.66 for the Non-OECD, and −.04 for the OECD countries. Similar to the real estate series, the current account deficits to GDP of the Non-OECD tend to be more volatile: the average standard deviation of the Current Account Deficits/GDP is 4.56, compared to 2.85 of the OECD countries. Using the Dickey–Fuller test for unit root with a trend term, we also find that most of the current account series are non-stationary: the Mackinnon approximate *p*-value of 41 countries is larger than .005.[8]

To examine further in details the stationarity of the real estate and the current account series, Table 2 reports a summary of unit root tests, one on the individual series for each country, and another across series in the panels. In the top panel, we can see that under the null hypothesis of a unit root the rejection rates of these

[8] A higher critical *p*-value of .05 would yield more rejections of the null of non-stationarity.

Table 2
A summary of unit root tests. The null hypothesis is non-stationarity for the augmented Dickey–Fuller test and the Phillips–Perron test. For the Kwiatkowski–Phillips–Schmidt–Shin test, the null is stationarity: a rejection of stationarity under the Kwiatkowski–Phillips–Schmidt–Shin test is reported as a non-rejection of the unit root. The null hypothesis is non-stationarity for the Levin–Lin–Chu (2002) test and the Im–Pesaran–Shin (2003) test. For the Nyblom–Harvey (2000) test, the test statistic can be considered as the generalization of the Kwiatkowski–Phillips–Schmidt–Shin test, and a failure to reject the null hypothesis of zero common stochastic trends is an indication that the series do not form a cointegrated combination. The test statistics correspond to specifications with time trend. Because the sample must be a balanced panel in order to perform the existing panel test procedures, the sample is restricted to 12 years (1993–2004) and 25 countries (19 OECD and 6 Non-OECD). ***, **, and * signify 1, 5, and 10 level of significance.

Testing procedures	Real Estate/GDP Deflator Appreciation			Current Account Deficits/GDP		
	Whole sample	OECD	Non-OECD	Whole sample	OECD	Non-OECD
Percent of rejecting unit roots						
Individual country series						
Augmented Dickey–Fuller	44.2	40.0	50.0	7.0	8.0	5.6
Phillips–Perron	44.2	36.0	55.6	9.3	8.0	11.1
Kwiatkowski–Phillips–Schmidt–Shin	97.7	100.0	94.4	100.0	100.0	100.0
Test statistics						
Panel of series						
Levin–Lin–Chu (2002)	−18.296***	−12.073***	−11.299***	−12.002***	−10.196***	−4.496*
Im–Pesaran–Shin (2003)	−2.783***	−2.586*	−3.014**	−2.138	−2.189	−1.769
Nyblom–Harvey (2000)	1.556	1.556***	.580*	1.556	1.556***	.561*

tests suggest that the stationarity properties of these series are inconclusive.[9] The augmented Dickey–Fuller test and the Phillips–Perron test indicate that more than 60% of the Real Estate/(GDP deflator) Appreciation series and around 90% of the Current Account Deficits/GDP series are non-stationary. On the other hand, the Kwiatkowski–Phillips–Schmidt–Shin (1992) test indicates that most of the two series are stationary.[10] These mixed results apply to both the OECD and Non-OECD countries, reflecting the low-power of the unit-root tests on the short time series in the sample. The bottom panel of Table 2 reports the results from applying the panel unit root tests. Because the sample must be a balanced panel in order to perform the existing panel test procedures, there are 12 years (1993–2004) and 25 countries that qualify.[11] The test statistics correspond to specifications with time trend, under the null hypothesis of non-stationarity for the Levin–Lin–Chu (2002) test and the Im–Pesaran–Shin (2003) test; for the Nyblom–Harvey (2000) test, the test statistic can be considered as the generalization of the Kwiatkowski–Phillips–Schmidt–Shin test, and a failure to reject the null hypothesis of zero common stochastic trends is an indication that the series do not form a cointegrated combination. Applying to the panel of Real Estate/(GDP deflator) appreciation, the Levin–Lin–Chu and the Im–Pesaran–Shin tests reject the null of non-stationarity. The Nyblom–Harvey test rejects the null of zero common trends for the panels of OECD and Non-OECD, but not for the whole sample. For the Current Account Deficits/GDP panels, the results are inconclusive: the Levin–Lin–Chu test rejects the null of unit root, but the Im–Pesaran–Shin test cannot reject. The mixed results reflect the sample size and also a number of limitations with the existing tests of unit root in the panels.[12] This may also reflect the possibility that CA/GDP ratio follows a unit-root process if its value stays within a certain range, but reverts to its long-run equilibrium when the CA/GDP ratio exceeds some threshold values (Ju and Wei, 2007). Due to these borderline results of the unit root tests, we first present a preliminary analysis of the variables in this section, followed by a formal estimation, taking into account non-stationarity of these series, in the next.

3.3. Sample distribution, the patterns of current account, real exchange rate and stock markets

Fig. 1 presents the patterns of investable indices at the sectoral level: residential, office, retail, and industrial. It confirms the strong co-movements of these indices. Further, between different sectors of real estate indices, both at the country level and city level, the correlations between residential housing valuation and other segments of the national real estate markets (office, retail and industrial) are positive and large.[13] Fig. 2 shows the correlations between the Current Account Deficits/GDP with the real exchange rates, the Real Estate/(GDP deflator) appreciation, and the Stock Markets/(GDP deflator) appreciation. We also plot as references of international interest rates the 3-month nominal interest rates using the US Treasury Bill, the Japan Financing Bill, and the London Interbank Offer Rate (LIBOR, pound sterling). During the sample period, the correlations between the appreciation of real estate prices and the current account deficits increase by .041% per year (p-value 0.0) among all countries, .029% (p-value .006) among the OECD countries, and.036% (p-value .283) among the Non-OECD countries.[14] Regressing the correlations between current account deficits and real estate appreciation on the LIBOR, the estimated coefficient is −.061 (p-value .000) for all countries, −.051 (p-value .000) for the OECD countries, and −.048 (p-value .449) for the Non-OECD countries.[15]

The above results confirm our prior hypothesis that real estate prices exhibit greater persistency and lower volatility than stock prices (see our earlier discussion in Section 2).[16] We turn now to analyze the degree to which real estate and stock prices are correlated

[9] The test statistics correspond to specifications with time trend. Except for the Kwiatkowski–Phillips–Schmidt–Shin test, the null hypothesis is non-stationarity. The rejection of stationarity under the Kwiatkowski–Phillips–Schmidt–Shin test is reported as a non-rejection of the unit root.

[10] Faruqee and Lee (2008) also find that the Kwiatkowski–Phillips–Schmidt–Shin test tends to not rejecting the null of unit root (88% out of 94 countries from 1960–2003).

[11] The countries available for the panel unit-root tests include 19 OECD and 6 Non-OECD: Australia, Austria, Belgium, Bulgaria, Canada, Denmark, Finland, France, Germany, Indonesia, Ireland, Italy, Japan, Korea, Malta, The Netherlands, New Zealand, Norway, Singapore, Sweden, Switzerland, Taiwan, Thailand, United Kingdom, and United States.

[12] See for example the discussion in Enders (2004, pp. 156–230).

[13] At the country level, the correlations between the residential and the office real estate markets are positive in seven out of the eight countries, six of which are above 0.5. The correlations between the residential and the retail real estate markets are positive for seven out of the eight countries, four of which are above 0.5. The correlations between the residential and the industrial real estate markets are positive for all eight countries, four of which are above 0.5.

[14] Let ρ denote the correlation and t the time trend, the approximate convergence rate (b_2) is derived from running the OLS regression of $\rho = a_2 + b_2 t + \omega_2$; where ω_2 is an error term.

[15] In addition, the cross-section and correlations of standard deviation over time suggest global convergence in these indices. See NBER Working Papers No. 13921.

[16] While the stock market wealth may not exceed the real estate (and housing) wealth as a share of national wealth in most countries, stock market wealth is more liquid, traded with relatively low transaction costs, hence more readily convertible to consumption than real estate wealth. This applies especially in countries in which home equity loans are not widely available; as is the case for most countries, except the US. See also Case and Quigley (2008).

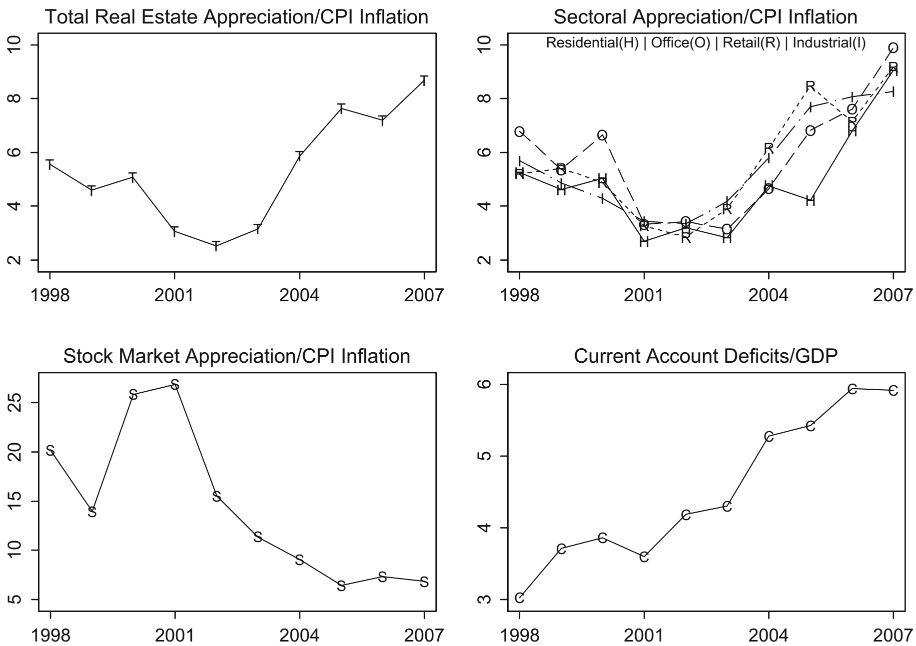

Fig. 1. Patterns of different sectors of real estate markets. This figure depicts cross-country averages of current account deficits/GDP (%), the 'real appreciation of stock markets' = change per year of investable stock market indices/GDP deflator (%; source: MSCI investable), and the 'real appreciation of real estate prices' = change per year of investable real estate prices/CPI inflation (%; source: Investment Property Databank) for four sectors of real estate markets: housing/residential (H), office (O), retail (R), and industrial (I). The sample includes 12 countries with complete time series of these variables over the period of 1998–2007 (10 annual observations).

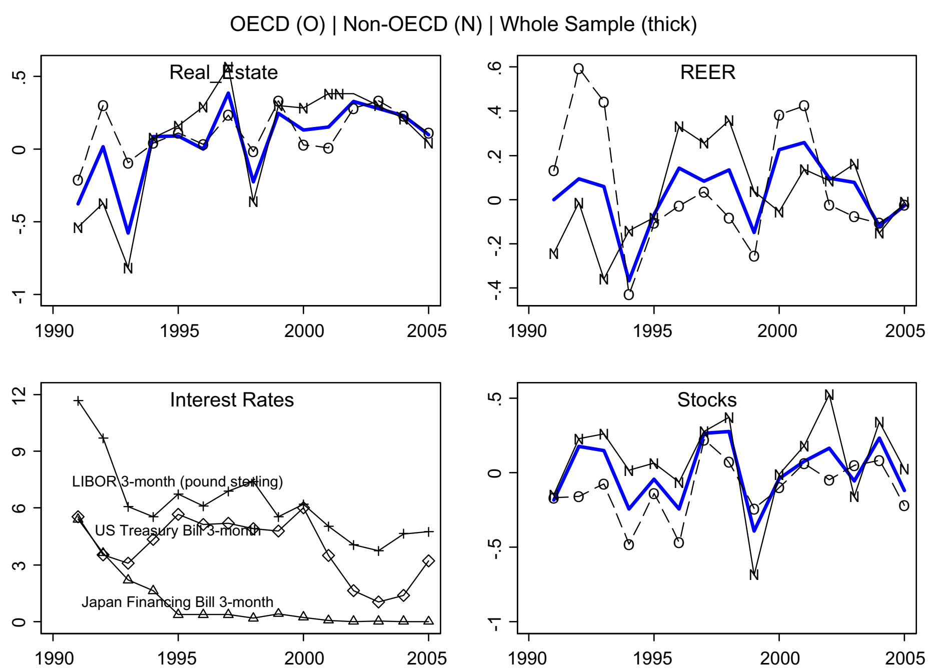

Fig. 2. Contemporaneous correlations with current account deficits/gdp: national indices, annual. This figure depicts the statistical correlations (cross-country average) of each variable with current account deficits/GDP (%). The variables are real exchange rate appreciation (%), the 'real appreciation of real estate prices' = change per year of real estate prices/GDP deflator (%), and the 'real appreciation of stock markets' = change per year of stock market indices/GDP deflator (%). There are 43 countries in the whole sample (thick line), including 25 OECD (connected O) and 18 Non-OECD (connected N). The figure also provides 3-month market interest rates, including the pound-sterling LIBOR (connected x), the US Treasury Bill (connected ◇), and the Japan Financing Bill (connected Δ).

with lagged current account/GDP.[17] We check the cross-correlograms of each series with the current account deficits/GDP using the national and investable real estate indices, respectively. Using the national real estate indices, Table 3 reveals a significant association between the lags/leads of the current account deficits/GDP and the real estate/(GDP deflator) appreciation (column 1), and a much weaker association between the current account deficits/GDP and the stock market/(GDP deflator) appreciation (column 3). Note that this simple correlation shows a rather strong negative correlation (around −.15)

[17] The much lower transaction costs of trading equities relative to real estate suggests that pricing of equities is more forward looking than that of real estate, hence one expects a higher correlation between lagged current account/GDP and real estate valuation.

Table 3
Cross-correlograms with Current Account Deficits/GDP: National Indices, Annual. This table provides for each country and variable the cross correlograms with current account deficits/GDP. The variables are real exchange rate appreciation (%), the 'real appreciation of real estate prices = change per year of real estate prices/GDP deflator (%), and the 'real appreciation of stock markets' = change per year of stock market indices/GDP deflator (%). The 12 countries included have complete time series of these variables over the period of 1990–2005 (16 annual observations): AUS, AUT, CAN, CHE, DEU, FRA, GBR, JPN, KOR, NLD, NOR, and USA.

	Real Estate/GDP Deflator Appreciation	Real Exchange Rates Appreciation	Stock Market/ GDP Deflator Appreciation
Average correlation with Current Account Deficits/GDP			
Lags/leads (years)			
−4	−.10	.03	.00
−3	−.10	.06	−.02
−2	−.14	.08	−.04
−1	−.18	.09	−.09
0	−.16	.08	−.13
1	−.07	.09	−.10
2	.04	.11	−.04
3	.09	.17	.02
4	.10	.18	.00
OLS on #lags/leads			
Coefficient estimate	.03	.02	.00
Standard deviation	.01***	.01**	.01
R-square	.14	.06	.00
Observations	108	108	108
Countries	12	12	12

Robust standard errors, with ∗∗∗, ∗∗, and ∗ signify 1, 5, and 10 level of significance.

between lagged current account deficits and contemporaneous real estate appreciation (column 2). However, the correlation is only a cross-correlogram for bivariate time series.

Our hypothesis – and indeed the results of the multivariate analysis in the following section – is that the correlation is positive once the influence of other controls is taken into account. In addition, the correlation between the current account deficits/GDP and real exchange rates that is found to be tenuous in high-frequency data, but more robust in low-frequency data (see Krugman, 1991, 2007), also characterizes the present sample. At the annual frequency and country level, we also find that the current account/ GDP deficit is a good leading indicator of real estate markets for France, the UK, Japan, South Korea, The Netherlands, and the US. On the other hand, we find no statistical association between the lags/leads of the current account deficits and the stock markets/ (GDP deflator) appreciation.[18] We also examine the degree to which current account deficits/GDP is a good leading indicator of the real estate and equity prices in several cities, including Bangkok, Hong Kong, Kuala Lumpur, and the UK. Using the city-level data of investable real estate indices at a quarterly frequency, we find that the current account tends to forecast the real estate prices better than the stock prices.[19]

4. Estimation and results

Further insight regarding the association between the current account deficits/GDP and the real estate/(GDP deflator) appreciation is gained by applying a battery of panel regressions, controlling for relevant macroeconomic variables. The previous sections suggest that the current account deficits are contemporaneously correlated with the real appreciation of real estate prices across countries. However, the real estate markets are more likely to adjust along with the current account deficits with lags. This is also true for the effects of other macroeconomic variables that we consider, including Urban Population Growth, Capita GDP Growth, Inflation, Financial Depth, Institution, and Real Interest Rates.[20]

4.1. Lags, trends and transformations

To account for the lagged effects and also for the non-stationarity of these macro time series, we make the following variable transformation. First, we include in the panel estimation the lagged values of the Current Account Deficits/GDP and other macroeconomic variables. The current account variable enters the panel regressions with a maximum of five lags, and other macro variables with one lag. While the choice of five lags is arbitrary, we test and report the results using other lag specifications. Later, we also supplement the benchmark estimation with additional results using the average and the cumulative change of the variables, though the results are not directly comparable to the panel regressions using annual data because the cross-section regressions do not take into account the lag structure and short- to medium-run dynamics.

Second, we note that trend and non-stationarity not only characterize the Real Estate/(GDP deflator) appreciation and the Current Account Deficits/GDP reported in Table 1, but also apply to other macro time series in the sample. The trends in these series can contain both stochastic and deterministic components: differencing can remove the former, and detrending can remove the latter. As we have seen with the current accounts and the real estate series the results of different individual and panel unit root tests on them tend to be inconclusive. In the sample, the maximum length of time series available is sixteen years (1990–2005): the standard Box–Jenkins methodology recommends differencing as the form of the trend may not be essential for short-term forecasts, but the form of the trend becomes more important as the forecast horizon expands. Yet, some series may have a deterministic trend, a stochastic trend and a stationary component (trend plus noise series). For our baseline estimation, we adopt a parsimonious approach to these macroeconomic variables to make sure that they are stationary. For Real Estate/(GDP deflator) appreciation, Urban Population Growth, Capita GDP Growth, Real Interest, we use their first difference; for Financial Depth, Institution, Current Account Deficits/ GDP, we use their change. As our focus is on short to medium-run fluctuations rather than the equilibrium long-term trends, we linearly de-trend these series. After the transformation, Augmented Dickey–Fuller tests reject the null of unit root with trend in the resultant series. We also provide estimation results using other variable transformations. These include a sign-preserving de-trended current account series (to take into account the persistent trend feature of the current accounts) and non-transformed series (of which the estimates are not consistent and the statistical inference do not hold). After constructing the lags and transforming the macroeconomic variables, we have 354 observations and 41 countries available for the panel estimation.

[18] We run the OLS of the cross-correlograms between each variable and the CA Deficits/GDP, and report the coefficient estimates in the bottom panel of Table 3.

[19] The coefficient estimates from the OLS of the cross-correlograms between the current account deficits/GDP and real estate/(GDP deflator) appreciation on the lags/ leads are statistically significant and larger, with lower standard deviation than those of the correlograms between the current account deficits/GDP and the stock markets/ (GDP deflator) appreciation.

[20] Another relevant variable, but beyond the scope of this paper, is the government regulation on real estate markets. The importance of this variable is highlighted in the case of China, where the published real estate indices tend to understate the underlying trends in major Chinese cities. Zheng and Kahn (2008) find that in Beijing, while the land prices and real estate prices decline with distance from the city center, the residential building heights and housing unit sizes do not, indicating some binding urban planning policies that do not reflect market forces.

4.2. Baseline specification

We apply the dynamic equation, with the Real Estate/(GDP deflator) Appreciation as the dependent variable ($y_{i,t}$; % change per year).

$$y_{i,t} = \alpha y_{i,t-1} + \gamma' x_{i,t-1} + \beta'(L) z_{i,t-1} + \theta'[x_{i,t-1} \times z_{i,t-i}] + \lambda_t + \eta_i + \upsilon_{i,t} \quad (1)$$

where x is a set of main explanatory variables, including Urban Population Growth, Capita GDP Growth, Inflation, Financial Depth, Institution, Real Interest rate; z is a vector of past Current Account Deficits/GDP; $\beta(L)$ a vector of polynomials in the lag operator; λ_t a time effect common to all countries; η_i a permanent but unobservable country-specific effect; $\upsilon_{i,t}$ an error term.[21] Table 4 reports the benchmark results. The 'Dynamic Panel' regressions [Eq. (2)] are in columns 1–5 using Arellano and Bonds (1991) GMM estimators. The 'Fixed Effects' regressions using the least squares dummy variable (LSDV) estimation are in columns 6 and 7. The pooled OLS are in column 8.

Across the econometric specifications, the lagged Real Estate/(GDP deflator) appreciation is negatively associated with its current value. The lagged Urban Population Growth and the lagged Capital GDP Growth are positively associated with the appreciation of real estate prices. A higher lagged Inflation is associated with a lower Real Estate/(GDP deflator) appreciation in the next period. The effects of the Financial Depth and the lagged Institution are statistically insignificant. The effect of the lagged real interest rates is significant with the expected sign: the higher the cost of borrowing, the lower the appreciation of real estate prices. Most significantly, we find that the lagged Current Account Deficits/GDP is positively associated with the appreciation of real estate prices across the specifications. The effects are stronger for the lags 1–3 according to the benchmark dynamic panel specification. Based on the fixed-effects and the OLS estimation, the positive effects of the Current Account Deficits/GDP on the Real Estate/(GDP deflator) appreciation persist five years, and are statistically significant. For the interaction between the current account and other key macro variables, we find that the effects of the current account deficits are magnified by the level of inflation and financial depth. We noted that inflation itself has a negative effect, but a combination of inflation and current account deficits adds a further small impact in the real estate appreciation. As inflation varies by a couple of percent (its standard deviation is 2.12), this has a negligible impact relative to the direct current account effect. A deeper Financial Depth in itself has no statistical association with the real estate prices, but it increases the effects of the current account deficits on the real estate market appreciation. The interaction between the CA Deficits/GDP and the Institution is negative and significant. The effects of the current account deficits on the real estate appreciation tend to be smaller in a country with a better quality of institution. Overall, the results are consistent across the benchmark and alternative specifications. Our estimation explains around 70% of the variation in the real estate/(GDP deflator) appreciation across countries.

We use the present panel methodology to examine several important issues. Column I of Table 5 compares the conditional correlations between the real exchange rates-the current accounts with that between the real estate appreciations-the current accounts. This is done by applying a version of Eq. (1), replacing the real estate appreciation with the real exchange rates as the dependent variable. The real exchange rate appreciation is significant but weakly associated with the current account deficits at the 3–5 year lags, while it is significant and strongly associated with the current account deficits at the 1–3 year lags in the case of the real estate appreciation (Table 4). We then compare the association between the current accounts-the real estate prices with the association between the current accounts-the stock prices. Column II of Table 5 reports the results of replacing the real estate appreciation with stock market appreciation as the dependent variable in a variant of Eq. (1). Consistent with the findings in previous sections, the relationship is weak; it is negatively significant only at the one year lag. This suggests that, in our sample, a current account signal is fully internalized within one period.[22]

In Column III of Table 5, we verify the possible role of real estate financing patterns, adding the 'loan to value' (LTV) ratio to the explanatory variables, subject to data limitations: the LTV is available only in a cross-section. Of the 43 countries in the sample, the 2000–05 average of LTV ratios ranges from 90% in Estonia to 40 in the Czech Republic. Interacting the LTV ratio with the current account deficits, we find that the positive effects of current account deficits at 2 and 3 year lags remain. The LTV ratio interacted with the current account deficits/GDP turned out to have a positive, but insignificant association with the real estate/(GDP deflator) appreciation.[23] Note that a pair wise correlation between current account deficit and loan-to-value is $-.25$ (statistically significant at 1%). This seems to suggest that the inclusion of loan-to-value as interaction tends to bias downward the coefficient estimate on the current account deficit, which explains why the lagged current account deficit becomes large, negative and insignificant.

Columns IV and V of Table 5 take into account two features of the CA Deficits/GDP patterns. The first feature of the current account is that the sustainability of the imbalances can be related to the country's size.[24] Fig. 3 plots the lagged 3-year cumulative correlations between the Real Estate/(GDP deflator) appreciation and the Current Account Deficits/GDP, against the countries' GDP Size. The observed association is rather weak in the present sample, though excluding large G7 countries uncovers a small and non-linear correlation between the country size and real estate-current accounts appreciation. To account for this size feature, we include the interaction between the Current Account Deficits/GDP and the country's GDP Size as another explanatory variable. Because our estimation period is 1990–2005, we use the GDP Size as the average over the period of 1980–1989. The second feature is the persistence of the current account series:[25] a country can run current account deficits for an extended period, followed by a reversal. To account for this trend pattern, we follow Faruqee and Lee (2008) by de-trending the current accounts with the sign-preserving trend:

$$sgn(CA_{i,t-1}) \times trend;\ sgn(CA_{i,t-1}) = \frac{CA_{i,t-1}}{|CA_{i,t-1}|}. \quad (2)$$

[21] This specification is based on the presumption that real estate appreciation is a function of lagged variables, reflecting the observation that real estate markets are slow to adjust to fundamentals relative to financial markets. Note that the error-correction model would allow for possible reaction of real estate evaluation to current changes in fundamentals (e.g. Capozza et al., 2004). Motivated by the model in Section 2, our empirical specification can be seen as a reduced form, with all contemporaneous variables substituted out.

[22] These results are in line with the view that the price adjustment of equities (assets traded in well organized liquid markets, subject to low trading costs) is faster than that of real estate (less liquid assets, subject to high trading costs).

[23] The availability of panel information on LTV would allow future research to examine in detail the role of monetary policy and capital account openness on real estate markets. For example, in China some real estate developers, facing a tightening credit environment, turn to external financing, including foreign hedge funds which are eager to lend to the Chinese property companies: not only can they charge higher interest rates (25% or more), they also expect to gain from the continuing appreciation of the Chinese Renminbi (Economist, 2008). See Ahearne et al. (2005) for the relationship between house prices and monetary policy in OECD countries.

[24] Aizenman and Sun (2008) find that, with the exception of the US, the length of current account deficit spells is negatively related to the relative size of the countries' GDP.

[25] See Taylor (2002).

Table 4

Benchmark estimation. The dynamic equation for the appreciation of real estate prices ($y_{i,t}$; % change per year of real estate prices/GDP deflator) is $y_{i,t} = \alpha\, y_{i,t-1} + \gamma' x_{i,t-1} + \beta'(L) z_{i,t-1} + \theta'[x_{i,t-1} \times z_{i,t-1}] + \lambda_t + \eta_i + \upsilon_{i,t}$ where x = {Urban Population Growth, Capita GDP Growth, Inflation, Financial Depth, Institution, Real Interest}; z = Current Account Deficits/GDP; $\beta(L)$ a vector of polynomials in the lag operator; λ_t a time effect common to all countries; η_i a permanent but unobservable country-specific effect; $\upsilon_{i,t}$ an error term. The 'Dynamic Panel' regressions (columns 1–5) use Arellano and Bond's (1991) GMM estimators. The 'Fixed Effects' regressions use 'least squares dummy variable' (LSDV) estimation. The variables are corrected for unit root; first-differenced, de-trended). The sample period is 1990–2005. Robust standard errors are in parentheses. $***$, $**$, and $*$ signify 1, 5, and 10 level of significance.

Coefficient estimates of explanatory variables	Lag	Dynamic panel estimation					Fixed effects		Pooled OLS
		5-lag	4-lag	3-lag	2-lag	1-lag	5-lag	3-lag	5-lag
Lagged Real Estate/GDP Deflator Appreciation	1	−.49 (.10)***	−.50 (.10)***	−.50 (.10)***	−.41 (.10)***	−.43 (.10)***	−.60 (.10)***	−.63 (.10)***	−.56 (.13)***
Urban Population Growth	1	2.53 (1.53)*	2.47 (1.53)	2.44 (1.52)	2.43 (1.56)	2.43 (1.55)	1.70 (1.64)	1.65 (1.66)	1.53 (1.23)
Capita GDP Growth	1	.75 (.31)**	.75 (.31)**	.75 (.31)**	.57 (.31)*	.56 (.31)*	.57 (.30)*	.64 (.30)**	.53 (.51)
Inflation	1	−.33 (.04)***	−.33 (.04)***	−.34 (.04)***	−.31 (.04)***	−.31 (.04)***	−.21 (.04)***	−.24 (.04)***	−.18 (.07)**
Financial Depth	1	−4.90 (7.35)	−4.59 (7.34)	−4.52 (7.33)	−6.56 (7.49)	−7.10 (7.41)	4.87 (7.04)	4.35 (7.08)	2.75 (9.45)
Institution	1	−15.62 (11.24)	−14.53 (11.17)	−14.25 (11.15)	−16.40 (11.41)	−17.04 (11.30)	−16.58 (9.36)*	−13.69 (9.33)	−16.59 (12.03)
Real Interest	1	−2.65 (.22)***	−2.64 (.22)***	−2.63 (.22)***	−2.62 (.23)***	−2.55 (.22)***	−1.75 (.23)***	−1.80 (.23)***	−1.77 (.75)**
CA Deficits	1	1.02 (.28)***	.98 (.28)***	.94 (.27)***	.77 (.27)***	.81 (.27)***	.85 (.24)***	.76 (.24)***	.77 (.37)**
	2	.57 (.16)***	.49 (.14)***	.45 (.13)***	.23 (.13)*		−.10 (.16)	−.18 (.16)	−.05 (.24)
	3	.64 (.15)***	.56 (.13)***	.52 (.12)***		.59 (.12)***	.44 (.11)***	.63 (.25)**	
	4	.18 (.14)	.09 (.12)			.33 (.13)**		.38 (.15)**	
	5	.14 (.14)				.22 (.13)*		.27 (.12)**	
Inflation $*$ CA Deficits	1	.01 (.00)***	.01 (.00)***	.01 (.00)***	.01 (.00)***	.01 (.00)***	.04 (.00)***	.03 (.00)***	.04 (.01)***
Financial Depth $*$ CA Deficits	1	12.76 (2.67)***	13.18 (2.63)***	13.21 (2.63)***	12.25 (2.69)***	14.03 (2.47)***	42.46 (5.47)***	39.03 (5.33)***	43.02 (16.37)***
Institution $*$ CA Deficits	1	−8.52 (3.10)***	−8.85 (3.08)***	−8.86 (3.08)***	−7.11 (3.13)**	−8.66 (2.98)***	−4.70 (2.80)*	−5.78 (2.78)**	−4.37 (2.95)
p-Value/R-square		.00	.00	.00	.00	.00	.73	.72	.74
Observations		354	354	354	354	354	354	354	354
Countries		41	41	41	41	41	41	41	41

Table 5

Additional results. The dynamic equation for the appreciation of real estate prices ($y_{i,t}$; % change per year of real estate prices/GDP deflator) is $y_{i,t} = \alpha\, y_{i,t-1} + \gamma' x_{i,t-1} + \beta'(L) z_{i,t-1} + \theta'[x_{i,t-1} \times z_{i,t-1}] + \lambda_t + \eta_i + \upsilon_{i,t}$ where x = {Urban Population Growth, Capita GDP Growth, Inflation, Financial Depth, Institution, Real Interest}; z = Current Account Deficits/GDP; $\beta(L)$ a vector of polynomials in the lag operator; λ_t a time effect common to all countries; η_i a permanent but unobservable country-specific effect; $\upsilon_{i,t}$ an error term. Note that in the first and second columns, we replace the appreciation of real estate prices with the appreciation of real exchange rates ($y_{i,t}$; %) and the appreciation of stock markets ($y_{i,t}$; % change per year of stock indices/GDP deflator), respectively. Countries may run current account deficits/surpluses for an extended period, followed by a brief reversal. To account for this trend pattern, the current accounts can be de-trended using the sign-preserving trend: $sgn(CA_{i,t-1}) \times trend; sgn(CA_{i,t-1}) = \frac{CA_{i,t-1}}{|CA_{i,t-1}|}$. The GDP Size is the average over 1980–1989. All regressions use Arellano and Bond's (1991) GMM estimators. The variables are corrected for unit root; first-differenced, de-trended). The sample period is 1990–2005. Robust standard errors are in parentheses. $***$, $**$, and $*$ signify 1, 5, and 10 level of significance.

Coefficient estimates of explanatory variables	Lag	Replacing real estate appreciation with		Adding interaction with loan-to-value (III)	GDP size interactions		Sign-preserving trend by country group		No variable transformation
		Real exchange (I)	Stock prices (II)		Normal trend (IV)	Sign-preserving trend rate (V)	OECD (VI)	Non-OECD (VII)	
Lagged real estate/GDP deflator appreciation	1	−.47(.05)***	−.32(.05)***	−.49 (.10)***	−.48(.10)***	−.49(.10)***	−.87 (.26)***	−.66 (.17)***	.03 (.02)
Urban Population Growth	1	−.03(.92)	11.77(3.69)***	2.52 (1.52)*	2.55 (1.54)*	2.32 (1.52)	.26 (3.40)	1.03 (2.34)	.03(1.06)
Capita GDP Growth	1	−.08 (.20)	−.46 (.78)	.74 (.31)**	.70 (.31)**	.63 (.31)**	−.10 (.21)	.53 (.60)	1.10 (.19)***
Inflation	1	−.18 (.24)	.21 (.21)	−.33 (.04)***	−.33 (.04)***	−.33 (.04)***	−2.86 (1.68)*	−.29 (.06)***	−.04 (.06)
Financial Depth	1	−5.25 (4.35)	−1.38 (16.72)	−4.94 (7.33)	−4.34 (7.38)	−4.04 (7.32)	−3.22 (18.68)	−36.62 (33.34)	.06 (.04)
Institution	1	10.57 (6.66)	−20.83 (30.70)	−14.53 (11.29)	−15.38 (11.29)	−13.08 (11.20)	−25.80 (23.90)	−14.81 (17.65)	−3.96 (1.37)***
Real Interest	1	−.30 (.31)	1.14 (.67)*	−2.66 (.22)***	−2.64 (.22)***	−2.63 (.22)***	−2.56 (1.38)*	−1.80 (.37)***	.70 (.12)***
CA Deficits/GDP	1	.03 (.17)	−1.40 (.66)**	−2.12 (3.23)	1.43 (.42)***	1.83 (.48)***	−.11 (.18)	6.23 (1.32)***	−1.03 (.94)
	2	−.12 (.15)	−.17 (.48)	.56 (.16)***	.65 (.21)***	.48 (.20)**	.18 (.07)***	−.33 (.24)	−.54 (.19)***
	3	−.21 (.11)*	−.17 (.34)	.63 (.15)***	.79 (.18)***	.78 (.19)***	.19 (.12)	.62 (.19)***	.21 (.20)
	4	−.36 (.09)***	−.08 (.35)	.16 (.14)	.27 (.17)	.28 (.18)	.05 (.13)	.22 (.18)	−.26 (.20)
	5	−.32 (.08)***	.25 (.34)	.13 (.14)	.20 (.17)	.24 (.19)	−.03 (.19)		
Inflation $*$ CA Deficits	1	−.01 (.05)	.04 (.06)	.01 (.00)***	.01 (.00)***	.01 (.00)***	.09 (.22)	.03 (.01)***	.07 (.02)***
Financial Depth $*$ CA Deficits	1	1.40 (4.44)	−9.34 (13.24)	12.69 (2.67)***	13.77 (2.83)***	15.33 (2.80)***	−1.71 (12.94)	41.34 (7.03)***	.00 (.00)
Institution $*$ CA Deficits	1	.73 (1.87)	11.55 (8.90)	−9.19 (3.16)***	−8.50 (3.13)***	−7.73 (3.12)**	20.36 (11.10)*	−14.11 (5.32)***	.09 (.18)
Loan to Value $*$ CA Deficits	1			.05 (.05)					
GDP Size $*$ CA Deficits	1				−.36 (.24)	−.68 (.34)**			
	2				−.17 (.19)	−.13 (.26)			
	3				−.29 (.19)	−.38 (.26)			
	4				−.16 (.21)	−.20 (.32)			
	5				−.10 (.22)	−.15 (.33)			
p-Value/R-square		.00	.00	.00	.00	.00	.00	.00	.00
Observations		341	343	354	354	354	242	112	354
Countries		40	41	41	41	41	24	17	41

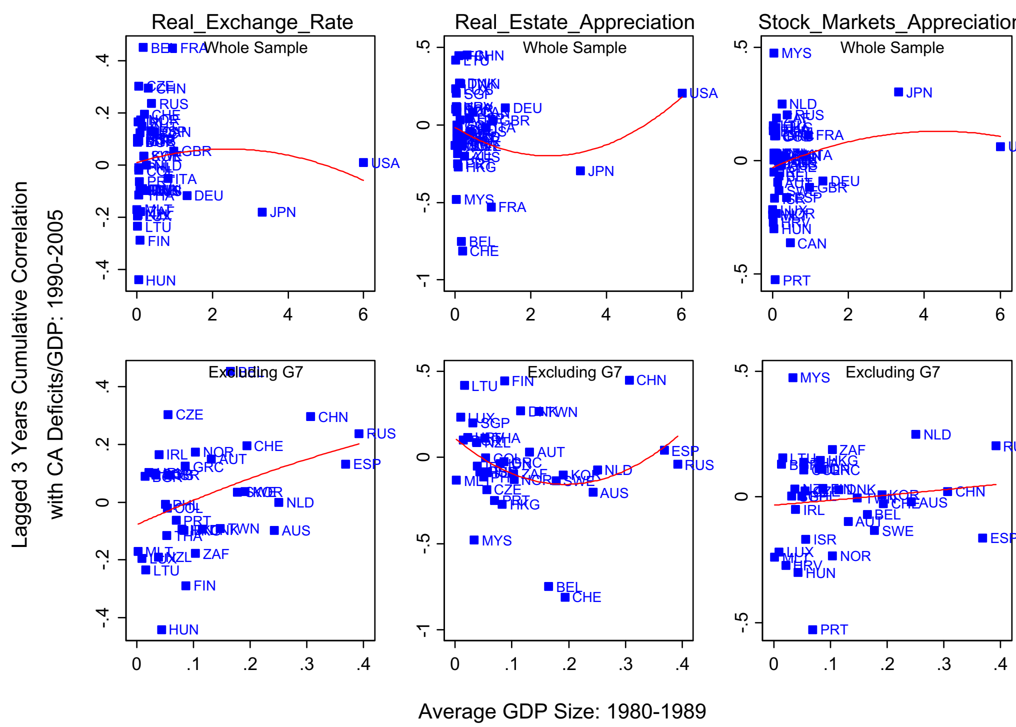

Fig. 3. Average GDP size and lagged 3 years cumulative correlation with current account deficits/GDP. This figure plots for each country on the horizontal axis the GDP Size (constant year-2000 trillion US$), averaged over the period 1980–1989, against the correlations between the variable and the lagged current account deficits during 1990–2005. The correlations are cumulative over previous 3 years. The variables are real exchange rate appreciation (%), the 'real appreciation of real estate prices' = change per year of real estate prices/GDP deflator (%), and the 'real appreciation of stock markets' = change per year of stock market indices/GDP deflator (%). The top panel plots the whole sample, whereas the bottom panel excludes Canada, US, Japan, Germany, U.K., France, and Italy. Excluding G7 countries, R^2 from a regression of each variable on the GDP size and (GDP size)^2 is 0.16 for the real exchange rate; 0.09 for the real estate appreciation; 0.01 for the stock markets appreciation.

Including the GDP Size interactions of five lags, for both the normal de-trended and the sign-preserving de-trended current account series, we find that the main results continue to hold. Using the sign-preserving de-trended current account series, we can see that the current account deficits are positively associated with the real estate appreciation, the effects which increase (via interaction) with the rate of inflation, the level of financial depth, and the lower quality of institution.[26] The size of the coefficient estimates on the five lags of the current account deficits are also similar to those obtained using the normal de-trended current account series in Table 4. The country-size effects are negative at all lags, but only statistically significant at one year lag in the regression using the sign-preserving de-trended current account series.

4.3. OECD versus non-OECD

We report in columns VI and VII of Table 5 the estimation of Table 4 separately for OECD and non-OECD countries. The impact of current account deficits on real estate appreciation is stronger and faster for the non-OECD. Additional effect from the interaction of current account deficits with inflation is significant only for the non-OECD countries. Interestingly, while the interaction between the current account deficits and financial depth is positively associated with real estate appreciation in non-OECD, the association is positive and insignificant for the OECD. Further, the interaction between the current account deficits and quality of institution is negatively associated with real estate appreciation in non-OECD, whereas the association is positive for the OECD. Together, these results highlight that one of the channels that make real estate markets in the non-OECD countries more vulnerable to capital flows is through the deepening of their financial system and the quality of institution.

Table 6 checks the sensitivity of the estimation with respect to the choices of real estate variables. We re-estimate the main regressions in Table 4, for different types of real estate markets, using the investable indices of twelve countries. While this sample is smaller, it is more balanced than the one in Table 4, enabling us to include more lags for the real estate indices and the LTV interactions.[27] We find that inflation and real interest rates are still negatively associated with the real estate markets. The results indicate that current account deficits/GDP have positive effects on the real appreciation of office, retail, and industrial markets with the one-year lag, and the residential/housing market with the two-year lag. We also find that a higher LTV mitigates the real estate appreciation associated with higher current account/GDP deficit. While statistically significant, this effect is very small – mitigating about 1.5% of the induced real appreciation. Note that the important characteristic is that the "national" indices apply to (owner-occupied) housing, whereas the "investable" apply to commercial real estate, mostly office and retail properties. Since foreigners do not directly buy into housing, one would expect the direct link from current account to house prices to be absent, and the total effect to be weaker for this index. Our estimated lagged effects of current account deficits on the housing/residential indices are supportive to the increasing correlations of the owner-occupied housing and commercial real estate markets (see Gyourko, 2009).

[26] These results are consistent with the possibility discussed in the model [see the Appendix], where the housing risk premium is impacted by interaction among various factors.

[27] Due to the short sample length of the investable indices, we include only two lags of the current account deficits to preserve the degree of freedom; nevertheless lags 3 to 5 are statistically insignificant once included in the estimation.

Table 6
Using investable indices by types of real estate markets. The dynamic equation for the appreciation of real estate prices ($y_{i,t}$; % change per year of real estate prices/GDP deflator) is $y_{i,t} = \alpha y_{i,t-1} + \gamma' x_{i,t-1} + \beta'(L) z_{i,t-1} + \theta'[x_{i,t-1} \times z_{i,t-1}] + \lambda_t + \eta_i + \upsilon_{i,t}$ where x = {Urban Population Growth, Capita GDP Growth, Inflation, Financial Depth, Institution, Real Interest, Loan to Value}; z = Current Account Deficits/GDP; $\beta(L)$ a vector of polynomials in the lag operator; λ_t a time effect common to all countries; η_i a permanent but unobservable country-specific effect; $\upsilon_{i,t}$ an error term. Loan to Value is available as a cross-section approximate and enters as an interaction term. The estimation uses Arellano and Bond's (1991) dynamic panel GMM estimators. The variables are corrected for unit root; first-differenced, de-trended). The sample period is 1995–2007, covering twelve countries with investable indices compiled by the Investment Property Databank (IPD). Robust standard errors are in parentheses. ∗∗∗, ∗∗, and ∗ signify 1, 5, and 10 level of significance.

Coefficient estimates of explanatory variables	Lag	Dynamic panel estimation using investable indices by types of real estate markets				
		Total	Residential/housing	Office	Retail	Industrials
Lagged real estate/GDP deflator appreciation	1	−.15 (.09)	.02 (.14)	−.00 (.07)	−.37 (.13)***	−.23 (.10)**
	2	−.21 (.09)**	.03 (.12)	−.23 (.07)***	−.21 (.15)	−.11 (.09)
Urban Population Growth	1	−.27 (.88)	9.42 (4.07)**	.30 (1.01)	−.72 (1.01)	−.21 (.84)
Capita GDP Growth	1	.46 (.27)*	1.12 (.33)***	.75 (.31)**	.42 (.31)	.38 (.25)
Inflation	1	−1.13 (.46)**	−1.09 (.59)*	−.81 (.50)	−1.41 (.56)**	−1.48 (.45)***
Financial Depth	1	−4.35 (3.05)	−9.31 (4.08)**	−12.42 (3.33)***	−3.99 (3.34)	−8.03 (2.82)***
Institution	1	14.47 (10.30)	23.29 (19.36)	6.05 (11.76)	20.84 (11.87)*	3.95 (11.07)
Real Interest	1	−.65 (.38)*	−.34 (.53)	−.46 (.41)	−.88 (.46)*	−.70 (.37)*
CA Deficits/GDP	1	5.28 (1.78)***	−2.51 (2.66)	7.64 (1.99)***	5.92 (2.32)**	3.06 (1.68)*
	2	−2.66 (2.53)	7.35 (2.65)***	4.68 (2.82)*	−5.07 (2.84)*	−1.49 (2.38)
Inflation ∗ CA Deficits	1	−.36 (.15)**	−.24 (.24)	−.27 (.18)	−.32 (.18)*	−.16 (.15)
Financial Depth ∗ CA Deficits	1	−2.84 (3.78)	−11.27 (5.96)*	2.53 (4.24)	−1.39 (4.35)	−3.27 (3.66)
Institution ∗ CA Deficits	1	.84 (1.89)	6.08 (6.81)	1.25 (2.18)	.28 (2.23)	2.96 (2.01)
Loan to Value ∗ CA Deficits	1	−.08 (.03)***	.03 (.04)	−.11 (.03)***	−.09 (.03)***	−.05 (.02)*
	2	.04 (.04)	−.11 (.04)***	−.07 (.04)	.08 (.04)*	.02 (.04)
p-Value		.00	.00	.00	.00	.00
Observations		61	38	62	61	60
Countries		12	8	12	12	12

4.4. Robustness

We also run the regressions with other econometric specifications. First, we split the movements of real estate prices into the appreciation and the depreciation, then apply the panel Tobit estimation. We find that the positive effects of the current account deficits/GDP on the real estate prices are more significant for the appreciation or boom period. We also run a dynamic panel estimation using the average and the cumulative change of the explanatory variables. Because these cross-section regressions ignore the short- to medium-run dynamics and the lag structure of the current account deficits, they are not directly comparable to the benchmark estimation using annual data in Table 4. Nevertheless, using the average and the cumulative change of the explanatory variables, we find that the effects of Inflation and Real Interest Rates remain, as well as the positive effects of the interaction of Inflation and Financial Depth with the Current Account Deficits/GDP.

As the model of Table 4 has only predetermined explanatory variables, simultaneity is not an issue. The model could either be seen as a structural model (in line with our focus on the lagged price adjustment in real estate valuation), or it could be seen as a reduced form, where the contemporaneous interaction has been substituted away. Nonetheless, it may be useful to allow for simultaneous dependence; in other structural models the causality between real estate valuation and the current account could operate in both ways. To illustrate, an exogenous increase in the availability of international capital may increase the demand for real estate assets in a capital-recipient country, leading to a real estate appreciation there. Alternatively, the permanent income hypothesis and the present value model of the current accounts predicts that a real estate boom that increases households' perceived wealth may lead consumers to increase their consumption and thus generates current account deficits. In both cases, we may observe a positive correlation between the real estate appreciation and the current account deficits. Furthermore, although real estate may be viewed as an asset class that can be the target of international investment (thus having the characteristics of tradables), the dominant portion of real estate remains nontradable. This provides a conceptual affinity to the analysis of nontradable prices in the present value model of the current account (e.g. Bergin and Sheffrin, 2000).

To sort out these possibilities, we also produce three additional sets of evidence. First, we check the results of reversing the baseline specification (reported earlier in Table 4), using the current account deficits as the dependent variable and the real estate/(GDP Deflator) appreciation and its lags as explanatory variables. We find that the case for "reverse causality," from real estate prices to current account deficits, is not supported in the present panel sample. We then apply another approach, using the simultaneous-equations and instrumental-variables estimation. We include the real exchange rate and the percentage of population older than 65 years as additional instruments for the current account deficit/GDP.[28] Based on the three-stage estimation (3SLS), the effect of current account deficits on the real estate appreciation is positive and significant, but not the other way around. Finally, we use the Granger causality tests on the quarterly data of current account deficits and various real estate indices in the US and the UK. Using this relatively long and high frequency data, we find that the causality can indeed run in both directions, varying across locations and types of national real estate markets. In the UK, the causality tests suggest two way feedbacks between the current account deficits and the real estate appreciation for all types of real estate returns and market sectors. The US findings may be a case of a large real estate market in a large country, "driving" the business cycles.[29] While the composite indices (both the NCREIF and the Case and Shiller data) display reverse causality from the real estate appreciation, there are differences at the regional level. The current account deficits/GDP "drives" the real estate markets in the Midwest, whereas the real estate/(GDP deflator) appreciation in the West "drives" the US current account deficits.[30] One possible explanation is that the West

[28] See Lee and Chinn (2006) for the structural relationship between real exchange rates and the current account, and Campbell and Joao (2007) for the relationship between house prices, age structure, and consumption.

[29] See Leamer (2007).

[30] It is important to note, however, that in intertemporal models with forward looking-agents, Granger causality will typically not be informative of true causal structure. Two-way Granger causality, however, does suggest some important bivariate interdependencies [see Hoover and Sheffrin (1992)].

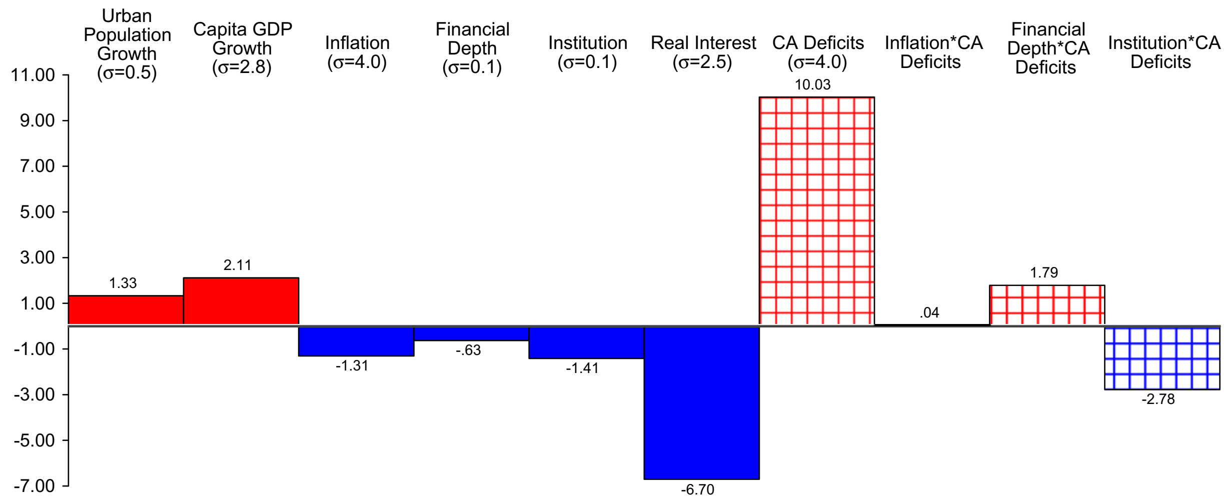

Fig. 4. Real estate/GDP deflator appreciation and macroeconomic variables.Based on the 'Dynamic Panel' estimation with lagged 5 years (Table 4, first column). Each bar represents the estimated response of the appreciation of real estate prices ($y_{i,t}$; % change per year of real estate prices/GDP deflator), calculated for each macroeconomic variable ($x_{i,t}$; $z_{i,t}$) by multiplying a 1-standard deviation increase (σ) of the variable with its coefficient estimate (γ, β, θ). For instance, a 10.03% CA Deficits shock is the outcome of (a one s.d. of CA Deficits = 4.0) × (coefficients of its lags) = 4.0 × (1.02 + 0.57 + 0.64 + 0.18 + 0.14) ≈ 10%. For the economic significance of the interaction between Financial Depth * CA Deficits: (one s.d. of Financial Depth ∗ CA Deficits = .14) × 12.76 (its coefficient estimate) = .14 * 12.76 ≈ 1.79%. The sample comprises 41 countries from 1990 to 2005. The dynamic equation for the appreciation of real estate prices ($y_{i,t}$) is $y_{i,t} = \alpha y_{i,t-1} + \gamma' x_{i,t-1} + \beta'(L) z_{i,t-1} + \theta'[x_{i,t-1} \times z_{i,t-1}] + \lambda_t + \eta_i + \upsilon_{i,t}$ where x = {Urban Population Growth, Capita GDP Growth, Inflation, Financial Depth, Institution, Real Interest}; z = Current Account Deficits/GDP; $\beta(L)$ a vector of polynomials in the lag operator; λ_t a time effect common to all countries; η_i a permanent but unobservable country-specific effect; $\upsilon_{i,t}$ an error term. All variables are stationary (no unit root; first-differenced and detrended).

is the place where price/rental ratio exhibits more fluctuations and is more subject to speculative bubbles. To the extent that it does, this finding might suggest that increased perceived wealth drives up prices and also drives up consumption and current account deficit.

Having done extensive robustness checks, we now summarize the key factors accounting for real estate/(GDP deflator) variation in our sample by reporting the economic significance of the explanatory variables in our benchmark regression (Table 4, column 1). This is done in Fig. 4, reporting the association between a one standard deviation change in each of the conditioning variables and the real estate/(GDP deflator). The estimated response of the appreciation of real estate prices ($y_{i,t}$; % change per year of real estate prices/(GDP deflator) in Table 4), are calculated for each macroeconomic variable ($x_{i,t}$; $z_{i,t}$; $x_{i,t-1}$ x$z_{i,t-1}$) by multiplying a one standard deviation increase (σ) of the variable with its estimated coefficient (γ, β, θ). The importance of the various factors accounting for variations of the real estate/(GDP deflator) is gauged in Fig. 4. A one standard deviation increase of the current account deficit (about 4%) is associated with a cumulative real estate/(GDP deflator) appreciation of about 10%.[31] The impact of the current account deficit on the real estate/(GDP deflator) appreciation is further magnified by financial depth (about 1.8%),[32] and mitigated by better quality of institutions (about 2.8%). Intriguingly, the most important factor accounting for the appreciation of the national real estate is a one standard deviation increase of the *current account deficit* (associated with 10% real estate/(GDP deflator) appreciation), exceeding the adjustment to a one standard deviation drop of the *real interest rate* (about 7% appreciation), and a one standard deviation increase of the *GDP/Capita growth* (about 2% appreciation).

[31] The 10% change is the product of a one standard deviation current account shock (4%) times the sum of the coefficients of its lags = 4.0 × (1.02 + 0.57 + 0.64 + 0.18 + 0.14) ≈ 10%.

[32] The 1.8% change is the product of a one standard deviation of (Financial Depth ∗ CA Deficits), [=.14], times its estimated coefficient = 0.14 × 12.76 = .14 ∗ 12.76 ≈ 1.8%.

5. Concluding remarks and interpretations

Our results are consistent with the notion that for all countries, current account deficits are associated with sizable real appreciation of the real estate. This effect holds controlling for the real interest rate, GDP growth, inflation, other conditioning variables, and extensive robustness checks.[33] We also find evidence consistent with growing globalization of national real estate markets. These findings are consistent with various scenarios explaining patterns of capital flows across countries, including differential productivity trends and varying saving patterns. In the absence of pre-existing distortions, financial inflows are unambiguously welfare improving. Yet, in a second-best environment, public finance considerations imply that inflows of capital may magnify distorted activities, thereby increasing the ultimate costs of these distortions. Arguably, the experience of emerging markets in the aftermath of financial liberalizations during the 1990s illustrated these concerns. Needless to say, this second-best assertion is not an argument against financial integration, but a cautionary tale – greater financial globalization implies the need to be more assertive in dealing with moral hazard and other pre-existing domestic distortions.

Appendix. A model

This appendix outlines a model describing economic channels determining the long-run relative price of the housing stock. To simplify, we focus on perfect foresight model, thereby ignoring the stock flow adjustment in the presence of uncertainty. The model considers households maximizing intertemporal additive utility, V, where the temporal utility at time t is the CES aggregator of consuming a traded good, c, and the non-traded housing services, h. To simplify notation, we assume that the temporal utility is a log Cobb–Douglas:

[33] An extended and detailed version of this paper is available as NBER Working Papers No. 13921.

Table A.1
Sources of national real estate prices in 43 countries. The real estate series are taken from the Datastream and the Global Property Guide.

No.	Country	Real estate price indices	Source name
1	Australia	House price index, eight capital cities	Aus Stat
2	Austria	Residential property price index, Vienna	Oesterreichische (Austria) National Bank
3	Belgium	Residential property price index, Flats	Institute National de Statistique
4	Bulgaria	Dwelling: Avg. price per sq. meter	National Statistical Institute of Bulgaria
5	Canada	New housing price index	Canadian Statistics
6	China	Property price index: Bldg: CM: residential	National Bureau of Statistics of China
7	Colombia	New housing price index	Departamento Administrativo National de Estadistica
8	Croatia	New dwellings sold price index: 1995 = 100	Republic of Croatia – Central Bureau of Statistics
9	Czech Republic	Prices of habitable area, multi-dwelling	Cesky Statisticky Urad
10	Denmark	Property price index: one family houses: all Denmark	Statistics Denmark
11	Estonia	Ave. price per sq. meter of dwellings in satisfactory condition, 2 rooms and kitchen, Tallinn	Statistikaamet
12	Finland	Dwellings in old blocks of flat, whole country	StatFin
13	France	Index of prices of old residences, France	Institute National de la Statistique et des Etudes Economiques
14	Germany	Prices of owner-occupied flats	BulweinGesa
15	Greece	Index of prices of dwellings, other urban	Bank of Greece
16	Hong Kong	Property price index: 1999 = 100: Domestic Premise (DP)	差餉物業估價處
17	Hungary	House prices, Budapest – old condominium	Otthon Centrum
18	Indonesia	Residential property price index, new houses, major cities	Bank Indonesia
19	Ireland	Average property price: new	Department of the Environment, Heritage and Local Government
20	Israel	Average prices of owner occupied dwellings	Central Bureau of Statistics
21	Italy	Average price for residential, 13 urban areas	Nomisma Spa Real Estate
22	Japan	Urban land price index: REI: whole nation: average	財団法人 日本不動産研究所
23	Korea	House price index	Kookmin Bank
24	Lithuania	Ave. price of one- to two-room apartments, Vilnius	Invalda Real Estate
25	Luxem burg	Price of habitable surface	STATEC Luxembourg
26	Malaysia	House price index: Malaysia	Valuation and Property Services Department, Ministry of Finance
27	Malta	House price index	Central Bank of Malta
28	The Netherlands	House price index, nationwide	Nederland se Vereniging van Makelaars
29	New Zealand	House price index, detached houses	Reserve Bank of New Zealand
30	Norway	House price index: New Detached: sa	Statistisk Sentralbyra
31	Philippines	Ave. price of prime 3-bedroom condominiums, Makati CBD	Colliers International
32	Portugal	Bank evaluation on housing, mainland	Instituto Nacional de Estatistica de Portugal
33	Russia	Property price index: residential: primary sales (PS): YoY	Federal State Statistics Service (Rosstat)
34	Serbia	Avg. price of dwellings: new construction: Republic of Serbia	Републички Завод за Статистику
35	Singapore	Property price index: private residential (PR): all	Urban Redevelopment Authority
36	South Africa	ABSA house price index	ABSA
37	Spain	Housing price index: free house	Instituto Nacion al de Estadistica
38	Sweden	Real estate price index for 1- and 2-dwelling buildings	Statistics Sweden
39	Switzerland	Real estate price index: single family homes	Swiss National Bank
40	Taiwan	Sinyi residential property price index: Taiwan Area	信義企業集團
41	Thailand	Housing price index: single detached house: including land	ธนาคารอาคารสงเคราะห
42	United Kingdom	House price index: UK	Nationwide
43	United States	House price index: OFHEO: United States	Office of federal housing enterprise oversight

$$V_t = \sum_{j=t}^{\infty} \beta^{s-t}[(1-\alpha)\log c_t + \alpha \log h_t]. \tag{a.1}$$

We use the consumption good as the numeraire, and denote the relative price of a house at time t by $P_{H,t}$. The household rents residential services, paying rental price (or user cost) of R_t. Total expenditure at time t is

$$z_t = c_t + R_t h_t. \tag{a.2}$$

The value of household held bonds at the end of period t is denoted by b_{t+1}; and $r_t b_t$ is the interest income on bonds acquired previously, and y_t is income at time t. The financing constraint is

$$b_{t+1} - b_t = r_t b_t + y_t - c_t - R_t h_t. \tag{a.3}$$

The consumer's first order conditions imply that $\frac{\alpha c_t}{(1-\alpha)h_t} = R_t$. Hence, denoting total expenditure by $z_t = c_t + R_t h_t$, household demand for housing services at time t is[34]

$$h_t = \alpha z_t / R_t. \tag{a.4}$$

The rental market is competitive. A house deprecation rate is δ. The rental market is risky – the representative household may behave opportunistically, failing to pay the rent, inducing a risk premium ϕ. The rents are determined by an arbitrage condition such that the rental income equals the expected income from buying a house at time t, renting it out for a period, and reselling it next period. This leads to the well known condition

$$\begin{aligned} R_t &= P_{H,t} - \frac{(1-\delta)P_{H,t+1}}{1+r_{t+1}+\phi} = P_t \frac{r_{t+1} - \pi^h_{t+1} + \phi + \delta + \pi^h_{t+1}\delta}{1 + r_{t+1} + \phi} \\ &\cong P_{H,t}[r_{t+1} - \pi^h_{t+1} + \phi + \delta], \end{aligned} \tag{a.5}$$

where $\pi^h_{t+1} = (P_{t+1} - P_t)/P_t$. The approximation in (a.5) assumes relatively small risk premium, real interest rate, and intertemporal house's relative price changes. The risk premium can be modeled in ways that recognize agency and moral hazard considerations, implying that the risk premium would depend negatively on household's collateral and wealth, as well as the quality of institutions [see Aghion et al. (2004)].

The supply of houses in the economy is H^s, where $H^s = H^s(P_H); H^{s\prime} > 0$.

[34] The unitary elasticity of the demand with respect to the rental price is the outcome of the Cobb–Douglas assumption. In the general CES specification, this elasticity is determined by the substitutability between the consumption good and housing services.

Table A.2
Sources of investable real estate indices and macroeconomic variables. The time series of the macroeconomic variables cover 1980–2005. WDI = World Development Indicators; IFS = International Financial Statistics. Non-stationary series are first-differenced and de-trended for the panel estimation and VAR.

Variables	Definition	Data source: code	Transformation for estimation
Real estate/GDP deflator appreciation	National: % change per year of real estate, house, and	National sources and government statistics property prices, deflated by GDP deflator	First differenced; de-trended
	Investable: AUS CAN DEU FIN FRA GBR IRL NLD NZL SWE USA ZAF	Investment Property Databank	None, reference
	Investable: Bangkok, Beijing, Hong Kong, Kuala Lumpur, Shanghai, United Kingdom	Jones Lang LaSalle Research	First differenced for VAR
	10 Cities in United States	S&P/Case–Shiller indices	First differenced for VAR
Urban Population Growth	Annual growth (%) of population in the urban areas	WDI: SP.URB.GROW	First differenced; de-trended
Capita GDP Growth	Annual growth (%) of GDP per capita (constant price year 2000 US$)	WDI: NY.GDP.PCAP.KD.ZG	First differenced; de-trended
Inflation	GDP deflator (%)	WDI: NY.GDP.DEFL.KD.ZG	First differenced; de-trended
	CPI inflation (%)	Datastream (quarterly; city level)	
Financial Depth	Domestic credit provided by banking sector (% of GDP)	WDI: FS.AST.DOMS.GD.ZS	Percentage change; de-trended
Institution	Measure of law and order, 0–12 scale (higher = better)	International Country Risk Guide	Percentage change; de-trended
Real Interest	Annual real interest rates (%)	WDI: FR.INR.RINR	First differenced; de-trended
Current Account Deficits/GDP	End of year current account of deficits to GDP (%)	WDI: BN.CAB.XOKA.GD.ZS (annual) Datastream (quarterly)	Percentage change; de-trended
Stock Market/GDP Deflator Appreciation	% change per year of the stock market indices, deflated by GDP deflator	Datastream; WDI	First differenced; de-trended
		MSCI (Investable Indices)	None, reference
Nominal Interest (3-month)	US Treasury Bill Rate Constant Maturity (%)	IFS	None, reference
	Japan Financing Bill Rate (%)	IFS	None, reference
	London Interbank Offer Rates (pound sterling, %)	IFS	None, reference
GDP size	GDP (constant year-2000 trillion US$)	WDI: NY.GDP.MKTP.KD	average: 1980–1989
Real Exchange Rate	Trade-Weighted Real Effective Exchange Rates	WDI: PX.REX.REER (annual) JP Morgan (quarterly)	First differenced; de-trended
Population age above 65 years old	Population ages 65 and above (% of total)	WDI: SP.POP.65UP.TO.ZS	First differenced; de-trended
Loan to value	Estimated average loan-to-value of new mortgage loans	Warnock and Warnock (2008)	None (cross-section)

Assuming an economy populated with N households, the intermediate-run equilibrium condition is (See Tables A.1, A.2)

$$H^s = N\alpha z/R = \frac{N\alpha z}{P[r+\phi+\delta]}, \tag{a.6}$$

where z is the intermediate-run expenditure.[35] Consequently, the intermediate-run relative price of a house is given by

$$\begin{aligned} &P_H = P_H(r+\phi, \delta, N, Y, B); \quad P'_{H,r+\phi} < 0; P'_{H,\delta} < 0; \\ &\quad P'_{H,N} > 0; P'_{H,Y} > 0; P'_{H,B} > 0. \end{aligned} \tag{a.7}$$

where B denotes the net wealth of the economy.[36] Capital inflows [the other side of current account deficits] would impact the real estate valuation via several channels. The first is the financial one – inflow of capital tends to reduce the interest rate (r), and may reduce the cost of risk (the risk premium,ϕ). Capital flows in the form of foreign demand for domestic real estate would increase the demand for housing directly by raising the effective N, biding up P_H.

Suppose that the real interest rate is determined by the sum of domestic and foreign saving (S_d;S_f, respectively) available to the economy, [S_f is also the current account deficit]. Capital inflows or higher domestic saving tend to reduce the real interest rate, though this effect may be subject to diminishing marginal impact. Similarly, one may presume that higher aggregate saving tends to reduce the cost of risk:

$$\begin{aligned} &r = r(S_d + S_f; X); r'_{S_d+S_f} < 0; r''_{S_d+S_f} < 0, \\ &\phi = \phi(S_d + S_f; X); \phi'_{S_d+S_f} < 0; \phi''_{S_d+S_f} < 0 \end{aligned} \tag{a.8}$$

where X is the vector of all the other factors impacting the real interest rate.

These assumptions imply that current account deficits opt to induce real appreciation of domestic real estate. It also suggests the possibility of non-linear interactions, where the impact of inflow of capital on the risk premium and the interest rate would be affected by the quality of institutions, etc.

[35] It is easy to verify that in the case where $(1+\beta)r = 1$, and z is the annuity value of wealth, $z = rW/(1+r)$, where $W$is the sum of the initial asset position and the net present value of income.

[36] The net wealth includes net foreign asset position.

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