REAL ESTATE VALUATION, CURRENT ACCOUNT AND CREDIT GROWTH
PATTERNS, BEFORE AND AFTER THE 2008-9 CRISIS

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ABSTRACT

This paper explores the stability of the key conditioning variables accounting for the real estate valuation before and after the crisis of 2008-9, in a panel of 36 countries, for the period of 2005:I -2012:IV, recognizing the crisis break. Our paper validates the robustness of the association between real estate valuation of lagged current account patterns, both before and after the crisis. The most economically significant variable in accounting for real estate valuation changes turned out to be the lagged real estate valuation appreciation (real estate inflation minus CPI inflation), followed by changes of the current account deficit/GDP, domestic credit/GDP, and equity market valuation appreciation (equity market appreciation minus CPI inflation). The first three effects are economically substantial: a one standard deviation increase in lagged real estate appreciation is associated with a 10 % increase in the present real estate appreciation, much larger than the impact of a one standard deviation increase in the current account deficit (5%) and of the domestic credit/GDP growth (3%). Thus, the results are supportive of both current account and credit growth channels, with the animal-spirits and momentum channels playing the most important role in the boom and bust of real estate valuation.

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1. Introduction and overview

The global crisis of 2008-9 sparked a vibrant debate on the factors contributing to the crisis. Were global imbalances or excessive credit growth the key suspects? Contributors to the debate include Borio and Disyatat (2011), conjecturing that the main causing factor to the financial crisis was not "excess saving" but the "excess elasticity" of the international monetary and financial system; and Obstfeld (2012:20), noting that "The balance sheet mismatches of leveraged entities provide the most direct indicators of potential instability, much more so than do global imbalances, though the imbalances may well be a symptom that deeper financial threats are gathering." Against this background, we revisit these questions in the context of the real estate market. The macro importance of the real estate market is well appreciated by now. A prime example of it has been the U.S., where Leamer (2007)'s title succinctly summarized it: "Housing is the business cycle."

A priori, one expects that both the current account and credit growth trends would impact the valuation of national real estates. A primary link between real estate valuation and the current account deficit follows from national accounting and the absorption approach. Growing current account deficits is a signal of a growing gap between the spending of domestic residents [absorption] and their output. As long as the demand for key non-traded durable assets, like real estate, is positively correlated with absorption, one expects higher current account deficits to be associated with higher real estate valuation. Yet, as most households co-finance the purchase of their dwelling thorough the banking system, greater financial depth and accelerated growth rate of credit tend to increase the demand for houses, probably increasing the real estate valuation.

Thus, one expects that both current account and credit trends matter for the valuation of real estate, and a priori there is no obvious reason to surmise which of the two should dominate. In Aizenman and Jinjarak (2009) we looked empirically at these issues in 41 countries, for the years 1990–2005, investigating the association between lagged current account deficits and the appreciation of the real estate prices/GDP deflator, controlling for macro factors associated with real estate valuation [lagged GDP/capita growth, inflation, financial depth, institution, urban population growth and the real interest rate]. We found a strong positive association between

lagged current account deficits and an appreciation of the real estate, where the 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.

A growing literature identified several related channels contributing to the positive association of the current account and credit growth patterns with real estate valuation. Tomura (2010) analyzed the roles of credit market conditions in the endogenous formation of housing-market boom–bust cycles, in a business cycle model. When households are uncertain about the duration of a temporary high income growth period, expected future house prices rise during a high growth period and fall at the end of the period. These developments induce in his model expectation-driven boom–bust cycles in house prices, only if the economy is open to international capital flows. Furthermore, high maximum loan-to-value ratios for residential mortgages per se do not cause boom–bust cycles without international capital flows. Laibson and Mollerstrom (2010) noted that national asset bubbles may explain the international imbalances -- the bubbles raised consumption, resulting in large trade deficits. In their sample of 18 OECD countries plus China, movements in home prices alone explain half of the variation in trade deficits. Gete's (2010) model showed that an increased demand for housing may generate trade deficits without the need for wealth effects or trade in capital goods, and that housing booms are larger if the country can run a trade deficit. These predictions were found consistent with the pre-crisis experience of the OECD countries. Adam et al. (2011) outlined an open economy asset pricing model with households characterized by subjective beliefs about price behavior and update these beliefs using Bayes' rule. They show that the resulting belief dynamics propagate considerable economic shocks and contribute to replicating the empirical evidence of the association between current account patterns and real estate valuations. Belief dynamics can temporarily delink house prices from fundamentals, so that low interest rates can fuel a house price boom.

As there is no reason for the relative importance of the current account and the credit patterns to stay stable overtime in accounting real estate valuation, we explore in this paper the degree to which the pre global crisis patterns continues to hold after the crisis. Specifically, we look at the following questions:

i.   Stability of the key conditioning variables accounting for the real estate valuation before and after the crisis; specifically the relative importance of the current account and credit growth patterns.

ii.   The importance of 'momentum' in the pricing of real estate, as measured by the impact of lagged real estate appreciation in accounting for the present real estate appreciation, controlling for other macro factors. This issue is related to concerns about possible bubble dynamics, where lagged appreciation is reinforcing expectations of future appreciation.

iii.   Symmetry of the patterns during real estate appreciation versus real estate depreciation.

iv.   The possible two way causality between current account and real estate valuation patterns.

v.   The degree to which the valuation of equities is accented by similar conditioning variables.

Overall, our paper reveals a complex of time varying patterns, yet it validates the robustness of the association between real estate valuation of lagged current account patterns both before and after the crisis. The base regression is a dynamic panel estimate of 36 countries, during the periods 2005:I -2012:IV, recognizing the crisis break. It accounts for the appreciation rate of the real estate valuation (real estate inflation minus CPI inflation) as explained by the following correlates: lagged appreciation rate of the real estate valuation, lagged changes in the current account/GDP, lagged changes in the domestic credit/GDP, lagged changes in the equity market valuation appreciation (equity market appreciation minus CPI inflation), and a vector of lagged changes of macro controls [inflation, growth of industrial production, TED spreads, sovereign spreads, VIX, and international reserves]. The most economically significant variable in accounting for real estate valuation changes turned out to be the lagged real estate valuation appreciation, followed by current account deficit/GDP, domestic credit/GDP, and equity market valuation appreciation. The first three effects are economically substantial: a one standard deviation increase in lagged real estate appreciation is associated with a 10 % increase in the present real estate appreciation, much larger than the impact of a one standard deviation increase in the current account deficit (5%) and that of domestic credit/GDP growth (3%). Thus, the results are supportive of both current account and credit growth channels, with the animal-spirits

and expectations channels playing the most important role in the boom and bust of real estate valuation.

While positive reverse feedback of real estate appreciation to current account deficit cannot be ruled out theoretically, we find that it is not supported during our sample period. We find support for a positive feedback of real estate appreciation to equity market appreciation, which is consistent with the wealth effects from real estate valuation to equity investment.

2. Sample

We use quarterly data to understand how short- to medium-term adjustment of the real estate valuation interacts with current accounts, domestic credit, and relevant macro and global variables. Using quarterly data comes at a cost of sample length: subject to data availability, our data covers the period of 2005:I to 2012:IV. Obviously we miss out earlier episodes of real estate booms and busts. However, in the present context of our investigation this may not be so costly since previous cycles would be varying across countries, meaning that there would be a variety of other driving factors in country-specific episodes. On the other hand, the current sample period fits well with our interests that specifically focus on the real estate valuation over the global crisis, with quarterly adjustment dynamics. Alternatively, using annual data instead would allow for a longer sample period back in the historical past, but could not capture the dynamics of short- to medium-term interactions between real estate data and confounding macro fundamentals that we try to understand.

The data are drawn from several sources, as shown in Appendix A, including Oxford Economics, Economist Intelligence Unit (EIU), Federal Reserve Economic Data (FRED), and Credit Market Analysis (CMA). Our main variable of interests is real estate valuation appreciation (real estate inflation minus CPI inflation). As a user of secondary data, we are made well aware that the primary collection method of our most important variable, the real estate valuation series, is known to be highly heterogeneous across countries. National statistical offices and local real estate agencies have their own approaches in compiling the data; e.g. some are repeated sales, others are not; some include both residential and commercial, others do not, etc. Hence, pooling real estate series across countries amounts to an aggregation problem. Our

real estate series, which are drawn from a compilation of Oxford Economics database, are also subject to this data issue, as is the case in other earlier studies and datasets.[1] Yet, as is shown in Aizenman and Jinjarak (2009) using real estate data from different cross-country databases, residential series and commercial real estate series, the econometric evidence are largely consistent across the data sets on the empirical relationships of real estate, current account, and macro variables.

Altogether there are 36 countries in the sample, covering both developed and emerging markets. Appendix A provides the list of countries and Appendix B shows geographically the locality of real estate markets included. Some of these are large, hot spot markets, widely monitored and publicized by the press, e.g. China and the US, whereas many others are smaller in size and may not be known as boom-bust spots in the global real estate markets. As shown by standard deviation of real estate valuation appreciation highlighted in the figure of Appendix B, several of these countries are considered highly volatile markets for the period before and after the global crisis.

2.1 Preliminary statistics

Panel unit root tests suggest that real estate valuation appreciation, current account deficit/GDP, and domestic credit growth/GDP are all nonstationary. As the power of unit root tests undoubtedly varies across study samples, not to mention panel data extension of the tests, we report both Im-Pesaran-Shin statistic and Levin-Lin statistic (Appendix C). These two tests assume that all series are non-stationary under the null hypothesis; the former is consistent under the alternative that only a fraction of the series are stationary, while the latter assumes that all series are stationary under the alternative. Both tests appear consistent with each other in our sample, pointing to the existence of unit roots in the series. Next, we examine whether there is any co-integrating relationship among these variables.[2]

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[1] The cross-country series currently available are not sufficiently details to resolve the issues, as well as in term of cross-series comparability, in contrast to, for example, Standard and Poor's (S&P) Case-Shiller for the US real estate series.

[2] To smooth seasonal fluctuations in quarterly real estate valuation appreciation, current account deficit/GDP, and domestic credit growth/GDP, we use their four-quarter moving averages (current plus three lags) here and in the following estimation.

The panel co-integration test does not reject the null of no co-integration between real estate valuation appreciation and current account deficit/GDP; real estate valuation appreciation and domestic credit growth/GDP; real estate valuation appreciation and equity market valuation appreciation (equity market appreciation minus CPI inflation); current account deficit/GDP and domestic credit growth/GDP. The panel co-integration test statistics have the null of no integration for all cross-sections of countries, based on Westerlund panel error-correction-model (ECM) tests. We report test statistics both when an alternative is error correction term less than zero for at least one country, and when an alternative is error correction term less than zero for all countries. Both statistics are consistent with each other in rejecting co-integration. While there is some weak evidence of co-integration between current account deficit/GDP and domestic credit growth/GDP, this is not statistically significant at the 5 percent level of the test.

Based on the panel unit-root and panel co-integration tests, the application of dynamic panel data estimation in first-differenced series is deemed necessary for the real estate and macro variables in our sample. With 36 countries and over 20 quarterly periods for each country, the fixed-effect estimation may also be applicable. However, given that several series are known to be highly persistent in the panel of countries (i.e. real estate prices, current accounts, domestic credit growth, as well as equity prices), including lagged terms of dependent variables on the right-hand side of estimating equations may entail empirical correlation between the lagged regressors and the error terms, and hence the endogeneity issue. For these reasons, we focus in the following on coefficient estimates from dynamic panel estimation as our main econometric evidence.

2.2 Patterns of real estate valuation appreciation and current account deficit/GDP

Mean reversion in real estate appreciation across national markets is quite noticeable in the data. As shown in Figure 1, we plot cumulative real estate valuation appreciation for the period of 2005:I-2007:III on the horizontal axis, and cumulative real estate valuation appreciation for the period of 2008:III-2012:IV on the vertical axis. The relationship between cumulative real estate appreciation between the two periods is negative: the slope coefficient from OLS estimation is -0.5 and is statistically significant at the 1 percent level, with $R^2 = 0.28$. Ireland, Spain, South Africa, United States, and United Kingdom provide clear example of mean revision before and after the global crisis. There are a few outliers in this relationship; including

mostly small markets, i.e. Hong Kong, Ireland, and Romania (not included in the plot for illustrative purposes).

Once we plot the country-specific evolution of real estate valuation appreciation series, it appears that there are large differences across countries in the associated patterns against the backdrop of the global financial crisis. Shown in Figure 2A, real estate valuation varied markedly before and after the global crisis events, as marked by the two vertical lines for 2007:III (Northern Rock event) and for 2008:III (Lehman Brother event), respectively. While real estate valuation appreciation of some countries increased until the crisis events (e.g. Canada, Ireland), for several others the real estate valuation appreciation valuation were already spiraling downward even before the global crisis (e.g. US, South Africa). For some markets, the real estate valuation appreciation appear to bounce back soon after the global financial panic (e.g. Australia), while for a few others, national real estate markets continued to be highly volatile (e.g. Hong Kong, Singapore).

The patterns of current account deficit/GDP and domestic credit growth/GDP were also heterogeneous across countries over the periods before and after the global financial crisis. As shown in Figure 2A for current account deficit/GDP and in Figure 2B for domestic credit growth/GDP, the quarterly adjustment dynamics of these two variables tracked real estate valuation appreciation in some countries quite well, whereas for several others there appeared no relationship between the two variables and the real estate valuation appreciation valuation. Hence, as an alternative to using the global crisis events (i.e. Northern Rock even and Lehman Brothers event) to mark the turning points, we assign a new binary variable "Current account deficit/GDP's Break" to identify a country-specific break date, or structural shift, in the empirical association between real estate valuation appreciation and current account deficit/GDP, according to QLR statistics[3]; and a new binary variable "Domestic credit/GDP's Break", which is defined similarly for the stock of domestic credit/GDP. As shown in figures 2A and 2B, these empirical turning points closely resemble the global crisis events for a majority of countries

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[3] Quandt likelihood ratio test for a break at an unknown break date (Stock and Watson, 2012). Here we are mainly interested in empirical breaks of the association between real estate valuation appreciation and current account deficit/GDP (or growth of domestic credit/GDP) in each country over the sample period of 2005:I-2012:IV. For identification of extreme capital flow episodes from 1986-2009, see Forbes and Warnock (2012).

(notably, i.e. US, UK, Australia, Spain), whereas they were not the same turning points in a number of countries.

3. Baseline Results

3.1 The Global Financial Crisis

From our baseline estimation, real estate valuation is positively and significantly associated with current account deficits in both periods before and after the crisis of 2008-09. Real estate valuation is positively associated with domestic credit growth to a lesser degree, statistically significant only in the period before the crisis [see Appendix D for the empirical specification]. Column 1 of Table 1 provides the main results, using 2007:III (Northern Rock event) as the turning point that marked the global financial crisis, while column 2 uses 2008:III (Lehman Brothers event) as an alternative turning point. Both estimation results are consistent with each other, suggesting that the association of real estate valuation appreciation with current account deficit/GDP and with domestic credit growth/GDP are positive and statistically significant (accounting coefficient estimates on the four lags of current account deficit and domestic credit growth).[4]

The baseline results also show that equity market appreciation and inflation are empirically associated with real estate valuation, while the relationship with other variables (growth, global interest rate, sovereign risk, reserve accumulation) is not supported in the current sample. The positive association between real estate valuation appreciation and equity market valuation appreciation is consistent with the wealth effects from real estate valuation to equity investment, as capital gains in the equity investment spillover to the real estate sector. The association between real estate valuation appreciation and inflation is negative as one might expect. The coefficients of other variables are not statistically significant; for some variables, coefficient estimates have an unexpected sign (i.e. growth of industrial production, TED spread, and foreign reserve accumulation).

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[4] The coefficients are obtained from the Arellano-Bond dynamic panel estimation. While only lagged real estate valuation appreciation is treated as an endogenous regressor, the autocorrelation test suggests that AR(2) is only marginally significant at the 10 percent level, but not at the 5 percent level.

Interestingly, coefficient estimates of lagged real estate valuation appreciation indicate persistence in real estate valuation up to two quarters, consistent with popular commentaries that real estate markets are driven by animal spirits and momentum, with macroeconomic and regulatory environment playing a supporting role. The lagged real estate coefficients are equal to 0.6 for the first two quarters and statistically significant at the 1 percent level, suggesting that more than half of real estate valuation was carried on from one quarter to the next three quarters on average.[5] However, our sample focuses on a specific episode before and after the global crisis. Hence, the findings do not imply that expectation-driven persistence in real estate valuation may last only half a year, but instead that this observed momentum appears to be the case over the period of 2005:I to 2012:IV.

3.2 Breaks in current account deficits and domestic credit growth

The positive association between real estate appreciation and current account deficit remains robust for alternative turning points in their relationship, but the association between real estate appreciation and domestic credit growth does not. As shown earlier in Figures 2A and 2B, for a majority of countries, the global crisis events (Northern Rock in 2007:III and Lehman Brothers in 2008:III) coincided with the empirical turning points in the relationship between real estate valuation appreciation and current account deficit/GDP, as well as the relationship between real estate valuation appreciation and domestic credit growth/GDP. To verify, instead of using a Global crisis binary variable as done in Table 1, we use in Table 2 a new binary variable "Current account deficit/GDP's Break" that identifies a country-specific turning point in the association between real estate appreciation and current account deficit/GDP, according to QLR statistics as described in Section 2.2; "Growth of domestic credit/GDP's Break" is defined similarly for domestic credit growth/GDP; both are depicted in Figure 2. These country-specific breaks enter the estimation of Table 2 individually, and also as interaction terms with current account deficit/GDP series and with growth of domestic credit/GDP series. Table 2 column 1 reports the dynamic panel estimates from these new specifications. We find that the positive association between real estate valuation appreciation and current account deficit/GDP is still

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[5] The coefficient estimate on a third lag is negative, but much smaller than the first two, so the net effect remains positive for three quarters. In Section 4, we revisit the economic significance of lagged real estate valuation in more details.

statistically significant, while the positive association between real estate valuation appreciation and growth of domestic credit/GDP becomes insignificant.

In addition, with these alternative turning points, using the fixed-effect estimation does not change the main finding on the positive and statistically significant association between real estate valuation and current account deficit. As shown in column 2 of Table 2, the coefficient estimates of current account deficit/GDP remain statistically significant in the fixed-effect estimation; the coefficient estimates of lagged real estate valuation appreciation and equity market valuation appreciation also remain statistically significant. Further, current account deficit/GDP enters the estimation positive and statistically significant both individually and as interaction terms. The explanatory power, as measured by R^2 in column 2, suggests that the estimation is able to explain about 80 percent of variation in the real estate valuation over the period of 2005:I to 2012:IV. Since a drawback of fixed-effect estimation is a lack of empirical treatment on endogeneity in the presence of lagged dependent variable (real estate valuation appreciation), we take the fixed-effect estimates as supportive evidence and continue onwards with the dynamic panel estimation in the following.[6]

3.3 Current account deficit vis-à-vis of domestic credit growth

Horseracing current account deficit vis-à-vis growth of domestic credit suggests that the former is more statistically significant in the empirical association with real estate valuation. The findings in Tables 1 and 2 show that the positive association between real estate valuation appreciation and current account deficit/GDP is always statistically significant, whereas the association between real estate valuation appreciation and growth of domestic credit/GDP is insignificant in several specifications (i.e. columns 1 and 2 of Table 2). Perhaps this difference

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[6] For real estate valuation and current account relationship, it is not an objective of this paper and nevertheless beyond a scope of the study to defend either method of the panel estimation. Hypothetically, in the context of reduced-form analysis, endogenous regressors may include not only lagged real estate valuation appreciation, but also additional lags of the right-hand-side variables, i.e. current account deficit/GDP, growth of domestic credit/GDP, and equity market valuation appreciation. Alternatively, one may consider current account as endogenous and study the present value of current account with real estate valuation (and for that matter, other asset prices) and VAR (although the causal ordering has never been clear in such setting for all contemporaneous coordinates). Essentially, in the general-equilibrium analysis, all the variables would be endogenous, even the incidence of global crises. Hence, since we take no stance and there is no point to be too defensive about the main specifications reported in this paper, instead we hereby provide a battery of results based on various specifications for the readers to judge.

might be due to common underlying factors in both current account and credit growth series; the patterns illustrated in Figures 2A and 2B seem to suggest that both series tracked real estate valuation appreciation quite well for a majority of countries, before and after the global crisis. Alternatively, the difference might be due to insufficient lagged adjustment allowed for these two variables in the estimation. Accordingly, in Table 3 we allow for four lags of current account deficit/GDP in column 1, excluding growth of domestic credit/GDP and a binary variable for global crisis or a binary variable for turning points in the association between real estate valuation appreciation and current account deficit/GDP. Similarly, we allow for four lags of growth of domestic credit/GDP in column 2, excluding current account deficit/GDP and a binary variable for global crisis or for the turning points in growth of domestic credit/GDP. Based on these alternative specifications, the findings are consistent with the coefficient estimates of Tables 1 and 2. Without growth of domestic credit/GDP in the estimation, the association between real estate valuation appreciation and current account deficit/GDP remains positive and significant (column 1). On the other hand, without current account deficit/GDP in the estimation, the association between real estate valuation appreciation and growth of domestic credit/GDP is still weak and insignificant at all lags (column 2).

Based on statistical pair-wise correlation and panel co-integration tests, multi-collinearity between current account deficit and growth of domestic credit is unlikely, at least for the 2005:I-2012:IV sample. As discussed earlier via Appendix C, the panel co-integration tests cannot reject the null of no co-integration between current account deficit/GDP and growth of domestic credit/GDP. We also find that the pair-wise correlation between the two series is only 0.1 across countries in our sample. Nevertheless, this does not imply that we should rule out altogether potential feedback between current account deficit and growth of domestic credit in other samples, presumably with a longer sample and covering episodes other than we currently examine. Useful extension may also try to understand causality between current account and credit growth across time and countries. One may suspect some intertwining of household debt accumulation, consumption of durables, and domestic indebtedness in foreign currency become important factors in such setting.

4. Sensitivity Analysis

4.1 Reverse feedback

We find that reverse and positive feedback of real estate appreciation to current account deficit is not supported by the data over the crisis period. To investigate for possible feedback from real estate valuation appreciation, Table 4 column 1 reverses the empirical specification of column 1 in Table 1 by placing current account deficits/GDP on the left-hand side of the estimating equation. This specification is not a straightjacket model of current account, but is a simple verification of possible influence on current account from real estate valuation. The coefficient estimates suggest that there is no evidence of positive feedback of real estate valuation appreciation to current account deficit/GDP in the data. As shown in Table 4, the coefficient estimates of real estate valuation appreciation, while statistically significant, have negative sign, opposite to what one might expect, before and after the global crisis period. This counterintuitive finding seems to be rather consistent with the panel co-integration tests in Appendix C where we cannot reject the null of no co-integration between current account deficit/GDP and real estate valuation appreciation. However, these non-findings do not rule out positive and reverse feedback of real estate appreciation to current account deficits in other samples, but only that any support for such reverse feedback is not prevalent during 2005:I-2012:IV period that we study.

On the other hand, and contrary to panel co-integration tests, the coefficient estimates of dynamic panel estimation suggest positive feedback of real estate appreciation to equity market appreciation, a finding consistent with the wealth effects from real estate valuation to equity investment. In column 2 of Table 4, we replace a left-hand-side variable of the estimating equation with equity market valuation appreciation. As shown in the column, a positive association between equity market valuation appreciation and real estate valuation appreciation is statistically significant before and after the global crisis period. However, we suspect that common underlying causes of these two variables may not be the same. In the present context, the association between equity market valuation appreciation and current account deficit/GDP is negative before the global financial crisis (Table 4 column 2), whereas the association is positive between real estate valuation appreciation and current account deficit/GDP (earlier in Table 1 column 1). Interestingly, the relationship between equity market valuation appreciation and growth of industrial production, TED spread, sovereign CDS, and foreign reserve accumulation in Table 4 are also statistically significant with expected signs, in contrast to the equation of real estate valuation in Table 1. This finding may also imply that the momentum and animal-spirits

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channels in the real estate valuation can change rather independently from those in equity investment over the crisis period.[7]

4.2 Asymmetric adjustment

Additional sensitivity checks show that for appreciation episode of the real estate valuation, a positive association between real estate appreciation and current account deficit is statistically significant, while the positive association between real estate appreciation and growth of domestic credit is statistically significant but to a lesser degree. In Table 5, we allow for asymmetric adjustment, assigning different coefficients for the estimation of real estate valuation appreciation (column 1) and the estimation of real estate valuation depreciation (column 2); the specification is closely resembled to that in Table 1, but here we separate the whole sample into real estate appreciation sample and real estate depreciation sample. For the real estate appreciation episode, estimation results are largely consistent with the results from the whole-sample estimation in column 1 of Table 1; an exception is coefficient estimates of equity market valuation appreciation and inflation are insignificant. For the real estate depreciation episode, the estimation results are markedly different from the whole-sample estimation, as only lagged real estate valuation appreciation and equity market valuation appreciation are found statistically significant in the association with the real estate valuation. Hence, we find that when real estate markets were on the rise, the real estate valuation adjusts with respect to macro variables differently from when the markets were declining. Asymmetric bubbly dynamics are evident in the real estate valuation.

4.3. Economic Significance

Based on sample standard deviation and estimation results, the economic significance on real estate valuation is driven mostly by lagged real estate appreciation, followed by current account deficit, growth of domestic credit, and equity market appreciation. We reach this conclusion by accounting for all our main findings and sensitivity checks, including in particular positive feedback of real estate appreciation to equity market appreciation (Table 4) and asymmetric adjustment in real estate appreciation and in depreciation episodes (Table 5).

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[7] Carroll, Otsuka, and Slacalek (2011) find that an eventual marginal propensity to consume from a $1 change in housing wealth is about 9 cents, substantially larger than the effect of shocks to financial wealth. Hence, our emphasis placed on the real estate valuation has additional merit at a macro level.

Essentially, we revise the empirical specification of column 1 in Table 1, hereby verifying our estimation in Table 6 by treating real estate appreciation and equity market appreciation both as endogenous regressors. Our benchmark findings are reported in Table 6, for the whole sample in column 1, and for the episode of real estate appreciation in column 2. Next, we calculate the economic significance on real estate valuation of each macro variable by multiplying one standard deviation of each variable with its coefficient estimate of column 1 in Table 6. As shown in Figure 3 for the real estate valuation on annualized basis, the most economically significant variable is lagged real estate valuation appreciation (10.4%), then current account deficit/GDP (5.0%), growth of domestic credit/GDP (3.0%), and equity market valuation appreciation (1.5%), for our sample of 36 countries during 2005-12.

5. Concluding Remarks

Our paper confirmed a robust positive association between the appreciation of real estate valuation and increases in current account deficits and the growth rates of credit (both as fractions of the GDP) in 36 countries, covering the OECD and emerging markets, before and after the global financial crisis. While the relative impact of the current account deficit is larger than that of credit growth in our sample, one should recognize that the growth of credit/GDP is a noisy measure of the effective credit growth in the real estate market. Data limitations prevented us from controlling directly for the credit conditions in the real estate markets, and factors like the stringency of credit standards, required down payment, the effective spreads in the mortgage markets, etc.[8] Thus, there is no reason to expect that the relative ranking of the importance of the current account versus the credit channels in accounting for real estate appreciations should be stable overtime.[9] Yet, as theory suggests, both channels are potent and should not be ignored.

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[8] Favilukis et al. (2012) found that credit standard variables provide the most important information in accounting for the in house price growth in the U.S. over the period 1992-2010. They made a similar, though a weaker inference for a sample of 11 OECD countries.

[9] In principle, counter cyclical leverage policy in the face of credit booms facilitated by hot money inflows and other factors may mitigate the impact of credit booms and raising current account deficits. Yet, the implementation of these polices is frequently subject to policy lags, and leakages allowing the private sector to bypass regulations [see Calvo (2012)]. Indeed, in the US, it took the crisis of 2008-9 to induce the tightening of the credit standards.

Notwithstanding these results, the most important factor accounting for the appreciation of real estate turned out to be the impact of momentum: the lagged quarterly appreciations in the past year. This effect is large: a real estate appreciation of 1% in a given quarter was associated with a projected real appreciation of more than 1% in the next three quarters.[10] This result is consistent with Shiller's (2000) concerns regarding Irrational Exuberance in the USA in the early 2000s, with Case, Shiller, and Thompson (2012)'s findings on the significant role of expectation for demand in real estate markets, and with Glaeser, Gottlieb, and Gyourko (2013)'s questioning the role of cheap credit on real estate boom. Importantly, our results were derived in a sample of 36 countries, suggesting that Shiller's concerns apply globally. The painful adjustment in the real estate markets of the US, Spain and other affected countries in the aftermath of the crisis of 2008-9, and the key importance of momentum effects call for further research on policies that would mitigate possible bubble-dynamics.

References

Adam, Klaus, Pei Kuang and Albert Marcet (2011) "House Price Booms and the Current Account," NBER Chapters, in: *NBER Macroeconomics Annual* 2011 (26): 77-122.

Aizenman, Joshua and Yothin Jinjarak (2009), "Current Account Patterns and National Real Estate Markets," *Journal of Urban Economics*, 66(2): 75-89.

Borio, Claudio and Piti Disyatat (2011), "Current account patterns and national real estate markets Global imbalances and the financial crisis: Link or no link" BIS Working Papers Number 346.

Case, Karl E., Robert J. Shiller, and Anne K. Thompson (2012), "What have they been thinking? Homebuyer behavior in hot and cold markets," *Brookings Papers on Economic Activity*, 2: 265-298.

Calvo, Guillermo (2012), "On Capital Inflows, Liquidity and Bubbles," manuscript, Columbia University.

Carroll, Christopher D., Misuzu Otsuka, and Jiri Slacalek (2011), "How large are housing and financial wealth effects? A new approach," *Journal of Money, Credit, and Banking*, 43(1): 55-79.

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[10] The sum of the statistically significant quarterly lags is a 1.08 for the whole sample, and 1.17 for real state appreciation episodes (see Table 6). These results suggest that the momentum effect is stronger on the appreciation than the deprecation side.

Favilukis Jack, David Kohn, Sydney C. Ludvigson and Stijn Van Nieuwerburgh (2012), "International Capital Flows and House Prices: Theory and Evidence," NBER Working Paper No. 17751.

Forbes, Kristin J. and Francis E. Warnock (2012), "Capital flow waves: Surges, stops, flight, and retrenchment," *Journal of International Economics*, 88(2): 235-251.

Gete, Pedro (2010), "Housing Markets and Current Account Dynamics," manuscript, Georgetown University.

Glaeser, Edward L., Joshua D. Gottlieb, and Joseph Gyourko (2013), "Can cheap credit explain the housing boom?" in *Housing and the Financial Crisis*, E. Glaeser and T. Sinai (editors), University of Chicago Press.

Laibson, David and Johanna Mollerstrom (2010). "Capital Flows, Consumption Booms and Asset Bubbles: A Behavioural Alternative to the Savings Glut Hypothesis," *Economic Journal*, 120(544): 354-374.

Leamer, Edward E. (2007). "Housing is the business cycle," *Proceedings, Federal Reserve Bank of Kansas City*, pages 149-233.

Obstfeld, Maurice (2012). "Does the Current Account Still Matter?" *American Economic Review*, 102(3): 1-23.

Shiller, Robert (2000). *Irrational exuberance,* Princeton University Press. See also the 2nd edition, 2005.

Stock, James H. and Mark W. Watson (2012), *Introduction to Econometrics*, 3rd edition, Pearson, Essex, England.

Tomura, Hajime, (2010) "International capital flows and expectation-driven boom–bust cycles in the housing market," *Journal of Economic Dynamics and Control*, 34(10): 1993–2009.

Appendix A. Quarterly Data, 2005:I-2012:IV.

Variable	Description
Real estate valuation appreciation	Nominal growth of national real estate price indices, minus consumer price inflation. Source: Oxford Economics, Economist Intelligence Unit (EIU).
Current account deficit/GDP	Current account deficits (billion US$) divided by gross domestic product (billion US$). Source: EIU.
Growth of domestic credit/GDP	Bank lending (billion local currency) divided by gross domestic product (billion local currency). Source: EIU.
Equity market valuation appreciation	Change in US$ value of national stockmarket indices, minus consumer price inflation. Source: EIU.
CPI inflation	Consumer price inflation. Source: EIU.
Growth of industrial production	Change in national industrial production indices. Source EIU.
TED spread	3-month LIBOR (based on US$) minus 3-month US Treasury bill rate (secondary market). Source: FRED (online).
VIX	CBOE Volatility Index: VIX. Source: FRED (online).
Sovereign CDS	Sovereign credit default swap prices for 5-year contract (basis points). Source: CMA.
Foreign reserve accumulation	Change in foreign-exchange reserves (billion US$), divided by gross domestic product (billion US$). Source: EIU.

36 countries in the sample and country codes in figures. Australia:AU, Austria:AT, Belgium:BE, Bulgaria:BG, Canada:CA, China:CN, Czech Republic:CZ, Denmark:DK, Finland:FI, France:FR, Germany:DE, Greece:GR, Hong Kong:HK, Hungary:HU, Indonesia:ID, Ireland:IE, Italy:IT, Japan:JP, Korea:KR, Malaysia:MY, Netherlands:NL, New Zealand:NZ, Norway:NO, Poland:PL, Portugal:PT, Romania:RO, Singapore:SG, Slovakia:SK, South Africa:ZA, Spain:ES, Sweden:SE, Switzerland:CH, Taiwan:TW, Thailand:TH, United Kingdom:GB, United States:US

Appendix B. Volatility of Real Estate Valuation.
This figure shows standard deviation of real estate valuation appreciation over the period 2005:I - 2012:IV for all 36 countries in the sample.

[2.1,3.7]
(3.7,4.7]
(4.7,6.8]
(6.8,10.5]
(10.5,39.6]
No data
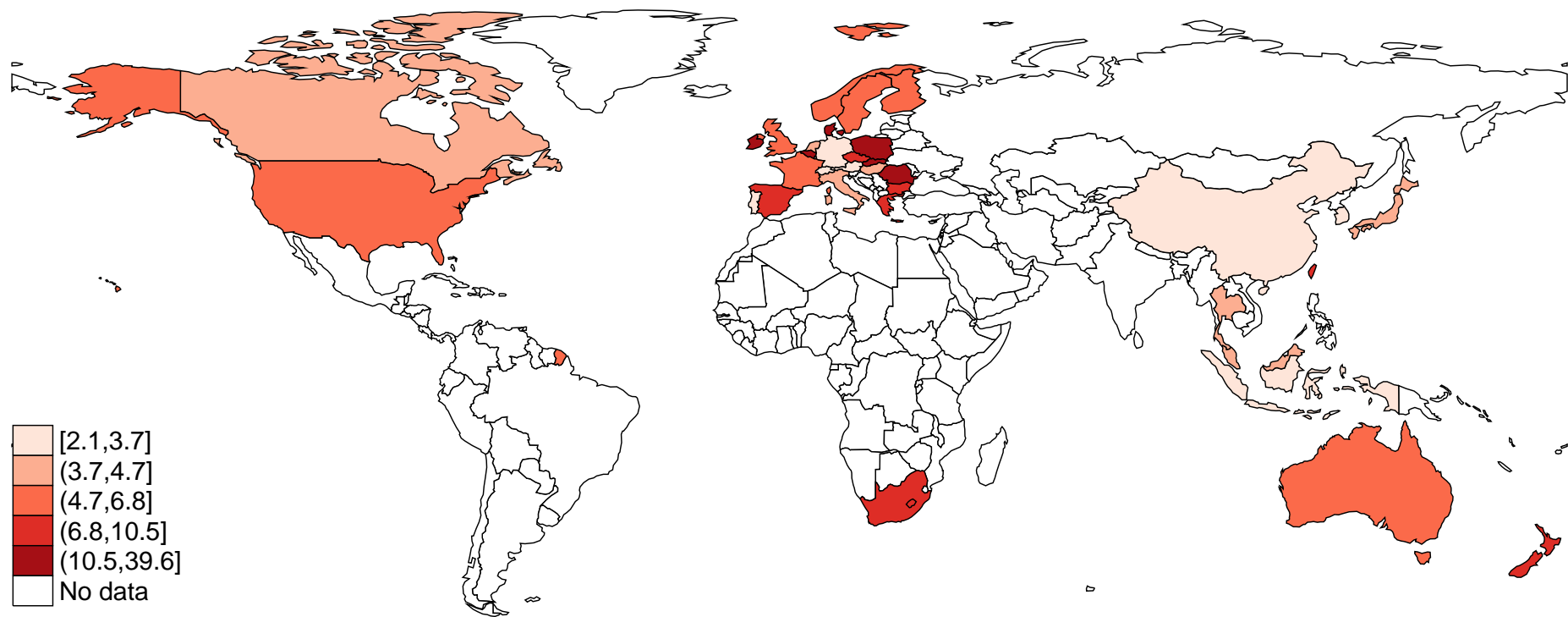
Appendix C. Panel Unit Root and Cointegration Tests.
This table reports t-statistic [1% critical value in bracket] of Im-Pesaran-Shin test and Levin-Lin tests for unit root in panel data. Both tests assume that all series are non-stationary under the null hypothesis; the former is consistent under the alternative that only a fraction of the series are stationary, while the latter assumes that all series are stationary under the alternative. The panel cointegration test statistics [p-value in bracket] for real estate valuation appreciation series, current account deficit/GDP series, equity market appreciation series, and domestic credit growth series, have the null of no integration for all cross section of countries, based on Westerlund ECM tests. The tests include four lags of each variable, using quarterly data over the period 2005:I-2012:IV for all 36 countries in the sample.

Series\Test	Im-Pesaran-Shin Statistic	Levin-Lin Statistic
Real estate valuation appreciation	-1.449 [-1.810]	-9.488 [-0.776]
Current account deficit/GDP	-0.897 [-1.810]	-5.328 [3.991]
Growth of domestic credit/GDP	-1.199 [-1.820]	-5.114 [4.477]

Panel co-integration (Westerlund Statistic)	Real estate valuation appreciation - Current account deficits/GDP	Real estate valuation appreciation - Credit growth/GDP
alternative: error correction term <0 for at least one country	-7.170 [0.514]	-7.649 [0.317]
alternative: error correction term <0 for all country	-3.851 [0.745]	-1.649 [1.000]

Panel co-integration (Westerlund Statistic)	Real estate appreciation - Equity market appreciation	Current account deficit/GDP - Domestic credit growth/GDP
alternative: error correction term <0 for at least one country	-4.969 [0.993]	-8.449 [0.093]
alternative: error correction term <0 for all country	-4.629 [0.361]	-4.571 [0.394]

Appendix D. Empirical Specification.

The estimation methodology is Arellano-Bond dynamic panel regression. All the variables of Tables 1-6 are in changes, denoted by Δ, for both dependent and explanatory variables. The regression equation is

$$\Delta\left[\text{Real estate appreciation} - \text{Inflation}\right]_{it} = \beta_0 + \sum_{\tau=1}^{4}\beta_{1,t-\tau}\Delta\left[\text{Real estate appreciation} - \text{Inflation}\right]_{it-\tau}$$

$$+\left\{\sum_{\tau=1}^{2}\beta_{2,t-\tau}^{0}\Delta\left[CAD/GDP\right]_{it-\tau}\right\}^{Before\ Break} + \left\{\sum_{\tau=1}^{2}\beta_{2,t-\tau}^{1}\Delta\left[CAD/GDP\right]_{it-\tau}\right\}^{After\ Break}$$

$$+\left\{\sum_{\tau=1}^{2}\beta_{3,t-\tau}^{0}\Delta\left[DCR/GDP\right]_{it-\tau}\right\}^{Before\ Break} + \left\{\sum_{\tau=1}^{2}\beta_{3,t-\tau}^{1}\Delta\left[DCR/GDP\right]_{it-\tau}\right\}^{After\ Break}$$

$$+\sum_{\tau=1}^{2}\beta_{4,t-\tau}\{\Delta\left[DCR/GDP\right]_{it-\tau}\times\Delta\left[DCR/GDP\right]_{it-\tau}\}$$

$$+\sum_{\tau=1}^{4}\beta_{5,t-\tau}\Delta\left[\text{Equity market appreciation} - \text{Inflation}\right]_{it-\tau}$$

$$+X'_{t-1}\theta + \varepsilon_{it}$$

Where t denotes time (quarterly); i country; CAD/GDP current-account deficit/GDP; DCR/GDP domestic credit/GDP; and X denotes a vector of controls in changes, including CPI inflation, growth of industrial production, TED spread, VIX, Sovereign CDS spread, and foreign reserve accumulation.

Table 1. Global Financial Crisis and Real Estate Appreciation.
This table reports dynamic panel estimation, using quarterly data over the period 2005:I-2012:IV. The dependent variable is Δreal estate valuation appreciation (changes in nominal price growth minus CPI inflation). The Global financial crisis's Break is a 1/0 binary variable, equals to 1 before 2007:III (Nothern Rock event) for estimation in the first column, whereas, alternatively, it is equal to 1 before 2008:III (Lehman Brothers event) in the second column; see also Figure A. The crisis breaks enter the estimation individually, as well as interaction terms with changes in current account deficit/GDP (ΔCAD/GDP) and with changes in domestic credit/GDP (ΔDCR/GDP) series. Standard errors are in parentheses, with *** (**,*) denotes statistical significance at 1 (5,10) percent.

Dep. Var. : ΔReal estate appreciation	lag	(1) Break (Crisis) 2007:III	(2) Break (Crisis) 2008: III
Regressors		coefficient (std. err.)	coefficient (std. err.)
ΔReal estate valuation appreciation	1	0.63 (0.02)***	0.63 (0.02)***
	2	0.64 (0.04)***	0.62 (0.04)***
	3	-0.20 (0.06)***	-0.19 (0.06)***
	4	0.00 (0.03)	-0.00 (0.03)
Global financial crisis's Break	binary (1/0)	2.35 (1.47)	-1.68 (1.05)
ΔCAD/GDP × Before Break	1	1.40 (0.90)	-1.58 (0.79)**
	2	1.53 (0.77)**	2.65 (0.68)***
ΔCAD/GDP × After Break	1	0.33 (0.65)	0.55 (0.66)
	2	1.92 (0.65)***	1.91 (0.66)***
ΔDCR/GDP × Before Break	1	1.37 (0.39)***	0.88 (0.33)***
	2	-0.35 (0.26)	-0.32 (0.25)
ΔDCR/GDP × After Break	1	0.19 (0.19)	0.16 (0.19)
	2	0.17 (0.14)	0.16 (0.14)
ΔCAD/GDP × ΔDCR/GDP	1	-0.02 (0.01)	-0.01 (0.01)
	2	0.00 (0.01)	0.00 (0.01)
ΔEquity market valuation appreciation	1	0.21 (0.04)***	0.21 (0.04)***
	2	-0.16 (0.07)**	-0.14 (0.07)*
	3	0.07 (0.06)	0.07 (0.06)
	4	-0.00 (0.02)	-0.00 (0.02)
ΔCPI inflation	1	-0.95 (0.50)*	-1.18 (0.51)**
ΔGrowth of industrial production	1	-0.09 (0.10)	-0.07 (0.10)
ΔTED spread	1	2.06 (1.75)	0.99 (1.71)
ΔVIX	1	-0.05 (0.09)	0.11 (0.10)
ΔSovereign CDS	1	-0.07 (0.22)	-0.11 (0.22)
Foreign reserve accumulation	1	0.06 (0.06)	0.08 (0.06)
constant	0	-0.77 (0.51)	-0.05 (0.57)
observations		791	791
Arellano-Bond AR(2) test p-value		0.084	.

Table 2. Turning Points of Current Account Deficit/GDP and Growth of Domestic Credit/GDP.
This table reports dynamic panel estimation (first column) and fixed-effect estimation (second column), using quarterly data over the period 2005:I-2012:IV. The dependent variable is Δreal estate valuation appreciation (nominal price growth minus CPI inflation). Instead of using a Global crisis binary variable as done in Table 1, this table uses a new binary variable "Current account deficit/GDP's Break" to identify country-specific turning point in the association between real estate appreciation and current account deficit/GDP, according to QLR statistics; "Growth of domestic credit/GDP's Break" is defined similarly for stock of domestic credit/GDP; see also Figure 2. These country-specific breaks enter the estimation individually, and as interaction terms with ΔCAD/GDP and ΔDCR/GDP series. Standard errors in parentheses, with *** (**,*) for significance at 1 (5,10) percent.

Dep. Var. : ΔReal estate appreciation	lag	(1) Dynamic panel estimation coefficient (std. err.)	(2) Fixed-effect estimation coefficient (std. err.)
ΔReal estate valuation appreciation	1	0.64 (0.02)***	0.63 (0.02)***
	2	0.62 (0.04)***	0.65 (0.05)***
	3	-0.17 (0.06)***	-0.19 (0.07)***
	4	-0.01 (0.03)	-0.01 (0.03)
Current account deficit/GDP's Break	binary (1/0)	0.80 (1.18)	2.93 (1.53)*
ΔCAD/GDP × Before Break	1	0.09 (0.73)	0.21 (0.69)
	2	2.11 (0.69)***	1.49 (0.64)**
ΔCAD/GDP × After Break	1	0.38 (0.66)	0.23 (0.63)
	2	1.99 (0.65)***	1.56 (0.61)**
Growth of domestic credit/GDP's Break	binary (1/0)	-1.67 (1.22)	-1.45 (1.45)
ΔDCR/GDP × Before Break	1	0.36 (0.29)	0.20 (0.21)
	2	-0.01 (0.20)	0.00 (0.15)
ΔDCR/GDP × After Break	1	0.19 (0.20)	0.04 (0.18)
	2	0.18 (0.15)	0.15 (0.14)
ΔCAD/GDP × ΔDCR/GDP	1	-0.01 (0.01)	-0.01 (0.01)
	2	-0.00 (0.01)	-0.00 (0.01)
ΔEquity market valuation appreciation	1	0.21 (0.04)***	0.15 (0.04)***
	2	-0.15 (0.07)**	-0.09 (0.07)
	3	0.07 (0.06)	0.02 (0.06)
	4	-0.00 (0.02)	0.01 (0.02)
ΔCPI inflation	1	-1.23 (0.50)**	-0.40 (0.46)
ΔGrowth of industrial production	1	-0.07 (0.10)	-0.08 (0.09)
ΔTED spread	1	0.66 (1.70)	0.41 (1.68)
ΔVIX	1	-0.01 (0.08)	-0.01 (0.08)
ΔSovereign CDS	1	-0.10 (0.23)	-0.05 (0.27)
Foreign reserve accumulation	1	0.04 (0.06)	0.04 (0.06)
constant	0	-0.32 (0.66)	-1.40 (0.73)*
observations		791	791
Arellano-Bond AR(2) test p-value		.	$R^2 = 0.81$

Table 3. Current Account Deficit vis-à-vis Growth of Domestic Credit on Real Estate Valuation.
This table reports dynamic panel estimation, using quarterly data over the period 2005:I-2012:IV. The dependent variable is Δreal estate valuation appreciation (nominal price growth minus CPI inflation). Standard errors are in parentheses, with *** (**,*) denotes statistical significance at 1 (5,10) percent.

Dep. Var. : ΔReal estate appreciation	lag	(1)	(2)
Regressors		coefficient (std. err.)	coefficient (std. err.)
ΔReal estate valuation appreciation	1	0.64 (0.02)***	0.64 (0.02)***
	2	0.63 (0.04)***	0.61 (0.04)***
	3	-0.18 (0.06)***	-0.15 (0.06)**
	4	-0.01 (0.03)	-0.02 (0.03)
ΔCurrent account deficit/GDP	1	-0.56 (0.75)	
	2	5.33 (1.64)***	
	3	-3.02 (1.67)*	
	4	0.56 (0.61)	
ΔGrowth of domestic credit/GDP	1		0.15 (0.23)
	2		0.23 (0.45)
	3		-0.18 (0.40)
	4		0.08 (0.14)
ΔEquity market valuation appreciation	1	0.20 (0.04)***	0.23 (0.04)***
	2	-0.13 (0.07)*	-0.17 (0.07)**
	3	0.06 (0.06)	0.08 (0.06)
	4	-0.00 (0.02)	-0.01 (0.02)
ΔCPI inflation	1	-1.25 (0.49)**	-1.20 (0.50)**
ΔGrowth of industrial production	1	-0.04 (0.10)	-0.08 (0.10)
ΔTED spread	1	0.58 (1.70)	1.42 (1.68)
ΔVIX	1	-0.02 (0.08)	-0.02 (0.08)
ΔSovereign CDS	1	-0.06 (0.22)	-0.08 (0.22)
Foreign reserve accumulation	1	0.06 (0.06)	0.06 (0.06)
constant	0	-1.05 (0.44)**	-0.93 (0.44)**
observations		765	765
Arellano-Bond AR(2) test p-value		.	.

Table 4. Reverse Feedback of Real Estate Appreciation to Current Account and Equity Market.
This table reports dynamic panel estimation, using quarterly data over the period 2005:I-2012:IV. The dependent variable is Δcurrent account deficit/GDP in the first column and Δequity market appreciation in the second column. The Global financial crisis's Break is a 1/0 binary variable, equals to 1 before 2007:III (Nothern Rock event); see also Figure 2. The crisis break enters the estimation individually, and as interaction terms with real estate appreciation/CPI series. Standard errors are in parentheses, with *** (**,*) denotes statistical significance at 1 (5,10) percent.

Regressors	lag	(1) ΔCAD/GDP coefficient (std. err.)	(2) ΔEquity Appreciation coefficient (std. err.)
ΔCAD/GDP	1	0.40 (0.04)***	-3.87 (1.42)***
	2	0.61 (0.08)***	0.87 (3.28)
	3	-0.91 (0.08)***	-1.48 (3.38)
	4	0.33 (0.03)***	0.34 (1.24)
Global financial crisis's Break	binary (1/0)	0.17 (0.10)*	4.87 (2.19)**
ΔReal estate appreciation × Before Break	1	-0.01 (0.02)	1.46 (0.67)**
	2	-0.05 (0.02)**	-0.07 (0.73)
ΔReal estate appreciation × After Break	1	-0.04 (0.01)***	1.02 (0.42)**
	2	-0.01 (0.02)	-0.01 (0.58)
ΔEquity market valuation appreciation	1	0.00 (0.00)	-0.56 (0.07)***
	2	0.00 (0.00)	1.43 (0.13)***
	3	-0.00 (0.00)	-1.24 (0.11)***
	4	0.00 (0.00)	0.41 (0.03)***
ΔCPI inflation	1	0.06 (0.03)**	-6.19 (0.95)***
ΔGrowth of industrial production	1	0.01 (0.01)*	0.56 (0.19)***
ΔTED spread	1	0.20 (0.11)*	-12.64 (3.15)***
ΔVIX	1	-0.01 (0.01)	0.01 (0.16)
ΔSovereign CDS	1	-0.02 (0.01)	-0.72 (0.43)*
Foreign reserve accumulation	1	0.01 (0.00)**	0.22 (0.12)*
constant	0	-0.07 (0.03)**	-2.30 (0.96)**
observations		789	791
Arellano-Bond AR(2) test p-value		0.921	0.600

Table 5. Appreciation vis-à-vis Depreciation Episodes of Real Estate Valuation.
This table reports dynamic panel estimation on the episode of real estate market appreciation in the first column and on the episode of real estate market depreciation in the second column, using quarterly data over the period 2005:I-2012:IV. The dependent variable is Δreal estate valuation appreciation (nominal price growth minus CPI inflation). Instead of using a Global crisis binary variable, as in Table 2 this table uses a binary variable "Current account deficit/GDP's Break" to identify country-specific turning point in the association between real estate appreciation and current account deficit/GDP, according to QLR statistics; "Domestic credit/GDP's Break" is defined similarly for growth of domestic credit/GDP; see also Figure 2. The country-specific breaks enter the estimation individually, and as interaction terms with ΔCAD/GDP and ΔDCR/GDP series. Constant term included, not reported. Standard errors in parentheses; *** (**,*) denotes significance at 1 (5,10) percent.

Dep. Var. : ΔReal estate appreciation	lag	(1) Appreciation Episodes coefficient (std. err.)	(2) Depreciation Episodes coefficient (std. err.)
ΔReal estate valuation appreciation	1	0.60 (0.03)***	0.65 (0.03)***
	2	0.87 (0.07)***	0.54 (0.05)***
	3	-0.29 (0.10)***	-0.20 (0.07)***
	4	0.03 (0.05)	0.00 (0.04)
Current account deficit/GDP's Break	binary (1/0)	2.26 (1.46)	0.68 (1.33)
ΔCAD/GDP × Before Break	1	-0.86 (0.88)	0.35 (0.85)
	2	2.83 (0.90)***	0.32 (0.79)
ΔCAD/GDP × After Break	1	-0.75 (0.81)	0.79 (0.76)
	2	2.70 (0.81)***	0.25 (0.77)
Growth of domestic credit/GDP's Break	binary (1/0)	-1.23 (1.44)	-1.25 (1.31)
ΔDCR/GDP × Before Break	1	0.13 (0.40)	0.15 (0.24)
	2	0.27 (0.26)	-0.08 (0.17)
ΔDCR/GDP × After Break	1	-0.08 (0.27)	0.36 (0.22)
	2	0.54 (0.21)**	-0.14 (0.16)
ΔCAD/GDP × ΔDCR/GDP	1	-0.01 (0.01)	-0.00 (0.01)
	2	-0.01 (0.01)	-0.01 (0.01)
ΔEquity market valuation appreciation	1	0.08 (0.06)	0.24 (0.04)***
	2	0.00 (0.10)	-0.21 (0.07)***
	3	-0.03 (0.08)	0.09 (0.06)
	4	0.02 (0.03)	-0.01 (0.02)
ΔCPI inflation	1	0.11 (0.74)	-1.13 (0.47)**
ΔGrowth of industrial production	1	-0.17 (0.14)	-0.08 (0.10)
ΔTED spread	1	-2.89 (2.80)	0.89 (1.80)
ΔVIX	1	-0.04 (0.14)	-0.03 (0.09)
ΔSovereign CDS	1	-1.62 (1.98)	-0.14 (0.22)
Foreign reserve accumulation	1	0.01 (0.07)	-0.04 (0.08)
observations		367	424
Arellano-Bond AR(2) test p-value		0.495	.

Table 6. Benchmark Results.
This table reports dynamic panel estimation, using quarterly data over the period 2005:I-2012:IV. The dependent variable is Δreal estate valuation appreciation (nominal price growth minus CPI inflation). The empirical specification is similar to that of Table 1 columm (1), but in this table both lagged Δreal estate appreciation and lagged Δequity market appreciation are endogenous regressors. The Global financial crisis's Break is a 1/0 binary variable, equals to 1 before 2007:III (Nothern Rock event) for estimation; see also Figure A. The crisis breaks enter the estimation individually, as well as interaction terms with current account deficit/GDP (ΔCAD/GDP) and with domestic credit/GDP (ΔDCR/GDP) series. Standard errors in parentheses, with *** (**,*) denotes statistical significance at 1 (5,10) percent.

Dep. Var. : ΔReal estate appreciation	lag	(1) Whole Sample	(2) Appreciation Episodes
Regressors		coefficient (std. err.)	coefficient (std. err.)
ΔReal estate valuation appreciation	1	0.63 (0.02)***	0.60 (0.03)***
	2	0.65 (0.04)***	0.88 (0.07)***
	3	-0.20 (0.06)***	-0.31 (0.10)***
	4	-0.00 (0.03)	0.03 (0.05)
Global financial crisis's Break	binary (1/0)	1.82 (1.06)*	1.93 (1.32)
ΔCAD/GDP × Before Break	1	0.79 (0.68)	0.02 (0.83)
	2	1.50 (0.61)**	1.98 (0.82)**
ΔCAD/GDP × After Break	1	0.35 (0.55)	-0.59 (0.75)
	2	1.67 (0.55)***	2.29 (0.78)***
ΔDCR/GDP × Before Break	1	0.81 (0.27)***	0.36 (0.36)
	2	-0.19 (0.19)	0.22 (0.25)
ΔDCR/GDP × After Break	1	0.12 (0.15)	-0.04 (0.25)
	2	0.11 (0.11)	0.42 (0.20)**
ΔCAD/GDP × ΔDCR/GDP	1	-0.01 (0.01)	-0.01 (0.01)
	2	-0.00 (0.01)	-0.00 (0.01)
ΔEquity market valuation appreciation	1	0.15 (0.03)***	0.07 (0.05)
	2	-0.10 (0.06)	0.01 (0.10)
	3	0.03 (0.05)	-0.03 (0.08)
	4	0.01 (0.02)	0.02 (0.03)
ΔCPI inflation	1	-0.53 (0.42)	0.24 (0.71)
ΔGrowth of industrial production	1	-0.06 (0.08)	-0.15 (0.13)
ΔTED spread	1	1.52 (1.56)	-0.96 (2.81)
ΔVIX	1	-0.04 (0.08)	-0.08 (0.14)
ΔSovereign CDS	1	-0.10 (0.21)	-1.16 (1.91)
Foreign reserve accumulation	1	0.05 (0.05)	0.02 (0.07)
constant	0	-0.95 (0.47)**	-1.18 (0.77)
observations		791	367
Arellano-Bond AR(2) test p-value		0.495	0.468

Figure 1. Mean Reversion in Real Estate Appreciation.
This figure plots cumulative real estate valuation appreciation (real estate inflation minus CPI inflation) for 2005:I-2007:III and for 2008:III-2012:IV.
The OLS estimates are given by $\qquad$ $y = -0.5x+0.8$ $\quad$ $R^2 = 0.28$.
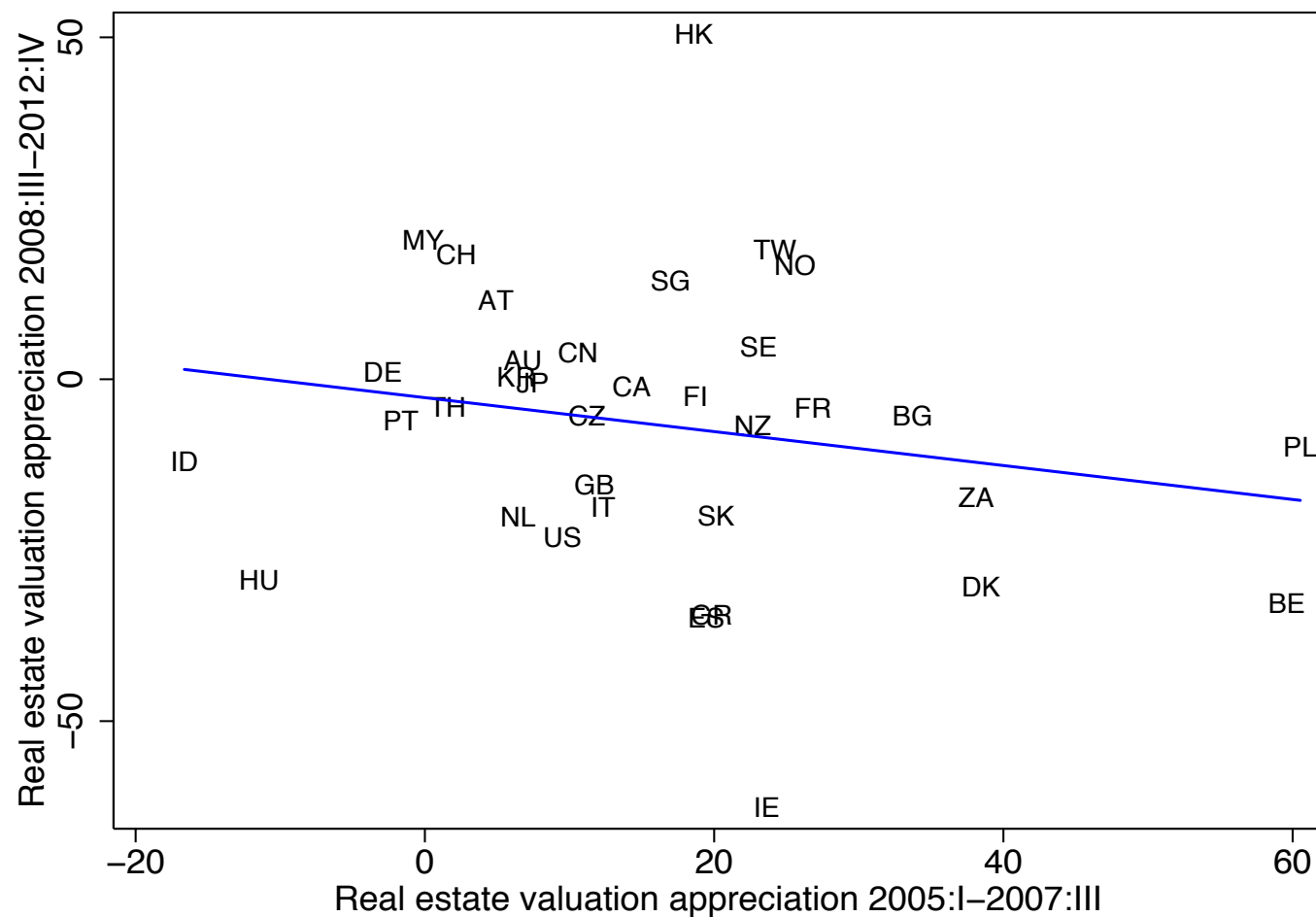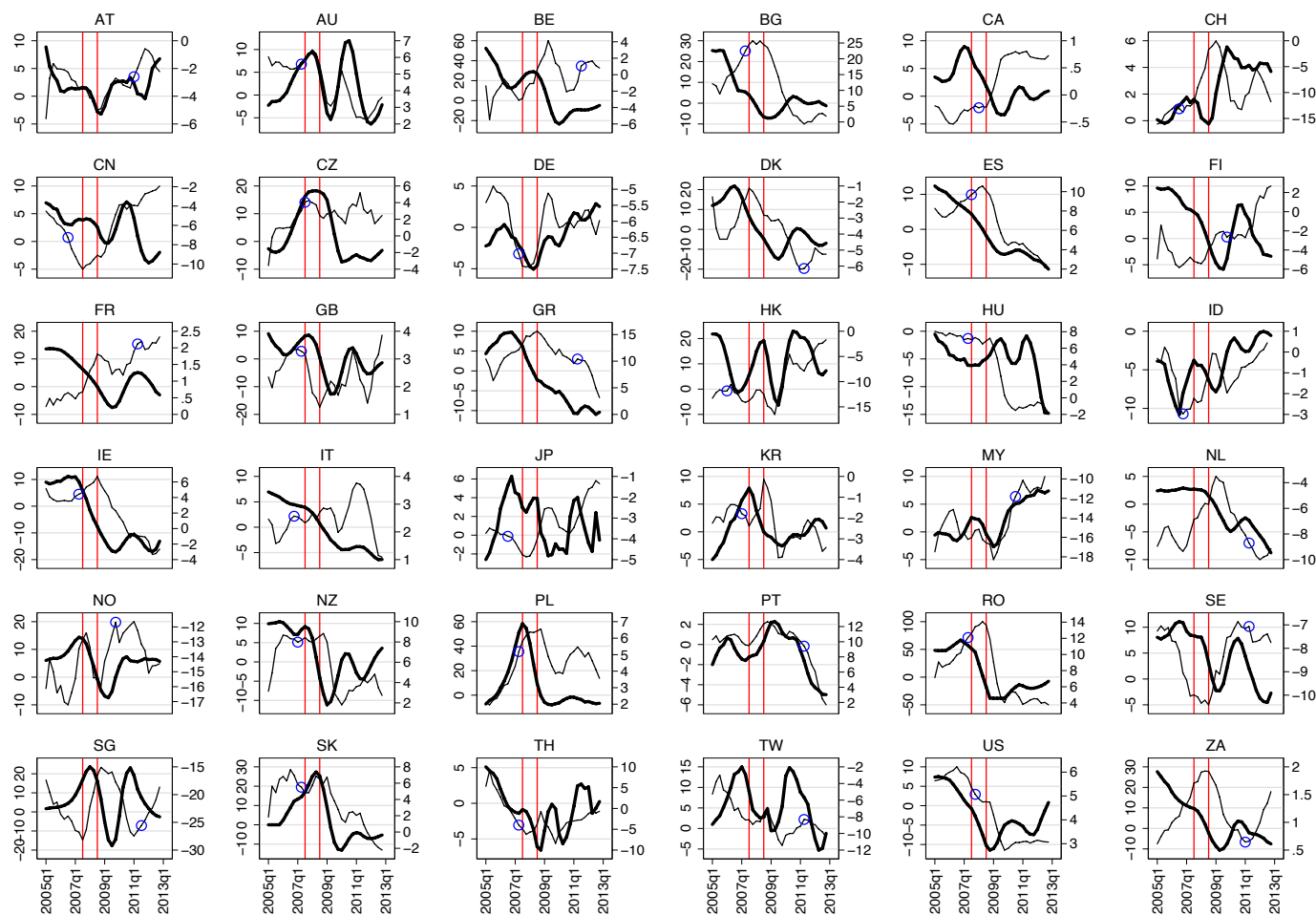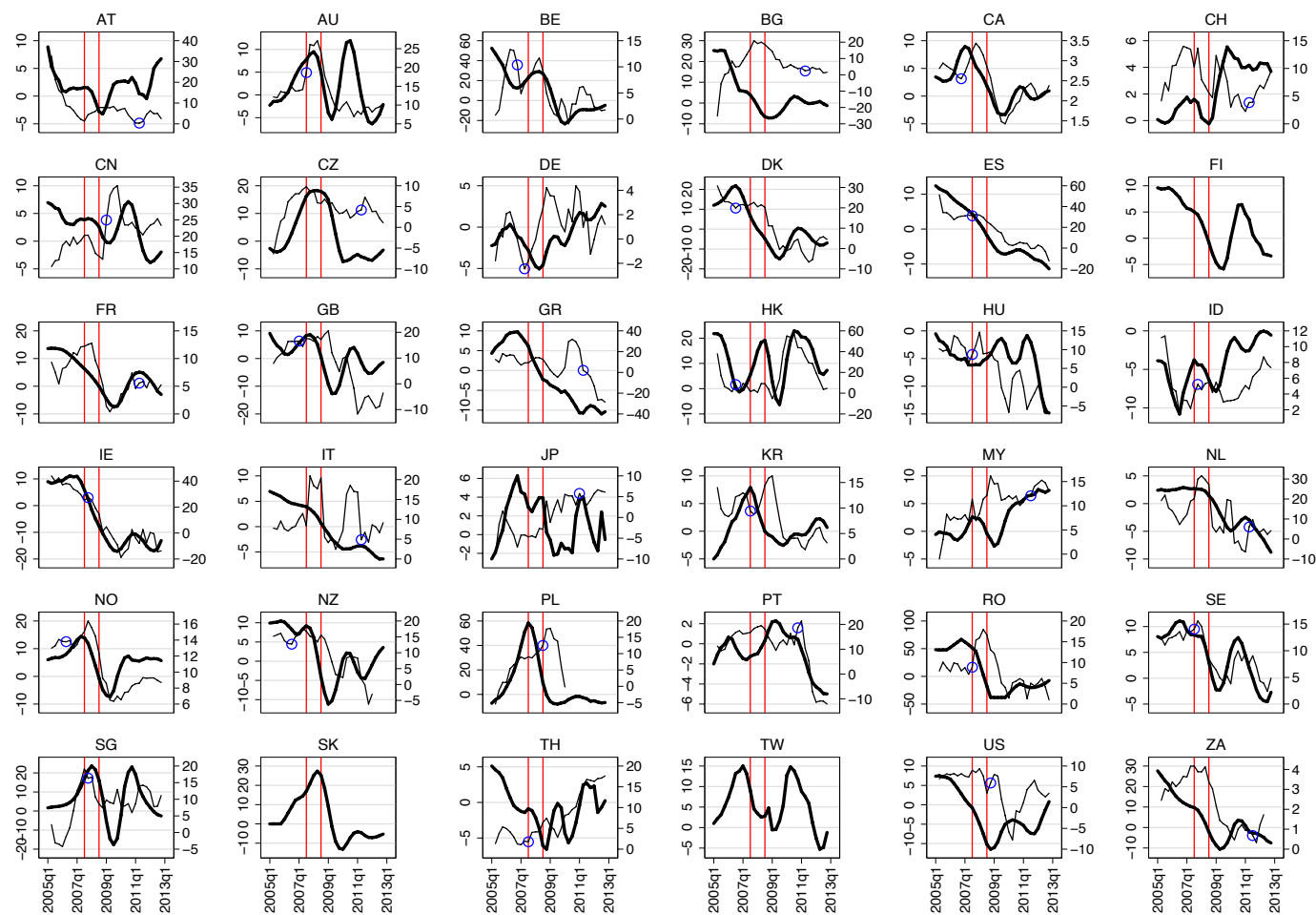$\qquad\qquad\qquad\qquad$ (s.e.) (0.1) (4.3)

Figure 2A. Real Estate Valuation Appreciation and Current Account Deficit/GDP.

Note: Real estate appreciation is a darker line on the left scale. The two vertical lines denote 2007:III and 2008:III, respectively. The circle denotes structural break in the relationship, based on QLR statistics, between the current-account deficit/GDP and the real estate valuation appreciation in the sample period.

Figure 2B. Real Estate Valuation Appreciation and Growth of Domestic Credit/GDP.

Note: Real estate appreciation is a darker line on the left scale. The two vertical lines denote 2007:III and 2008:III, respectively. The circle denotes structural break in the relationship, based on QLR statistics, between the growth of domestic credit/GDP and the real estate valuation appreciation in the sample period.

Figure 3. Economic Significance of Macro Variables on Real Estate Valuation.

This figure shows the adjustment of real estate valuation appreciation (the appreciation rate of the real estate inflation minus CPI inflation) due to a one-standard-deviation increase of changes of each macroeconomic variable, based on the regression of Table 6 for the whole sample.