Analysis of NI HPI Regression Model during Covid-19 Pandemic Q2 2020

In order to stop the spread of the covid-19 virus within the UK, on 23 March 2020, the UK Government announced lockdown measures which

1. Required people to stay at home, except for very limited purposes.
2. Closed certain businesses and venues.
3. Stopped all gatherings of more than two people in public.

This essentially paused the housing market as buyers and sellers were advised not to move and not to allow viewings to take place. The advice relating to the property market remained in place in NI until 15 June 2020.

The lockdown measures resulted in a reduced number of transactions being recorded during this period and so the number of sales available for April – June 2020, on which to predict average prices, fell to approximately 35% of normal volume of transactions. In order to guarantee that predicted prices would remain robust and reliable, the following analysis was undertaken to assess sales received and the strength of the regression model.

Characteristics of Sales

Firstly, it is important to check the characteristics of the cohort of sales recorded by HMRC during the lockdown period to ensure that they were representative of the whole property market and were not skewed towards one specific characteristic used within the model.

Property Type

Table 1 below shows the number of verified[1] sales recorded in each quarter between Jan 2017 and June 2020 and table 2 shows the proportion of sales in each property type for the same time period. The spread of sales across property types in Q2 2020 is similar to all previous quarters, therefore the cohort of sales, although reduced in number, is representative of all property types.

Table 1 Number of Verified[1] Sales

| | Number of Verified Sales in each Quarter | | | | |
	Apartment	Detached	Semi-Detached	Terrace	Total
Q1 2017	442	1,488	1,817	1,460	5,207
Q2 2017	492	1,888	2,040	1,702	6,122
Q3 2017	478	1,991	2,322	1,753	6,544
Q4 2017	534	2,050	2,409	1,805	6,798
Q1 2018	443	1,620	1,894	1,517	5,474
Q2 2018	490	1,850	2,193	1,664	6,197
Q3 2018	488	2,052	2,247	1,780	6,567
Q4 2018	543	2,066	2,360	1,802	6,771
Q1 2019	384	1,469	1,904	1,422	5,179
Q2 2019	466	1,921	2,132	1,676	6,195
Q3 2019	515	2,115	2,347	1,767	6,744
Q4 2019	470	1,989	2,314	1,877	6,650
Q1 2020	421	1,496	1,651	1,387	4,955
Q2 2020	116	528	563	445	1,652

1 Verified residential property sales are defined as sales recorded by HM Revenue & Customs which could be matched to a domestic property in the NI Valuation List.

Table 2 Proportion of Verified[1] Sales in each Property Type

	Percentage of Sales in each Quarter			
	Apartment	Detached	Semi-Detached	Terrace
Q1 2017	8%	29%	35%	28%
Q2 2017	8%	31%	33%	28%
Q3 2017	7%	30%	35%	27%
Q4 2017	8%	30%	35%	27%
Q1 2018	8%	30%	35%	28%
Q2 2018	8%	30%	35%	27%
Q3 2018	7%	31%	34%	27%
Q4 2018	8%	31%	35%	27%
Q1 2019	7%	28%	37%	27%
Q2 2019	8%	31%	34%	27%
Q3 2019	8%	31%	35%	26%
Q4 2019	7%	30%	35%	28%
Q1 2020	8%	30%	33%	28%
Q2 2020	7%	32%	34%	27%

Housing Market Area

LPS Housing Market Areas (LPS HMA) were defined and used as part of the Computer Assisted Mass Appraisal of all domestic properties in 2007. This process assigned a capital value to all domestic properties to use as the basis of its rating assessment for the first time. There are 24 LPS HMAs which were built from 900+ neighbourhoods and broadly align to the old 1992 Local Government District boundaries. Neighbourhoods were defined by local valuers to try to ensure that any properties within them, of broadly the same type & characteristics (size, repair, type etc), would have broadly the same Capital Value. The LPS HMAs are used as the location characteristic within the regression model to predict house prices for the house price index.

Table 3 shows the number of verified[1] sales within each LPS HMA recorded in each quarter between Jan 2017 and June 2020 and table 4 shows the proportion of sales in each LPS HMA in the same time period. The spread of sales across LPS HMAs in Q2 2020 is similar to all previous quarters, therefore the cohort of sales, although reduced in number, is representative of all locations.

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Table 3 Number of Verified Sales in each LPS Housing Market Area

	Q1 2017	Q2 2017	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020
ANTRIM	159	226	189	245	160	176	221	220	168	202	230	215	174	60
ARDS PENINSULA	71	65	82	108	73	89	98	102	60	89	98	107	78	37
ARMAGH	89	126	119	140	127	110	155	146	90	142	141	143	117	41
BALLYMENA	180	205	201	216	177	190	214	225	222	220	238	211	179	60
BALLYMONEY	72	78	120	120	87	111	110	129	73	103	127	117	71	26
BANBRIDGE	146	190	186	189	117	181	194	170	121	186	176	203	150	44
CASTLEREAGH	41	55	95	71	70	71	85	55	50	47	58	81	41	13
COLERAINE N COAST	214	297	329	319	270	295	314	288	212	253	283	279	206	65
CRAIGAVON	358	372	431	496	367	416	397	446	343	389	427	471	320	129
DERRY	261	290	307	322	290	315	324	306	266	331	364	309	228	69
DOWN	187	226	219	256	234	271	245	249	188	232	226	257	201	53
DUNGANNON & CLOUGHER VALLEY	135	154	152	143	139	145	159	188	116	167	150	170	120	43
EAST ANTRIM	254	302	346	342	242	338	339	341	294	335	386	332	264	94
FERMANAGH	108	135	167	188	140	149	164	138	129	135	165	154	114	54
GLENS	31	43	45	58	35	35	44	52	35	36	46	54	37	14
GREATER BELFAST	1,501	1,630	1,832	1,727	1,456	1,657	1,741	1,819	1,366	1,604	1,734	1,655	1,403	399
LIMAVADY	71	104	119	119	78	94	80	99	87	97	97	107	62	20
LISBURN	319	440	397	429	349	365	380	432	344	415	440	432	257	106
MID DOWN	154	233	195	215	159	204	212	221	178	202	234	196	141	62
MID ULSTER	174	182	184	177	175	167	190	213	190	214	214	177	154	48
NEWRY	180	183	220	245	186	202	252	221	163	215	215	226	150	61
NORTH DOWN	307	398	379	429	341	394	418	410	294	372	492	512	300	91
OMAGH	98	84	105	97	91	98	110	144	86	115	104	135	84	36
SOUTH ARMAGH	25	16	24	32	38	27	36	30	22	32	25	23	24	7
STRABANE	72	88	101	115	73	97	85	127	82	62	74	84	80	20
Northern Ireland	5,207	6,122	6,544	6,798	5,474	6,197	6,567	6,771	5,179	6,195	6,744	6,650	4,955	1,652

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Table 4 Proportion of Verified Sales in each LPS Housing Market Area

	Q1 2017	Q2 2017	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020
ANTRIM	3%	4%	3%	4%	3%	3%	3%	3%	3%	3%	3%	3%	4%	4%
ARDS PENINSULA	1%	1%	1%	2%	1%	1%	1%	2%	1%	1%	1%	2%	2%	2%
ARMAGH	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
BALLYMENA	3%	3%	3%	3%	3%	3%	3%	3%	4%	4%	4%	3%	4%	4%
BALLYMONEY	1%	1%	2%	2%	2%	2%	2%	2%	1%	2%	2%	2%	1%	2%
BANBRIDGE	3%	3%	3%	3%	2%	3%	3%	3%	2%	3%	3%	3%	3%	3%
CASTLEREAGH	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
COLERAINE N COAST	4%	5%	5%	5%	5%	5%	5%	4%	4%	4%	4%	4%	4%	4%
CRAIGAVON	7%	6%	7%	7%	7%	7%	6%	7%	7%	6%	6%	7%	6%	8%
DERRY	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	4%
DOWN	4%	4%	3%	4%	4%	4%	4%	4%	4%	4%	3%	4%	4%	3%
DUNGANNON & CLOUGHER VALLEY	3%	3%	2%	2%	3%	2%	2%	3%	2%	3%	2%	3%	2%	3%
EAST ANTRIM	5%	5%	5%	5%	4%	5%	5%	5%	6%	5%	6%	5%	5%	6%
FERMANAGH	2%	2%	3%	3%	3%	2%	2%	2%	2%	2%	2%	2%	2%	3%
GLENS	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
GREATER BELFAST	29%	27%	28%	25%	27%	27%	27%	27%	26%	26%	26%	25%	28%	24%
LIMAVADY	1%	2%	2%	2%	1%	2%	1%	1%	2%	2%	1%	2%	1%	1%
LISBURN	6%	7%	6%	6%	6%	6%	6%	6%	7%	7%	7%	6%	5%	6%
MID DOWN	3%	4%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	4%
MID ULSTER	3%	3%	3%	3%	3%	3%	3%	3%	4%	3%	3%	3%	3%	3%
NEWRY	3%	3%	3%	4%	3%	3%	4%	3%	3%	3%	3%	3%	3%	4%
NORTH DOWN	6%	7%	6%	6%	6%	6%	6%	6%	6%	6%	7%	8%	6%	6%
OMAGH	2%	1%	2%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
SOUTH ARMAGH	0%	0%	0%	0%	1%	0%	1%	0%	0%	1%	0%	0%	0%	0%
STRABANE	1%	1%	2%	2%	1%	2%	1%	2%	2%	1%	1%	1%	2%	1%

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Socio-Demographic Characteristics of the Property Location

Acorn is a segmentation tool produced by CACI, which categorises the UK's population into demographic types. Acorn segments households, postcodes and neighbourhoods into 6 categories, 18 groups and 62 types. LPS merge the category level postcode data for NI with sales records to assign one of the following 6 categories to each sale:

1. Affluent Achievers
2. Rising Prosperity
3. Comfortable Communities
4. Financially Stretched
5. Urban Adversity
6. Not Private Households

This provides a measure of the demographics of the area where the sold property is located, demographics are known to be a key determinant of house prices.

Table 5 shows the number of verified sales[1] in each Acorn category between 2017 and June 2020, and Table 6 shows the proportion of sales in each category during the same time period. The spread of sales across Acorn categories in Q2 2020 is similar to all previous quarters, therefore the cohort of sales, although reduced in number, is representative of all types of locations.

Table 5 Number of Verified Sales in each Acorn Category

	Number of Verified Sales in each Quarter in each Acorn Category					
	1. Affluent Achievers	2. Rising Prosperity	3. Comfortable Communities	4. Financially Stretched	5. Urban Adversity	6. Not Private Households
Q1 2017	897	456	2,189	1,053	597	15
Q2 2017	1,086	486	2,661	1,232	639	18
Q3 2017	1,221	573	2,786	1,316	628	20
Q4 2017	1,137	711	2,893	1,327	698	32
Q1 2018	943	536	2,264	1,090	615	26
Q2 2018	1,124	579	2,566	1,281	622	25
Q3 2018	1,189	590	2,801	1,309	648	30
Q4 2018	1,173	636	2,894	1,321	670	77
Q1 2019	829	526	2,122	1,150	513	39
Q2 2019	977	650	2,564	1,324	636	44
Q3 2019	1,113	662	2,879	1,365	682	42
Q4 2019	1,098	618	2,797	1,387	691	58
Q1 2020	785	312	2,125	1,165	534	34
Q2 2020	276	94	729	394	152	7

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Table 6 Proportion of Verified Sales in each Acorn Category

	Number of Verified Sales in each Quarter in each Acorn Category					
	1. Affluent Achievers	2. Rising Prosperity	3. Comfortable Communities	4. Financially Stretched	5. Urban Adversity	6. Not Private Households
Q1 2017	17%	9%	42%	20%	11%	0%
Q2 2017	18%	8%	43%	20%	10%	0%
Q3 2017	19%	9%	43%	20%	10%	0%
Q4 2017	17%	10%	43%	20%	10%	0%
Q1 2018	17%	10%	41%	20%	11%	0%
Q2 2018	18%	9%	41%	21%	10%	0%
Q3 2018	18%	9%	43%	20%	10%	0%
Q4 2018	17%	9%	43%	20%	10%	1%
Q1 2019	16%	10%	41%	22%	10%	1%
Q2 2019	16%	10%	41%	21%	10%	1%
Q3 2019	17%	10%	43%	20%	10%	1%
Q4 2019	17%	9%	42%	21%	10%	1%
Q1 2020	16%	6%	43%	24%	11%	1%
Q2 2020	17%	6%	44%	24%	9%	0%

As the sales received during Q2 2020 were representative of the property market, LPS were content to use the sales to predict prices to calculate the NI HPI in the usual way.

Calculating Property Prices for NI HPI

A house is essentially a bundle of characteristics (size, type, location, garage, garden etc) and individual buyers will pay different amounts based on the variety of features which are important to them. There is no market for characteristics, since they cannot be sold separately, so we cannot tell the price of the individual characteristics. However, the demand and supply for the properties implicitly determine the characteristics' marginal contributions to the price of the properties and regression techniques, essentially mathematical equations, are used to estimate the characteristics contributions to the price.

The regression is calculated using the sales in each quarter to produce coefficients which give the implicit price in natural log terms, of the characteristics of the property. These coefficients and the average value of each characteristic from sales in the previous year, are multiplied together to calculate the standardised house price for the quarter. It is important to assess the strength of the regression model each quarter to ensure the coefficients are reliable, and especially following the large reduction in sales volumes this quarter due to the Covid-19 pandemic lockdown measures.

R-Square Value

The R-Square value produced by the regression equation measures how much of the price paid for the house is explained by the selected characteristics (size, private/public build, type of property, location, type of area, new/existing dwelling). The R-square value can range between 0 and 100% and the higher the value the more variation in house price is explained by the characteristics.

The selected characteristics consistently explain around 78% of the price paid for houses in Northern Ireland each quarter. The R-square value for the regression model in Q2 2020 was 78.2%, therefore, although the number of sales is greatly reduced, the model is still reliable as the characteristics still explain a high proportion of the sale price.

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It is not possible to measure all the characteristics that may influence prices. In particular, qualitative factors relating to the condition of properties, amount of traffic, distance to shopping/places of work, etc are not measured. There are also a number of quantitative financial measures such as household income which are not available but are implicitly linked to the ability to purchase a particular property. Consequently it is not possible to explain all of the variation in prices that is observed.

Residuals

Residuals is the term given to the remaining 22% of variation in house price which could not be explained by the selected property characteristics. Residuals should be random and unpredictable, in other words, the characteristics should explain so much of the price variation that the remainder is caused by the randomness of real-world buyer preference and choices.

The randomness of the residuals is tested by looking at the scatterplot of all the residual values calculated by the regression equation. If the regression model is a good predictor of house prices, the standardised residuals should all be centred around zero, form a random pattern, and 95% of them should lie within +/- 2 (as they have a mean of 0 and a standard deviation of 1).

Figure 1 and 2 below show the scatterplot of residual values for sales recorded in Q1 2020 and Q2 2020 respectively. Both models produce residual values which are randomly centred around zero, therefore LPS are content that, although the number of sales is greatly reduced in Q2 2020, the regression model and prices calculated as a result are robust.

Figure 1 Scatterplot of Standardised Residuals for Sales Q1 2020
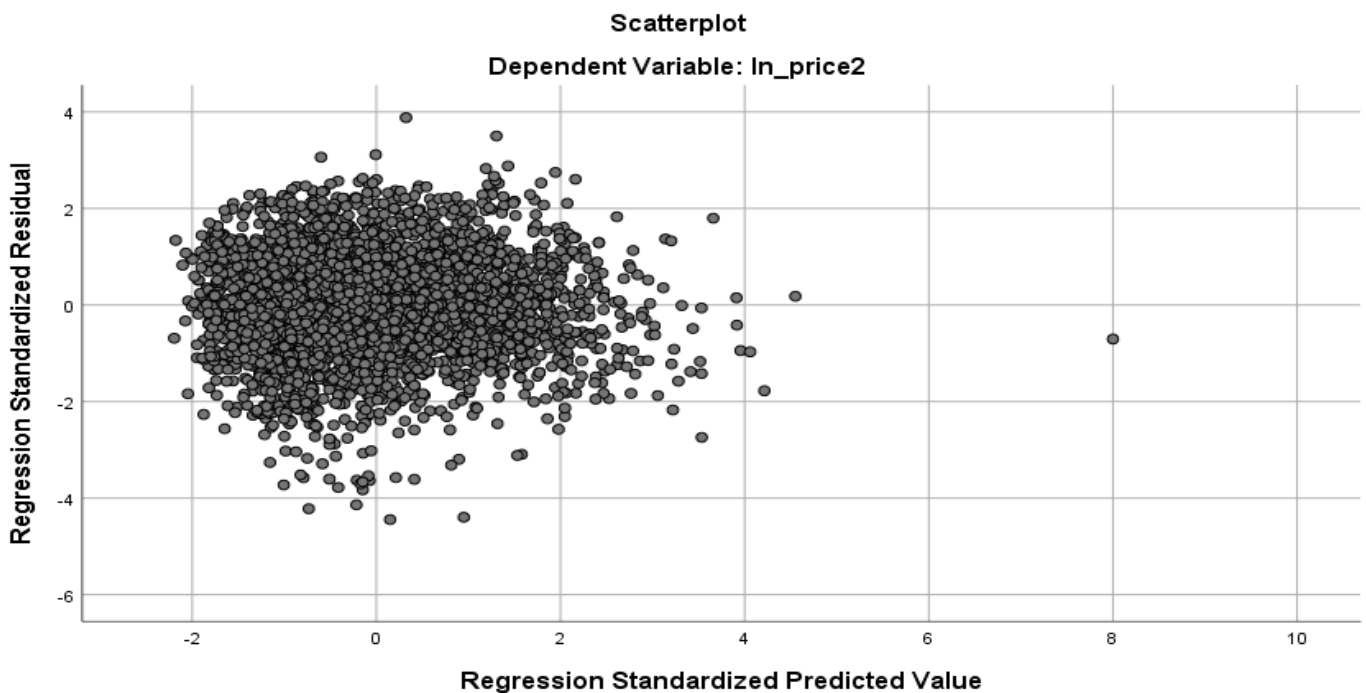
Scatterplot
Dependent Variable: ln_price2

Figure 2 Scatterplot of Standardised Residuals for Sales Q2 2020

Scatterplot
Dependent Variable: ln_price2
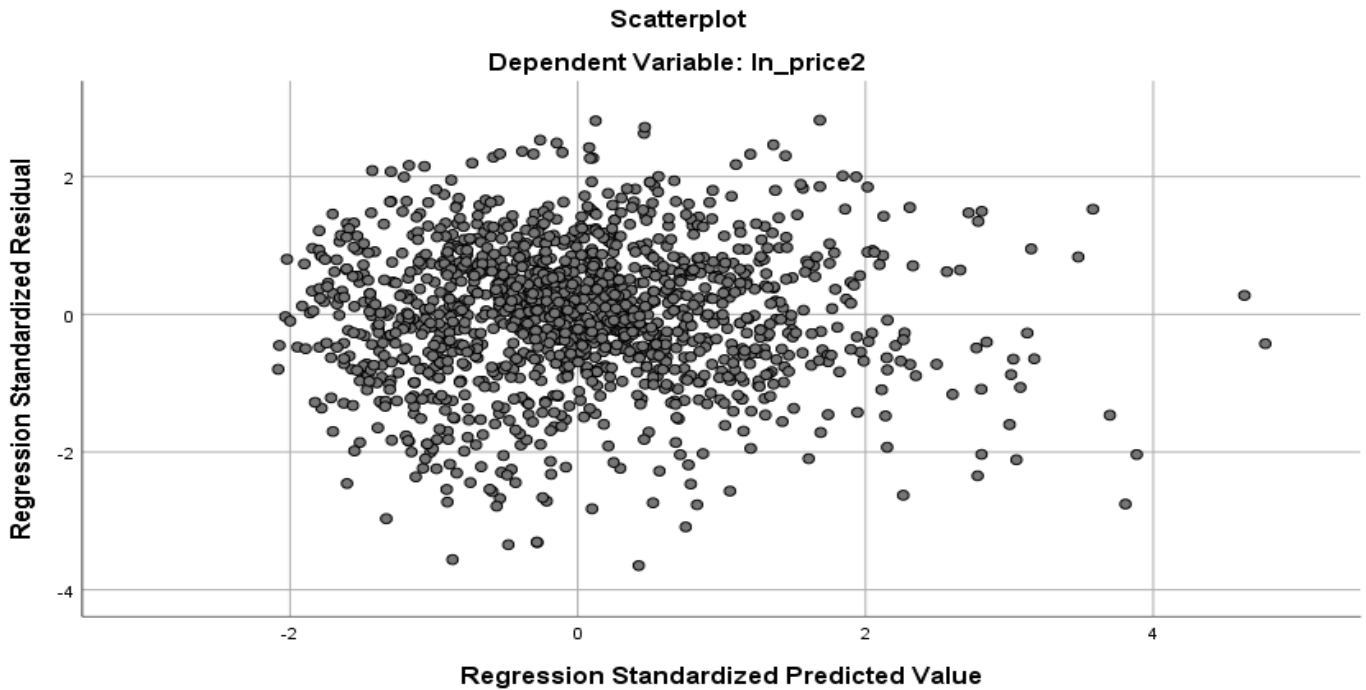
As the sales LPS received during April – June 2020 were representative of all property types and locations, and the regression model is robust, LPS have used the Q2 2020 sales to predict a standardised average price for residential property in Northern Ireland in the normal manner. The NI HPI quarterly series will be updated and now runs between January – March 2005 and April – June 2020.

It should be noted that the NI HPI is based on completed sales and prices paid. It takes approximately 6 – 8 weeks between the sale being agreed and completion, therefore it is very likely that the majority of sales recorded during April – June 2020 had been agreed before lockdown measures were introduced.

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