Review of

Margins of adaptation to water markets – Evidence from Chilean fruit production

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Reviewed by Aaron Watt

1 Summary

This paper examines farmer behavior in the face of increased prices for agricultural water. The setting is Chile, where the national government can restrict the flow of new water rights, which excites a previously dormant market for existing water rights. Farmers in this setting can choose to buy or sell their surface or ground water rights (measured in flows, like liters per second), change their level of output, switch crops, or change the relative amounts of capital and water inputs.

The author presents both OLS and IV estimates of the effect of increasing the share of local water rights restrictions on behavioral adaptations, using a 5-year lag of local weather to instrument for the share restricted. The IV results show that increases in water restrictions result in meaningful (but imprecise) changes to more efficient irrigation (table 5), switching to less water-intensive fruits (table 7), and larger farms with fewer employees that export more of their product (table 6). Overall, this paper is well-written with a really interesting and globally important question. The analysis is nearly complete with attention to robustness in all the ways that I was concerned about. The structure of the paper is good, with some work still to do on the model.

2 Key Considerations

(2.1) Model use

(2.2) Water in the model

2.1 Model use

The model mainly seems to be used to provide predictions about behavioral responses. However, the first prediction that water usage will decrease is not estimated because the amount of water extracted by users is

not observed. So this prediction doesn't seem to contributing to the paper. The second prediction (that the effect of increasing water prices on capital use is ambiguous) is used to motivate the empirical estimation that follows. But the second prediction is followed by an intuitive explanation of why the ambiguous prediction makes sense – that substitutability between water and capital determines if capital use will increase or decrease in the face of rising water prices.

At the end of that discussion, I expected the paper to estimate the elasticity of substitution between water and capital and other structural parameters in order to discuss counterfactual responses from other forms of the policy. But the focus of this paper is estimating the observed behavior responses, not estimating structural parameters. Perhaps I am too easily sucked into a model, but it seems that the model here is distracting the reader from great empirical paper. I would suggest putting the model in the appendix and referencing it as a motivation that the effects of increasing water prices on capital are ambiguous and must be determined empirically.

2.2 Water in the model

The model allows for cost distinctions between surface and ground water. But in both the derivatives in section 3.2 and in the estimation of water restriction effects, surface and ground water are lumped together, indistinguishable. Is there a reason to distinguish them in the model if those separate costs are not used in the estimation process? Paragraph 4 of section 3.1 explains that prices for ground vs surface water may differ because of different geographical/regional frictions to obtaining the water. So though these are perfect substitutes, I would expect that if prices for water are changing, then there may be some cases where a farm previously only using ground water adapts to increasing ground water prices by also purchasing access to cheaper surface water from a nearby canal. So though the model initially takes into account differences in prices, section 3.2 and the rest of the paper seem to ignore them.

It's possible that in practice there are basically no farms that use both ground and surface water, before or after restrictions are in place. This might indicate that fixed costs are high for adding or switching water sources and that it is appropriate to lump all water together in section 3.2. If this is the case, a note within section 3 would be helpful to the reader. If there are some farms that use both types of water, it would be appropriate to discuss how this might impact your empirical results if only one of their water sources is under restriction.

3 Minor Suggestions

- Section 6.2: In the second paragraph, you describe the IV estimate of impacts of having any restriction on irrigation efficiency types. You use the metric of a difference of one standard deviation, however, the table shows results from the indicator variable. Without referencing the values in the table, it makes it confusing for the reader to compare their interpretation of the table to your explanation in the text. If you want to keep the one SD metric, it would be helpful to explain somewhere how that connects to the values in the table. Or just change the table to match how you would like to explain it?

- In table 5, in the description, you say that the independent variable is the share of area under a restriction, but the first paragraph of section 6.2 describes it as the effect of any restriction. "the effect of any restrictions" sounds like to me an indicator variable for any restriction, whereas "the share of area under a restriction" sounds like a continuous variable. Perhaps this could be clarified.

- Table 6: the % exporting outcome variable has an effect size of 0.96 from an increase in restrictions. This seems high – is this the correct interpretation: increasing the share of the area that has water restrictions by 10% results in a 9.6-percentage-point increase in farms that export? Table 3 shows that the means of the exporting indicator for never treated and any treated are only different by 2%. However, you've told us that the estimate include "control" groups that receive treatment in the future, so this difference in means is not totally comparable. Overall, the numbers in Table 5 seem very large compared to the means and some explanation of those would be beneficial to the reader.

- In section 3.2, ρ appears in equation (8). Should this be σ from equation (2)? I can't find where it's defined. Also, are you willing to add the derivation of question (8) to the appendix?