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DO LOCAL PROPERTY TAXES AFFECT NEW BUILDING DEVELOPMENT? RESULTS FROM A QUASI-NATURAL EXPERIMENT IN NEW ZEALAND [1]

Norman Gemmell, Arthur Grimes and Mark Skidmore [2]

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ABSTRACT

This paper takes advantage of a quasi-natural experiment in local property tax reform that arose from the amalgamation of several local councils in 2010 in Auckland, New Zealand, to form a unitary local authority. The reform involved several tax changes including a *shift* in the base of the local tax (known as 'Rates' in New Zealand) from a land-value, to a capital-value, base; changes in the *relative levels* of Rates across the former councils; and changes in the level of a separate tax (Development Contributions) levied specifically on new and altered buildings.

These reforms provide opportunities to examine empirical support for a number of established hypotheses in the local property tax literature related to the level and structure of local taxation. Empirically, the exogenous nature of the New Zealand reforms enables more reliable estimates than hitherto of hypothesized effects of the tax changes on new property development arising from the tax switch (land to capital values), and changes in relative levels of both Rates and Development Contributions.

To test these hypotheses, we use difference-in-difference type regression analysis to examine how far observed changes in consents for new building development are consistent with predictions from our economic models, having controlled for a variety of other influences. Our results suggest that there is little evidence of tax effects on *new* building development after the amalgamation, but there is stronger support for such effects on building *alterations*. Since our dataset covers only two post-amalgamation years, we speculate that this apparent difference may arise from the greater flexibility of building alterations to respond in the short-run, compared with new development responses.

[1] This paper reports on results from a Lincoln Institute supported project: "Auckland Agglomeration: An Inquiry into the Impacts of Agglomeration, Development Contributions and Land Taxation on Rate and Density of Development – Phase II". We are grateful to the Institute for their generous support of, and enthusiasm for, this research, especially Joan Youngman and Semida Munteanu. We are especially grateful to our research assistants – Marc Reinhardt, Yen Le and Loc Nguyen – for their comprehensive inputs to the project.

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I. Introduction

Property taxes form a component of tax revenues in most developed countries, but the optimal nature of property taxes, and their consequences, has long been a matter of debate. The effect of different forms of property taxes on economic efficiency – and especially on incentives to develop urban land – has been highlighted (e.g. Dye and England, 2009; Oates and Schwab, 2009). However, the paucity of natural experiments relating to changes in property taxes means that there is scant empirical evidence on whether the form of property taxes has a material effect on urban development.

Different countries adopt different systems of property taxation. In particular, the choice of land value versus capital value (i.e. the value of land plus improvements) as the base for a property tax varies across countries (Franzsen, 2009). Even within countries, it is the case that the property tax base may vary both across municipalities/regions and across time. McCluskey et al (2002 and 2006) document such spatial and temporal variation within New Zealand. However, changes from one form of property tax to another may reflect other (endogenous) forces at work that favour a change of taxation system. In such circumstances, it is difficult to draw conclusions about the causal effects of the property tax change.

Based on the analyses of the classical economists (Ricardo, 1817; Mill, 1865; George, 1879), economists typically favour land value as the property tax base that yields the most efficient form of tax. However, other considerations, such as distributional concerns (Plummer, 2009; Coleman and Grimes, 2010) may lead authorities to choose a different base. Mill (1865), while supporting a form of land value taxation, highlighted the implications for property rights of the introduction of a property tax. Thus the appropriate base for a property tax is not uncontested. Once the lack of rigorous information about the effects of different property taxes on development is added to the equation, there is even less certainty as to which tax system is best.

We utilise a rare natural experiment to shed light on the development impacts of land value versus capital value tax systems. In 2009, New Zealand's central government established a Royal Commission of enquiry into the governance of the Auckland region (New Zealand Government, 2009). The region at that stage had eight local governments including seven local councils ('Territorial Local Authorities', TLAs) plus a broader body, the Auckland Regional Council, having different responsibilities.[3] The eight extant councils had multiple forms of property tax systems that included a land-value base and a capital-value base. The Royal Commission, backed by subsequent central government legislation, recommended the compulsory amalgamation of the eight councils into a single (unitary) body, the Auckland Council. The amalgamation occurred in November 2010.

Central government determined through legislation that the base for Auckland Council property taxes (called 'Rates' in New Zealand) would be capital value. This decision resulted in four of the former councils having an exogenously imposed shift in their Rates basis from land value to capital value. It is this natural experiment that we leverage to test whether the shift in property tax system affected spatial development patterns across the region.

[3] Prior to an earlier local government reorganization in 1989, the region comprised 44 local authorities (Grimes, 2011).

Specifically, we compile Rates data for before and after the amalgamation and test whether the change in rating system affected development patterns in a systematic manner reflecting the prior rating systems.

Our empirical analysis is complicated by a number of factors. First, no former council had a pure form of land value or capital value rating system; each also included fixed charges and targeted rates, some of which varied within the TLA. We utilise data at the Area Unit spatial level (a Statistics New Zealand defined area that equates to a narrow suburb definition), which is at a smaller spatial level than the TLA, to account for such intra-TLA variation.

Second, councils also levy Development Contributions (DCs) on new developments, with DCs varying across TLAs prior to amalgamation. Both Rates and DCs have converged towards a single system since amalgamation. We have data on DCs by TLA both before and after the amalgamation and we utilise this information to test whether differences in the size of DCs affected development across the region.[4]

Third, the Auckland housing market has been affected by major macroeconomic influences including the Global Financial Crisis (GFC) which caused a lull in building activity (and house prices) post-2007, and by strong subsequent immigration flows which have contributed to a housing market boom since 2011 (Greenaway-McGrevy and Phillips, 2016). By concentrating on developments solely within the Auckland region, we mitigate the problems that such factors have on our analysis. Nevertheless, it is possible that our results could be affected if some of these macro factors had different intra-regional impacts.

Fourth, TLAs impose a variety of regulations that affect several aspects of development including zoning, height and density restrictions (Grimes and Mitchell, 2015). To the extent that these regulations form binding constraints on new development, the influence of the tax system on development patterns will be muted.

The paper proceeds as follows. Section II provides more detail about the Auckland region and about the amalgamation process. Section III describes what we expect from theory about the effects of the amalgamation on development patterns based on the changes to property Rates and DCs across TLAs. We then provide relevant property and taxation descriptive statistics in section IV prior to reporting on regression results in section V. These regressions offer some support for our proposed hypotheses but only for building alterations, not new-builds. Some conclusions are drawn in section VI.

[4] Some councils also levied infrastructure fees separate from DCs, but we have no reliable data on these separate contributions.

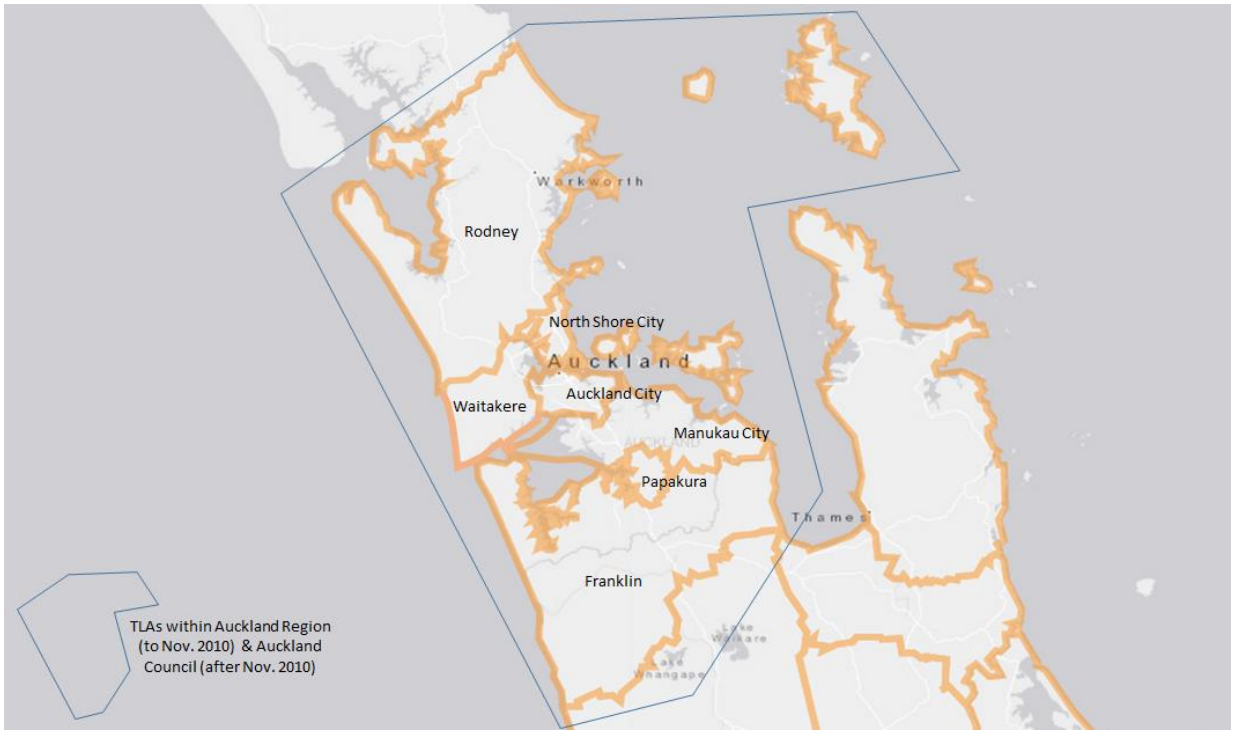
II. The Auckland Quasi-Natural Experiment: Background

The Auckland Region represents the largest urban centre in New Zealand, accounting for about one-third of the country's population in the latest (2013) census and covering approximately 5,000 kms^2, or just under 2% of New Zealand's total land area.

Local government activities (including the setting of taxes and expenditures) in New Zealand are mainly organised by the 'second tier' of local government: Territorial Local Authorities (TLAs). These sit alongside a 'first tier' of Regional Councils.[5] Prior to the amalgamation of the Auckland TLAs in November 2010, the Auckland region accounted for 7 of New Zealand's total of 73 TLAs nationally. In addition to the 7 Auckland TLAs, the city's governance included the Auckland Regional Council (ARC) which also levied some property taxes on, and provided some services to, Auckland residents. The 7 pre-amalgamation TLAs were: Rodney, North Shore City, Auckland City, Waitakere, Manukau City, Franklin, Papakura (see Figure 1).

From 1 November 2010, a new 'unitary authority', Auckland Council (AC), was created as an amalgamation of the 7 TLAs and the ARC. Also from this date, the previous 7 TLAs were reconfigured as 21 'Local Boards', roughly corresponding to the political 'Ward' boundaries (a 'Ward' is an electoral area with political representatives on the AC for each Ward). Two maps below (Figures 1A and 1B) show the 'before amalgamation' and 'after amalgamation' configurations.

Figure 1A Auckland's TLAs Prior to Amalgamation



[5] TLAs are not, however, simple sub-divisions of regional councils; for example, one TLA may form part of more than one region.

Figure 1B Auckland Council and 'Boards' After Amalgamation (2011)

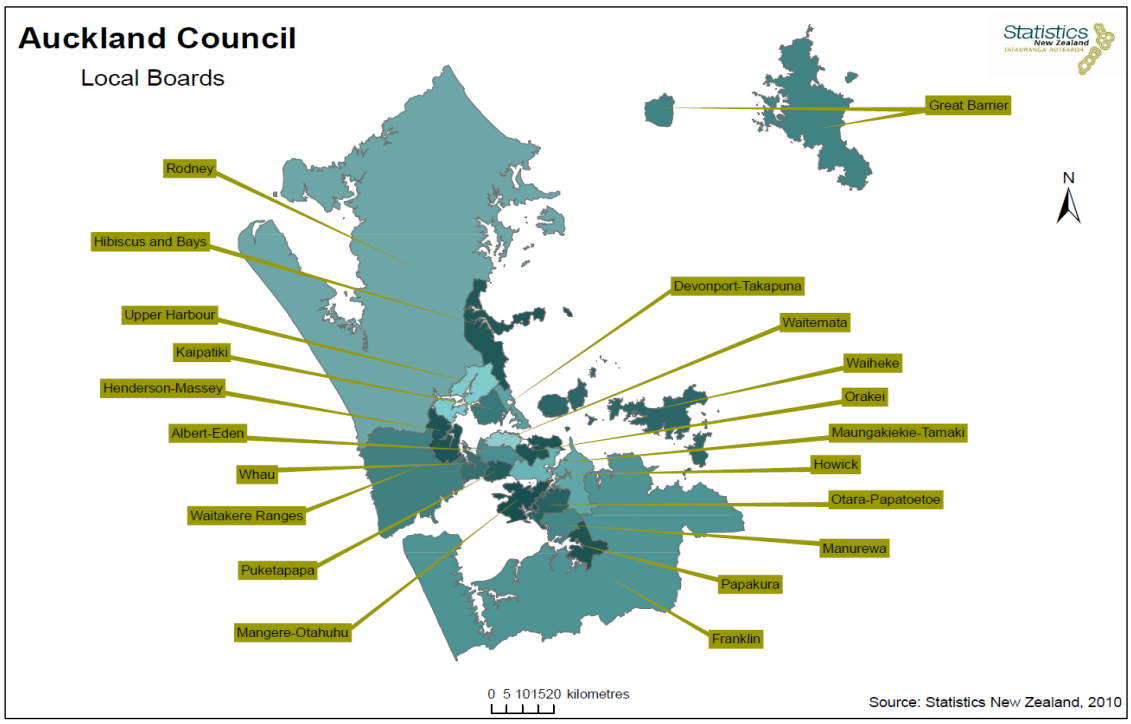


Table 1 shows the breakdown of Auckland's population and total housing stock ('total residential dwellings') across TLAs as recorded in the 2006 Census – the last census before amalgamation. It can be seen that out of a total population of 1.3 million and almost 500,000 dwellings in 2006, around one-third of both were in Auckland City. Other large TLAs are Manukau (21% of dwellings), followed by North Shore and Waitakere (16% and 14% respectively). Rodney, Franklin and especially Papakura can be seen to be relatively small TLAs (8%, 5% and 3% of dwellings). In our later analysis, data for some variables for Papakura are not available but, as can be seen in Table 1, this represents a small fraction of the full sample.

Table 1 Auckland TLA Populations and Dwellings

	Percent of total (2006; Census)	
	Population	Dwellings
Auckland City	31%	34%
North Shore	16%	16%
Rodney	7%	8%
Manukau	25%	21%
Waitakere	14%	14%
Franklin	5%	5%
Papakura	3%	3%
Total Numbers (2006)	1,303,068	476,406
Total Numbers (2015)	1,415,550	509,625

For the purposes of our analysis, data on relevant economic and fiscal variables are available at two levels of disaggregation with the highest level (TLAs) being divided into Area

Units (AUs)[6]. Importantly, though many fiscal parameters are set at TLA level, some differ within a TLA – such as some local tax Rates – and hence can differ across AUs. Wherever possible we therefore pursue our analysis at the AU level. The Auckland region contains 356 AUs, with an average land area of around 14 kms^2, while Auckland AU resident population sizes in 2013 varied from as few as 40 (in a mainly commercial AU) to over 12,000 in one of the central Auckland AUs.

Why does this Auckland local government restructuring represent a good natural experiment for our purposes?

Firstly, as the following section clarifies, public finance theory suggests that property-based taxation levied on the value of the *land*, rather than the full capital value of the *land-plus-structures* is more efficient. This reflects the fact that generally land size and quality cannot be altered in response to a tax impost, while the size, type and value of structures on the land can often readily be altered in response to such a tax impost. Theory therefore predicts different building responses in different local areas if some use land-value as the relevant property tax base (to which the property tax rate is applied) while others use a capital-value tax base.

Fortunately, the 7 pre-amalgamation Auckland TLAs used different tax bases with a range of local taxes being applied variously to a land-value (LV) or capital-value (CV) tax base.[7] For example, The Auckland Rates system, though it involves a number of components fixed in dollar terms each year, also includes a substantial 'General Rates' component. This involves a tax rate per $ of assessed property value ('Rates') being applied to the property tax base. Before amalgamation, in four TLAs (Rodney, North Shore, Waitakere, Papakura) the relevant base was the land value, while in the remaining three (Auckland City, Manukau City, Franklin), capital values formed the tax base. After amalgamation however, as the Auckland Council moved to a uniform Rates system from 2011, central government required that all 7 former TLAs' Rates became based on capital values. This provides a convenient natural experiment where three TLAs experienced no change, while four did experience an exogenously imposed change in tax base from a land-value, to a capital-value, form.

Secondly, Auckland's Rating system, in addition to the land- or capital-value based General Rates (GRs), included a set of specific 'Targeted Rates' (TRs). These were set within each TLA and were associated with specific local government-provided amenities that required local funding. These were mostly levied at a fixed $ amount per liable property, though a few TRs of relatively low value used the land- or capital-value basis to determine the TR liability. These TRs included, for example, Rates levied (at least notionally) to pay for local transport, leisure centres, museums etc. After amalgamation, the Auckland Council sought to move towards a uniform Rating system, with a transition period, such that the dispersion of both GRs and TRs across former TLAs would be reduced (see section IV below). These pre-/post-amalgamation

[6] The smallest geographic disaggregation in administrative data is the 'meshblock'. There are around 11,700 meshblocks in the Auckland region with around 30 meshblocks per AU on average. However, data at this disaggregation are not available (or do not differ across meshblocks within an AU) for most of the variables required for our analysis.

[7] Some TLAs used properties' so-called 'annual value' as the tax base, but since this was set at 5% of the capital value it can be treated identically to a capital-value tax base.

differences in the level of Rates across TLAs provide an opportunity to examine whether it had any impact on building patterns pre- versus post-amalgamation.

Thirdly, as with the Rating system, before amalgamation Auckland TLAs applied a set of property-related 'Development Contributions' (DCs), levied on *new* building developments and on some forms of building alterations, designed to contribute to the cost of providing new local amenities, such as roads, water supply, storm/waste water infrastructure, libraries etc. Unlike Rates these are one-off payments levied on developers but are substantial. Depending on relevant supply and demand elasticities, some of the DC payment will be reflected in the undeveloped land value (if, for instance, restrictive zoning rules resulted in this value being above the rural value of land), and some may be passed on to subsequent property purchasers. As with the Rating system changes associated with amalgamation, Auckland Council implemented a Council-wide DC system that sought to move former TLA DC levels towards uniformity over post-amalgamation years. As of 2015, this process was not yet complete; see section IV.

The above three aspects of the changes associated with the Auckland Council amalgamation provide opportunities to test a number of predictions from theory.

Firstly, by comparing outcomes in the land-value versus capital-value TLAs we can test whether the transition from land-value to capital value taxation in 4 TLAs had any impact on observed building development relative to the 3 TLAs with capital-value taxation throughout.

Secondly, a large component of both the level of total Rates in a given TLA, and changes in them over time, are unrelated to either land or capital values; see section IV. However, since amalgamation affected the overall levels of these Rates differently across TLAs, as they moved towards uniformity, we can test whether the changes in *total* local Rate levels affected house building differentially across TLAs, and for AUs within TLAs.

Thirdly, different trajectories over time in the DCs set by TLAs, and subsequently by Auckland Council, allow us to apply a similar exercise to DCs, as we apply to Rates.

In our Conclusions, we discuss further hypotheses that may be tested as a result of the tax switch following amalgamation, as data covering a longer post-amalgamation period becomes available.

III. Local Property Taxation and Auckland Amalgamation: What Would We Expect?

The changes that occurred in Rates and Development Contributions in 2010 due to the amalgamation was exogenously imposed by national government. The amalgamation thus provides an excellent opportunity to evaluate the impacts of changes in the tax regime and changes in Development Contributions on the rate and density of development. Below, we offer a theoretical discussion of what we expect to happen to the pattern of development as the regional tax environment changes. We then offer corresponding discussion of the expected effects of changes in Development Contributions.

The issue of property value versus land value taxation is of both academic and policy interest. There are in fact few examples in history of distinct shifts from one type of property tax regime to another, and fewer still of such changes that were carefully evaluated. A particularly difficult challenge is that in most cases, the changes in tax regimes are endogenously determined. Thus, identifying causal impacts is a challenge. This is why the Auckland case is of particular interest, give the exogenous imposition.

In addition, as previously discussed, the tax environments within each of the TLAs that were amalgamated were affected differentially. One potentially complicating factor is whether public services changed significantly in response to the amalgamation. While development decision-making and services have been centralized to the Auckland Council, public services offered at local levels remained broadly stable over the initial years of amalgamation covered by our study. These conditions offer an excellent opportunity to identify the potential impacts of the change in the tax regime on the pattern of development within the region.

In theory, reduced reliance on the more efficient land tax and increased reliance on a distortionary tax on land and capital that occurred in Rodney, North Shore, Waitakere, and Papakura as a result of amalgamation is expected to reduce development, and its density in these areas. The intuition is that a property tax (on land and capital) is distortionary, increasing housing costs and reducing density of capital investment, whereas a land tax is neutral in its effect on land development decisions.

Pollack and Shoup (1977) develop a model and empirically test this notion, providing support for this view. Other work suggests that the anticipated effect is also negative for development but for different reasons. Consider the case of a revenue-neutral shift from a land tax to a property tax; the rate on vacant land will necessarily fall because the tax base under a property tax is much larger. To illustrate the effect, consider the model by Shoup (1970) which shows that a reduction in the tax rate applied to undeveloped land will lengthen the optimal time to development because the cost of holding the land in its undeveloped state is reduced. In a continuous-time partial equilibrium model, development occurs at time T when the percentage increase in the property's post-development value, V, equals the interest rate, r, plus the property tax rate, τ:

$$\frac{V'(T)}{V(T)} = r + \tau \qquad (1)$$

The interest rate represents the return to wealth earned if it were not invested in the property. In this scenario, the property tax rate is the cost of holding the property. Development occurs when the growth in its developed value no longer exceeds the sum of the

costs of holding the property in its undeveloped state. The model assumes that at the optimal time of development the growth rate of the property in its developed state is declining.

In the case where τ decreases, the first order condition in the Shoup (1970) model requires the growth rate of the developed value of the undeveloped property to be higher at the optimal time of development. As a result, the optimal time to development moves further away. Zax and Skidmore (1992) confirm this result empirically in the case of an unanticipated property tax increase. This discussion leads us to our primary hypothesis that, *conditional on the overall level of property tax liability/revenue*:

H1: TLAs shifting away from a land tax to a property tax (and thus a reduced tax rate on vacant land) will experience a reduction in building consents.

We must also take into consideration that Rodney, North Shore, Waitakere, and Papakura exist within the broader Auckland region. Thus, the changes that occur in these TLA's may also have an impact on development patterns in other TLA's in the region. It is important therefore to consider the interactions that may occur across jurisdictions; Brueckner (2003) offers an excellent summary of this research.

In the case of Auckland, after controlling for the overall tax level and for existing spatial trends in development, we might expect the change in relative taxes to shift development from Rodney, North Shore, Waitakere and Papakura to Auckland City, Manukau City and Franklin. The work of Skidmore et al. (2012) shows how relative changes in tax rates shift development patterns and rates of capitalization in the context of Detroit, Michigan. Our secondary hypothesis (also conditioned as above) is:

H2: The relative decrease in the tax rate applied to undeveloped land in Rodney, North Shore, Waitakere, and Papkura will increase development in Auckland City, Manukau City, and Franklin.

In addition, the impact of changing Development Contributions on development is potentially important. A Development Contribution is paid for by the developer, who then typically embeds these costs into the price of the newly constructed home. The work of Burge and Ihlanfeldt (2006a) for Florida suggests that such fees enable local authorities to more readily approve new development because they offer a direct source of funding for the required infrastructure.

However, some studies also show that these fees are fully passed on to home buyers in the form of higher prices (Delaney and Smith, 1989). Further, Burge and Ihlanfeldt (2006b) show that such 'impact fees' tend to discourage multi-family housing development. Skidmore and Peddle (1998) study the effects of impact fees (a form of development contribution) across communities in the Chicago region (Illinois). They find that the adoption of impact fees reduced the rate of residential development and property taxes. Their findings demonstrate a significant shifting of the infrastructure finance from the community as a whole to new home buyers. In summary, while development contributions offer a needed source of infrastructure funding, they may also increase housing prices and reduce the construction of more affordable and dense development. The resulting hypotheses in the Auckland case are therefore:

H3: An increase in Development Contributions will result in a reduction of building consents, and vice versa.

H4: A relative increase in neighbour TLA Development Contributions will increase development in the TLA of interest, and vice versa.

Finally, since the Auckland Council amalgamation also involved a general increase in the overall *level* of both Rates and Development Contributions post-amalgamation (see section IV), this can be expected to have a ceteris paribus, downward impact on building consents across the region to the extent that it raised building costs to builders and/or house buyers. We therefore hypothesise that (other things equal):

H5: An absolute increase in Rates and/or Development Contribution levels across all TLAs will result in a reduction in building consents, and vice versa.

In the next section we offer a detailed description of the data and the changes resulting from amalgamation, before pursuing regression analysis to address these hypotheses in section V.

IV. The Auckland Quasi-Natural Experiment: Some Descriptive Statistics

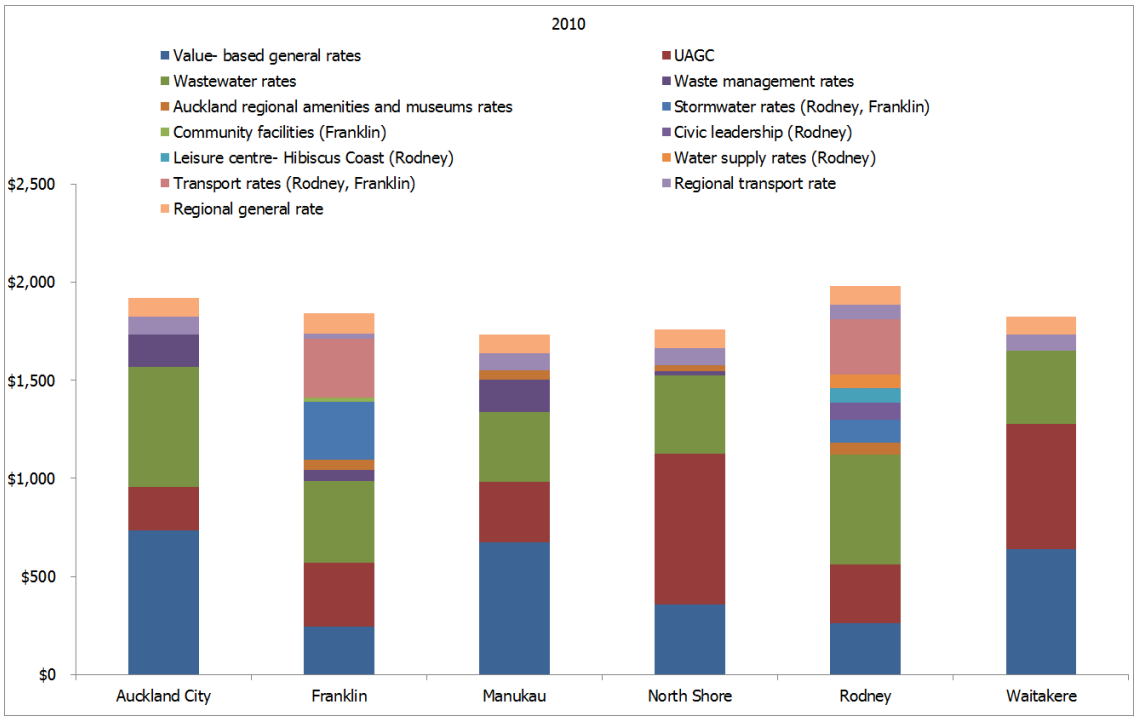
Before turning to regression analysis it is helpful to set out some descriptive statistics on Auckland Rate and DC changes, building consents, and on background variables such as house prices, across TLAs.

The Auckland Local Tax System

Appendix 1 describes in more detail the nature of the Auckland local tax system and the changes associated with amalgamation. Important aspects for our purposes are the land-value (LV) versus capital-value (CV) element of the Rates system and the size of Development Contributions. Figure 2.1 shows how the various individual Rates which contribute to a household's total Rates bill differ across TLAs, for a common type of residential property.[8] To illustrate we use a property with the median capital value ($430,000) and land value ($250,000) across Auckland in 2010 – the final pre-amalgamation year.

Figure 2.1 identifies the complexity of the range of Rates elements, despite focusing only on the larger components.[9] The 2010 total Rate for this median residential property varied between a high of $1,993 in Rodney, to a low of $1,746 in Manukau. As can be seen, the 'value-based' element in General Rates varied much more across TLAs (the lowest, blue segment of each bar), ranging between $263 (Rodney) and $736 (Auckland City).

Figure 2.1 Major Components of Auckland TLAs' Total Rates, 2010



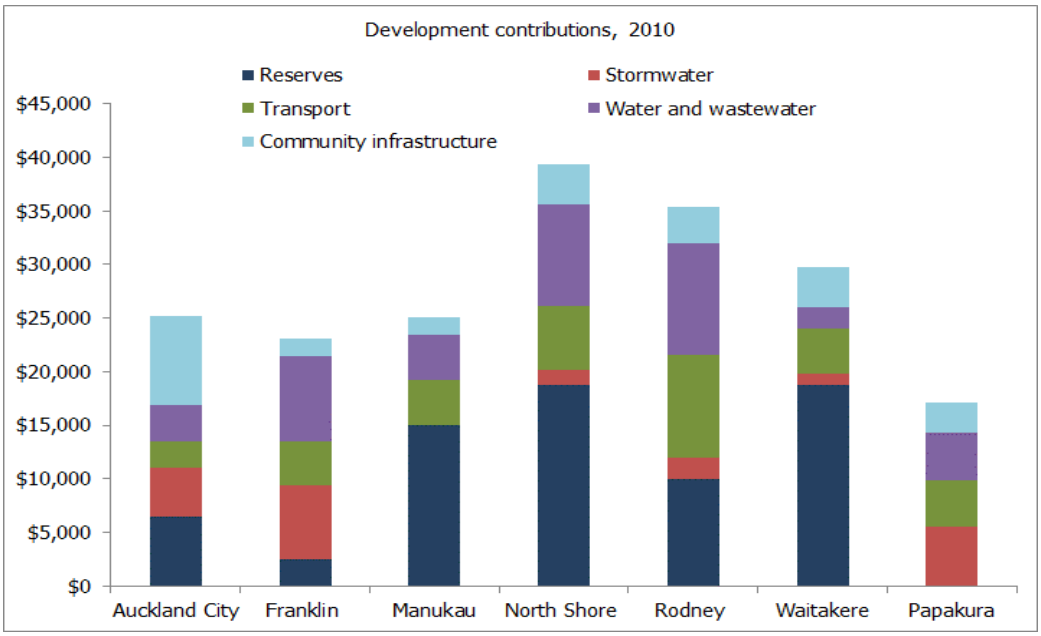
Note: UAGC = Uniform annual general charge (a Targeted Rate set in fixed $ terms). Papakura is omitted due to missing water rates data.

[8] Papakura is omitted from Figure 2.1 owing to unavailability of water rates data. Data on Papakura in Figure 2.2 should be treated with caution given limited available information for this Council, and the much lower value of the sum of the components shown in Figure 2. Papakura appears to have no 'Reserves' contributions.

[9] The Figure excludes some minor component Rates (in value terms), such as the 'Regional Biosecurity Rate' (average value across TLAs: $6.70) and the 'Rugby World Cup Levy' ($4.00) payable only in Waitakere.

Figure 2.2 provides equivalent information on DCs in 2010. As for Rates, these are specified in relation to particular amenities that the revenue is (notionally at least) designed to finance, such as stormwater and other water-related infrastructure, transport, nature reserves etc. As the Figure shows, DC values are much larger than Rates (TLA average = $30,060) since the former are one-off levies payable on construction, whereas the latter are an on-going annual liability. For most residential developments these DCs are payable per building unit developed (new, or certain alterations/extensions to an existing unit).

Figure 2.2 Components of Development Contributions by TLA, 2010



This figure also illustrates that the variation across TLAs is quite substantial in terms of both total, and component, values. Thus, for example, total DCs in North Shore were around 70% higher than in Franklin, while the Reserves component (typically the largest) was almost 8 times higher in North Shore than in Franklin. By 2014 these differences had been considerably smoothed out with values much closer to uniformity.[10]

Pre- and Post-Amalgamation Trends

Of interest for testing our hypotheses are trends over time across TLAs in these taxes (Rates and DCs) and trends in the potentially affected variables, especially new building units developed. Figures 3.1 – 3.4 respectively show trends from 2009-2014 in average Rates, DCs, house sale prices and total building unit consents for each Auckland TLA.[11] Figures 4.1 – 4.4 then show the equivalent trends but where TLAs have been aggregated into two groups: those with LV-based, and those with CV-based, Rating systems.

In interpreting those figures, it should be borne in mind that, while 2011 is the first full year of operation of the new Auckland Council, this was very much a transition year, with 2012 the first year when new Auckland-wide systems began to be implemented. These included arrangements aimed at achieving uniformity over several future years. In addition

[10] With the exception of Franklin (which has a longer post-amalgamation transition period), DCs in the remaining 5 TLAs with full data, were all within $1,000 of the TLA-6 average.

[11] Because building consents data are collected regularly by Statistics New Zealand, a longer time-series is available. In this section we are therefore able to show building consents from 2006, but other variables from 2009.

it is likely that, at least in 2010, the amalgamation was widely anticipated, which may have had 'expectation' effects on some economic and fiscal variables.

Figure 3.1 and 3.2 show clearly the move towards more uniform Rates and DC levels by 2012, but with a fairly wide dispersion of tax levels before amalgamation. Notably, Rates in Manukau, having been the lowest in 2009, can be seen to be the (joint) highest in the post-amalgamation years. Likewise for DCs: Franklin having had the lowest levels in 2009, had the highest post-amalgamation, while North Shore moved in the other direction.

Figures 3.3 and 3.4 show house price and building consents respectively. In general both charts reveal that although both prices and the volume of consents vary considerably across TLAs, trends from 2009-14 are quite similar. Both likely reflect the effects of the global financial crisis in New Zealand; prices are fairly static from 2009-11. We do not have comparable data for 2006-09 but Auckland house price trends in that period were generally downward; see Appendix 2. Building consents show distinct downward trends across TLAs from 2006 to 2009, are then fairly static to about 2012, thereafter tending to recover towards past levels.

The simple comparisons between CV-basis and LV-basis TLAs in Figures 4.1 to 4.4 reveal some interesting changes between pre- and post-amalgamation years. Average Rates in LV-TLAs in Figure 4.1 for example, shift from being above CV-TLAs till 2011, to being below CV-TLAs from 2012. A similar and more dramatic story emerges from Figure 4.2 for Development Contributions. There, LV-TLAs had much higher DC levels before 2012, but shift to being slightly below CV-TLAs' DC levels from 2012.

Similar pre- and post-amalgamation patterns in house prices and building consents can be seen in Figures 4.3 and 4.4 respectively. House prices in LV-TLAs were slightly below those in CV-TLAs on average before amalgamation, but thereafter begin to catch-up with CV-TLA levels, reaching parity by 2014. For building consents in Figure 4.4, LV-TLAs appear to have fewer consents before amalgamation (at least for the early years, 2006-08), but after amalgamation building consent levels look similar across all TLAs or are possibly higher in the LV-TLAs.[12]

These differential trends for land-value versus capital-value TLAs suggest there is at least a *prima face* case for considering whether the Auckland Council amalgamation – in particular the move towards uniform capital-value based taxation – had a differential effect across TLAs on building development. We explore this issue more systematically with econometric analysis in section V.

[12] In the case of building consents, the simple bivariate comparison is contrary to our expectations, *ceteris paribus*, that areas with low initial capital value Rates would experience a decline in development after amalgamation. However, clearly 'other things' such as overall Rate levels and population densities are not being held constant in these simple bivariate comparisons.

Figure 3.1 Average Rates by TLA

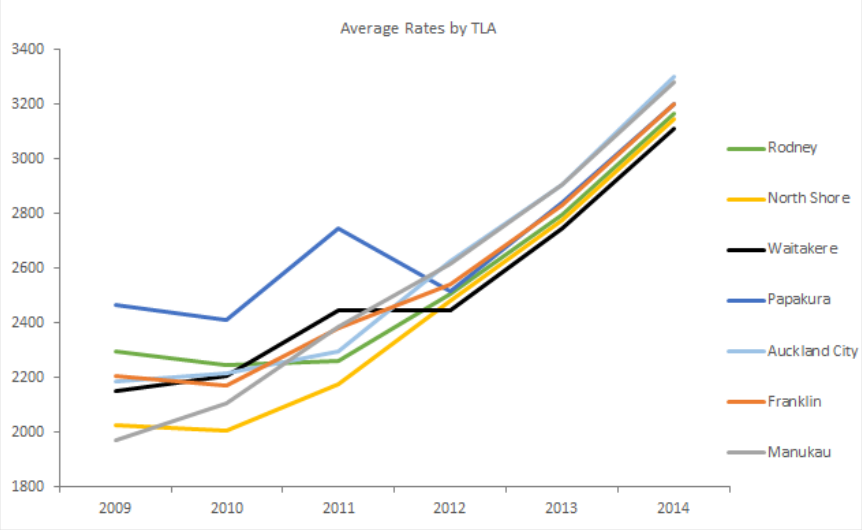


Figure 3.2 Average Development Contributions by TLA

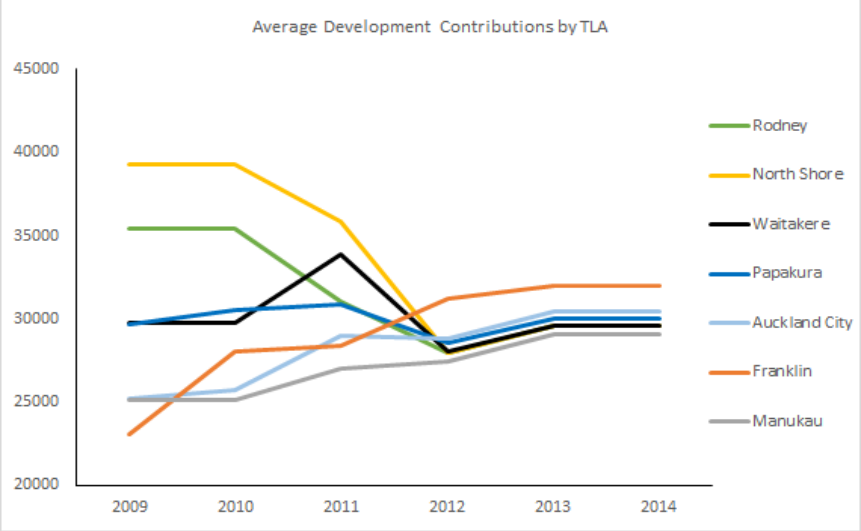


Figure 3.3 Average House Sale Prices by TLA

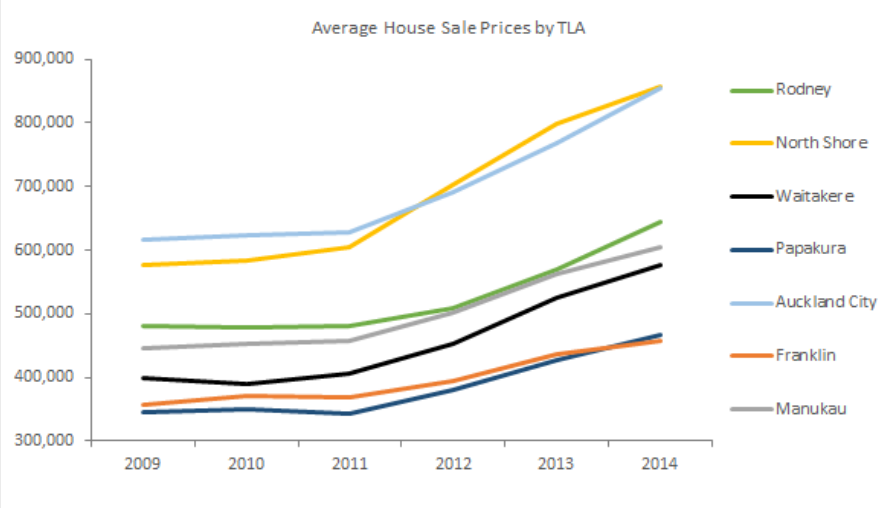


Figure 3.4 Total Building Unit Consents by TLA

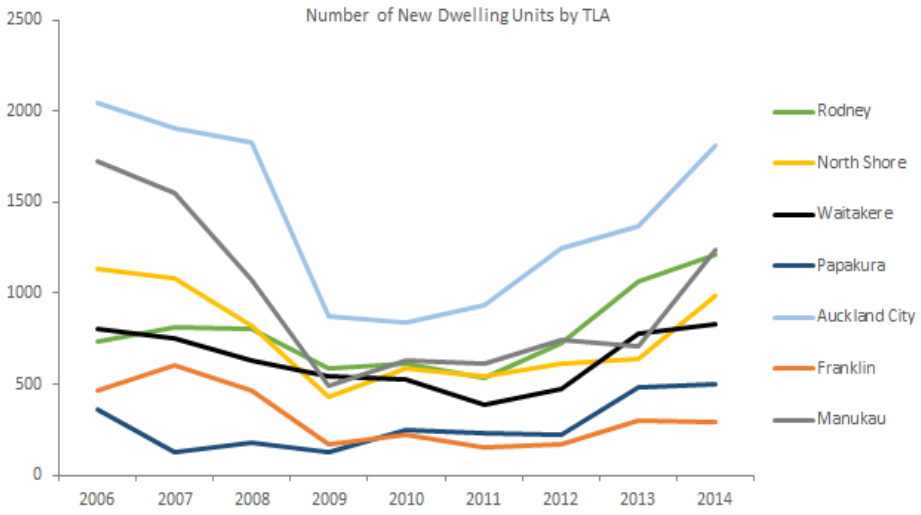
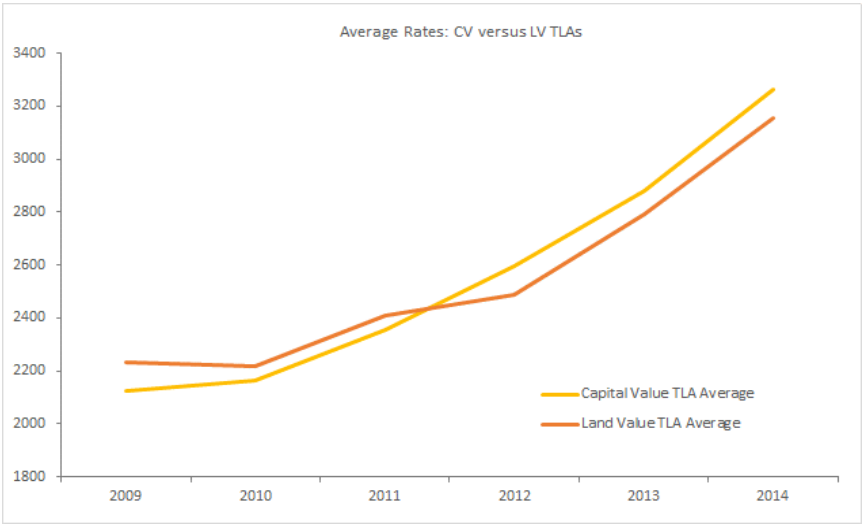
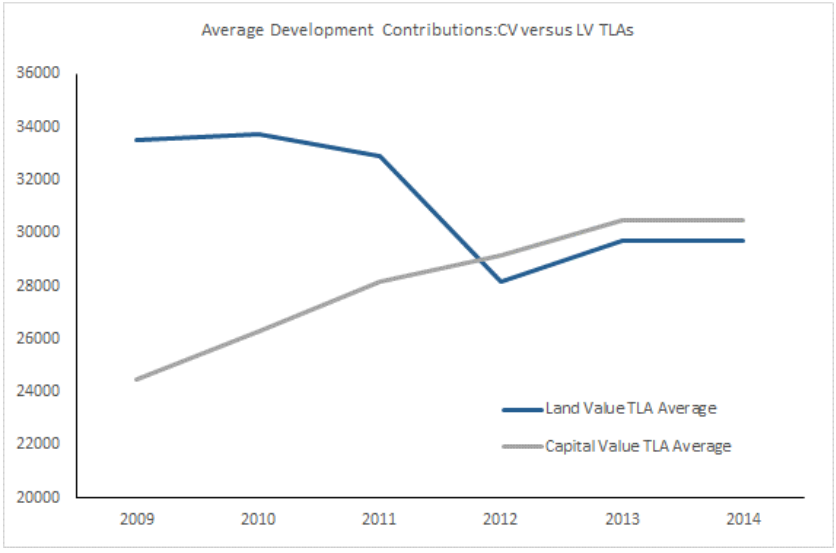


Figure 4.1 Average Rate: CV versus LV TLAs



Note: LV = Rodney, North Shore, Waitakere, Papakura; CV = Auckland City, Manukau, Franklin

Figure 4.2 Average Development Contributions: CV versus LV TLAs



Note: LV = Rodney, North Shore, Waitakere, Papakura; CV = Auckland City, Manukau, Franklin

Figure 4.3 Average House Sale Prices: CV versus LV TLAs

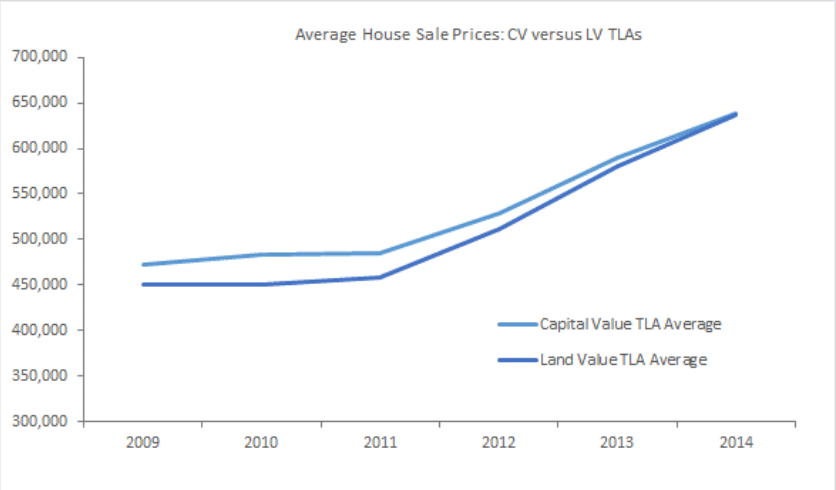
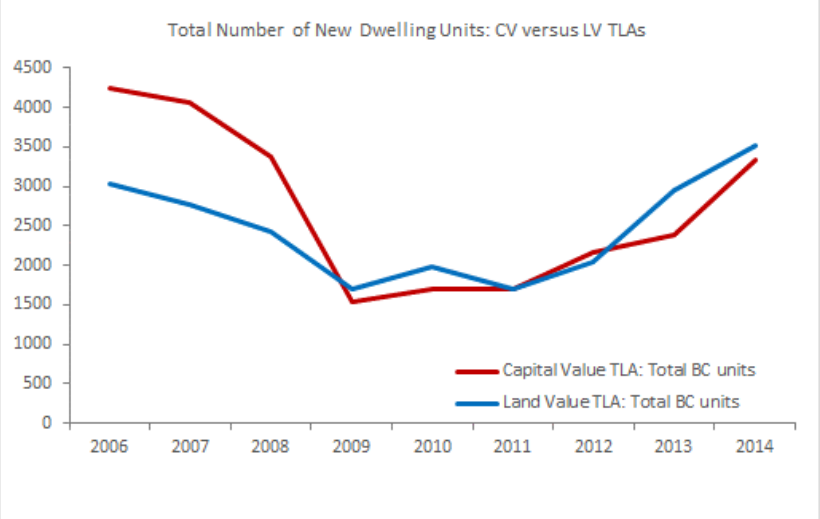


Figure 4.4 Total Building Unit Consents: CV versus LV TLAs



V. *The Auckland Quasi-Natural Experiment: Econometric Approach and Results*

Following the hypotheses discussed in section III, we adopt a simple econometric specification that nevertheless takes account of the timing of amalgamation, potential lagged effects from that process, potential endogeneity of responses, and the nature of the data.

Econometric Specification

Since amalgamation occurred in 2010, with Rates changes starting in 2011, we adopt a simple cross-section regression (in differences for the dependent variable) where 2009 and 2010 are combined into a single pre-amalgamation period, and where 2013 and 2014 are combined into a single post-amalgamation period. We omit 2011 and 2012 as these years are likely to be transition years where development decisions may have been in process at the time of amalgamation but only executed after it.

Combining two years of data for the 'before' and 'after' comparisons (i.e. *t-1* and *t*) is designed mainly to accommodate the inherent noisiness of the building consents data, especially at the small Area Unit spatial level, and partly to keep the estimation simple.

Our estimating equation is as follows:

$$\Delta\left(\frac{BC}{Dwellings}\right)_{it} = \beta_0 + \beta_1 LVRate_{it-1} + \beta_2 CVRate_{it-1} + \beta_3 DC_{it-1} + \beta_4 \frac{OwnTLAavRate}{AKLDavRate}_{it-1} + \beta_5 \Delta \frac{OwnTLAavRate}{AKLDavRate}_{it} + \text{control variables}_{it-1} + \varepsilon_{it} \quad (2)$$

where *i* represents the Area Unit, *t* (= 1, 2) represents the time period (2009-10 and 2013-14) and:

BC is number of building consents (i.e. building permits);
Dwellings is number of existing dwellings in the area;
LVRate is our land-value Rates variable;
CVRate is our capital-value Rates variable;
DC is our Development Contributions variable;[13]
OwnTLAavRate is the average Rate in the TLA in which Area Unit *i* is located;
AKLDavRate is the population-weighted average Rate across all Auckland (*AKLD*) AUs.

To minimise endogeneity risks, we use the lagged (pre-amalgamation) level (*t-1*) of variables based on 2009 data, or earlier 2006 census data where relevant. We also include both the lagged level of, and the change in, $\left[\frac{OwnTLAavRate}{AKLDavRate}_{it}\right]$ to account both for the effects of initial conditions and of relative changes in Rate levels across TLAs. The set of control variables, all at *t-1*, includes population density (persons per km^2), mean number of bedrooms in AU dwellings as at the 2006 census, and the average value of consents in 2009. The last two variables proxy for quality differences across AUs while population density proxies for

[13] *DC* is missing for a small number of AUs; we include a *DC_missing* binary variable to account for DCs in these AUs.

availability of developable sites (with a lower density expected to enable greater new-build activity).[14]

Based on the hypotheses in section III, the form of equation (2) yields the following sign predictions for our variables.

Firstly, Area Units in former LV-based TLAs (i.e. those with high $LVRate_{it-1}$ and low $CVRate_{it-1}$) are hypothesised to experience a reduction in BC's relative to the Auckland-wide average, since their Rates on capital value increased after amalgamation The opposite holds for Area Units in former CV-based TLAs. Hence we expect $\beta_1 < 0$ and $\beta_2 > 0$ (i.e. hypotheses H_1 and H_2).

Secondly, Area Units that had high (low) DC_{it-1} saw those DC's reduce (increase) absolutely and in relative terms after amalgamation, as shown in the graphs in section IV, so we expect $\beta_3 > 0$ (hypotheses H_3 and H_4).

Thirdly, being in a TLA with high initial Rates $\left(\frac{OwnTLAavRate}{AKLDavRate}_{it-1}\right)$ could initially have been a disincentive for development or it could reflect previously strong growth of the area that required high Rates to fund increased services; hence the sign of β_4 is ambiguous.

Fourthly, being in a TLA with a relative *increase* in Rates may act as a disincentive for development (and is not likely to reflect local development factors immediately after amalgamation) so we would expect a negative response such that $\beta_5 < 0$.

Hence, in summary our sign expectations from regressions on equation (2) are:

Variable (parameter)	Expected Sign	Variable (parameter)	Expected Sign
$LVRate_{it-1}$ (β_1)	< 0	$\left[\frac{OwnTLAavRate}{AKLDavRate}_{it-1}\right]$ (β_4)	> or < 0
$CVRate_{it-1}$ (β_2)	> 0	$\Delta\left[\frac{OwnTLAavRate}{AKLDavRate}_{it}\right]$ (β_5)	< 0
DC_{it-1} (β_3)	> 0		

Regression Results

OLS regression results are reported in Table 2. These report two different specifications for the numerator (BC): New Units (BC-NEW) and Altered Units (BC-ALT) where the latter represents consented alterations to existing dwellings. We present the results separately for these two types of building consents since: (i) they may respond differently in magnitude to the tax and DC changes; and (ii) they may respond with a different time lag to the changes. Our prior is that alterations can react faster than new-builds since the latter may require new infrastructure and land development plus more intricate negotiations with Council prior to a new building consent being granted. We do not report separate regressions for housing types (houses, apartments etc) because, as indicated in Appendix 2, there are insufficient building consents within most AUs for Apartments (either 0-9 units or 10+ units) in most years of our

[14] Since this is a cross section (difference) regression, there are no time fixed effects, while area unit fixed effects are effectively differenced out.

data; see Appendix Tables A2.3 and A2.4. In all cases heteroskedastic robust standard errors are reported.

To interpret the results tables, note that lagged variables (*'t-1'* in equation (2)) use data from 2008-09 (2009 Rates data), and are identified in the results tables by the subscript '09'.[15] Control variable labels are as follows:

'Own_AKLD_AvRates09' = $\left[\frac{OwnTLAavRate}{AKLDavRate}_{it-1}\right]$;

'Diff_Own_AKLD_AvRates' = $\Delta\left[\frac{OwnTLAavRate}{AKLDavRate}_{it}\right]$, where Δ = change from *t-1* to *t*;

'DC09missing' = 1 iff DC09 = 0 (which indicates that DC data is missing); and

'DC09missing' = 0 otherwise;

'PopDens09' = $PopDens_{it-1}$ is population density for the year ending 2009, calculated at the AU level;

'Rooms06' = mean number of bedrooms per dwelling, based on the 2006 census, calculated at the AU level;

'AvNew_Value09' ('AveAlt_Value09') = mean value of new consented unit (mean value of alteration or addition).

While we include a number of control variables in our regressions, there are many geographic and demographic factors that are likely to influence the number of building consent applications in an Area Unit, and for which we are unable to control. For example, in these urban AUs, the amount of suitable vacant land is likely to be important for new building consents, and the ability to build 'up or out' will constrain building extensions. We discuss below one strategy we adopt to ameliorate such effects.

Similarly, the age and condition of existing buildings on a given plot will affect decisions to demolish existing structures, and build new structures or to amend existing structures. This is especially important in the case of apartment blocks where many new (building consent) units can be created where the age/condition of existing structures merit demolition. Following the 2010 Christchurch earthquake, changes in earthquake-strengthening regulations also affected, and continue to affect, such decisions across the country. For these and other reasons, we do not expect high 'goodness of fit' statistics for our regressions and, indeed, these are typically around 7-8% in Table 2.[16]

A further issue, affecting the choice of sample considered, concerns the dependent variable – building consents. As Appendix Table A2.2 shows, in many AUs there are no, or very few building consent applications during our period of study. In 2008-09, for example, out of a

[15] Rates (and DCs) are set annually on a July (q3) Year1 – June (q2) Year 2 basis. Hence the Rates year 2009 is equal to the Rates set for q3 2008 – q2 2009. Building consent applications happen throughout the year; in allocating BC data to years for regressions we adopt those 'Rating years'. Auckland Council's post-amalgamation common Rates policy came into full effect from q3 2012, replacing the transitional Rates (though some differences in Rates across former TLAs were allowed to persist). Papakura is excluded from estimation because of incomplete Rates and DC data before 2012.

[16] Among other reasons is that by examining *differences* in building consent variables and *differences* in right-hand side variables (even though some of the latter are replaced by lagged levels of variables to remove endogeneity), we have removed the 'common fixed effects' that affect building consents similarly across all AUs,so reducing apparent goodness of fit.

total of 341 AU observations, 141 AUs had less than 5 BC applications for new houses; 66 for house alterations; and only 7% or less of all AUs had non-zero BCs for apartments.

How AUs with zero or very few building consents should be treated in the analysis is an important consideration. Existing building density, land availability, regulations etc. before amalgamation may be such that in some AUs there were few if any opportunities to build further. In this case it would be best to exclude such AUs from our analysis as the *potential* for tax reform-related responses is very limited. On the other hand, some AUs could have zero or low numbers of building consents before amalgamation in part due to disincentives inherent in the tax regime. These AUs may respond after amalgamation in which case we would want to include them in our analysis.

Given the likely dominance of the former argument, and the well-known biases that can arise in econometric testing when there are large numbers of zero-valued observations, we are inclined towards omitting AUs with low BC numbers. For completeness, Table 2 reports both results – those based on all AUs as well as for the subset of AUs with BC > 5. This latter number is chosen with the aim of removing 'low' values while at the same time avoiding substantial reductions in sample size.

If we are correct that low or zero BC numbers largely reflect exogenous factors to our analysis, this can be expected to add nose to the analysis, making it difficult to reliably identify responses to the tax reform changes associated with amalgamation. Indeed Table 2 results confirms the low signal-to-noise ratio when all AUs are included (columns 1 & 3), and we are inclined to put more emphasis on results based on the sub-samples where BC > 5 (columns 2 & 4).

Considering first results for new developments, the table suggests very little evidence of statistically robust effects associated with the tax changes – none of the estimated Rates or DC parameters is statistically significant at even the 10% level in column 2. Of the control variables, we find (as expected) that areas with high population density experienced a lower increase in BCs per existing dwelling than did areas with lower population density.

For building alterations, and omitting the AUs with fewer than 5 BC observations, there is more evidence of statistically significant tax-related effects in support of some of our hypotheses. These results are shown in column 4.

Firstly, for building alterations, and based on a 10% significance level, results for initially LV-based AUs suggest a decline in BCs after amalgamation, supportive of our hypothesis that $\beta_1 < 0$ in equation (2). For initially CV-based AUs we expect $\beta_2 > 0$ but the results suggest no significant effect (though with a negative estimated sign). This 'non-effect' could reflect the fact that there was no tax base change for those AUs, even though they experienced a *relative* tax base decline compared to previous LV-based AUs.

Secondly, AUs with relatively high initial DCs (and therefore subsequently lower DCs) appear to have an increase in alterations after the amalgamation, consistent with our hypothesis, $\beta_3 > 0$ in equation (2).

Thirdly, we argued above that the expected sign on β_4 in equation (2) is ambiguous, being dependent on the balance of two effects – pre-amalgamation high taxes acting as a disincentive for development (negative sign), and more rapid pre-amalgamation development in an AU

(reflected in higher BCs) requiring higher Rates to fund the necessary increased services (positive sign). Table 2, column 4 results suggest that for building alterations, AUs with initially high average Rates experienced a decline in alterations after amalgamation which is consistent with the former, negatively signed, effect dominating.

Fourthly, tests of the hypothesis that $\beta_5 < 0$ confirm that AUs with large increases in Rates (relative to the Auckland-wide average) after amalgamation, also had a post-amalgamation decline in building alterations. Indeed this tendency appears especially strong in the results.

Table 2 Regressions Results+

VARIABLE (parameter)	(1) BC-NEW	(2) BC-NEW	(3) BC-ALT	(4) BC-ALT
LandRates09 (β_1)	0.172	0.170	-0.00752	-0.0356*
	(0.153)	(0.137)	(0.0157)	(0.0183)
StructureRates09 (β_2)	-0.146	-0.0596	-0.0195	-0.0165
	(0.163)	(0.108)	(0.0135)	(0.0165)
DC09 (β_3)	0.00129	-0.00376	0.000468	0.000699*
	(0.00560)	(0.00598)	(0.000291)	(0.000408)
DC09missing	200.4	-121.4	14.62*	17.81*
	(222.0)	(150.8)	(7.875)	(10.64)
Own_AKLD_AvRates09 (β_4)	20,031*	13,055	-496.7	-2,743**
	(11,003)	(11,155)	(1,158)	(1,205)
Diff_Own_AKLD_AvRates (β_5)	16,518	12,637	-634.0	-3,136***
	(12,921)	(12,284)	(1,241)	(1,198)
Control variables:				
Rooms06	103.7	73.07	4.140**	5.626**
	(104.7)	(69.96)	(1.797)	(2.831)
AvNew_Value09	2.49e-05	-2.95e-05		
	(1.54e-05)	(5.05e-05)		
AvAlt_Value09			3.21e-06	6.19e-06
			(2.61e-06)	(8.25e-06)
PopDens09	-0.0485**	-0.0207*	0.000431	0.00112
	(0.0237)	(0.0125)	(0.000569)	(0.000762)
Constant	-2,759*	-1,762	67.89	357.4**
	(1,422)	(1,344)	(156.3)	(163.4)
Observations	339	205	339	283
R-squared	0.073	0.079	0.072	0.077
BC sample	All	BC >5	All	BC >5

Robust standard errors in parentheses
*** p < 0.01, ** p < 0.05, * p < 0.1

+ Dependent variable is $\Delta\left(\frac{BC}{Dwellings}\right)_{it}$.

These Table 2 results raise the question of why building *alterations* reveal relatively strong support for our tax-related hypotheses while *new* building developments do not? One plausible explanation is that the typical length of development processes means that planning for building alterations are much more likely to be flexible (when faced with changed incentives) than new development within a short period following a policy change. In addition, given the much higher degree of regulation, and required negotiation with councils, associated with major new building developments, building regulations are arguably a more binding constraint for new developments than for alterations.

For example, new building developments typically involve more substantial development contributions because of the additional infrastructure required (roading, water supply, wastewater etc.) and these may involve negotiating an agreement between the developer and the council before submitting the building application (to minimize the risk of rejection). With our data coverage after amalgamation limited to two years, there may yet be observable effects of the Auckland tax changes on new building consents that we are currently unable to identify.

Considering the magnitude of the impact of tax reforms, the regression results in Table 2, together with means and standard deviations of the variables, can be used to predict the magnitude of the resulting effects on (changes in) building consents. In Table 3 we use results from column 4 of Table 2 to identify how far the change in building consent for alternations, BC-ALT, would be affects by two reforms: (i) a 1 standard deviation increase in the relevant tax variable; and (ii) a 10% change (from the mean) in the relevant tax variable. Results are shown in Table 3.

Table 3 Impact on BC-ALT of Changes in Tax Variables

				Impact on BC-ALT of:	
	Parameter	Mean	SD	1 x SD change	10% change
BC-ALT		1.87	18.27		
LandRates09	-0.0356	228	275	-9.8	-0.81
StructureRates09	-0.0165*	1,212	157	-	-
DC09	0.0007	22,583	9,906	6.9	1.6
Own_AKLDavRates09	-2,743	0.134	0.0075	-20.5	-36.9
Diff_own_AKLDavRates	-3,136	-0.00071	0.0059	18.5	0.22

Note: * We ignore the 'StructureRates09' effect because the parameter is insignificant and wrongly signed; see Table 2. A negative sign has been applied to the standard deviation for 'Diff_own_AKLDavRates' to generate a decrease from the (negative) mean.

The table shows that the average value of BC-ALT is 1.87; that is, the change in building consents for alterations/extensions between pre- and post-amalgamation periods is typically for just under +2 housing units. However with a standard deviation of 18, clearly many AUs had substantial increases or decreases in property redevelopment between the two periods (ranging from around -16 to +20 consents per thousand dwellings at 1 standard deviation from the mean value). This means that between our two periods there was a slight increase in (alteration) building consents of about 2 consents per thousand dwellings on average across all Auckland AUs in the sample. The tax effect estimates in the two right-hand columns of Table 3 therefore indicate by how much more, or less, this average building consent increase would be predicted to change in association with the tax changes simulated.

Results in the two right-hand columns in suggest that, with changes in tax variables of either (i) or (ii) above, there is a non-negligible predicted change in average building consent growth across AUs. In several cases the impact on BC-ALT of either a one standard deviation, or a 10%, change is the equivalent of around half to more than one standard deviation of BC-ALT (= 18).

VI. Conclusions

This paper has exploited a quasi-natural experiment involving local property tax reform that arose from the amalgamation of several local councils in 2010 in Auckland, New Zealand. From 2011, seven previously separate councils in the Auckland region, and the higher tier Auckland Regional Council, (ARC) were amalgamated to form a unitary local authority – Auckland Council.

The reform involved several changes in the local property tax system – known as 'Rates' in New Zealand. These included a *shift* in the local tax base from a land-value basis to a capital-value basis in some former councils, changes in the *relative levels* of Rates across the former councils; and a change to the level of impact fees levied specifically on new, and on certain extended, properties known as Development Contributions (DCs). These reforms represent an exogenous source of identification for tax-induced effects on property development. It provides a rare opportunity to examine the extent of empirical support for a number of established hypotheses in the local property tax literature related to the impacts of the level and structure of local taxation.

Empirically, the exogenous nature of the New Zealand reforms enables more reliable estimates than hitherto of the effects of changes in the tax base, tax levels and development contribution levels on property development. These changes were hypothesized to affect building consent applications to the council, both for alternations to existing properties and for construction of new properties, the latter possibly with a lag, given the likely longer gestation periods involved.

To test these hypotheses, we used a difference-in-difference type regression method to examine how far observed changes in applications for new and altered building development are consistent with predictions from our economic models, having controlled for a variety of other influences.

Our results suggest that, while there is little evidence of tax effects on *new* building development in the initial period after amalgamation, there is support for such effects on building *alterations*. In particular, *ceteris paribus*, alterations fell in areas: (i) that switched from a land-value to a capital-value rates base, (ii) that experienced an increase in overall rates, and (iii) that experienced an increase in development contributions. Since our post-amalgamation data cover only two years (2012-14), we conjecture that the significant effects on alterations as opposed to new-builds may arise from the greater flexibility in the short-run of building alterations compared to new development. Future work could re-examine the effects on new-builds once a longer period of data becomes available.

Three other extensions to our analysis may also be warranted as the post-amalgamation period lengthens. First, one could estimate the effect of the tax changes on house prices across the former TLAs, with an emphasis on estimating differential effects depending on the original split (for a given house) between the value of its land and the value of its structures (i.e. improvements). Second, one could estimate the effect of the tax changes on the density of development both in terms of number of new units and the average value of new units per hectare. Third, at a methodological level, one could examine whether a regression discontinuity approach across former local council boundaries would yield additional insights, although this approach may require availability of considerable data at a fine spatial level.

The Auckland amalgamation therefore provides an opportunity to test several hypotheses about the effects of local property tax changes on urban outcomes. Our results indicate that we do see some effects on residential building alterations that are consistent with theoretical predictions, even within a short time period after the tax changes took effect.

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Appendix 1 The Auckland Local Tax System and Amalgamation Process

The pre-amalgamation Auckland TLAs and the post-amalgamation Auckland Council levied two kinds of Rates: General Rates and Targeted Rates. General Rates are used to fund Councils' general activities, those deemed to be of general or widespread benefit to Council ratepayers. General Rates include two components: a uniform annual general charge (UAGC), and a value-based annual General Rate. The UAGC is levied as a fixed dollar amount and varied from $0 to $770 among the former local councils. The Rates can be summarised as follows:

Rate type:	Value-based	Fixed $ amount
General	Capital-value, land-value,† or annual-value Rates	UAGC
Targeted	Transport Rate, Stormwater Rate Auckland Museum & regional amenities Rate	All other targeted Rates*

* See list in Table A1.1; † Waitakere and Papakura were the only TLA where this Rate was set as a step-function similar to an income tax structure; in Rodney, 2006-09, the general Rate varied across sub-areas of the TLA (e.g. Hibiscus Coast, rural, other townships). We construct an 'average' general Rate in this case.

The mixture of 'fixed' (dollar amount) and value-based Rates across Councils can be seen in Table A1.1 which is illustrative of the 2010 financial year:

Table A1.1 Fixed and Value-based Rates Components

	Auckland City	*Franklin*	*Manukau*	*North Shore*	*Rodney*	*Waitakere*
General Rate (2010):						
UAGC	F	F	F	F	F	F
Value-based	AV	CV	AV	LV	LV	LV
Targeted Rate (2010):						
Waste Management	F	F	F	F		
Stormwater		CV			LV	
Water supply capital/ loan repayments					F	
Wastewater	F*	F	F*	F	F	F
Transport		CV			LV	
CBD Targeted	F					
Miscellaneous (Auckland City)**	-					
Community Facilities		F				
Auckland Regional Amenities (from July 2009)		F	AV	LV	F	
Auckland Museums: War memorial Transport and technology		F		LV	F	

Representation		F				
Civic Amenities; Democracy & development					F	
Civic Leadership					F	
Leisure Centre for Hibiscus Coast					F	
Rugby World Cup levy						F

Note: F = Rate set as fixed dollar amount; CV (LV, AV) = capital-value (land-value, annual-value) based Rate.
* Paid directly to private supplier in these TLAs but added to Council Rates bill here. ** Miscellaneous includes Rates for 'Community Development and Housing', 'City Development', 'Open Spaces and Volcanic Cones', and 'Heritage and Urban Design'.

Value-based Rates

A. General Rates:

The value-based General Rates were assessed on properties' capital value (CV), land value (LV), or 'annual value' (AV). According to the Auckland Regional Council annual plan, CV is the total value of land with improvements. LV is the value of land without improvements. AV is the greater of either the annual rent at which the property could be let, or 5 percent of the capital value of the property.

These Rating values are assessed by the Council or Quotable Value (QV – a State Owned Enterprise) every three years. QV uses mass appraisal processes to determine rating valuations. Valuations are based on property attributes and relevant local sales around the time of the revaluation. Any relevant market trends are established and applied to similar properties.

In addition to the Rates levied by each TLA, each resident in a TLA was liable to pay an Auckland Regional Council Rate. Specifically, ratepayers paid capital value General Rates to fund a range of regional activities such as the regional growth strategy, storm water management etc. In addition, they may pay Targeted Rates in five areas of activities: biosecurity, possum control in South Kaipara, possum control in Awhitu, parkland purchase and transport. Table A1.2 indicates the value-base for General Rates in the former councils before July 2012.

Table A1.2 Value-based General Rates before amalgamation.

CV	LV	AV
Franklin	Waitakere	Auckland City
Auckland Regional Council	North Shore	Manukau (from July 2006)
	Rodney	
	Papakura	

Note: Manukau used land-value taxation before July 2006, but changed to an annual-value basis from July 2006 till July 2012.

B. Annual-value Rates:

According to the Auckland Regional Council annual plan, the 'annual value' of a property was the greater of either:

- 5 percent of the property's capital value; or

- The rental value of a property on the open market, less 20 percent to cover normal expenses for developed land, or less 10 percent for vacant land.

Due to data constraints, we assume an annual value for all residential property equal to 5 percent of the property's capital value.

According to the Auckland Council long-term plan 2012-2022, wastewater Rates are no longer charged directly by Auckland Council since July 2012. Instead they are billed directly to customers by Watercare - a separate organisation, wholly owned by the Auckland Council.

Targeted Rates

Targeted Rates raise revenue from specific 'targeted' local council services. Common services include transport, water and wastewater services. For example, Rodney and Franklin charged transport and stormwater Rates to fund costs of the roading network and the stormwater network. On the other hand, water and wastewater Rates were used to fund the council's water supply and wastewater network. Targeted Rates are variously set as a fixed dollar amount or are value-based. Thus, an individual TLA may use both capital-value based Rates and land-value based Rates. Rodney was the only council which did so. From 2006 to 2009, it used land-value taxation in both general Rates and targeted Rates. From 2010 to 2012, Rodney used land-value taxation for general Rates and capital-value for transport Rates (a component of targeted Rates). In 2010, a typical ratepayer paid $264 for value-based general Rates and $283 for transport Rates.

Development contributions

Development contributions are fees charged by the Council for residential development. They are used to fund the extra community and network (e.g. transport) infrastructure required as a result of new building development (Auckland Council, 2014). For each of the infrastructure activities funded by DCs, contribution catchments have been determined based on geography, service delivery, the nature of the infrastructure project, and local community needs.

Under section 198 of the Local Government Act (LGA), 2002, a territorial authority may require a development contribution when:

- a resource consent is granted under the Resource Management Act 1991 within its district;
- a building consent is granted under the Building Act 2004 for building work situated in its district;
- authorization for a service connection is granted.

Development contributions can only be required where a development is to occur. Section 197 of the LGA 2002 defines development as:

- any subdivision, building (as defined in section 8 of the Building Act 2004), land use, or work that generates a demand for reserves, network infrastructure, or community infrastructure;[17] but
- does not include the pipes or lines of a network utility operator.

Local councils set development contributions via the following steps:

Step 1: Identify the catchment;

Step 2: Estimate units of demand generated by the growth for each catchment;

[17] 'Reserves' refers to local land set aside as 'open spaces' for recreation etc. They include, but are not restricted to, nature reserves.

Step 3: Project the cost of growth for each catchment;

Step 4: Distribute the capital expenditure attributable to growth over the additional units of demand for each catchment;

Step5: Adjustments for open-space land acquisition, and stormwater activities (if applicable).

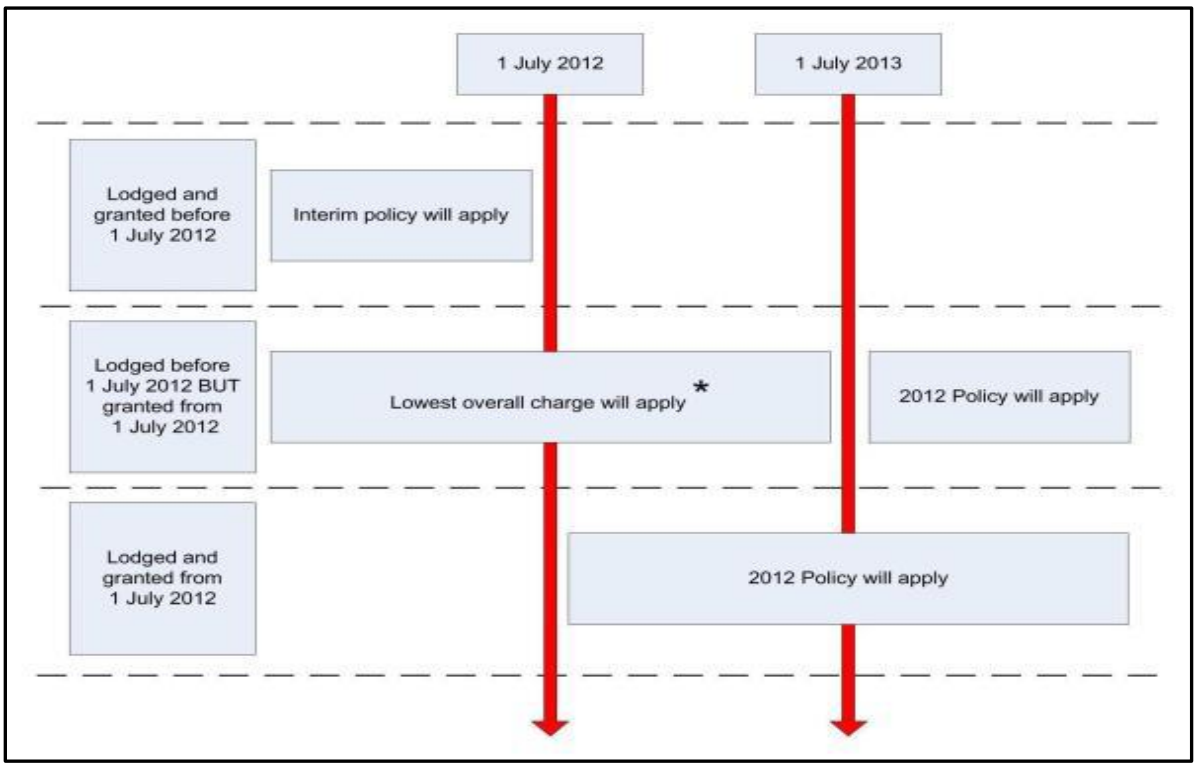
Section 203(1) of the LGA 2002 requires that a development contribution for reserves calculated under this policy must not exceed the greater of:

(a) 7.5 percent of the value of additional allotments created by a subdivision.
(b) the value equivalent of 20 square meters of land for each additional household unit created by a development.

The policy transition process

The amalgamation into Auckland Council in 2010 involved a 'transition process' whereby previously different council policies in each TLA transitioned towards a common policy. Table A1.3 presents the policy transition process for development contributions, and Table A1.4 for Rates (Auckland Council, 2012).

Table A1.3 The policy transition process for development contributions



It should be noted that Auckland Council has had no authority to charge water and wastewater contributions since July 2011. These contributions were replaced by the 'infrastructure growth charge' from Watercare. The charge is a fee applied to all new developments connecting to Watercare's networks in Auckland City, Manukau, North Shore, Waitakere and Rodney.

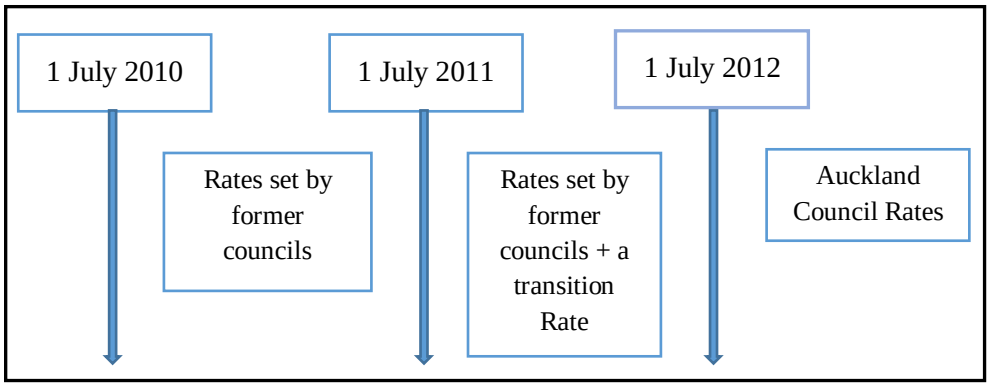
'Interim policy' refers to the development contribution policy set by former local councils.

The policy transition process for Rates is as follows.

- Rates for the 2010/2011 financial year were Rates set by former councils.

- Rates for the 2011/2012 financial year were equal to 2010/2011 Rates plus a transition Rate.
- From July 2012, Rates were set by Auckland Council (with provision for a smooth transition to the final standardised rate over time).

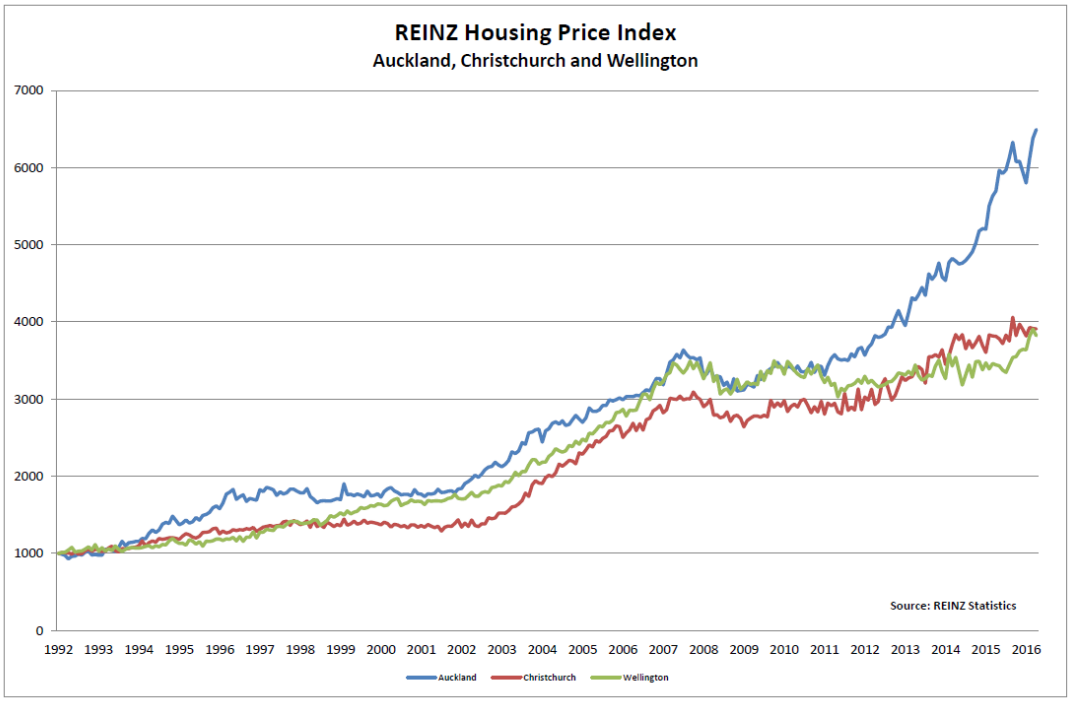
Table A1.4 The policy transition process for Rates



Appendix 2 Descriptive Statistics for Housing and Tax Variables

Auckland House Prices Time Series

Figure A2.1 New Zealand Regional House Sale Prices, 1992-2016



Partial Correlations among Some Sample Variables

Figure A2.2 Cross-plot of ΔBC (new units) and Land-value Rates

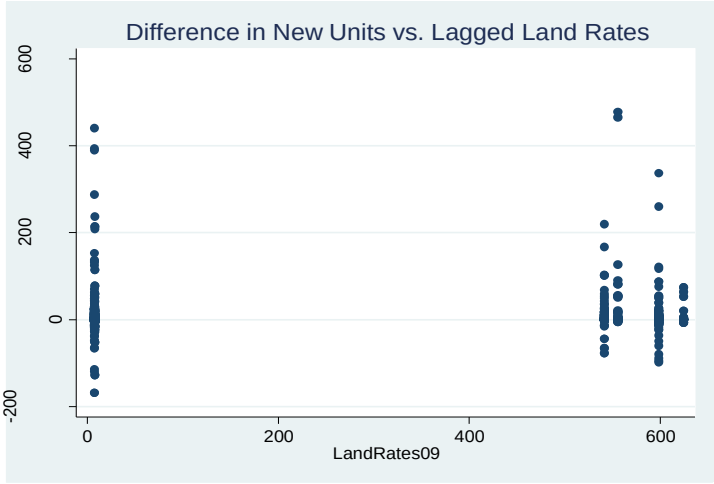


Figure A2.3 Cross-plot of ΔBC (total units) and Land-value Rates

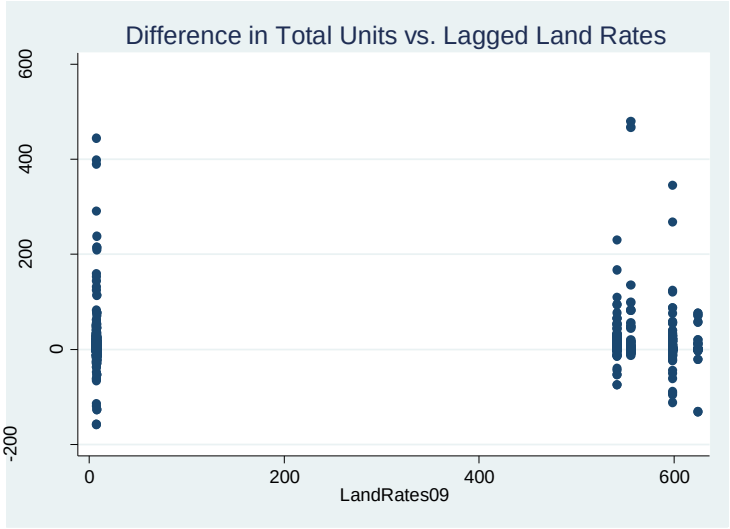


Figure A2.4 Cross-plot of ΔBC (new units) and Structure Rates

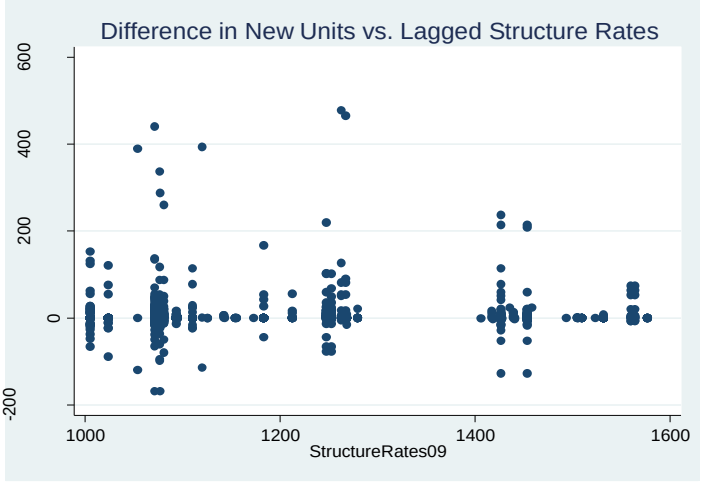


Figure A2.5 Cross-plot of ΔBC (total units) and Structure Rates

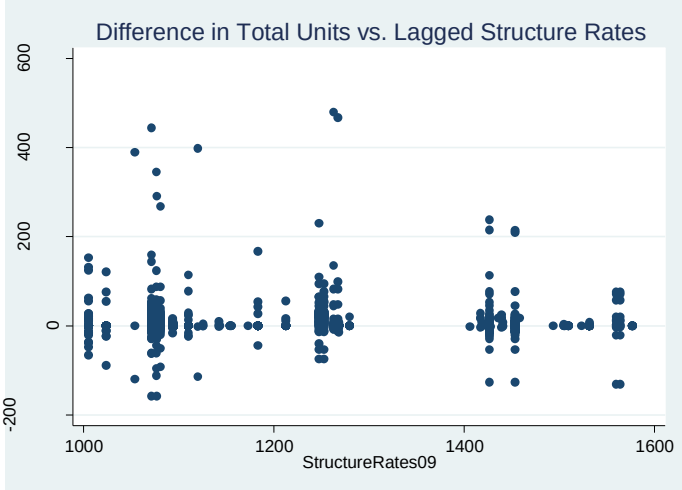


Figure A2.6 Cross-plot of ΔBC (new units) and Development Contributions

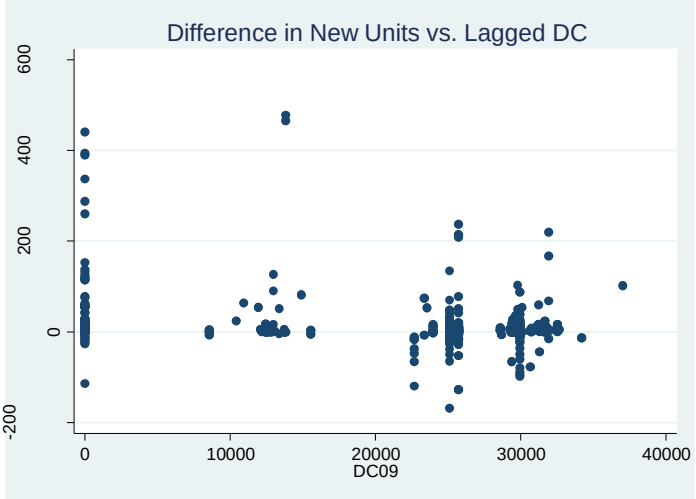
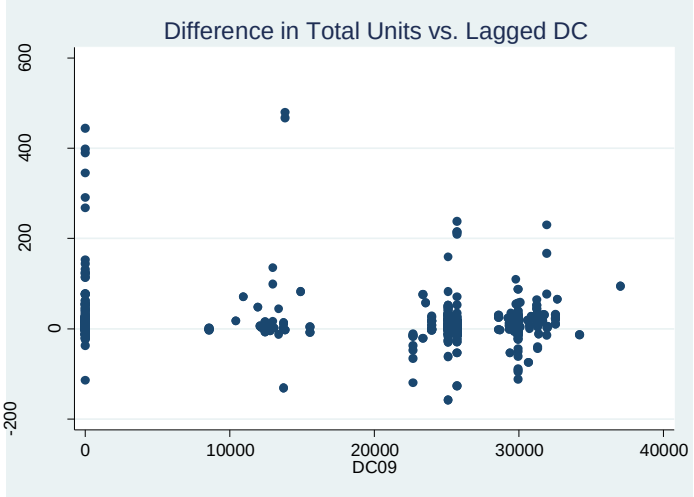


Figure A2.7 Cross-plot of ΔBC (total units) and Development Contributions



For the variables used in regressions in Table 2 (for BC > 5), descriptive statistics are given in Table A2.1.

Table A2.1 Descriptive Statistics for Regression Variables

Variable Name	Obs	mean	sd	min	max
BC-NEW	205	20.07	191.85	-266.67	2489.58
LandRates09	205	273	284	7	625
StructureRates09	205	1223	160	1071	1560
DC09	205	25039	6761	0	37060
DC09missing	205	0.029	0.169	0	1
Own_AKLD_avRates09	205	0.133	0.008	0.122	0.143
Diff_own_AKLD_avRate:	205	0.000	0.006	-0.008	0.008
Mean_Bedrooms06	205	3.129	0.313	1.500	4.300
AvNew_Value09	205	305182	147781	83569	927056
PopDens09	205	2477	1265	34	9927
BC-ALT	283	1.9	18.3	-257.6	30.463
LandRates09	283	228	275	7	625
StructureRates09	283	1212	157	1071	1560
DC09	283	22583	9906	0	37060
DC09missing	283	0.134	0.342	0	1
Own_AKLD_avRates09	283	0.134	0.007	0.122	0.143
Diff_own_AKLD_avRate:	283	-0.001	0.006	-0.008	0.008
Mean_Bedrooms06	283	3.062	0.353	1.500	4.400
AvAlt_Value09	283	93242	101680	13057	1153358
PopDens09	283	2729	1284	29	9927

Categorization of Building Consents (by Type, Size, Year and TLA)

Building types used in our analysis have been categorised/aggregated as shown below (based on the official codes and names of building types in the building consent database).

House (attached and unattached)	
	101 House - not attached to other
	102 Unit/flat/townhouse/studio - attached and unattached horizon
	104 Granny flat - unattached
	105 Dwelling added to other building
Apartment 0-9	
	103 Apartment block - attached vertically (0-9 Units)
Apartment 10 +	
	103 Apartment block - attached vertically (10 or more units)
Total Dwellings (the addition of the previous three types)	
	101 House - not attached to other
	102 Unit/flat/townhouse/studio - attached and unattached horizon
	103 Apartment block - attached vertically (0-9 Units)
	103 Apartment block - attached vertically (10 or more units)
	104 Granny flat - unattached
	105 Dwelling added to other building

Table A2.2 AUs with Building Consents by Size and Type (Pre-amalgamation years: 2008-09)

	Number of Units						
Dwelling type	**0**	**1-5**	**6-10**	**11-20**	**21-30**	**31+**	**Total**
House New	32	109	82	64	23	31	341
House Alt	9	57	48	91	59	77	341
House Total	6	24	37	60	61	153	341
Apartment (0-9) New	326	13	0	2	0	0	341
Apartment (10+) New	317	0	1	7	5	11	341

Note: Numbers in this table represent how many building consents, for each housing type, are in different size categories across the 341 AUs.

Table A2.3 Total New Units by TLA and Year

House (attached and unattached)

TLA	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Auckland City	776	794	796	520	690	709	842	878	976	6981
Franklin District	465	607	466	168	222	154	172	304	293	2851
Manukau City	1359	1350	995	454	593	543	693	643	999	7629
North Shore City	859	814	712	338	557	498	545	557	697	5577
Papakura District	365	129	176	127	235	228	221	484	452	2417
Rodney District	641	721	730	473	524	440	664	929	1038	6160
Waitakere City	669	664	613	441	462	385	447	641	694	5016
Total	5134	5079	4488	2521	3283	2957	3584	4436	5149	36631

Apartment (0-9 units)

TLA	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Auckland City	47	19	25	25	5	27	27	36	37	248
Franklin District	0	0	0	0	0	1	0	0	2	3
Manukau City	47	7	14	0	0	0	1	0	13	82
North Shore City	30	0	7	5	14	0	15	1	15	87
Papakura District	0	0	0	0	3	1	0	3	23	30
Rodney District	0	21	36	1	0	10	4	1	22	95
Waitakere City	1	0	2	0	0	0	0	3	1	7
Grand Total	125	47	84	31	22	39	47	44	113	552

Apartment (10+ units)

TLA	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Auckland City	1221	1090	1011	329	144	197	379	453	798	5622
Franklin District	0	0	0	0	0	0	0	0	0	0
Manukau City	319	192	61	34	40	74	49	67	227	1063
North Shore City	244	269	104	88	18	45	51	80	272	1171
Papakura District	0	0	0	0	10	0	0	0	27	37
Rodney District	92	71	36	112	92	86	59	132	156	836
Waitakere City	131	91	16	107	60	0	28	131	131	695
Grand Total	2007	1713	1228	670	364	402	566	863	1611	9424

Total Dwellings

TLA	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Auckland City	2045	1903	1832	874	839	933	1248	1367	1811	12852
Franklin District	465	607	466	168	222	155	172	304	295	2854
Manukau City	1727	1549	1070	488	633	617	743	710	1239	8776
North Shore City	1133	1083	823	431	589	543	611	638	984	6835
Papakura District	365	129	176	127	248	229	221	487	502	2484
Rodney District	733	813	803	586	616	536	727	1062	1216	7092
Waitakere City	801	755	631	548	522	385	475	775	826	5718
Grand Total	7269	6839	5801	3222	3669	3398	4197	5343	6873	46611

Table A2.4 Total Amended Units by TLA and Year

House (attached and unattached)

TLA	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Auckland City	2167	2066	1843	1629	1736	1691	1831	2050	2121	17134
Franklin District	301	257	245	163	179	229	197	203	195	1969
Manukau City	978	916	823	633	658	558	499	519	721	6305
North Shore City	976	861	926	707	783	845	979	968	1078	8123
Papakura District	152	194	124	116	118	86	61	69	88	1008
Rodney District	496	510	527	444	548	401	484	453	501	4364
Waitakere City	473	437	426	379	364	373	400	446	519	3817
Total	5543	5241	4914	4071	4386	4183	4451	4708	5223	42720

Apartment (0-9 units)

TLA	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Auckland City	37	45	45	54	54	52	64	45	62	458
Franklin District	0	0	0	0	0	0	0	1	0	1
Manukau City	0	0	1	0	1	0	0	0	3	5
North Shore City	6	1	5	4	5	2	3	6	9	41
Papakura District	0	0	0	1	1	0	0	1	0	3
Rodney District	1	0	0	1	1	1	2	0	1	7
Waitakere City	1	0	0	3	0	0	0	5	1	10
Grand Total	45	46	51	63	62	55	69	58	76	525

Apartment (10+ units)

TLA	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Auckland City	0	0	0	0	10	0	0	0	0	10
Franklin District	0	0	0	0	0	0	0	0	0	0
Manukau City	0	0	0	0	0	0	0	0	0	0
North Shore City	0	0	0	0	0	0	0	0	0	0
Papakura District	0	0	0	0	0	0	0	0	0	0
Rodney District	0	0	0	0	0	0	0	0	0	0
Waitakere City	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	10	0	0	0	0	10

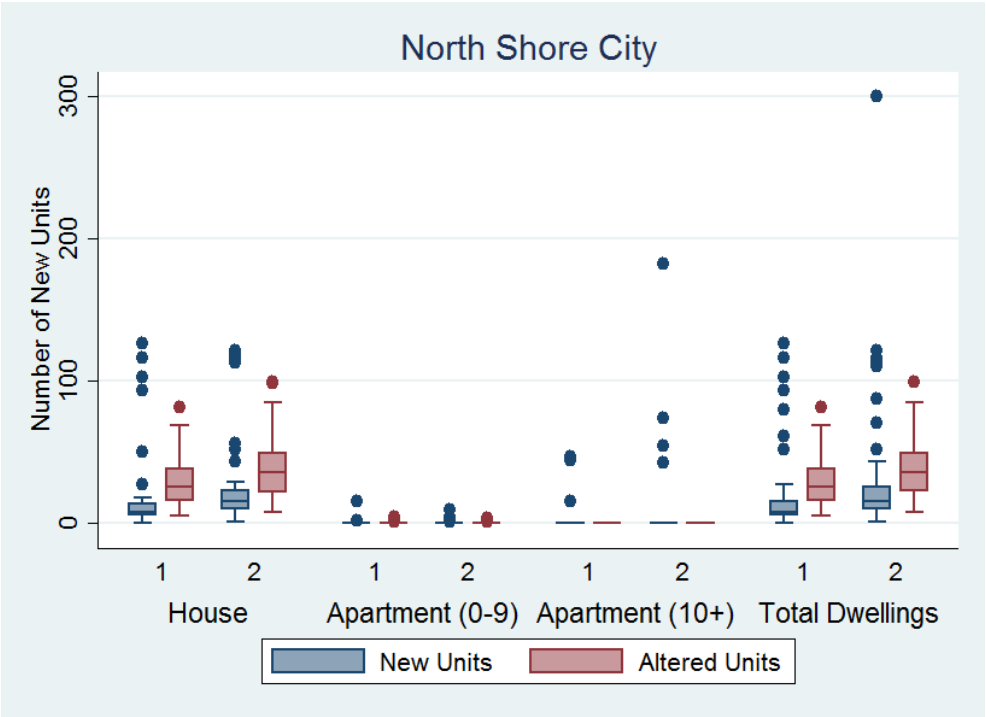
Total Dwellings

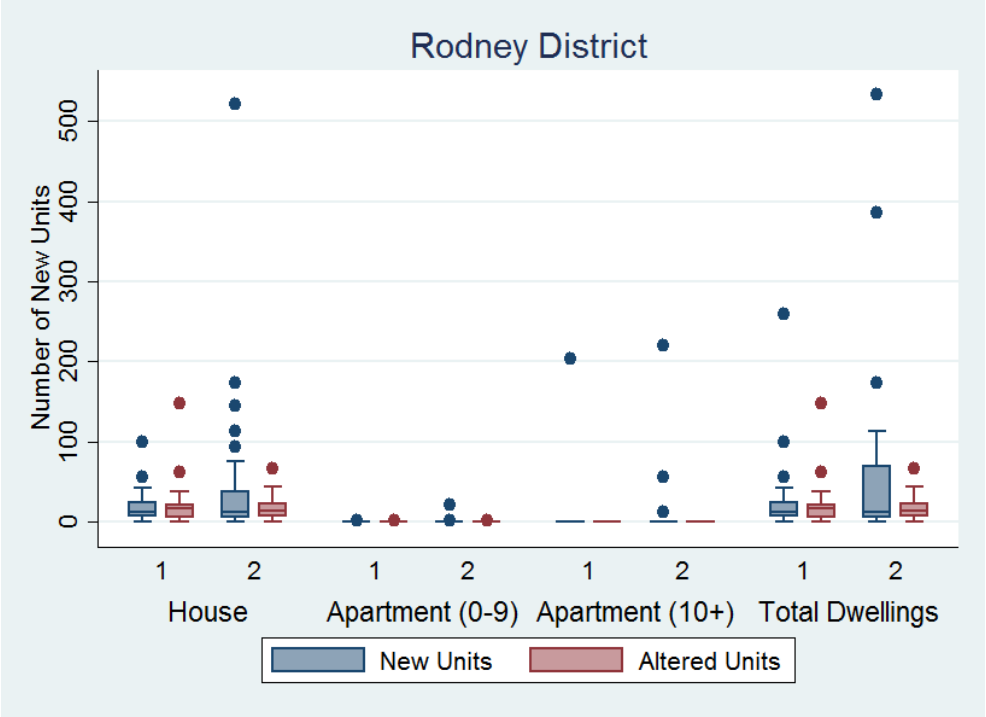
TLA	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Auckland City	2204	2111	1888	1683	1800	1743	1895	2095	2184	17603
Franklin District	301	257	245	163	180	229	197	204	195	1971
Manukau City	978	916	824	633	659	558	499	519	724	6310
North Shore City	982	862	931	711	788	847	982	974	1087	8164
Papakura District	152	194	124	117	119	86	61	70	88	1011
Rodney District	497	510	527	445	549	402	486	453	502	4371
Waitakere City	474	437	426	382	364	373	400	451	520	3827
Grand Total	5588	5287	4965	4134	4459	4238	4520	4766	5300	43257

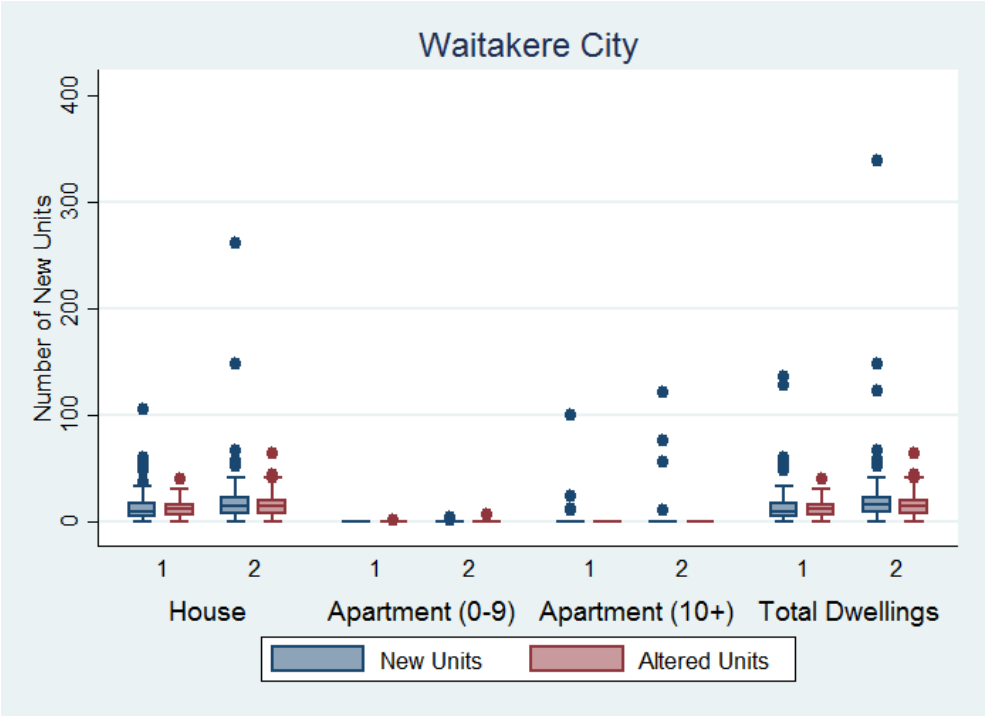
Building Consents "Before and After" Box Plots by TLA

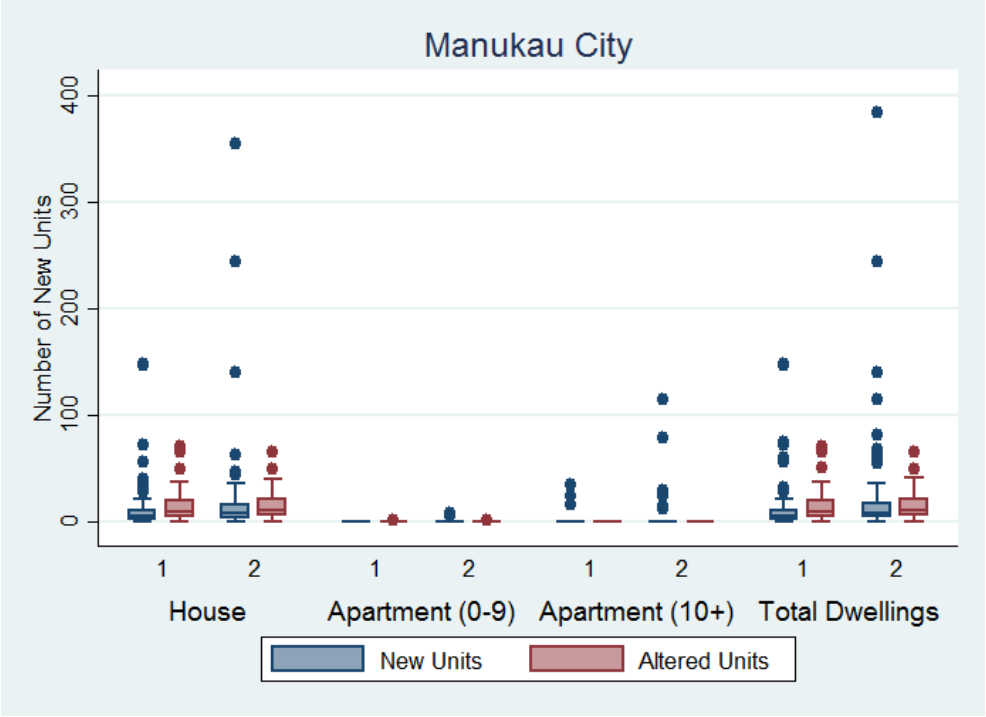
The following charts show box-plots for each TLA for the numbers of new and altered building consents. These are shown before (1) and after (2) amalgamation, and by housing type ('House', 'Apartment(0-9)' etc.). Box-plots include medians, inter-quartile range (the 'box'), the 10th/90th percentiles (the 'whiskers') and outlying observations outside those ranges.

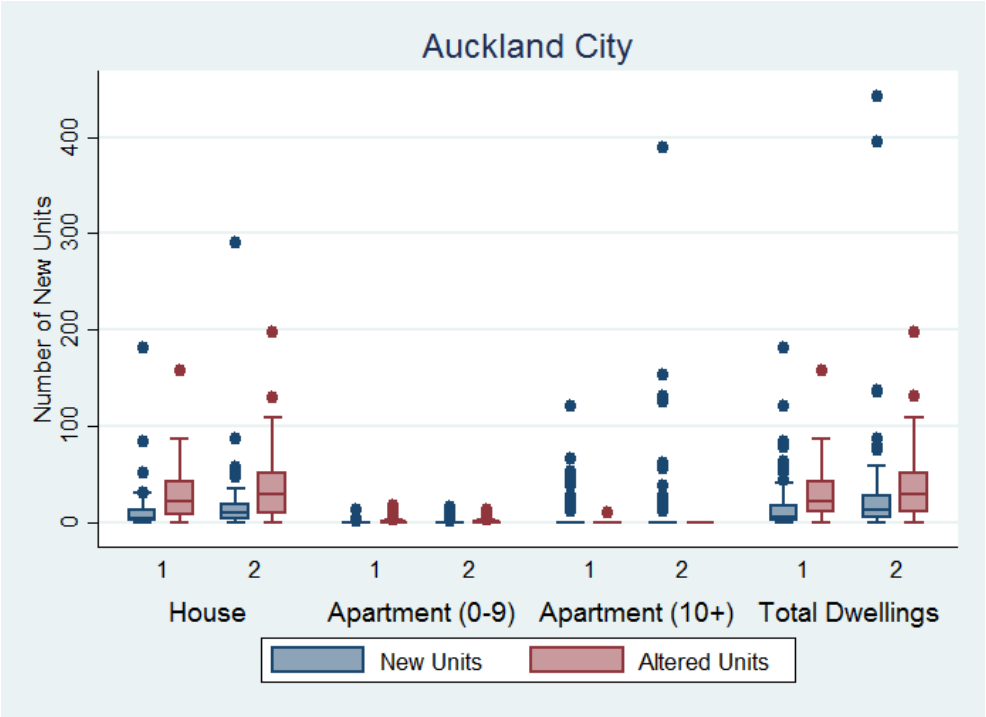
Note: 1 = 'before' (2008/9 – 2009/10). 2 = 'after' (2012/13 – 2013/14).

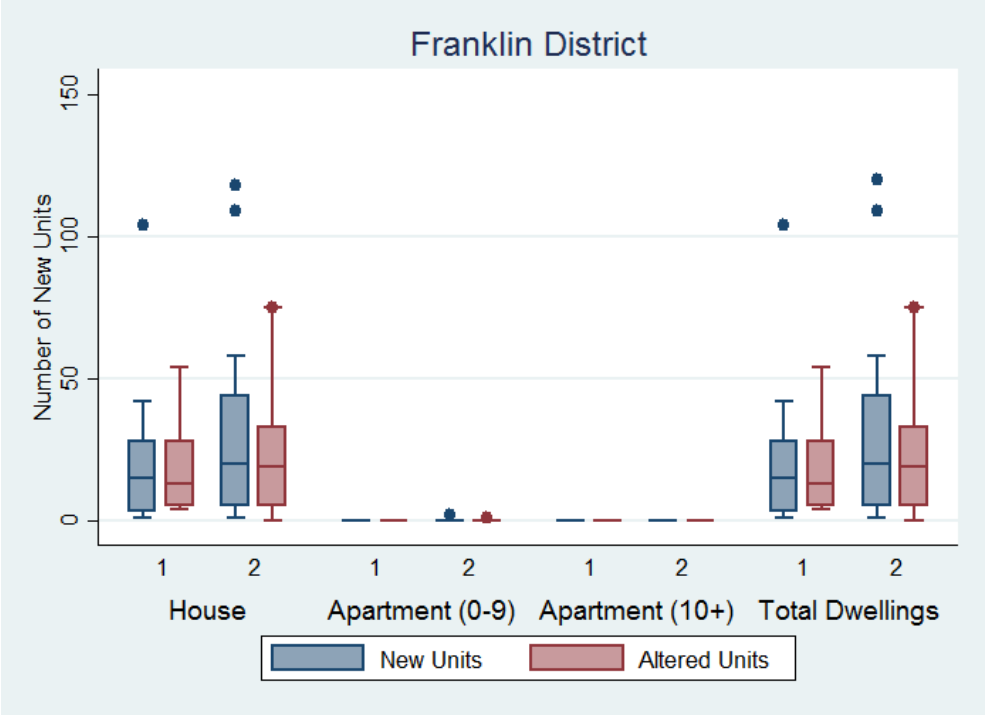





Waitakere City
Number of New Units
0
100
200
300
400
1
2
House
Apartment (0-9)
Apartment (10+)
Total Dwellings
New Units
Altered Units


Manukau City
Number of New Units
0
100
200
300
400
1
2
House
Apartment (0-9)
Apartment (10+)
Total Dwellings
New Units
Altered Units


Auckland City
Number of New Units
0
100
200
300
400
1
2
House
Apartment (0-9)
Apartment (10+)
Total Dwellings
New Units
Altered Units


Franklin District
Number of New Units
0
50
100
150
1
2
House
Apartment (0-9)
Apartment (10+)
Total Dwellings
New Units
Altered Units

Appendix 3 Calculation of Regression Analysis Variables

Population Density

AU land area is measured as square kilometres, obtained by adding Statistics New Zealand data on Meshblock land areas within each 2013 AU. Population estimates are from Statistics New Zealand, estimated 2009 population using 2015 boundaries and the 2013 Area Unit codes (all 2015 Meshblocks are in the same Area Units as the 2013 Area Units). Population Density $PopDens_{it}$ is then obtained as Area Unit i's population divided by its respective land area:

$$PopDens_{it} = \frac{Pop_{it}}{LandArea_i}$$

Dwellings per Area Unit

Dwellings data are obtained from the 2013 (Stats NZ) Census meshblock dataset for the Auckland Region, giving the 2013 Census number of occupied Dwellings, as well as mean number of bedrooms as reported in the 2013 census. We then calculate:

Dwellings = number of occupied dwellings per Area Unit in the 2013 census (in thousands).

Population Weighted Average Rate

$AKLDavRate_t$ is the population-weighted average Rate across all $(i = 1, \dots, N)$ Auckland Area Units.

$$AKLDavRates_t = \sum_{i=1}^{N} w_i ATR_{it}$$

where ATR_{it} is Area Unit i average Rate in period t and w_i is the population weight of Area Unit i which does not change over time. That is, $w_i = \frac{1}{P} pop_i$, where P is the total population (sum of all populations of area units in the sample), pop_i is Area Unit i's population in 2009. and $\sum_{i=1}^{N} w_i = 1$.

The average total Rate for each Area Unit is therefore the same for each Area Unit within a given TLA. Only the Area Units in our sample have been used to construct this population-weighted average Rate.

Definitions of all variables are given in Table A3.1.

Table A3.1 Variable Descriptions

Variable name		Variable definition	Data source
Dependent Variables			
BC-NEW	Δ NewUnits/TotalDwellings	Change in Number of New Units per 1000 occupied dwellings in an area unit. Where number of occupied dwellings are measured in the 2006 census.	**Building Consent data: Building Consents Statistics (StatsNZ); Dwellings: StatsNZ (Census)**
BC-ALT	Δ AlteredUnits/TotalDwellings	Change in Number of Altered Units per 1000 occupied dwellings in an area unit. Where number of occupied dwellings are measured in the 2006 census.	**Building Consent data: Building Consents Statistics (StatsNZ); Dwellings: StatsNZ (Census)**
BC-TOTAL	Δ TotalUnits/TotalDwellings	Change in Total Number of Units per 1000 occupied dwellings in an area unit. Where number of occupied dwellings are measured in the 2006 census.	**Building Consent data: Building Consents Statistics (StatsNZ); Dwellings: StatsNZ (Census)**
Independent Variables			
LandRates09	LandRates(t-1)	Average rates on land before amalgamation (2009). The sum of all land based rates for the year ending 2009 multiplied by a common median land value in the Auckland Region in 2009	**Rates: Former Territorial Local Authority Annual Reports; Median Land Value: Quotable Value Residential price Index**
StructureRates09	StructureRates(t-1)	Marginal rates liability on building an extra unit before amalgamation (2009). This is equal to rc*Uc + ra*Ua + AFC where rc is the sum of relevant capital value rates (in an area unit), Uc is the median capital value of a new unit, ra is the sum of relevant annual value rates (in an area unit), Ua is the median annual value of a new unit, and AFC is the sum of average fixed costs within an area unit.	**Rates: Former Territorial Local Authority Annual Reports; Median Values: Building Consent data (StatsNZ)**
DC09	DC(t-1)	Development Contribution for building an extra unit at the area unit level before amalgamation (2009)	**Rates: Former Territorial Local Authority Annual Reports**
DC09missing	DC09missing(t-1)	Missing DC variable dummy. Dummy variable taking on the value of 1 if we are missing data for DC09, equal to 0 otherwise	**N/A**
own_AKLDavRates09	OwnATR/AKLDavRate(t-1)	Ratio of average total rates in a TLA area in 2009 to the population weighted average rate in the same year. Calculated using estimated population in area units in 2009.	**Rates: Former Territorial Local Authority Annual Reports; Estimated Population: StatsNZ**
Diff_own_AKLDavRates	Δ OwnATR/AKLDavRate	Change in own_AKLDavRates between 2009 and 2014	**Rates: Former Territorial Local Authority Annual Reports; Estimated Population: StatsNZ**
Controls			
Controls			
MeanBedrooms06		Mean Number of Bedrooms per dwelling in area unit in 2006	
AvNew_Value09		Average Value of New Building Units before amalgamation. This is calculated by dividing the total value of new units by the total number of new units in a respective area unit.	
AvAlt_Value09		Average Value of Altered Building Units before amalgamation. This is calculated by dividing the total value of alteredunits by the total number of altered units in a respective area unit.	

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