Motu
ECONOMIC AND PUBLIC POLICY RESEARCH
Level 1, 97 Cuba Street, Te Aro, Wellington 6011; PO Box 24390, Wellington 6142
P: +64 4 939 4250 F: +64 4 939 4251 E: info@motu.org.nz W: http://motu.nz

NZIER (2012), "Model Review: Department of Labour's in-house minimum wage model"

Comments by Dean Hyslop & Dave Maré

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The basic form of the NZIER model (described on page 2), is

$$\log(Y_t) = \alpha + \sum_{i=1}^{4} \beta_i \log(Y_{t-i}) + \sum_{j=0}^{4} \gamma_j \log(Kaitz_{t-j}) + \sum_{k=0}^{4} \theta_k \log(D_{t-k}) + \nu t + \rho X_t + u_t$$

where:

- Y is the labour market (LM) outcome of interest (e.g. Employment, FTE employment, hours worked);
- Kaitz is the minimum wage index, measured as the ratio of the minimum wage to average wage (presumably the full-population or adult working wage);
- D is some economic cycle control variable;
- X a vector of other control variables (seasonal, other policy controls);
- t is a (linear) time trend;
- u is a residual (random error component); and
- $\alpha, \beta, \gamma, \theta, \nu, \rho$ are regression model coefficients to estimate.

Note: the paper describes the model being estimated for various sub-population groups (g, say)of interest, by age (16-17, 18-19, 20-24), females, and ethnicity (Maori, Pacific). We assume the model is also estimated for the full population to obtain aggregate labour market effects. For clarity, it might be useful to add the subscript-g to the variables. We assume the regression is estimated independently for each sub-group. The model is estimated using quarterly data aggregated to the level of sub-group estimation.

Before, commenting on the model, it's useful to consider its conceptual structure, which we interpret as follows:

- The model allows for up to 4-quarterly lags of the labour market dependent variable (Y_{t-i}), which provides <u>baseline dynamics</u> – i.e. irrespective of any other factors, these lags will generate dynamic responses to minimum wage changes.
- Minimum wage (Kaitz) changes, and the economic controls (D), may <u>directly</u> affect the LM outcome either contemporaneously or up to 4-quarters later. In addition to such direct effects these (and other control) variables have dynamic effects through the baseline LM dynamics specification.
- The model assumes there is an underlying <u>linear trend</u> (νt) in the LM outcome variable, so any dynamic effects are around and relative to this trend.
- The model's log-log specification implies the minimum wage coefficients are short-run elasticities, which is attractive for interpretation.
- Importantly, any minimum wage effects in the model are homogeneous with respect to other factors (especially, e.g., over the business cycle), with all other covariates acting as additive shifters to labour market outcomes.

Comments:

1. The modelling approach used is a single equation approach, independently for the full population of interest, as well as for (age, gender and ethnic) sub-populations of interest. An important implication of the single equation estimation approach is that it only estimates own-group elasticities, and there are no (cross-elasticity) interdependencies between the subgroups. Furthermore, it means that the model specification can and does vary across groups. This may be ok, but the model specification selection puts very strong reliance on the statistical properties of the data for each population subgroup. Given the relatively short time frame and variability in the data, such statistical properties may reflect sampling variation rather than true idiosyncratic differences across the subgroups.
2. The model estimates homogeneous elasticities for each sub-group (conditional on the additive effects of other control variables). This is despite the discussion in Appendix B that "the impact of the minimum wage … is potentially influenced by various economic factors", which implies allowing interactive minimum wage effects (e.g. with the business cycle variable D) would be more suitable.
3. The model's Kaitz variable also restricts the elasticity to be constant as the minimum wage increases relative to the average wage – i.e. an average wage decrease will have the same effect on the outcome as a symmetric minimum wage increase. A simple way to relax and assess this restriction would be to include log(min wage) and log(average wage) separately and test whether their coefficients are equal magnitudes and opposite signs.
4. There are various specification and model selection issues, particularly with the objective of having a parsimonious specification. This isn't to say the specification is wrong, rather to question how robust it is to alternatives. These include:
    a. Identification of both baseline dynamics and direct minimum wage dynamic responses. For example, as the baseline dynamics will propagate dynamic responses of purely contemporaneous minimum wage effect, how well identified are the lagged effects minimum wage (Kaitz index) effects? Similarly, the model also includes dynamic/lagged economic business cycle effects.
    b. Related to this issue is the extent of collinearity between the lags of a variable. In particular, given the minimum wage changes only annually, any within-year changes in the Kaitz index come from average wage (or inflation) changes, so the Kaitz index is likely to be highly collinear – e.g. it will exhibit an annual saw-tooth pattern associated with annual minimum wage increase followed by gradual erosion with inflation. It may be that the annual minimum wage increases provide sufficient variation that collinearity is not strong, but this is important to verify.
    c. How robust is the model to the linear trend specification (particularly with the baseline dynamics included)?
    d. The NZIER review argues the need to control for 'structural breaks' associated with substantial changes in the minimum wage series in 1997 and 2000, and the modelling includes dummy variables at these points in time. Although this may be sensible statistically, it's not clear there's any

substantive (economic or policy) justification for this: in each case, the 'break' simply appears to reflect a substantial increase in the minimum wage. A consequence of 'dummying out' such changes is that the analysis potentially loses important periods of variation in the data to address the issue of how outcomes changes in response to minimum wage changes.

   e. The NZIER model also dummies out the pre-1994 period for youth, when there was no statutory minimum wage teenager workers, which is conceptually sensible. The regression analysis for teenagers then proceeds to treat the Kaitz index as zero before 1994. Although this is technically correct using a "Kaitz" (in-levels) variable, it is problematic for a "log(Kaitz)" variable specification, which is undefined when Kaitz=0: in that case we believe data for all periods before 1994 should be excluded from such analysis. (See also comment 8b below on the use of Kaitz versus log(Kaitz) variables.)

5. Although the NZIER report discusses the importance of the time series properties (unit root and cointegration) of each of the variables used in the model, and reports some test results (Table 15, page 26), it's not clear how this informs the subsequent models that are estimated.
6. Appendix D's claims (page 30) that the model is informed-by (or consistent-with) economic theory seem deceptively ambitious. At a minimum, it's not really clear what the *economic theory* used is. Also, the review criticises the previous "in-house" model as unrealistic for its assumption of firm decision making in competitive markets (page 28), and notes that the perfect competition assumption implies minimum wage increases will necessarily cause employment loss. However, other than allowing empirically for non-negative employment effects of minimum wage increases (which we think were also possible in the in-house model), we don't see how the revised model relaxes this.
7. We believe that, conditional on the model specifications estimated, the post-estimation derivation of minimum wage effects is <u>wrong</u> in that it ignores any statistically insignificant coefficients, and uses only the statistically significant estimated coefficients from the model.
8. Some of the current model's results appear simply odd, and quite likely reflect potentially inadvertent errors.
   a. For example, large positive predicted increases in 18-19 year olds employment rates (elasticity=1.43), and zero 20-24 employment effects. The apparent justification for these results seems to be large substitution effects of 18-19s (for 16-17s) that more than outweigh any negative direct minimum wage effects on 18-19s employment (and presumably substitution effects for 20-24s that balance out any direct adverse effects).
   b. The estimated model seems to arbitrarily switch between using a log(Kaitz) and Kaitz (level) variable across the groups – e.g. the models in Tables 22-25 (for 16-17s, 18-19s, 20-24s and females) use Kaitz, while the models that follow in Tables 26-34 use log(Kaitz). While not strictly "wrong", without some discussion or justification, our sense is that a simply coding mistake has occurred somewhere. On the basis of the model outlined above, we assume all models should have used log(Kaitz). As discussed above, using the log(Kaitz) variable implies the coefficients

can be interpreted as 'elasticities', which is not the case with the level-'Kaitz' variable.

c. A consequence of ignoring statistically insignificant coefficient estimates when deriving minimum wage effects for subgroups is that the model predicts zero employment loss for Maori, simply because the estimated Kaitz coefficients are insignificant in that regression model.

In summary, we have identified a variety of conceptual, econometric specification and coding issues with the NZIER developed model used in MBIE's annual minimum wage review work. Regardless of the shortcomings discussed here, as it's going on 7 years since the NZIER review was commissioned, it would be useful to revisit the model specifications in light of the updated data and recent labour market experiences.