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The northern ireland housing market: would unification with the south be problematic?

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Abstract

Recent political events such as Brexit, as well as changing demographics have made the unification of Northern Ireland and the Republic likelier than recently thought possible. Unification would require addressing many political and economic issues. One change would be the adoption of the currency of The Republic-the euro. A low level of co-movement between Northern Irish and euro housing markets could be problematic both for the housing market and economy of Northern Ireland. If home prices in Northern Ireland were falling, while those in the rest of the euro zone were rising, the ECB would likely tighten policy. This would be the opposite of what would be optimal for Northern Ireland. We thus study house price co-movement between Northern Ireland and eight eurozone housing markets. When we employ measures that are mainly linear, results indicate that co-movement between euro housing markets and Northern Ireland may be no worse, and perhaps even greater than current co-movement with the UK. However, the use of a metric which accounts for differences in cyclical amplitudes reveals a very low level of co-movement with euro countries compared to that with the UK. Indeed, Northern Ireland exhibits much greater idiosyncrasy with the rest of the euro markets than even Ireland or Spain, which had housing booms and busts followed by sharp recessions. Joining the euro would thus entail substantial risk for the Northern Irish housing market and, hence its macroeconomy.

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1. Introduction

The status of Northern Ireland, either as a continuing part of the United Kingdom or as part of a unified Republic of Ireland has been a source of conflict going back decades since Irish independence. While nationalists in principle seek a united Ireland, until recently such an outcome seemed quite distant. Events of the last several years have made unification more likely, and potentially closer in time than would have been thought possible (The Economist, February 13th, 2020, p. 7).

First, Brexit has upset the status quo in two important ways. Most directly, Britain's departure from the European Union was unpopular in Northern Ireland (56 percent of voters in the six counties voted to remain versus forty-eight percent overall in the UK, Economist, 2020, p. 40). Brexit has opened up unresolved issues regarding the border between Ulster and the Republic. Less directly, Brexit, also unpopular in Scotland, has led to calls for a second referendum on Scottish independence. If Scotland were to leave the UK, it would remove ties between unionists in Northern Ireland and co-ethnics in Scotland, leaving less reason for Northern Ireland to stay in the UK (Economist, 2020, p. 40). Finally, Catholics may, by the Census of 2021, outnumber Protestants for the first time. This could possibly lead to a referendum on Northern Ireland's status (Economist, 2020, p. 40).

Beyond the politics of potential reunification are economic issues. Among the more prominent would be, if unification were to actually occur, the adoption by Northern Ireland of Ireland's currency-the euro. This would have important implications for Northern Ireland's housing market and macroeconomy. Housing affects the macroeconomy through a number of channels (Hatzius, 2008). This has certainly been the case for the eurozone, where housing bubbles and busts have led to sharp recessions in Greece, Ireland and Spain.

Accordingly, central banks, although they do not formally target home values, would prefer to take house prices into account when formulating policies. This is made easier when the regional or national economies over which a central bank presides have high levels of co-movement in house prices. Given the importance of this issue to the eurozone, there have been a number of studies on house price co-movement within this currency union (Alvarez, Bulligan, Cabrero, Ferrara and Stahl, 2010, Ferrara and Koopman, 2010, Van Steenkiste and Hiebert, 2011, Gupta, Andre and Gil-Alana, 2015, Tsai, 2018).

This is an issue that will confront Northern Ireland should it join the south as one nation. Once in the eurozone, if house prices in Northern Ireland were in a downturn, while those in other euro economies are growing, the European Central Bank would likely tighten monetary policy. This policy would be beneficial for most euro countries. However, it would lead to major hardship in Northern Ireland.

In this study we examine co-movement between Northern Irish and eight major national eurozone housing markets. We also compare what co-movement is found between Northern Irish and euro markets with that between Northern Irish and UK housing, to see if leaving the pound for the euro would lead to a loss of cohesion with the major housing markets of whichever currency union the six counties may choose. We start with basic linear measures, which seem to indicate that Northern Ireland may not suffer much loss of house price co-movement with other markets by unifying with the south and joining the euro.

However, we also employ a metric which reflects differences in both the amplitude and phase of cycles. Results from this measure indicate that Northern Ireland's housing has a level of co-movement with euro markets much less than any other country in the sample. This suggests that a political and currency merger between Northern Ireland and the Republic, whatever its other costs and benefits, would be highly problematic for housing and the macroeconomy of Northern Ireland.

2. Previous Literature

The impact of possible euro membership on Northern Irish house price co-movement is of interest beyond the impact on the property sector. Housing has been demonstrated, at least for the US, to be the leading indicator of the business cycle (Leamer, 2007, 2015). For central banks, in making policy in response to housing developments, it is helpful if the different housing markets under its purview have a high level of co-movement. Otherwise, the proper tight policy for regions with booming housing markets would be devastating to regions in housing downturns. This issue is especially salient for the euro zone, as the different housing markets are not just in different regions but in different countries. House price co-movement in the eurozone has thus been the subject of several studies.

Ferrara and Koopman (2010), authors of an early such study, state the issue as follows: "The existence of a common housing cycle among the countries of the euro zone could lead the ECB to integrate more easily the evolution of this specific asset price into its assessment. On the other side, if country-specific cycles were too large, this would complicate the task of the ECB" (p. 4). Thus, co-movement of euro zone house prices has received particular attention.

Ferrara and Koopman (2010) employed multivariate unobserved components models for France, Germany, Italy and Spain, and find that while French and Spanish housing markets exhibit a high degree of co-movement, German housing is relatively idiosyncratic among these four countries. Alvarez, Bulligan, Cabrero, Ferrrara and Stahl (2010) employ the Butterworth filter and find little cohesion among the same four housing markets studied by Ferrara and Koopman.

Van Steenkiste and Hiebert (2011) use a global VAR for seven euro nations and find that while house price spillovers between countries exist, they are limited. Gupta, Andre and Gil-Alana (2015) exhibit co-movement for seven eurozone housing markets using cointegration techniques and find that German housing exhibits decidedly different dynamics compared to other countries. Tsai (2018) utilizes a panel unit root test to determine if house prices in fifteen euro countries converged, and finds they did so after 1992.

There is also a literature on house price co-movement among the thirteen different regions of the UK. It will be important to compare how Northern Ireland co-moves vis-à-vis the UK with how it co-moves with euro countries. A finding that there is a low level of co-movement with euro countries does not necessarily imply that a move to the eurozone will cause difficulties relative to what Northern Ireland has now in the "pound" zone. Some papers on house price co-movement in the UK have found that Northern Ireland has little co-movement with housing markets in the rest of the Great Britain. Holmes and Grimes (2008) for instance found that regions further from London have the most persistent deviations from overall UK house prices. We will thus compare Northern Irish co-movement with euro housing markets as well as with the UK.

3. Data and Methodology

The Mack-Garcia database (Mack and Garcia, 2011-the database is continuously updated) contains quarterly house price data for a set of countries, including a number in the eurozone. We thus use the Mack-Garcia indices for eight of the larger euro economies-Belgium, Finland, France, Germany, Ireland, Italy, The Netherlands and Spain. For comparison purposes to be specified below, we also obtain data from the Mack-Garcia database on the UK. Data for Northern Ireland is taken from the Nationwide Building Society. All data is seasonally adjusted and runs from 1975:1 through 2019:3.

We will filter our data with the Christiano-Fitzgerald method, as did Mink et al. (2012). We will decompose each national (and Northern Irish) house price series into a trend and a cycle. What is left of the series is designated as the trend. We divide the cycle by the trend for each housing market to obtain the house price gap. We will employ two different frequencies for calculating these gaps. Given that housing cycles are often longer in duration than business cycles, we will first calculate measures based on cycles of between five and ten years of duration. As a robustness check, we will also calculate fluctuations at a business cycle frequency of one-half to two-and-a-half years. We will find the same patterns in terms of co-movement at both frequencies.

Having obtained the gaps, we will employ a measure developed by Mink et al. (2012) called synchronicity. This is computed as follows:

$$\varphi_{ir}(t) = (g_i(t)g_r(t))/(|\, g_i(t)g_r(t)|) \qquad (1)$$

Here, $g_i(t)$ is the housing gap for a country or Northern Ireland, while $g_r(t)$ is the reference gap. One could choose one particular housing market, but Mink et al. employed the median of all gaps in the sample, so we will do so as well. This metric has a value of 1 if the specific housing market (Northern Ireland, The UK or a euro nation) is in the same cyclical phase-expansion or contraction-as the reference gap. If the reference and national housing markets are in opposite cyclical phases, synchronicity takes a value of minus one. We will calculate synchronicity for a sample consisting of Northern Ireland and the eight euro countries. We will then, for comparison purposes calculate synchronicity for a sample consisting of Northern Ireland and the UK. Finally, although we include Ireland in the initial sample as a euro country, we will also compute synchronicity for a sample including just Ireland and Northern Ireland, as the Republic will of course have major influence on (non-monetary) housing policy in the six counties should unification occur. We will calculate average values for synchronicity over the sample and attempt to discern how often Northern Ireland might be in the same cyclical phase with the UK versus eurozone countries.

Of course, simply being in the same phase of a cycle does not necessarily indicate a high degree of cyclical co-movement. If Northern Ireland joins the eurozone, and its house prices are going through a bubble phase while those in the rest of the eurozone are only mildly rising, synchronicity would indicate a high level of co-movement, while in fact Northern Ireland would not in this case be very cohesive with the other euro nations. In terms of policy, Northern Ireland would benefit from a much tighter monetary stance than would be optimal for the other housing markets.

Mink et al. have fortunately developed a measure called similarity, calculated as follows:

$$\gamma_{it}(t) = 1 - (|\, g_i(t) - g_r(t)|) / \sum_{i=1}^{n} |\, g_i(t)|/n \quad (2)$$

This measure reflects both differences in the phase of a cycle between two housing markets and also differences in amplitude. It can range from a low of 2-n, where n is the number if markets in the sample, to a high of one. We will, as with synchronicity, compute one set of similarity measures for a sample including Northern Ireland and eight euro members, as well as a sample with just Northern Ireland and the UK and lastly a sample of Northern Ireland and The Republic. A key advantage of the Mink et al. measures is that they are calculated for each quarter, so that cohesion can be observed through time. This is in contrast to some other measures which yield only one value for an entire sample. This similarity measure can thus be tested for structural change, in order to see if there were significant shifts in cohesion, and if these changes are associated with euro membership. We will thus, as did Mink et al. employ the Andrews-Ploberger test. This allows for a break to be determined endogenously from the data, rather than being imposed by the researcher. Choosing a break date based on knowledge of the data can lead to erroneous inference (Hansen, 1992) so the Andrews-Ploberger method is to be preferred. We follow Mink et al. and regress each housing market similarity measure on a constant and trend, and use the Andrews-Ploberger test to discern endogenous structural change.

4. Results

In Table 1 we show the correlations between the Christiano-Fitzgerald-filtered, five to ten year cyclical gaps of Northern Ireland and the housing markets of the UK and the eight euro nations. This table displays correlations for the full sample running from 1975:1 to 2019:3. We see that Northern Ireland's highest correlation is with the Republic of Ireland-indicating, based on this initial linear measure, that uniting with the south could actually be beneficial in terms of co-movement with relevant housing markets. Co-movement with the UK is ranked fourth of nine markets. This is not terrible-there are five euro housing markets-those for France, Netherlands, Finland, Germany and Italy-which exhibit less linear cohesion with Northern Ireland than the UK, so that moving to the euro zone may entail some risks. But the fact that co-movement with Ireland is so high at least suggests that joining the euro zone may not lead to a monetary policy less suited to Ulster than it currently has with the Bank of England.

Table 1
Correlations Between Northern Ireland and National Medium Cycle Housing Gaps
Whole Sample 1975:1-2019:3

Nation	Correlation
Ireland	0.824937
Belgium	0.766552
Spain	0.679295
UK	0.516474
France	0.330757
Netherlands	0.113359
Finland	0.087768
Germany	-0.26633
Italy	-0.3526

These are correlations for gaps calculated with the Christiano-Fitzgerald filter for cycles of five to ten years.

Table 2 displays results for the pre-euro period running from 1975:1-1998:4. In terms of ranking national housing markets by their correlations with Northern Ireland, the results are identical to those in Table 1-there is no difference in relative ranking between pre-euro and full sample quarters. In Table 3 the medium-duration correlations of the housing gaps for the euro sample of 1999:1-2019:3 are shown. The results are similar, but bot identical, to those of Tables 1 and 2. Ireland still has the highest correlation with Northern Ireland. Germany, on the other hand, now has the lowest correlation with Northern Ireland. In addition, the UK has the third-highest correlation with Northern Ireland for these medium-duration gaps, and thus moving from the "pound zone" to the euro may not be painless. Nevertheless, results from Tables 1 through 3 indicate that moving to the euro may not be problematic for Northern Ireland.

Table 2
Correlations Between Northern Ireland and National Housing Medium Cycle Gaps
Pre-Euro Sample 1975:1-1998:4

Nation	Correlation
Ireland	0.800133
Belgium	0.748782
Spain	0.715238
UK	0.536122
France	0.183953
Netherlands	0.089758
Finland	0.013203
Germany	-0.31582
Italy	-0.51061

These are correlations for gaps calculated with the Christiano-Fitzgerald filter for cycles of five to ten years.

Table 3
Correlations Between Northern Ireland and National Housing Medium Cycle Gaps
Euro Sample 1999:1-2019:3

Nation	Correlation
Ireland	0.912514
Belgium	0.807438
UK	0.764175
Spain	0.741253
France	0.53459
Finland	0.376329
Italy	0.322698
Netherlands	0.184367
Germany	-0.23039

These are correlations for gaps calculated with the Christiano-Fitzgerald filter for cycles of five to ten years.

Table 4 displays the synchronicity results. The nine numbers for the housing markets displayed in the Table are the average medium-term synchronicity values calculated using a sample of regions consisting of Northern Ireland and the eight euro countries. The UK is not included in this sample, as it is not in the euro zone, so we also calculated synchronicity for a sample consisting of the UK and Northern Ireland. Although we included The Republic of Ireland in the sample with the euro countries, we also calculate synchronicity with a sample consisting of only Ireland and Northern Ireland, given the role of the Republic in Northern Irish housing policy in the event of unification.

For the sample with Northern Ireland and the euro countries, Ulster ranks sixth of nine housing markets in terms of overall synchronicity. While not high, the ranking of sixth is higher than that of euro economies Italy, Germany and The Netherlands.

As the legend in Table 4 displays, synchronicity between Northern Ireland and the UK is 0.5195333. Thus the synchronicity measure seems to indicate relatively close co-movement between Northern Irish and UK housing markets. This would be a reason to question Northern

Ireland's leaving the UK. However, synchronicity between Northern Ireland and the Republic is even higher, at 0.72067. Again, the linear measures indicate union with the south could be beneficial.

Table 4
Average Medium Cycle Synchronicity Results with Euro Countries

Country	Synchronicity
France	0.642458
Belgium	0.575419
Finland	0.575419
Spain	0.575419
Ireland	0.564246
N. Ireland	0.463687
Italy	0.441341
Germany	0.217877
Netherlands	-0.08379

The average synchronicity values over the sample were calculated using the median gap among Belgium, Finland, France, Germany, Ireland, Italy, The Netherlands, Northern Ireland and Spain. We note that when synchronicity was calculated between Northern Ireland and the UK, the value was 0.519553. When we calculated synchronicity between Northern Ireland and Ireland, the average synchronicity value was 0.72067.

Based on the correlation and synchronicity analysis, unification of Ireland and euro membership may not seem that hazardous compared to the current weak relationship between Northern Irish and UK housing markets. As all of these preceding measures only gauge linear co-movement and whether Northern Irish and other markets were in the same cyclical phase, with no accounting for differences in the magnitude of fluctuations, we turn in Table 5 to the results for the similarity metric.

As we did with synchronicity, we calculated a similarity measure for a sample including Northern Ireland and the housing markets of eight euro countries, with the results displayed in Table 5. We also calculated similarity for a sample consisting of Northern Ireland and the UK, as well as for a sample of Northern Ireland and Ireland.

Table 5
Average Medium Cycle Similarity Results with Euro Countries

Country	Similarity
Belgium	0.68615
France	0.595527
Spain	0.5242
Germany	0.511072
Finland	0.240858
Italy	0.146488
Netherlands	0.023685
Ireland	-0.62735
N. Ireland	-0.84829

The average similarity values over the sample were calculated using the median gap among Belgium, Finland, France, Germany, Ireland, Italy, The Netherlands, Northern Ireland and Spain. We note that when similarity was calculated between Northern Ireland Ireland, it was 0.19346. That between Ireland and the UK was 0.249655.

Results for similarity, which incorporates non-linear aspects of cyclical differences, are in stark contrast to those from the correlation and synchronicity measures. Similarity for Northern Ireland ranks last compared to all euro countries in our sample. These results are essentially the opposite of those of the linear metrics.

We also calculated medium-duration similarity for Northern Ireland and Ireland, as well as Northern Ireland and the UK. As discussed in the legend to Table 5, the medium similarity between Ireland and Northern Ireland is 0.19346. That between Northern Ireland and the UK is higher, at 0.249655, suggesting greater cohesion with the UK than the Republic. At the same time, the overall results in Table 5 suggest that joining the euro zone could be extremely problematic.

Table 6 displays results from regressing, as in Mink et al. (2012), each of the three short-term similarity measures (Northern Ireland/Euro countries, Northern Ireland/Ireland, Northern Ireland/UK) on a constant and trend, and testing for an endogenous break with the Andrews-Ploberger test.

. As displayed in the Table, the trends for the Northern Ireland/UK and Northern Ireland/Ireland are not significant. However, the trend for the Northern Ireland/Euro similarity is actually negative and significant, suggesting a decrease in cohesion. There is a significant break in the trend at 1999:4, in the first year of the euro's existence. The Northern Ireland/euro

medium similarity is falling at that point. Overall, these results, like those from examining short-term similarity suggest union with the Republic and joining the euro zone could be highly problematic for Ulster.

Table 6
Trends and Breaks for Medium Cycle Similarity

Similarity Measure	Trend Coefficient	Standard Error	P-Value	Break
N. I./Euro	-0.008767	0.001499	0.0000	1999:4
N. I./UK	-0.000624	0.000906	0.4918	2013:1
N. I./Ireland	0.001182	0.00092	0.2007	1988:3

Each similarity measure was regressed on a constant and trend, and tested for a break with the Andrews-Ploberger method. The P-value column displays the significance of the trend. As displayed, the trend for NI/euro similarity is significant at less than the one percent level, while the trends for the NI/UK and NI/Ireland similarity measures are not significant. The breaks for all three similarity measures are significant.

Housing cycles are longer than business cycles-Drehmann et al. (2012) find medium cycles in housing and credit characterize the financial cycle. Shorter frequency business cycles, however, are still relevant for housing (Leamer (2007) titles his paper "Housing IS the Business Cycle"). We thus, as a robustness check, compute the correlation, synchronicity and similarity measures we did for Tables 1 through 5 with such metrics calculated based on cycles lasting six months to two-and-a-half years.

Table 7
Correlations Between Northern Ireland and National Housing Short Cycle Gaps
Whole Sample 1975:1-2019:3

Nation	Correlation
Italy	0.109268
Finland	0.093288
Germany	0.05138
Belgium	0.04815
Spain	0.042574
France	0.033315
Netherlands	0.011551
UK	-0.22807
Ireland	-0.30901

These are correlations for gaps calculated with the Christiano-Fitzgerald filter for cycles of one-half to two-and a half years.

Table 7 shows that Northern Ireland's lowest correlation is with the Republic-a very different result from that found using medium cycles. Correlation with the UK housing market is second lowest, however, so the results looking at the linear measure may at first glance be ambiguous. In Table 8 we display correlations for the pre-euro quarters. Once again, the lowest co-movement is with the Republic, but the second-lowest is with the UK. In Table 9, correlations for the euro quarters indicate that cohesion between the Republic and Ireland may have become just slightly greater in the euro years-the correlation with Ireland is now the second lowest, rather than the lowest of all markets in the sample. However, correlation with the UK is now the fourth-highest in the sample. This might indicate that leaving the pound for the euro could be a problem.

Table 8
Correlations Between Northern Ireland and National Housing Gaps
Pre-Euro Sample 1975:1-1998:4

Nation	Correlation
Italy	0.169211
Belgium	0.133709
Spain	0.079261
Finland	0.073302
Netherlands	0.034979
France	0.029333
Germany	-0.0283
UK	-0.39548
Ireland	-0.41404

These are correlations for gaps calculated with the Christiano-Fitzgerald filter for cycles of one-half to two-and a half years.

Table 10 shows the short-cycle synchronicity results. Northern Ireland ranks next-to-last in the sample including the euro countries. As noted in the legend of Table 10, when synchronicity is calculated between Northern Ireland and the Republic, or between Northern Ireland and the UK, we get negative and identical values for both.

Table 9
Correlations Between Northern Ireland and National Housing Gaps
Euro Sample 1999:1-2019:3

Nation	Correlation
Finland	0.119353
Germany	0.094365
France	0.039605
UK	0.014547
Netherlands	-0.09881
Italy	-0.11431
Belgium	-0.14406
Ireland	-0.16884
Spain	-0.21968

These are correlations for gaps calculated with the Christiano-Fitzgerald filter for cycles of one-half to two-and a half years.

Whatever ambiguities about Northern Ireland's suitability for the euro obtained from linear measures, Table 11 provides strong evidence of serious problems should there be unification of the two regions. Northern Ireland was by far the lowest similarity measure of any country in the euro zone with these short cycles. Moreover, as displayed in the legend to Table 11, when similarity is calculated between Northern Ireland and the UK, the value is negative. However, the value for similarity between Northern Ireland and the Republic is also negative and even lower than that with the UK. Thus, even for short cycles, the same picture of great risk from euro membership arises as we found using more realistic longer cycles.

Table 10
Average Short Cycle Synchronicity Results with Euro Countries

Country	Synchronicity
Italy	0.418994
France	0.407821
Germany	0.385475
Belgium	0.351955
Netherlands	0.296089
Finland	0.273743
N. Ireland	0.26257
Ireland	0.251397
Spain	0.22905

These are the average values for synchronicity calculated with the Christiano-Fitzgerald filter for cycles of one-half to two-and a half years. We note that when synchronicity was calculated between Northern Ireland and the UK, the value was -0.1955. When we calculated synchronicity between Northern Ireland and Ireland, the average synchronicity value was an identical -0.1955.

As we did for the metrics calculated with medium cycles, we regress similarity on a constant and trend and test for structural change. As displayed, the trend with the euro countries is negative and significant, and the largest of all trends in magnitude. There is a break at 2008, suggesting a movement away from the euro zone housing markets. This could be related to the euro financial crisis, which did not hit Northern Irish housing nearly as badly as it did the south. This result would indicate that moving into the euro zone could be very hazardous.

Table 11
Average Similarity Results with Euro Countries

Country	Similarity
Belgium	0.723621
Germany	0.624552
France	0.492532
Finland	0.315919
Italy	0.220151
Netherlands	-0.0223
Ireland	-0.20603
Spain	-0.2624
N. Ireland	-1.3177

The average similarity values over the sample were calculated using the median gap among Belgium, Finland, France, Germany, Ireland, Italy, The Netherlands, Northern Ireland and Spain. We note that when similarity was calculated between Northern Ireland and the UK, the value was -0.307424, which is higher than that found using Ireland (-0.6801).

The trend with the UK is not significant, although it is positive. There is a break at 1999:1 at the start of the euro. The fact that there is a positive, but insignificant break with the UK suggests that co-movement is at least not getting worse with Northern Ireland's current dominant housing market. At the same time, the trend with Ireland, while having no significant break, is positive, and significant at the ten, but not five percent level. Overall, however the negative and significant trend in similarity with euro countries is a clear warning sign for union with the south.

Table 12
Trends and Breaks for Short Cycle Similarity

Similarity Measure	Trend Coefficient	Standard Error	P-Value	Break
N. I./Euro	-0.010731	0.002348	0.0000	2008:2
N. I./UK	0.00065	0.000821	0.4297	1999:1
N. I./Ireland	0.001354	0.000784	0.0858	None

Each similarity measure was regressed on a constant and trend, and tested for a break with the Andrews-Ploberger method. The P-value column displays the significance of the trend. As displayed, the trend for NI/Euro similarity is significant at less than the one percent level, while that for NI/Ireland is significant at the ten percent level, and that for NI/UK is not significant. The breaks for the N.I./Euro and NI/UK similarity measures are both significant at less than the five percent level, while that for NI/Ireland similarity was not.

4. Conclusion

There are many contentious issues regarding Northern Ireland's possible unification with the south, or continued union with the UK. And of course the cohesion of the housing market with other markets in a currency union should not be taken as the only consideration. Nonetheless, given housing's role in financial and macroeconomic crises, the very idiosyncratic nature of Northern Ireland's housing market could be a serious problem in the event of unification.

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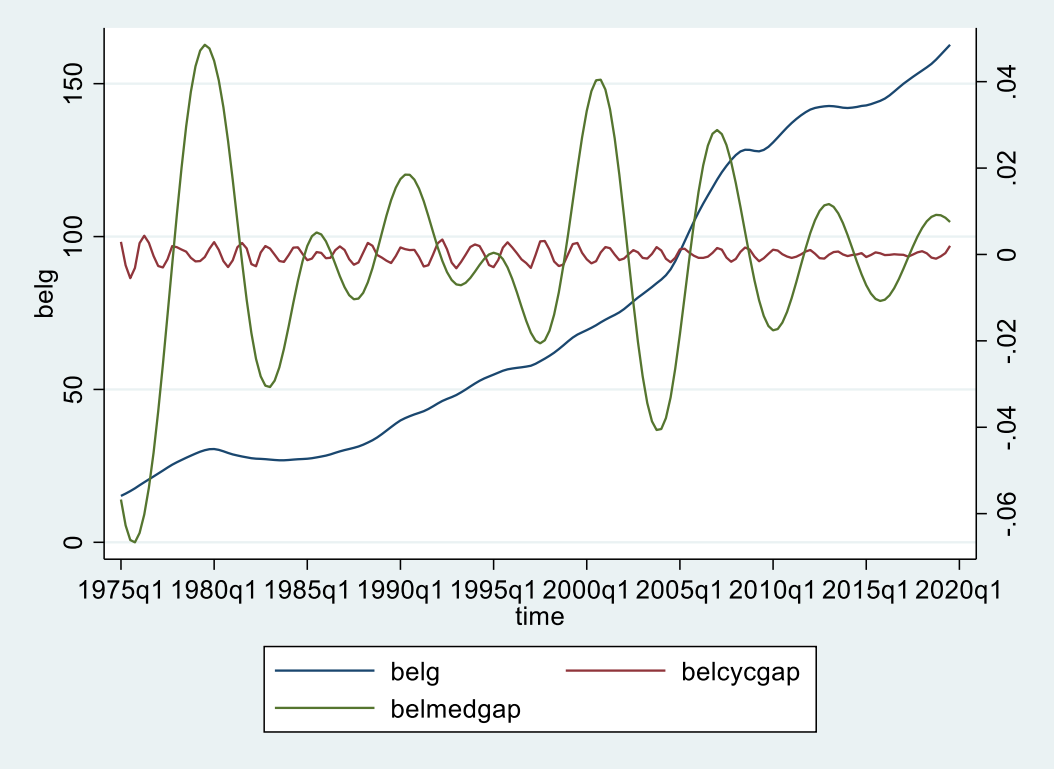
Appendix

Appendix Figures 1 through 10 display the home prices (the series rising through time), the gaps calculated from medium duration cycles (the "medgap" series, these have high amplitudes) and the gaps based on shorter cycles (these gaps have much lower amplitude than the medium gaps). One notable pattern from the figures is that the volatility of the medium gaps appears to have for the most part diminished in recent years. In eight of the ten countries, the medium gap is less volatile towards the end of the sample than in earlier years, with the exceptions to this pattern being Germany and Northern Ireland.

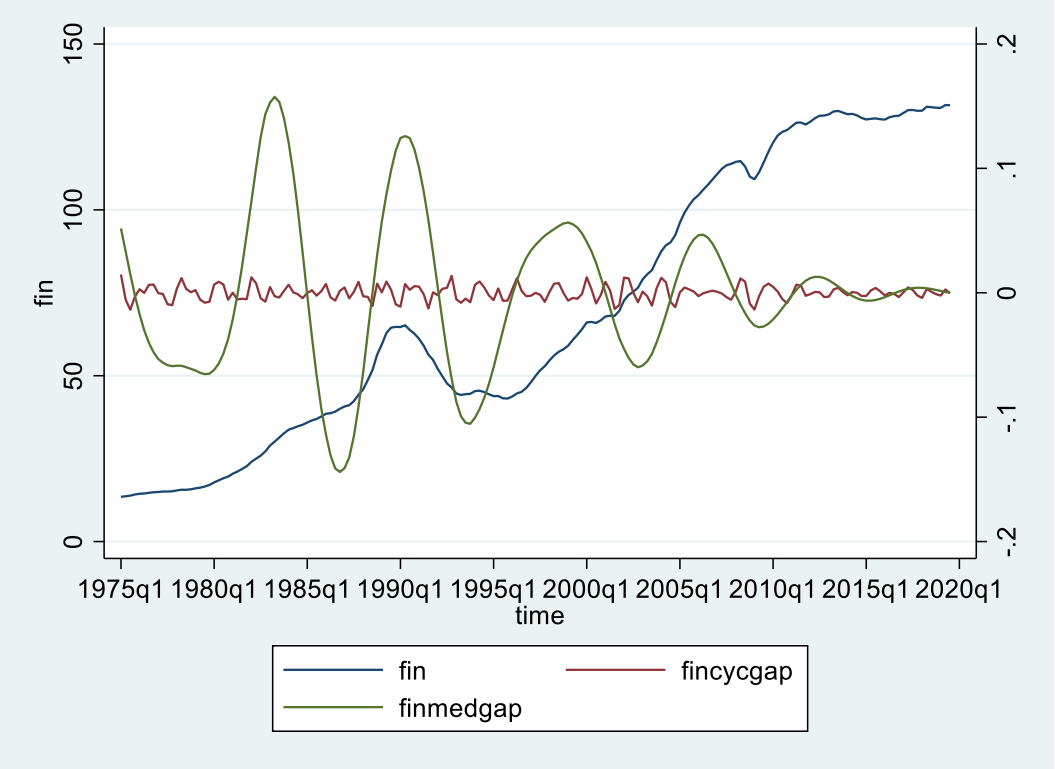
The pattern with the shorter cyclical gaps is not as clear. They exhibit declining variability for Italy, the Netherlands and Spain, but greater volatility later in the sample for Germany, and the rest of the housing markets do not exhibit any real pattern.

Appendix Figure 1: Belgium



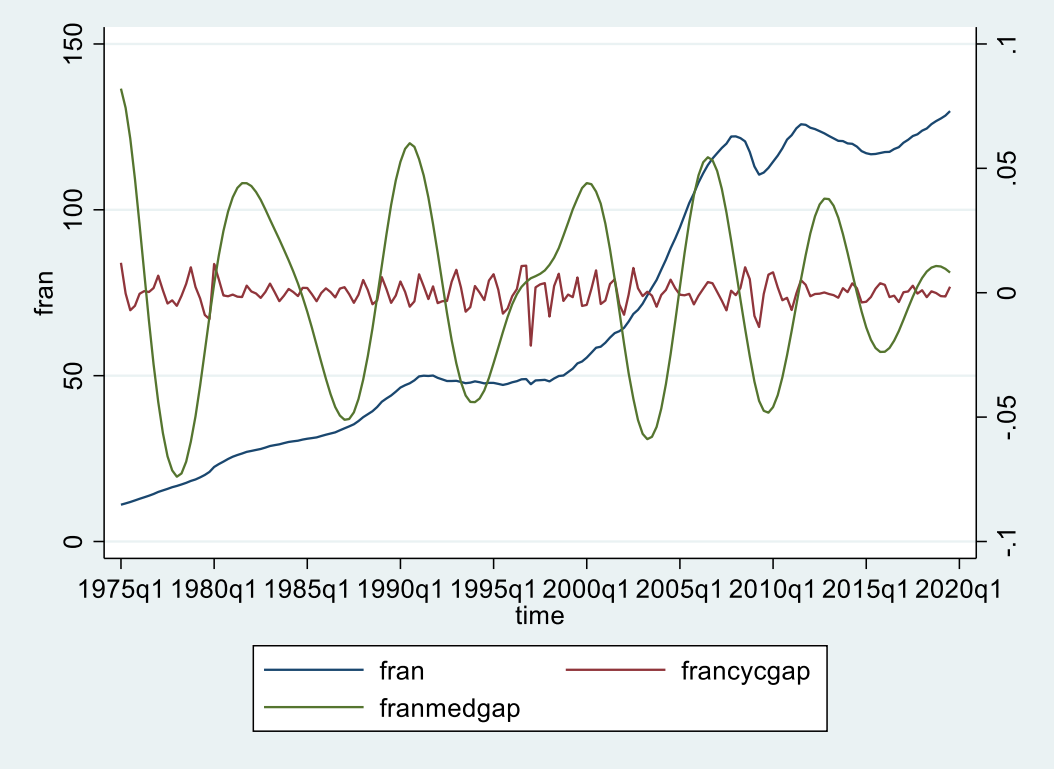
Belg is the Belgian house price series, belcycgap is the short-term Christiano-Fitzgerald filtered gap (cycle over trend) and belmedgap is the medium-term Christiano-Fitzgerald filtered gap.

Appendix Figure 2: Finland



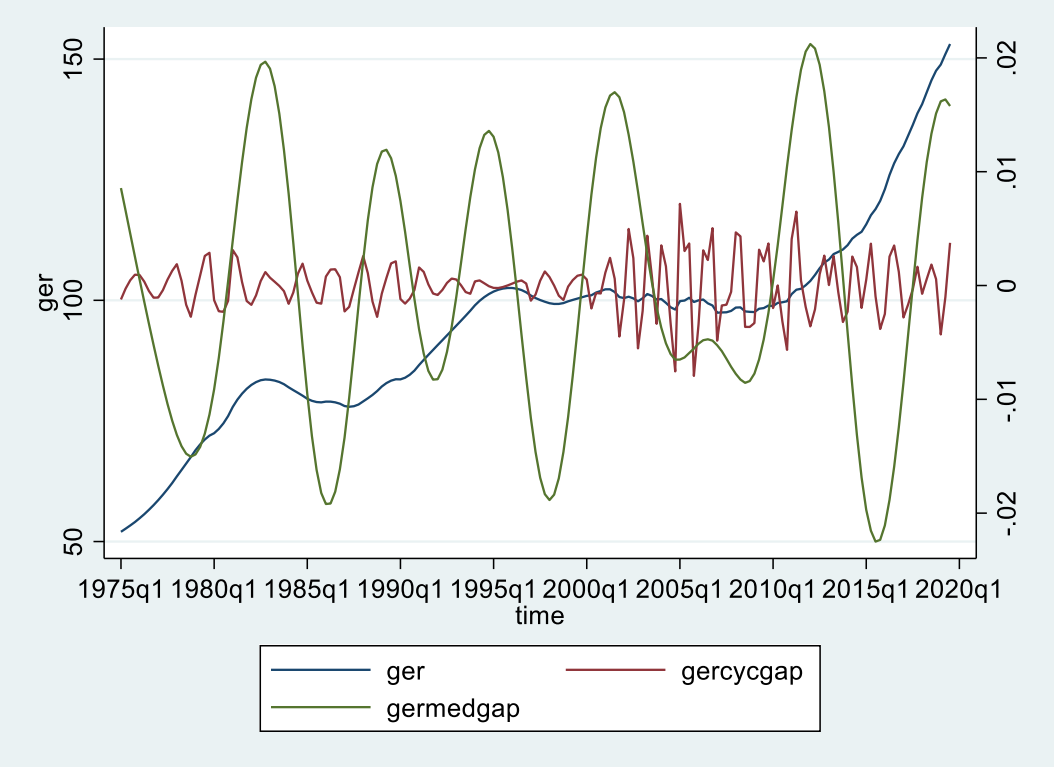
Fin is the Finnish house price series, fincycgap is the short-term Christiano-Fitzgerald filtered gap (cycle over trend) and finmedgap is the medium-term Christiano-Fitzgerald filtered gap.

Appendix Figure 3: France



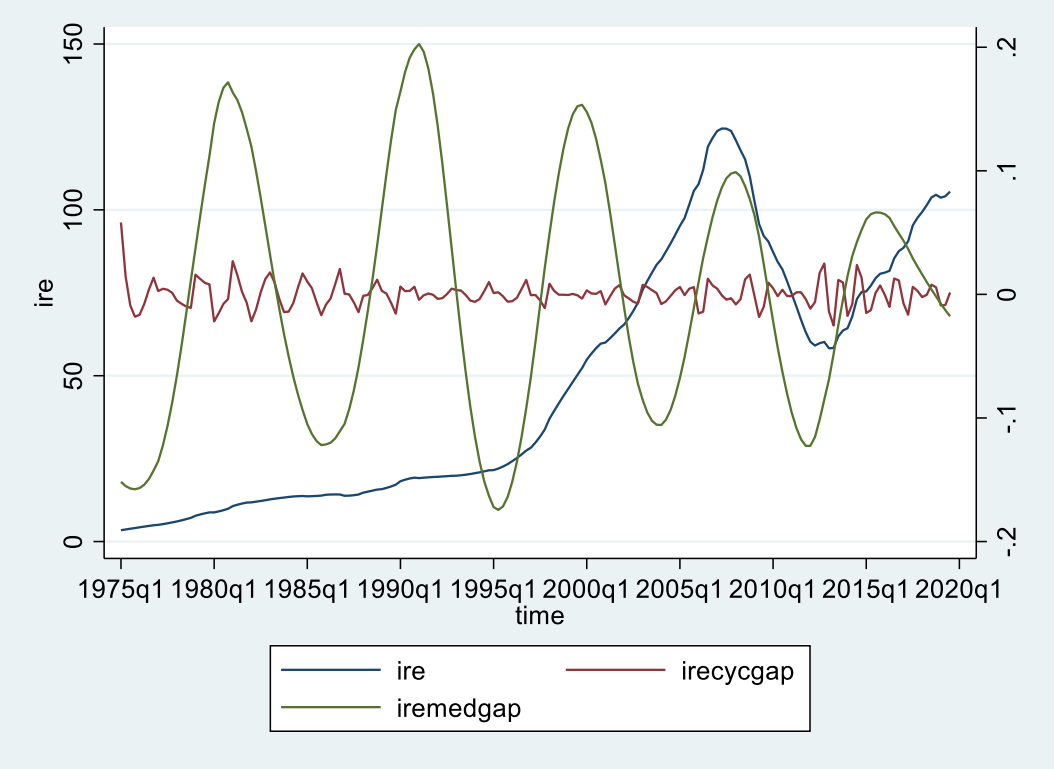
Fran is the French house price series, francycgap is the short-term Christiano-Fitzgerald filtered gap (cycle over trend) and franmedgap is the medium-term Christiano-Fitzgerald filtered gap.

Appendix Figure 4: Germany



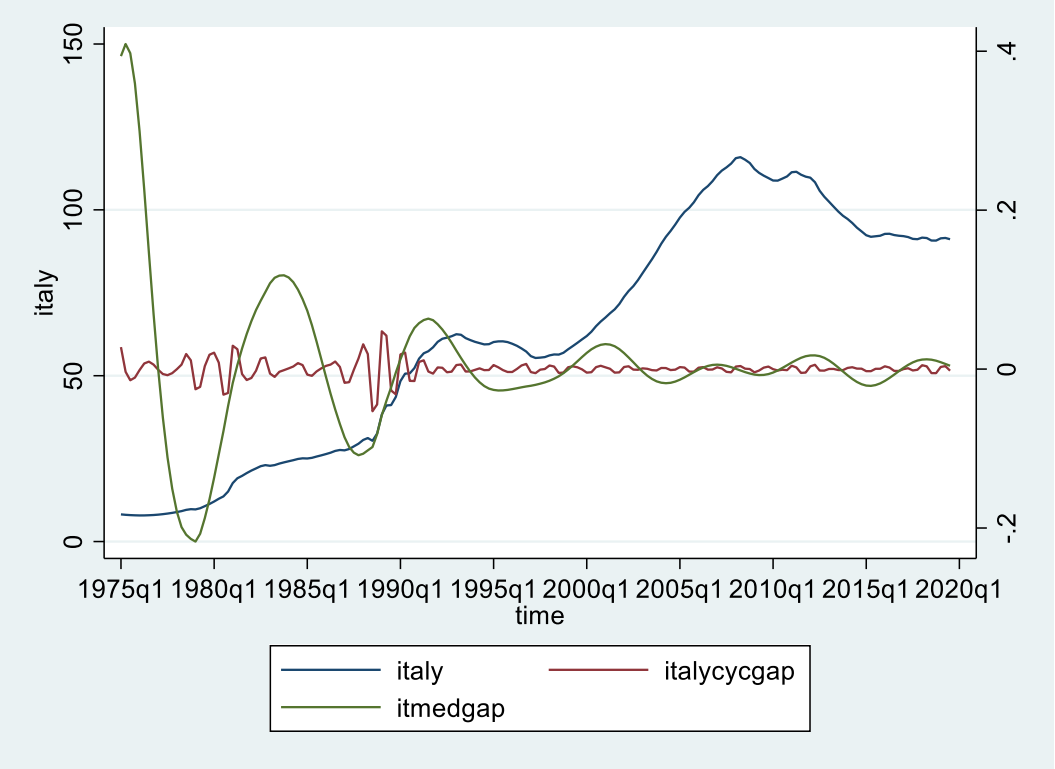
Ger is the German house price series, gercycgap is the short-term Christiano-Fitzgerald filtered gap (cycle over trend) and germedgap is the medium-term Christiano-Fitzgerald filtered gap.

Appendix Figure 5: Ireland



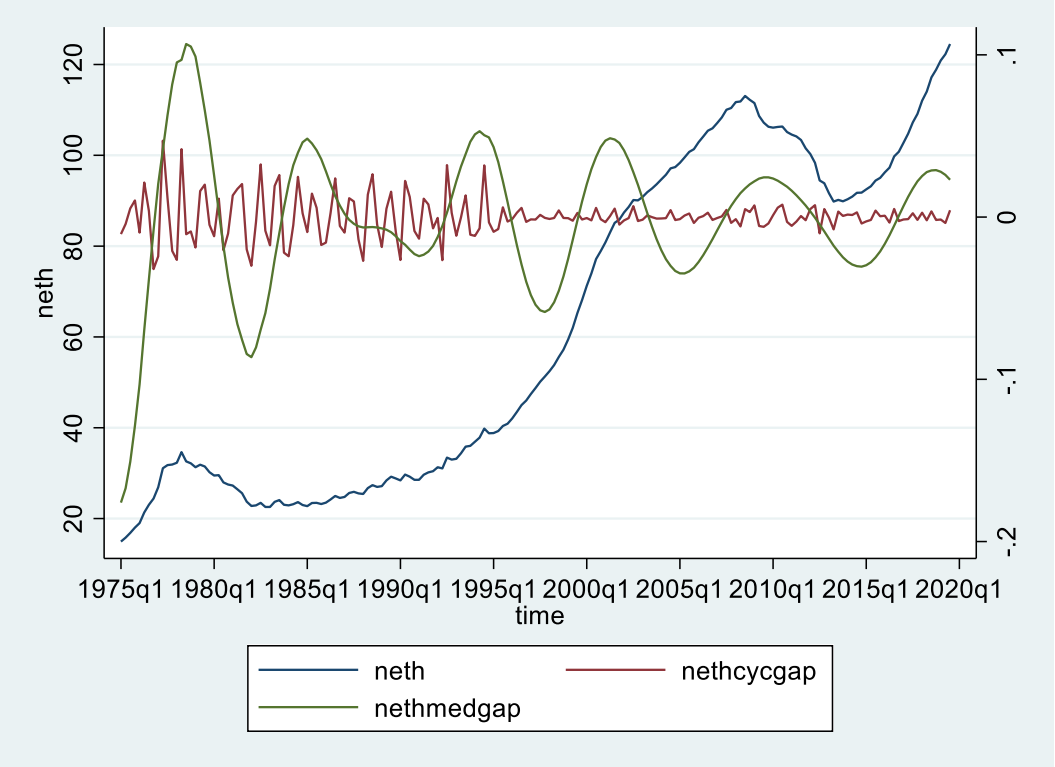
Ire is the Irish house price series, irecycgap is the short-term Christiano-Fitzgerald filtered gap (cycle over trend) and iremedgap is the medium-term Christiano-Fitzgerald filtered gap.

Appendix Figure 6: Italy



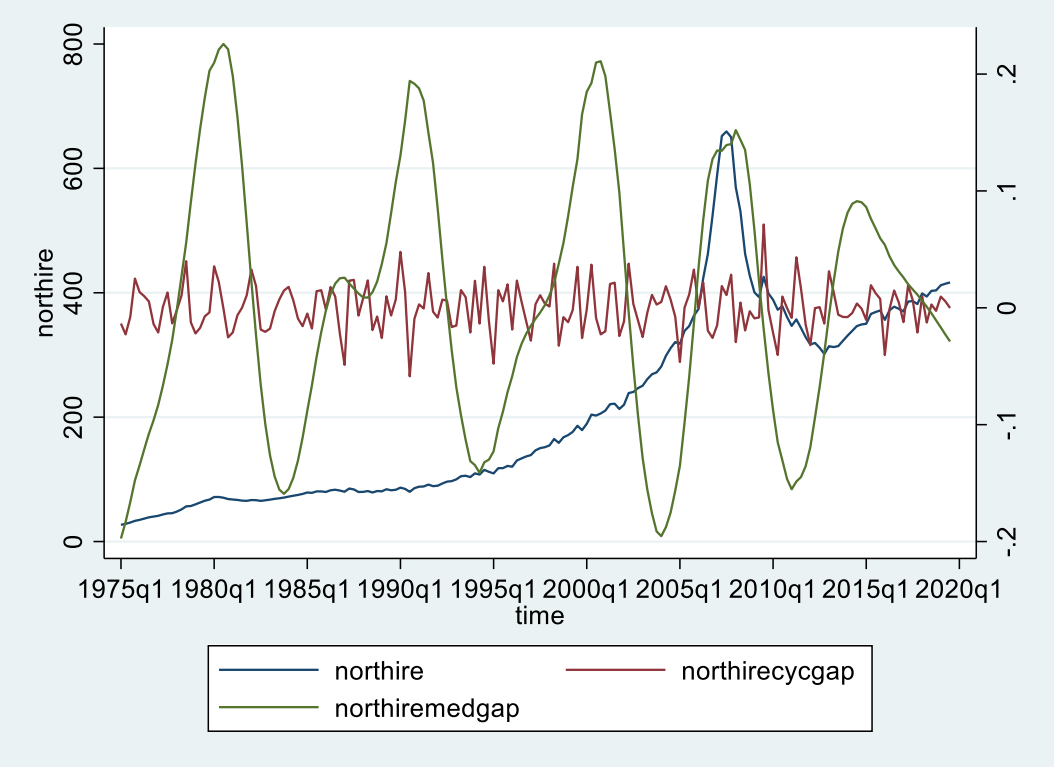
Italy is the Italian house price series, italycycgap is the short-term Christiano-Fitzgerald filtered gap (cycle over trend) and itmedgap is the medium-term Christiano-Fitzgerald filtered gap.

Appendix Figure 7: Netherlands



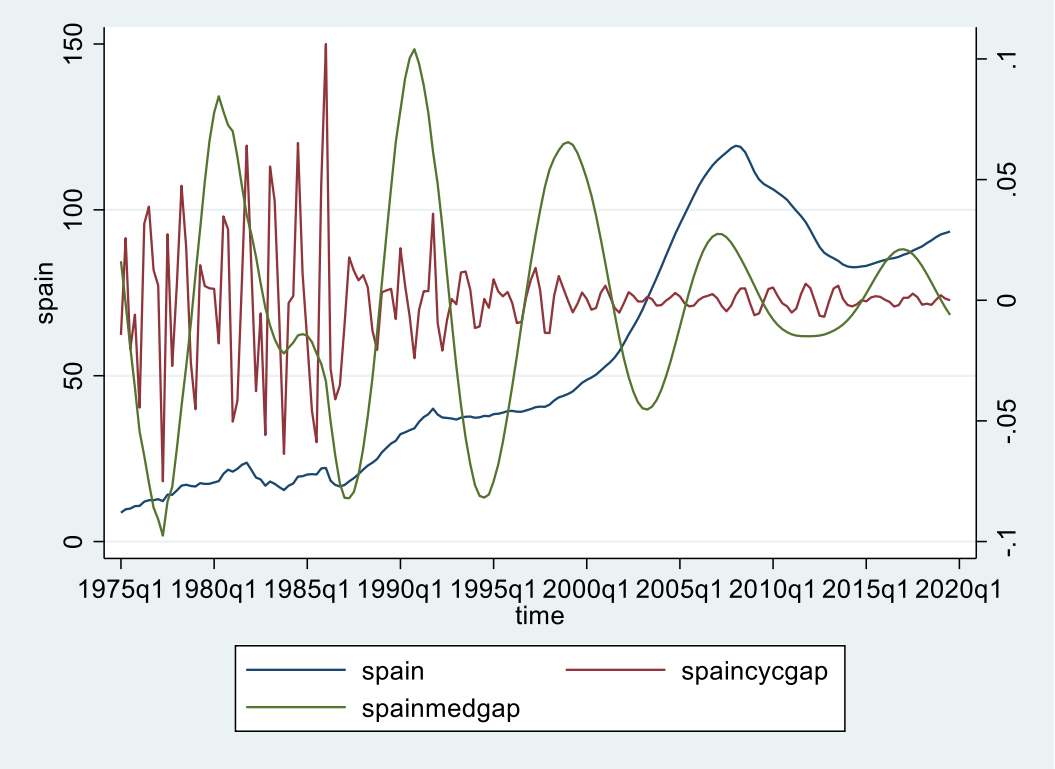
Neth is the Netherlands house price series, nethcycgap is the short-term Christiano-Fitzgerald filtered gap (cycle over trend) and nethmedgap is the medium-term Christiano-Fitzgerald filtered gap.

Appendix Figure 8: Northern Ireland



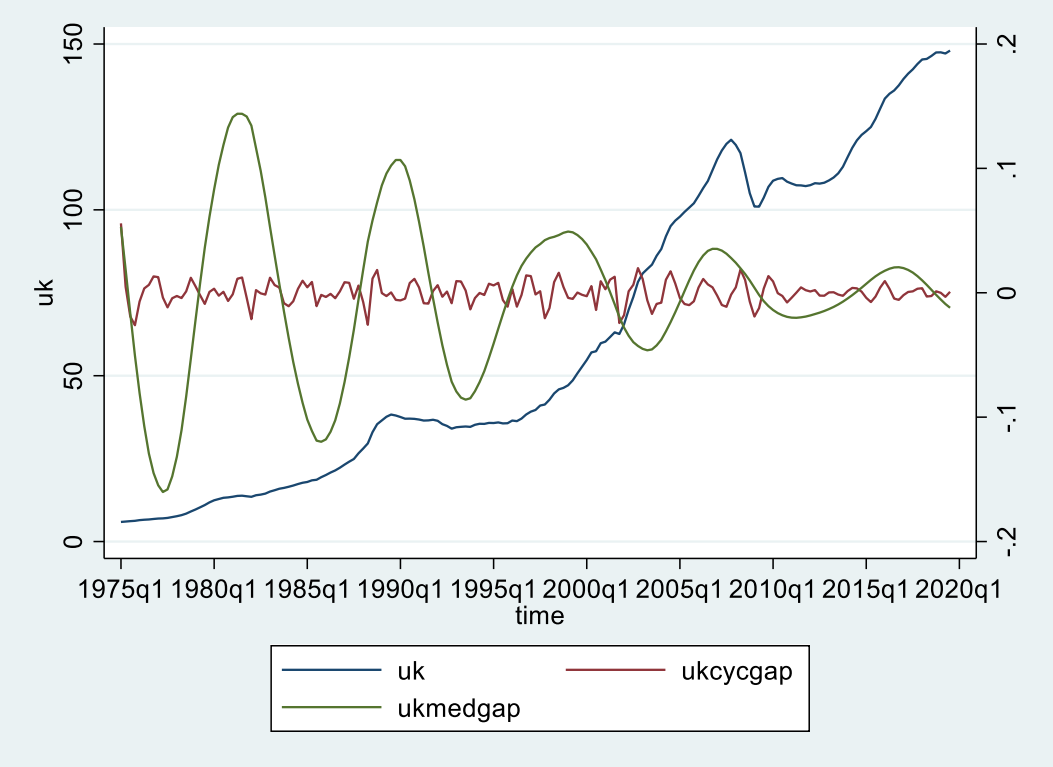
Northire is the Northern Irish house price series, northirecycgap is the short-term Christiano-Fitzgerald filtered gap (cycle over trend) and northiremedgap is the medium-term Christiano-Fitzgerald filtered gap.

Appendix Figure 9: Spain



Spain is the Spanish house price series, spaincycgap is the short-term Christiano-Fitzgerald filtered gap (cycle over trend) and spainmedgap is the medium-term Christiano-Fitzgerald filtered gap.

Appendix Figure 10: UK



UK is the UK house price series, ukcycgap is the short-term Christiano-Fitzgerald filtered gap (cycle over trend) and ukmedgap is the medium-term Christiano-Fitzgerald filtered gap.