Linking the New Zealand Emissions Trading Scheme to the International Carbon Market

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Motu Economic and Public Policy Research

Background

- Strong international interest in emissions trading
- Linking tradable permit markets allows units originating in one country to be used to meet obligations in another
- NZ offers an interesting case study for the price effects of linking a domestic scheme to an international market and then de-linking

Research Questions

- How do we expect the New Zealand Unit prices (NZU) and the Kyoto unit prices to relate to each other?
- How does this relationship change when future use of Kyoto units becomes uncertain (i.e. when ‘de-linking’ becomes a possibility)?

Overview of Presentation

- Give an NZ-specific exposition of Pizer and Yates' 2013 model of linking and delinking in an ETS
- Compare model with data on NZU and Kyoto prices and also with data on the types of units surrendered for compliance

Results Preview

- The model predicts that:
  - In a linked world: NZ prices equal Kyoto prices, unless Kyoto prices are sufficiently high (because the model assumes NZ has a selling constraint)
  - In a world with a future de-link: NZU and Kyoto prices diverge – provided that NZ ETS participants can't bank enough NZUs to drive NZU prices down to the international Kyoto price.
- Data show:
  - Price data and surrender data are roughly consistent with the model's predictions

Model

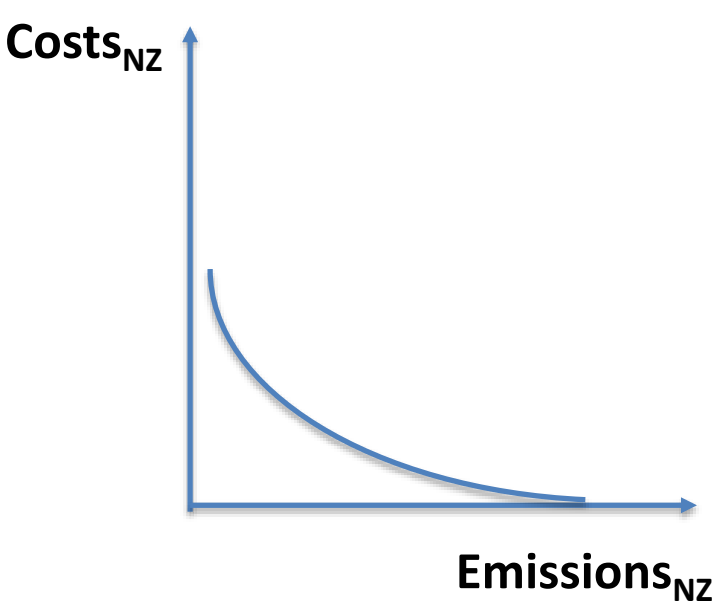
- The model is based on Pizer and Yates (2013)
- Two-period two-region models
  - The two-periods are ‘now’ and ‘the indefinite future’
  - The two-regions are New Zealand and ‘other countries’

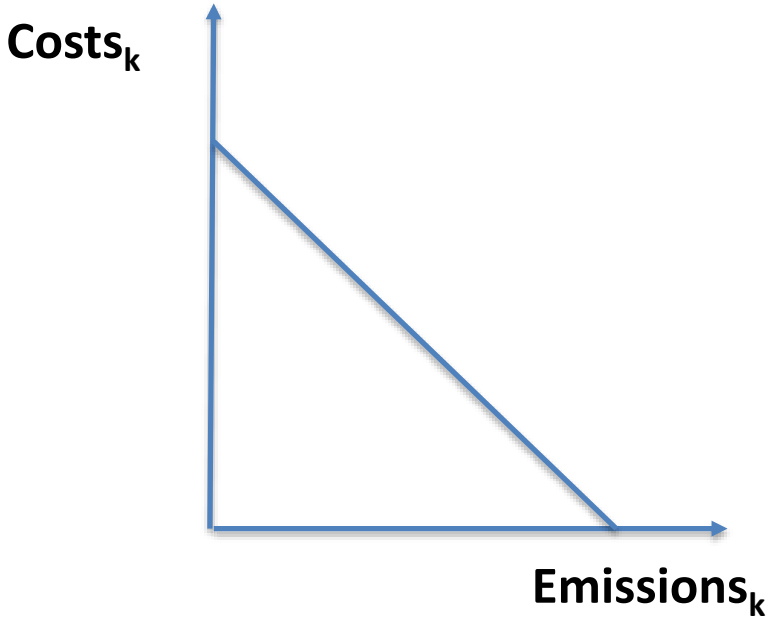
Model 1: Certain Linking

- Each region endowed with ω_{it} permits in each period. Where $i \in \{ NZ, k \}$ $t \in \{ 1,2 \}$
- NZ linked to Kyoto markets in both periods. Denote the net amount of imported Kyoto permits in period t by Δ_t
- Model assumes NZ cannot sell units - a simplification
- NZ and Kyoto countries can store or bank units from one period until the next. Denote the total banked permits in country i by B_i
- Real interest rate is 0% for simplicity

Cost functions:

- Each region has a total (mitigation) cost function $C_{it}(e_{it})$.
- For New Zealand this function, $C_{NZ,t}(e_{NZ,t})$ is convex and twice differentiable
- For Kyoto countries $C_{kt}(e_{kt})$ is linear (constant marginal cost = p_t) – this insures Kyoto price exogenous.





Model 1: Certain Linking

Benevolent Central Planner's Problem

$$\min_{e_{it}} \sum_{i \in \{NZ,k\}} \sum_{t \in \{1,2\}} C_{it}(e_{it})$$

Such that: ...

Model 1: Certain Linking

$$\min_{e_{it,}} \sum_{i \in \{NZ,k\}} \sum_{t \in \{1,2\}} C_{it}(e_{it})$$

Such that:

$$e_{NZ,1} + B_{NZ} = \omega_{NZ_1} + \Delta_1$$

$$e_{k,1} + B_k = \omega_{k_1} - \Delta_1$$

$$e_{NZ,2} \leq \omega_{NZ,2} + B_{NZ} + \Delta_2$$

$$e_{k,2} \leq \omega_2 + B_k - \Delta_2$$

$$\forall i \; B_i \geq 0$$

$$\forall t \; \Delta_t \geq 0$$

First Order Conditions: Linking Some Interpretation*

- **Marginal abatement costs in each country equal the price of that country's unit.**
- **Unless the Kyoto price is sufficiently high, unit prices are equalised.** Firm price is equalised as firms always buy the cheapest unit but this process can't occur when NZUs are cheaper than KUs as some foreign firms can only buy KUs.
- **Prices are constant or falling over time** – if we can bank units then future prices (after interest rate adjustment) cannot be higher than today's price; otherwise banking more permits is profitable

* See paper for mathematical detail

Model 2: De-Linking

$$\min_{e_{it,}} E = \sum_{r\in\{H,L\}} \sum_{t\in\{1,2\}} C_{it}(e_{it})$$

Such that:

$$e_{NZ,1} + B_{NZ} = \omega_{NZ_1} + \Delta_1$$
$$e_{k,1} + B_k = \omega_{k,1} - \Delta_1$$
$$e_{NZ,2} = \omega_{NZ,2} + B_{NZ}$$
$$e_{k,2} = \omega_{k,2} + B_k$$
$$\forall i \; B_i \geq 0$$
$$\Delta_1 \leq e_{NZ,1}$$

First order conditions: De-linking Interpretation*

The NZU price is determined by the scarcity of NZUs in period 2

If we can bank enough NZUs to drive this future price to the Kyoto price then, *ceteris paribus*, we have the same outcome as in the linking case

If the maximum linking constraint is binding, ($\Delta_1 = e_{NZ,1}$), then we import enough Kyoto units to cover current emissions and bank all NZUs for future use, so that the NZU price is higher than the Kyoto unit price

* See paper for mathematical detail

When the Linking and De-linking Policy are Uncertain

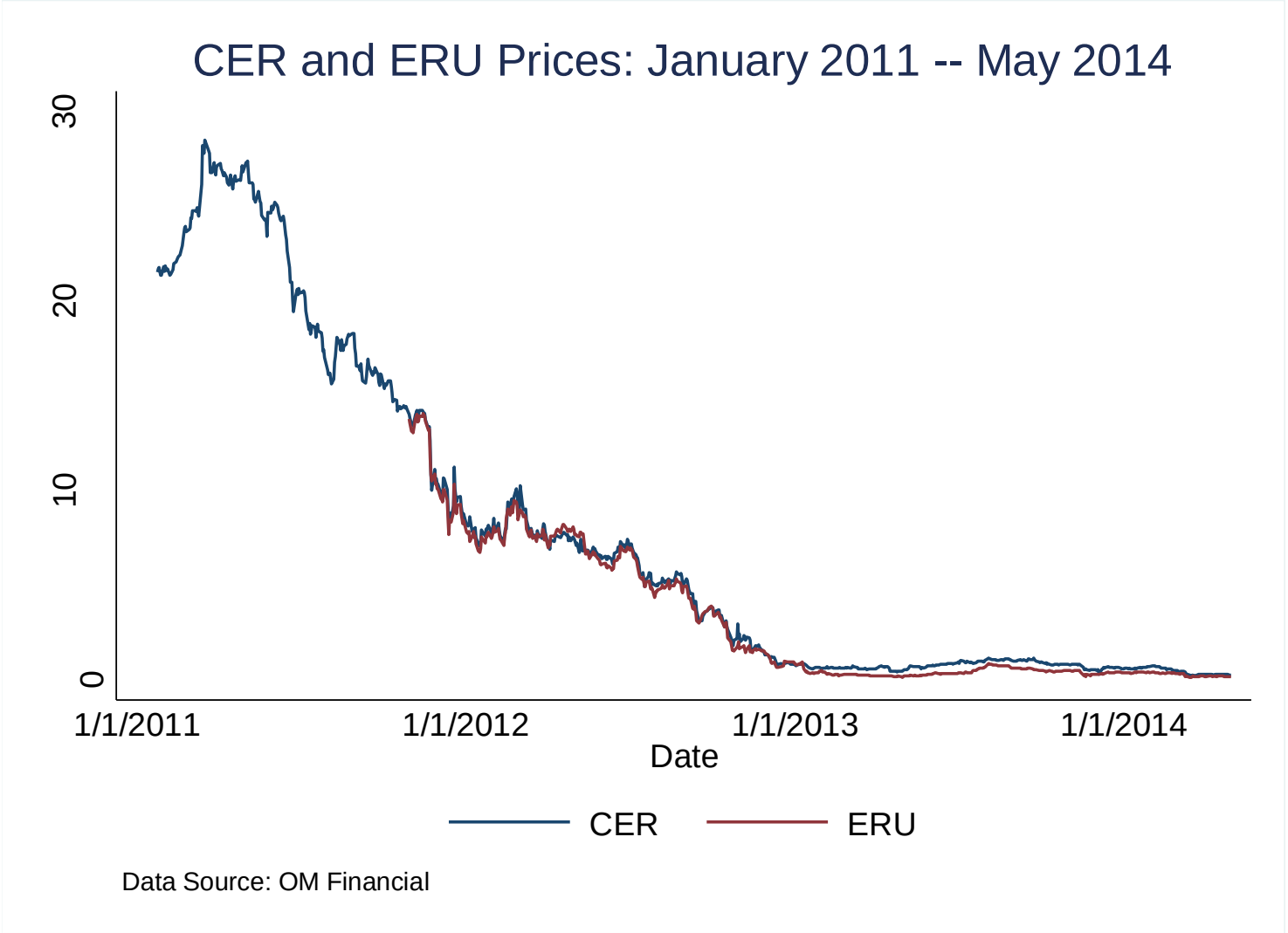
- Prices are a probability-weighted average between the linking model and the delinking model

Data

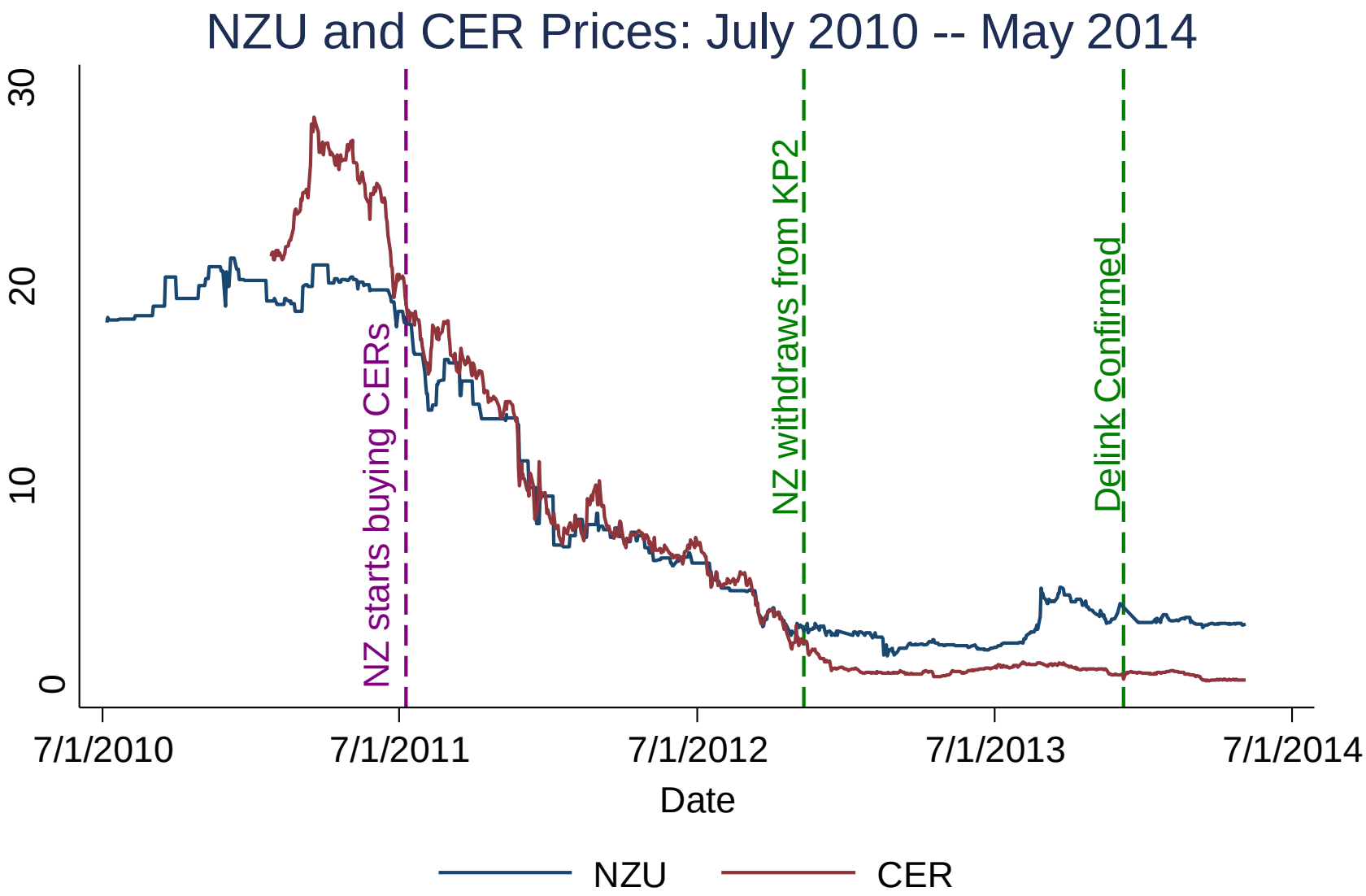
- We have daily data on NZU prices from trades at OM Financial*
- We have daily data on CER and ERU futures prices. These are two different Kyoto units – but their prices are essentially the same
- We have yearly data on the types of units firms surrender from the New Zealand Emissions Unit Registry

* Thanks to Nigel Brunel at OM Financial for providing this

CER Price ≅ ERU Price

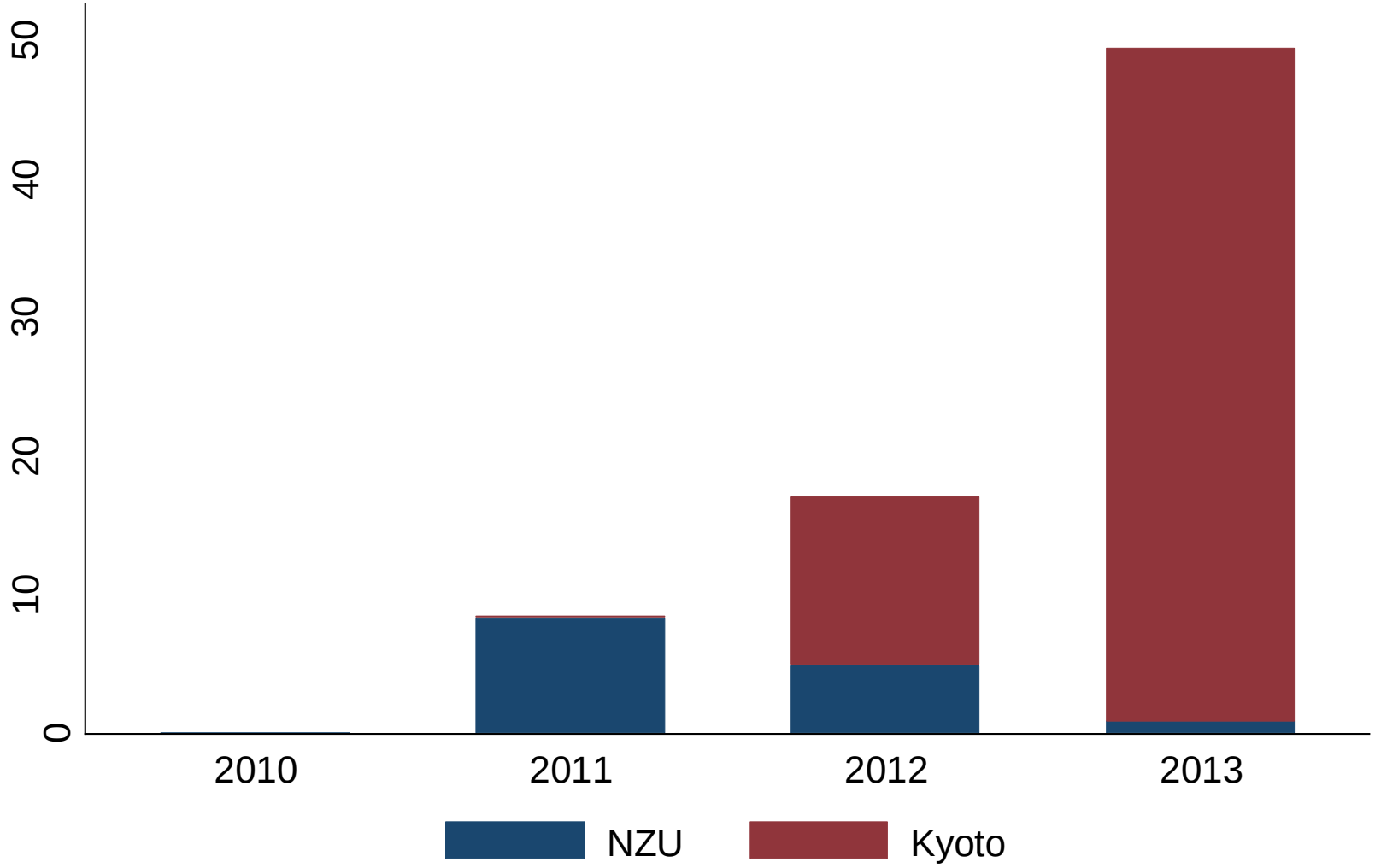


Data Source: OM Financial



Data Source: OM Financial

NZU and Kyoto Units Surrendered by Year



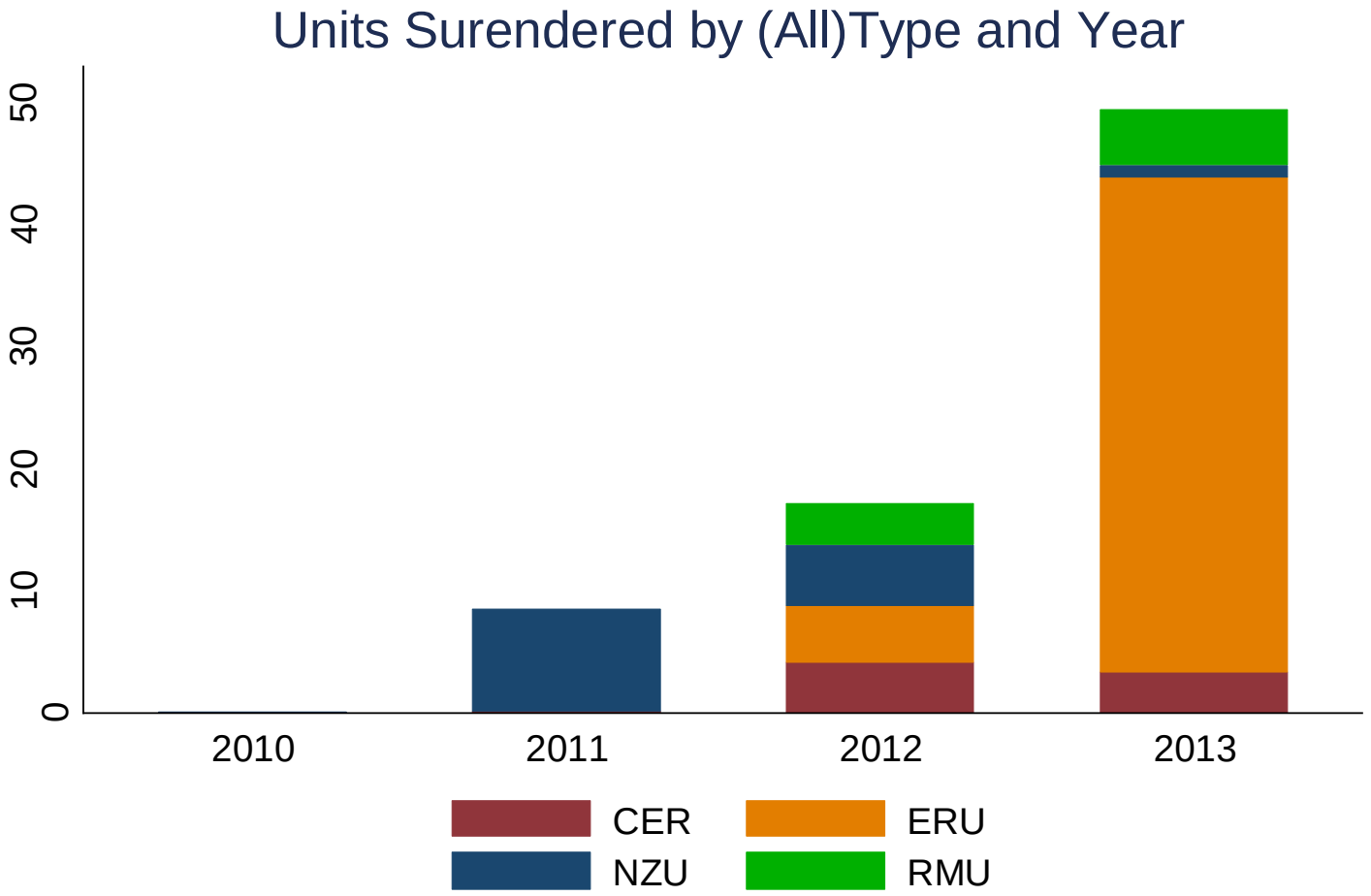
Data Source: New Zealand Emissions Unit Register

Conclusion and Further Research

- Model seems appropriate way to think of relationship between prices – and hence useful for ETS policy simulations
- Would be good to test for effect of NZ - specific shocks on Kyoto prices and NZU prices before and after de-link
- The current level of the NZU price is low – how much of this is due to the large bank and how much due to expectations of generous future allocation?

- Would like to get data going back further on Kyoto prices (especially ERU and RMU)
- Would like higher frequency surrender and import data to match high frequency daily data
- The best data would be observations on firms' marginal abatement costs – but this is typically not observed except via carbon prices

Appendix



Note that a small number of AAUs are included in this graph as NZUs
Data Source: New Zealand Emissions Unit Register