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The Voice and Advocate for the California Food Processing Industry since 1905

California League of Food Processors
Comments Submitted to the California Air Resources Board Regarding Greenhouse Gas Emissions Leakage Studies and Potential Changes to Emissions Allowance Allocations
June 10, 2016

Dear Chair Nichols:

The California League of Food Processors (CLFP) appreciates the opportunity to review and comment on the three studies sponsored by the California Air Resources Board (CARB) regarding potential emissions leakage due to the greenhouse gas (GHG) emissions cap-and-trade program. Our intention in these comments is to help inform CARB policy regarding future GHG allowance allocations with the goal of minimizing the potential harm to the California economy and avoid simply shifting emissions to other jurisdictions. It is not entirely clear at this point whether all of the emissions reductions commitments that have been made by other states and countries will be met, and when, if ever, a U.S. national cap-and-trade program might commence. Consequently, the decisions that CARB makes regarding emissions allocations will have a significant impact on the ability of firms in this state to compete and therefore should be approached with the goal of minimizing potential damage to California's economy given the continued absence of a federal program.

Background

Most food processors in California compete with companies in other states and countries. Tomato processors compete with operations located in four other states and at least 18 other countries. Cheese is produced in virtually every state, and in numerous countries around the world. Industrial dehydrators' main competition is almost entirely international.

Due to this level of competition, food is generally not considered a luxury item. As a result, margins in the food processing business tend to be small. Even modest shifts in cost can affect market share. The Cal Poly Study (Hamilton et.al.), through its sector specific analysis, demonstrates this point.

Current Leakage Metrics Unfairly Prejudice Food Processors

Under the existing allowance allocation methodology for the cap-and-trade program, CARB devised an emissions intensity and trade exposure metric that resulted in the food processing sector being designated as "medium" leakage risk. CLFP had concerns about this classification scheme from the onset as the estimation techniques employed were very crude. And the risk levels used to specify emissions intensity and trade exposure were based on gross measures of competitiveness, and arbitrary judgements about what constitutes high risk.

For example, under the current prescribed guidelines, a sector with a trade share metric of 19 percent would be designated as medium risk, while a sector with a 19.1 percent share would be designated at high risk. This arbitrarily selected break point could just as easily have been justified at 15 percent or 22 percent. The trade share metric is a general measure of a sectors trade exposure that does not capture all of the variables that affect the ability of a sector to compete in domestic or international markets.

CLFP appreciates that food processors were granted a 100 percent Industry Assistance Factor for the first two compliance periods. However, we believe that the initial analysis by CARB erred in assigning a medium risk designation to food processors, and was gratified that CARB funded the Cal Poly Study (Hamilton et.al.) to study this issue in more detail.

Food Processing Sector Study
In our review of the Cal Poly Study (Hamilton et.al.), CLFP believes that the research team did a good job of quantifying market transfer rates and production leakage. The results demonstrate that, without free emissions allocations, the impact of even modest carbon prices on the processing sector would be significant.

But what might be the net impact on global emissions due to leakage of California food production to other locations? In the case of processed tomato products, China is the worlds' second-largest producer and it is logical that production would likely shift to China and nations in the European Union. Although CLFP does not have facility specific information, it is our general understanding that a significant portion of Chinese industrial boilers and food processing equipment is coal-fired, as is over 70 percent of utility electric generation in China. Regarding China, emissions ratio comparisons will not be 1:1, being more likely to double or triple in comparison to current California industrial efficiencies. Turkey and Iran are also significant producers of processed tomato products, but CLFP does not currently possess dependable information regarding boiler fuel in those nations. For cheese, much of the competition comes from other states such as Wisconsin, New York, Minnesota, and Idaho.

In addition, there are dehydrated vegetable processors in the cap-and-trade program and the Cal Poly Study (Hamilton et.al.) did not evaluate the leakage risk for that sector. California accounts for a large share of U.S. production of dehydrated onions and garlic, but imports from China increased greatly in recent years, the result being that several companies closed and the U.S. imposed protective import duties to preserve the remaining California-based industries. Vegetable dehydration is a very energy intensive business and there remains significant potential for leakage to China, Egypt and other developing nations as a direct result of increased carbon compliance costs.

Proposed Changes in CARB Methodology for Estimating Leakage Risk
During the May 18 workshop, CARB staff, citing these new leakage studies, proposed a methodological framework for emissions leakage designation that alters assistance factors in the 3rd compliance period. The proposed framework updates assistance factors for industries in California by replacing old metrics with new metrics under the stated goal to "more precisely measure

leakage".[1] Specifically, CARB seeks to replace: (i) the old "trade exposure" metric with a new "international market transfer" metric; and (ii) the old "emissions intensity" metric with a new "domestic value-added loss" metric.

The view is predicated, in part, on the belief that other nations and states will soon be enacting their own climate change programs and, like California, imposing costs on their domestic industries. In turn, CARB suggests that this will help level the playing field for California industries.

But this is merely an assumption, and a very heroic one in the near term. To date, only some countries, and even fewer states, have shown any movement towards implementing their own programs. It is a better bet to assume that much of the world will likely remain outside these efforts, seeing substantially more benefit in allowing their domestic businesses to profit from lower cost structures unencumbered by carbon pricing.

In formulating an assistance policy to prevent emissions leakage, it is important to better account for trade patterns between California manufacturing industries and competing manufacturers in other regions. Some plants that compete with California manufacturing industries are from other regulated regions where emissions leakage is unlikely to be a significant concern (e.g., the European Union and Canada), while other plants that compete with California industries are located in unregulated regions where leakage potential is more substantial. More attention is needed on the location of the main trade partners with each California manufacturing industry and the CO2 regulations (or lack of regulations) currently in place with these trade partners. For example, leakage may be of limited concern for industries that trade mainly with EU countries, while leakage risk may be considerable for industries that trade mainly with producers in countries without climate change programs of their own.

As for California's cap-and-trade regulation, whether or not the new metrics more precisely measure leakage than the old metrics will depend on the relative precision of the old metrics versus the new metrics. However, the data used in the leakage studies is largely confidential and not available for public review, making it impossible to independently review the leakage models to assess the robustness of the results to alternative specifications and potentially omitted variables. Without the ability to fully examine the data and assess the validity of the estimated outcomes, there is no way to confirm that the estimates provided by the studies are reliable as a basis for ARB allowance allocations.

Short of allowing independent analysis to be conducted on the relative quality of the old and new metrics, it becomes even more important to compare the implied leakage results from the contracted studies to those obtained by existing leakage metrics. Will the use of the new metrics produce results consistent with the results of the old metrics? As a matter of course, and in particular for cap-and-trade obligated entities, the policy should clearly state the advantages and disadvantages of changing the leakage classification metrics to the proposed metrics.

[1] http://www.arb.ca.gov/cc/capandtrade/meetings/20160518/staff-leakage-workshop-methodology.pdf

In light of the need to obtain a professional assessment of the validity of the methodologies utilized in both the Domestic study (Fowlie, et. al.) and the International study (RFF), CLFP engaged the Brattle Group (Brattle) economist Armando Levy[2]. The findings contained in the Brattle Report, incorporated into these comments by CLFP, discuss several potential disadvantages of the proposed new metrics.

In essence, Brattle finds the new metrics being proposed are relatively imprecise, with high variance around the estimates and sensitivity of the results to the model specification used to estimate the parameters of interest.[3] Moreover, the data and variables employed by both studies do not seem to be appropriate for obtaining estimates of the parameters necessary to measure market transfer and emissions leakages (e.g., using value of shipments or value added as the outcome variable instead of physical quantities).

Highlights from the Brattle Group Report:

1. **Clarity should be provided on how CARB will address the error structure in the new leakage metrics**.
    - Many of the estimated coefficients in the studies are statistically insignificant, and in some cases the estimates are significant but with the wrong sign (i.e., positive effects of cost increases on the value of shipments, seemingly implying "negative leakage").
    - The international leakage study provides plots of values at the 25th and 75th quantiles from 192 separate regression models, but does not provide a sense of the error structure around these estimates.
    - The domestic study fails to report confidence intervals around their leakage estimates for individual industries.
    - The empirical approach taken in each paper introduces a vastly larger error structure which is entirely absent in the old metrics (energy intensity and trade exposure), and will require clarification on how this error structure will be handled in formulating policy on allowance allocations:
        - Are leakage estimates to be taken as zero when the estimated coefficient from that industry is significantly indistinguishable from zero?
        - And what is the prescribed confidence level for making this determination?
        - If a coefficient is large, but not significantly different from zero, how does CARB intend to use this estimated value, as opposed to a smaller, but highly significant coefficient?

[2] Dr. Armando Levy, a Brattle principal, holds a PhD in Economics and a MS in Statistics from Berkeley, and has over 20 years of experience as an academic and economic consultant. Dr. Levy has conducted extensive research and provided testimony involving the application of statistical and econometric techniques.

[3] As discussed by Fowlie et al. (2016, p.7), using the estimated parameters to obtain measures of market transfer and emissions leakage pushes up against the limits of the data, and the noisiness of the estimates prevents the estimation of "leakage potential for any particular industry with any degree of precision."

2. **How does CARB intend to use the Cal Poly Study for determining allowance allocations to the food processing industry?**
   CARB allocated public funds to the Cal Poly Study (Hamilton et.al.), which met its stated goal of measuring production leakage in four of the largest food processing industries in California. How do these estimated leakage results fit in with the new metrics proposed by CARB for making allowance allocations?

3. **Most importantly, the Brattle Report indicates that changes in the total value of shipments is an unreliable proxy for leakage. (see 1.C., page 6, *Brattle*)**
   The Brattle Group Report notes that the key unit of measurement for leakage is the quantity of reduced production in California that is offset one-to-one by increased production in unregulated regions. That is, leakage refers to changes in quantities produced. Both the domestic and international study estimate the effect of changes in energy prices on the total value of shipment (i.e., sales), which is the product of price times quantity in each market.

   It is well-established in economics that sales can rise or fall with a change in quantity produced depending on the elasticity of demand in the particular market. Specifically: (i) if demand is unit-elastic, a decrease in regional production results in no change in sales; (ii) if demand is inelastic, a decrease in production results in an *increase* in sales; and (iii) if demand is elastic, a decrease in production results in a *decrease* in sales. Depending on differences in the underlying demand conditions across industries, it is possible for two industries to have identical production leakage, while the estimated effect of increased energy costs on the value of shipments is positive for one industry and negative for the other. Therefore, use of the value of shipments as the outcome variable in both studies is unreliable as the basis for measuring production leakage.

   The Brattle Group Report finds that use of sales (total value of shipments) as the outcome variable in both the Domestic and International studies to be an unreliable proxy for production and emissions leakage. Brattle believes the same estimated effect on the value of shipments can be associated with positive, negative, or zero leakage depending on the unobserved value of the demand elasticity in each industry.

CLFP Recommendations

The food processing industry in California generates nearly 200,000 jobs, $25 billion in value added to the economy, and $8.2 billion in state and local tax revenue. Tomato, cheese, snack food, and dehydrated vegetable processors are a large component of the industry and stand to incur substantial compliance costs in the future as their allowance allocations decline. There is just too much at stake to base overarching regulation on studies that have not been vetted or peered reviewed.

Therefore, first and foremost, CLFP believes that food processors should be designated as a high leakage risk sector by CARB. As demonstrated by the Cal Poly Study (Hamilton et.al.), even modest carbon prices can induce significant leakage to other states or countries. Having a reliable and stable supply of safe, high quality, and affordable food should be a public policy priority. That, along with the important economic impact that food processors have in communities across the state, should be compelling enough reasons for CARB to designate food processors as high risk for leakage.

Secondly, stakeholders have not been given enough time to thoroughly review and analyze these very detailed technical studies. The accelerated timeline adopted by CARB staff provides stakeholders very little time to respond to the changes in allowance allocations that will be presented in draft form in July. Major state policy regulations, with significant economic implications to a number of industries, will be forthcoming based on studies that have yet to be properly vetted. CLFP urges CARB to extend the comment deadlines to allow for more review on the studies and reflection on CARB's new direction for assessing leakage risk.

Lastly, given the enormous reliance that CARB staff and Board will place on these studies in formulating future policy, CLFP believes that a second workshop is necessary in order to accommodate and adequately address the highly technical comments from stakeholders concerning the robustness of the Domestic and International studies and their suitability as a basis for new regulations.

CLFP looks forward to continued dialogue on this topic and will continue to provide information about the impact of AB32 on the California food processing industry.

Respectfully,

JOHN LARREA
Director, Government Affairs
California League of Food Processors

June 10, 2016

Dear Chair Nichols:

The California Air Resources Board (CARB) has proposed rules to minimize emissions leakage from California business subject to California's carbon cap-and-trade program. CARB has indicated that it intends to rely on two studies it has sponsored to allocate subsidies for firms subject to emissions leakage from within the state. I have been asked by the California League of Food Processors to examine the two studies and provide my comments.

The California League of Food Processors represents the interests of the food processing industry before the State Legislature and regulatory agencies (such as CARB). The 46 member firms produce a wide range of food products including canned fruit and vegetables, cheese, dehydrated onions and garlic, dried, and dehydrated fruits, nuts, and vegetables, olives and olive oil.[1]

While the two CARB-sponsored studies appear to be good faith efforts to estimate emissions leakage, they both rely on data that has not been made available to other researchers. Because the consequences of misallocating allowances are onerous— granting windfalls to some industries while undermining the competitiveness of other firms as well as undermining the effectiveness of climate change policy—it is imperative that the basis for calculating the subsidies be the result of a vetted, peer-reviewed scientific process. Neither of these studies has been rigorously vetted as would occur in a submission to an academic peer-reviewed journal, and a review of the manuscripts shows that the studies provide inadequate support for the calculation of leakage on an industry-by-industry basis. The rest of this comment details my most prominent concerns.

The first study that CARB sponsored is a study by Meredith L. Fowlie, Mar Reguant and Stephen P. Ryan from the University of California at Berkeley, Northwestern University and the University of Texas at Austin respectively (the "International Study").[2] This research estimates the amount of international leakage from California to foreign competitors for 96 (6-digit NAICS) industries in California. The second study authored by Wayne Grey, Joshua Linn and Richard Morgenstern from

[1] For a list of member firms, see http://clfp.com/food-processors/. Members of the California League of Food Processors supply premium quality fruit and vegetable products in the food and beverage processing sector, California's third largest manufacturing sector. Food and beverage processing in California accounts directly for $25.2 billion in value added and 200,000 direct full- and part-time jobs (Sexton, Richard J., Josue Medellin-Azuara and Tina L. Saitone, "The Economic Impact of Food and Beverage Processing in California and Its Cities and Counties," Report prepared for the California League of Food Processors, January 2015.)

[2] Fowlie, M., Reguant, M., and Ryan, S.P. (2016) "Measuring Leakage Risk," unpublished manuscript.

Resources for the Future (the "Domestic Study") estimates leakage from California to other U.S. states for 46 industries.[3] Both studies rely on the emergence of gas shale production in the U.S. as a sort of "natural experiment" for the effects of an exogenous price effect on energy prices to identify the effects of a California-only carbon tax on production.

Below, I list some issues with the two studies. I begin with issues that are common to both studies, and then move to critiques that are individual to each study. As a general theme, both papers seek to model a diverse set of industries in a "one-size-fits-all" approach, whereas a better economic analysis of each individual industry would account for details related to the market structure, production costs and demand conditions of that particular industry.

I. Critiques of Both Studies

A. Neither Study Controls for Forward Contracts in Agricultural Markets

Production at food processing facilities in California is generally arranged through forward contracting with farmers in the raw product sector. For example, in the case of processing tomatoes, fields are generally under contract on January 1 of each year with specific processors to provide harvest and processing over the period late June through October.[4] As of January 2016, tomato processor contracts, which either specify tonnage with derived acreage or acreage with derived tonnage, were reported to be for 13.2 million tons (271,000 acres producing 48.7 tons per acre).[5]

Table 1 shows intended and final contracted production for processing tomatoes over the period 1997-2016. Notice that virtually all production in each year is under contract by January 1 of that year.

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3 Grey, W., Linn, J., and Morgenstern, R. (2016) "Employment and Output Leakage under California's Cap-and-Trade Program" Resources for the Future Discussion Paper 16-17.

4 Hartz, Tim, Gene Miyao, Jan Mickler, Michelle Lestrange, Scott Stoddard, Joe Nunez, and Brenna Aegerter, "Processing Tomato Production in California," UC Vegetable Research & Information Center, University of California, Publication 7228: http://anrcatalog.ucanr.edu/pdf/7228.pdf.

5 United States Department of Agriculture, National Agricultural Statistics Service, "2016 California Processing Tomato Report," January 14, 2016: https://www.nass.usda.gov/Statistics_by_State/California/Publications/Vegetables/201601ptom.pdf

TABLE 1. INTENDED AND FINAL HARVESTED CONTRACTED PRODUCTION			
Year	January 1	Final	Difference
		Thousand tons	
1997	9,600	9,242	-358
1998	10,000	8,846	-1,154
1999	11,500	11,990	490
2000	10,100	10,131	31
2001	8,900	8,564	-336
2002	10,500	10,806	306
2003	10,900	9,141	-1,759
2004	11,000	11,000	350
2005	10,300	9,440	-860
2006	11,600	10,024	-1,576
2007	12,000	11,965	-35
2008	11,800	11,691	-109
2009	13,300	13,148	14
2010	12,600	12,212	-388
2011	12,600	11,900	-700
2012	12,700	12,540	-160
2013	13,000	11,900	-1,100
2014	13,500	13,965	465
2015	15,000	14,361	-639
2016	13,200	(NA)	(NA)

Source: USDA-NASS, 2016 California Processing Tomato Report

Processed tomato production reported to the U.S. Census each year, which is typically either tomato paste or canned diced tomatoes, closely approximates final tonnage of harvested tomato production in Table 1 after adjusting for the conversion of harvested tonnage to processed tonnage. Processed tomato production in the U.S. Census data is determined by three elements: (1) initial contract tonnage on January 1 of each year[6]; (2) the difference between intended and final contracted tonnage; and (3) conversion ratios to adjust tons of raw, harvested tomatoes into tons of processed tomato products. Initial contracts are in place at the end of the prior year for reporting on January 1. The difference in intended and final contracted production is largely determined by the difference between expected yield per acre at the time of initial contracts on January 1 and actual yields per acre, which depend on realized weather outcomes. Conversion ratios, which are approximately 6:1, reflect the loss of water and solids that are removed in the act of applying heat and pressure to raw processing tomatoes. Not one of these three features determining processed tomato output in a given year is explained by contemporaneous energy prices in that year. Energy prices can affect the final *price* of processed tomato production, but not the *quantity* produced.

Forward contracts are typical for all processed food products; thus, an empirical methodology that relies on variation in contemporaneous energy prices to explain variation in food processing production levels is conceptually unsound. Indeed, most models of agricultural production account for forward contracts by estimating the supply of farm products as a function of lagged prices.[7] Because the supply of raw farm products to food processing industries is determined by lagged prices, using contemporaneous energy prices to predict contemporaneous output changes in food processing industries is unreliable as the basis for estimating leakage in food processing industries.

B. NEITHER STUDY ACCOUNTS FOR AGRICULTURAL POLICIES IMPLEMENTED BY FEDERAL AND STATE MARKETING ORDERS

Most agricultural products procured by food processors in California are sold through marketing orders that either directly set prices or indirectly establish prices through cooperative bargaining.[8] The manner

[6] Calculation of a simple correlation from the figures in Table 1, show that contracted tonnage explains 93% of the annual variation in final tonnage.

[7] For a survey, see Just, Richard E. and Rulon D. Pope, "The Agricultural Producer: Theory and Statistical Measurement," *Handbook of agricultural economics* 1 (2001): 629-741.

[8] California Marketing Orders are available at: https://www.cdfa.ca.gov/mkt/mkt/ordslaws.html

in which agricultural products are produced and provided to food processors as raw material is inconsistent with the empirical framework relied on by the International Study and the Domestic Study. To see the nature of the bias introduced by the lack of attention to the behavior of agricultural marketing orders, consider the dairy sector.

U.S. and state agricultural policy in the dairy industry distorts global trade and the allocation of raw milk to food processing channels in the dairy sector in three ways: (1) by erecting import barriers and applying export subsidies for various manufactured dairy products; (2) by regulating raw milk prices for various end-uses in manufactured cheese, butter, and dry milk through federal and state marketing orders; and (3) through government purchases of manufactured dairy products to support the farm price of milk.[9]

The use of trade barriers is an important feature of U.S. dairy policy. Import barriers allow the domestic price of milk and dairy products in the U.S. to remain well above the prices in world markets. Import barriers make import responses to energy prices unreliable as a method to measure international leakage in the dairy industry. Moreover, since the 1980's, the Dairy Export Incentive Program (DEIP) has provided explicit price subsidies on U.S. exports of eligible dairy products, including milk powder, butterfat, cheddar, mozzarella, Gouda, feta, cream, and processed American cheeses, which makes export responses to energy prices unreliable as a method to measure international leakage in the dairy industry.

Within the U.S., eleven federal marketing orders have regulated the sale of milk produced in the country since January 2000. In addition, several states, including California, operate their own independent marketing orders. Marketing orders rely on price discrimination to raise the average price received by producers, setting minimum prices that processors must pay for Grade A milk according its end-use. Federal marketing orders distinguish between four end-use "classes" (fluid products, soft and frozen products, cheese, and butter / dry milk powder), while the California marketing order has five classes: fluid products (Class 1), heavy cream, cottage cheese, and yogurt products (Class 2), ice cream and frozen products (Class 3), butter and dry milk products (Class 4a) and cheese (Class 4b). California's milk marketing program adjusts relative prices for Class 2 and 3 milk prices bimonthly and Class 1, 4a, and 4b prices monthly, altering relative prices according to administratively-set formulas rather than in response to market forces in other industries that convey supply shocks in energy markets into manufactured goods prices.

Across the 11 regional marketing orders and the California marketing order, the fluid differentials often vary significantly across orders, altering price incentives on various end-uses of milk. For example, the Federal support price for butter increased 27.9% (from $1.47/kg to $1.88/kg) in June 2001, while

9 Sumner, Daniel A. and Balagtas, Joseph V. (2002) "United States' Agricultural Systems: An Overview of U.S. Dairy Policy," Encyclopedia of Dairy Sciences, Roginski, H., Furquay, J., Fox, P. eds., Elsevier Science Ltd.

remaining support prices were left unchanged;[10] at the same time, the California support price for butter and dry milk powder increased 5.2% (from $2.08/lb to $2.19/lb), while the support price for cheese increased 4.8% (from $14.16/cwt to $14.82/cwt).[11] To the extent that the dairy price supports were binding on prices over this period, the effect of this policy change would be to channel a greater share of milk towards end-uses in butter and away from other processed end-products such as cheese at dairy processing establishments outside California. Domestic shifts in dairy production between California dairy processors and dairy processors in neighboring states and between different end-uses such as butter and cheese are driven, in large part, by policy changes that have no connection to changes in relative energy prices, making estimates of domestic leakage of dairy products in the International Study and the Domestic Study that ignore this institutional feature unreliable. A similar story holds for sugar and other agricultural products sold through marketing orders.

By failing to account for changes in price supports and other agricultural policies in the dairy industry, CARB leakage studies introduce bias in the leakage analysis for food processing industries both in the measurement of international leakage and domestic leakage.

C. Changes in the Total Value of Shipments is an Unreliable Proxy for Leakage

Both the International Study and the Domestic Study are empirical analyses that estimate the relationship of energy prices to sales (total value of shipments).[12] Changes in the value of shipments can be positively related, negatively related, or entirely unrelated to production and emissions leakage, depending on market demand conditions in a particular industry.

The effect of a decrease in production on sales depends on the elasticity of demand. For example, if demand is unit-elastic, a decrease in regional production results in no change in sales. Conversely, a decrease in production results in an increase in sales when demand is inelastic and a decrease in sales when demand is elastic.

The two leakage studies confound changes in sales (total value of shipments) with changes in production. Holding the level of production leakage fixed across industries, the estimated effect of higher energy prices on the total value of shipments can be positive, negative, or zero in a given industry, depending on the unobserved value of the demand elasticity in each industry. Therefore, estimating the effect of energy prices on the total value of shipments across industries cannot possibly

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10 Ibid.

11 California Department of Food and Agriculture: https://www.cdfa.ca.gov/dairy/prices_main.html .

12 The domestic leakage study refers to the outcome variable as "output", but defines output as the total value of shipments (Grey et al., 2016, p9).

inform on production leakage across industries. Failing to account for demand relationships in the individual industries when estimating the effect of energy prices on the total value of shipments will produce biased leakage estimates.

D. BOTH STUDIES RELY ON SIMPLE SPECIFICATIONS THAT MAY NOT BE IDENTIFIED

In both the domestic and international leakage studies, the total value of shipments for each industry is measured in terms of production, imports and exports. To avoid confounding the estimate of the marginal effect of energy prices on sales, certain controls are added to the analysis including industry fixed effects, time fixed effects, a measure for the wage rate and capital intensity. The empirical equations are so-called reduced form equations that are estimated by generalized least squares regression.

A reduced form equation, which solves for the intersection of supply and demand, expresses the observable outcome like price or quantity as a function of "exogenous" variables that are taken as given and are not influenced by firms or consumers in the market. A reduced form equation is "identified" in a statistical sense if they are derived from a unique pair of supply and demand equations. Because the measures of leakage are related to quantity changes, the ability to link changes in energy prices to changes in quantity is essential.

The exogenous variables are those outside influences the shift the supply and demand curves. For example, changes in input prices shift the supply curve, while changes in the prices of complimentary or competing goods shift the demand curve. Importantly, the valid cost shifters and demand shifters *vary* by product market. For instance the price of eggplant may influence demand for tomatoes, but will not influence demand for cement. Both the International Study and the Domestic Study studies employ a one-size-fits-all approach that attempts to control for some common supply side factors like wages and energy costs but ignore other cost factors particular to each industry and ignore the demand side altogether. In contrast, the authors of the International Study recently published an analysis of the Portland cement industry in which they took care to include demand shifters for that *single* industry and fit a structural model rather than a reduced form specification.[13]

13 See equation 14 and the related discussion: "The matrix X_{mt} includes demand shifters such as population and economic indicators." Fowlie, Reguant and Ryan (2015) "Market Based Emissions Regulation and Industry Dynamics" *Journal of Political Economy* Vol. 124(1) 249-302. In an earlier study on the same industry, one of the authors included more controls: "I estimate several specifications of the demand function, including controls for housing permits, time trends and population." See Ryan (2012) "The Costs of Environmental Regulation in a Concentrated Industry" *Econometrica* Vol. 80(3)1019-1061.

The International Study estimates equations of the following form:[14]

$$\ln(q_{it}p_{it}) = \alpha_0 + f\left(p_{it}^d, p_{it}^f, X_{it}; \beta\right) + \gamma \ln(w_{it}) + \emptyset_i + \eta_{st} + \varepsilon_{it}$$

This equation is identical to the one that appears in the International Study, except I have written the "aggregate outcome" $y_{it}=q_{it}p_{it}$ explicitly as industry revenue (see the International Study for definitions of the other variables). This is an unusual reduced form to estimate. For example, assuming simple linear form for supply and demand would lead to a quadratic function of the exogenous variables in a revenue reduced form such as the one specified above.[15] Without a listing of the 192 specifications the authors considered, it is impossible to determine if any of the models are likely to be identified, that is consistent with unique structural model. Furthermore, as I discussed above, with the use of forward contracts in tomato processing the changes in revenue associated with changes in energy prices are likely to be through prices and not quantity.

The Domestic Study estimates equations of the form:[16]

$$\begin{aligned}\ln(y_{it}) = \beta_0 &+ \beta_{1e}^E s_j^E \ln\left(p_{ijt}^E\right) + \beta_{2e}^E s_j^E \ln\left(p_{R,ijt}^E\right) + \beta_{1g}^G s_j^G \ln\left(p_{ijt}^G\right) \\ &+ \beta_{2e}^G s_j^G \ln\left(p_{R,ijt}^G\right) + \gamma_{1e}^E \ln\left(p_{ijt}^E\right) + \gamma_{2e}^E \ln\left(p_{R,ijt}^E\right) + \gamma_{1e}^G \ln\left(p_{ijt}^G\right) + \gamma_{2e}^G \ln\left(p_{R,ijt}^G\right) + \Delta_e^E s_j^E \\ &+ \Delta_e^G s_j^G + \mu_1 LCOST_{ijt} + \mu_2 DGROWTH_{ijt} + \delta_j + \delta_t + \delta_{rt} + \delta_{jt} + \varepsilon_{ijt}\end{aligned}$$

In their specification y_{it} is measured as quantity, value added or employment (see the Domestic Study for definitions of the other variables). As in the case of the International Study, the reduced form does not account for other cost factors other than labor costs (LCOST) and energy prices and does not account for demand factors except through a "Demand Group Index" (DGROWTH) that is "based on a complex calculation using multiple data sources".

E. GENERAL METHODOLOGICAL CONCERN ON OMITTED VARIABLE BIAS

Both the International and Domestic studies rely on time series variation in energy prices to measure how different industries respond to changes in relative energy prices. Both studies encompass the period of declining U.S. natural gas prices relative to the rest of the world over the last decade, as a significant source of variation in global energy prices over this period is due to the U.S. shale gas boom.

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14 See page 26, Fowlie, Reguant and Ryan (2016) (the International Study).

15 In particular, if demand were unit elastic, revenue would be invariant to price movements and the model would not be identified.

16 See equation 2 of Grey, Linn and Morgenstern (2016) (the Domestic Study).

In general, a decrease in energy price in the U.S. relative to the rest of the world is likely to result in increased exports from U.S. manufacturing plants and decreased imports to the U.S. in energy-intensive industries. Within the U.S., the regions emanating the increase in exports flows will tend to be those individual plants with excess capacity to increase production, which will cause changes in regional domestic production to occur that are unrelated with relative changes in energy prices across domestic regions. This creates measurement error in the Domestic Study, which relies on relatively small variation in energy prices across regions, particularly for natural gas and does not control for differences in natural gas prices in the U.S. relative to the rest of the world.

Omitted variable bias is a potentially important problem in both studies. Many alternative causes can explain geographic shifts in production besides differences in energy prices across regions, including weather, availability and prices of material inputs, trade policies such as subsidies, tariffs and other barriers, and capital and labor market conditions. To the extent that these variables are correlated with energy prices, failing to control for these industry-specific factors will lead to omitted variable bias in the models.[17]

In the domestic leakage study, the unit of observation in the study is plant-industry-year. The model includes energy prices for individual plants (electricity and gas) and plants in neighboring states, fixed effects for industry, year, census division-year, industry-year, as well as labor cost index and demand growth index. The resulting estimates from the model will be biased if there are omitted variables that are correlated with residuals of plant-level outcomes (value of shipments, value added, employment). Some examples of omitted variables likely to introduce bias in the domestic leakage estimates include:

(1) Capital intensity of individual plants and plants in neighboring states.

(2) A labor cost index that includes cross-sectional variation in labor productivity across plants. There is substantial cross-state variation in labor productivity, for example California has considerably higher labor productivity than neighboring states.

(3) Federal or state policies that vary over time and across different products (and hence plants) within a 6-digit NAICS industry (e.g., trade barriers, marketing orders).

(4) Changes in energy intensity across plants over time. Natural gas shares in the study are fixed for all plants at levels reported in the 1991 survey of manufacturing energy costs, whereas industrial energy use has changed dramatically over the last 25 years due to plant-specific technology adaptation.

In the international leakage study, the unit of observation is industry-year (with industries defined at the 6-digit NAICS level). The model includes domestic and foreign energy prices, incorporating 3-digit

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17 The authors of the International Study concede this point (Fowlie et al., 2016, pp.27-28).

NAICS fixed effects, year-sector (incorporating 2-digit NAICS) fixed effects, domestic wage, domestic energy intensity and domestic capital intensity. The resulting estimates from the model will be biased if the omitted variables are correlated with model residuals. The paper calculates four foreign energy prices for each industry based on industry-specific trade partners: average electricity price for export destinations, average electricity price for import origins, and corresponding indices for natural gas prices. However, the study fails to incorporate similar controls for the following variables that are likely to change within 6-digit NAICS industries over time (and are thus unaccounted for by fixed effects currently included in the model):

(1) Real exchange rates. Celasun et al. (2014) illustrate the importance of adjusting for real exchange rates and labor costs in similar settings, as discussed in Fowlie et al. (2016; p. 10).

(2) Trade policy, such as the average tariff structure for each industry, which is a factor considered by Aldy and Pizer (2015).

(3) Foreign labor cost. The paper adjusts for "domestic wages"; however, as in the case of energy prices, it is important to consider relative prices of domestic and foreign labor inputs.

(4) Foreign capital cost or intensity. The paper adjusts for "domestic capital intensity"; however, it is important to account for the relative capital intensity of domestic and foreign industries.

(5) Foreign energy intensity. Similar to the comments above on labor and capital, it is important to account for the relative energy intensity of domestic and foreign industries.

(6) Regional demand measures for the U.S. and the rest of the world. For example, differences in trade flows over time can be driven by differences in global demand structure such as rising incomes, as controlled by variables such as U.S. GDP and "foreign GDP".

II. Specific Comments on the International Study

The basic empirical strategy is to use changes in domestic U.S. natural gas prices to predict changes in import and export volumes between the U.S. and other countries. Specifically, the paper uses the recent, sharp decline in U.S. natural gas prices relative to the rest of the world over the last decade due to the shale gas boom in the U.S. to estimate how changes in domestic energy costs relative to the rest of the world alter import and export flows for U.S. manufacturing industries at the 6-digit NAICS level. The study measures the value of shipments in domestic production, domestic exports, and foreign imports by industry using trade flows through California ports as a proxy for U.S. trade. I note that the international Study is clearly and expansively written, so that it is transparent how the authors built their data and analyzed it. For this reason, I have more detailed comments on their study than I do for the Domestic Study which is (unfortunately) much more opaque.

A. Use of international leakage estimates to make relative comparisons of international leakage across industries from California-specific policy is not appropriate.

As Fowlie, Reguant and Ryan (2016) observe, the proper interpretation of the results is the effect of regulation that raises U.S. energy costs on import and export flows from the U.S. Applying these results to California-specific policy results in an upper-bound on the projected impact of California-specific policy according to the market share of output produced in California in each industry. For industries with 100% of U.S. production in California, these estimates capture international leakage from California-specific policy, while for industries with 1% of U.S. production in California, the upper bound for leakage would be 100 times higher than expected, because 99% of the leakage estimated in the study emanates from states other than California.

On page 28, the paper discusses how estimating impacts on trade flows could overestimate the degree of market transfer. It should be possible to have a sense of how large this overestimation could be (even if it is a back of the envelope calculation). An analysis of the possible determinants of the size of the overestimation, and for which specific industries the overestimation is likely to be larger is appropriate. Understanding how the study overestimates market transfer in specific industries is important for the efficient application of California climate policy.

B. The use of import and export flows from California ports as a proxy for domestic import and export flows introduces bias in the leakage estimates.

Conceptually, a decrease in U.S. energy prices relative to the rest of the world should increase exports from U.S. ports and decrease imports to U.S. ports due to changes in domestic production costs that selectively alters U.S. terms of trade in energy-intensive industries. The central basis for measuring changes in U.S. terms of trade would be changes in total import and export volumes to and from the U.S.

The use of import and export flows from California ports is not an appropriate proxy for industry-specific changes in U.S. terms of trade for several reasons. First, relative to other domestic ports of entry, California ports will tend to emphasize container cargo from Pacific Rim countries as opposed to air freight. For example, the Port of Long Beach accounts for 1 in 3 loaded containers moving through California and 1 in 5 loaded containers moving through the U.S.,[18] which implies California ports together account for 60% (=3/5) of loaded containers moving through the U.S. The proximity of California seaports to container cargo emanating from the Pacific Rim will tend to emphasize trade with industries: (1) shipping predominantly by loaded container as opposed to air freight (i.e., shelf-stable,

[18] Port of Long Beach, "Facts at a Glance": http://www.polb.com/about/facts.asp

manufactured products with high weight to value ratios); and (2) industries that face trade pressure from Pacific Rim countries (e.g., China) as opposed to container ships crossing the Atlantic Ocean from the EU.

Second, imports and exports from California ports are not representative of overall U.S. trade patterns and therefore bias the international leakage estimates. The recent decline in U.S. energy prices altered relative prices of petroleum-based fuels in the U.S. These changes substantially affected transportation costs for shipping manufactured goods in the U.S., particularly for contained cargo with high weight to value ratios. Changes in energy prices alter not only the production of manufactured goods, but also the quantity of goods transshipped across U.S. states by truck and rail to seawater ports. Constraining the study to examining only imports and exports from California ports ignores changes in the pattern of trade driven by changes in transportation rates between U.S. states. Shipments originating in other states and delivered by rail to California ports would occur even if California had no manufacturing sector, and the amount of imports and exports traveling through California ports from other states will be correlated with energy prices. Failure to account for transshipment of goods from other states to California ports makes the international leakage estimates unreliable.

Table 2 compares the value of California processed food sales as a share of U.S. sales with the value of California processed food sales as a share of California exports. Notice that for some industries, for example fruit and vegetable canning (NAICS 311421), the share of exports emanating from California is roughly proportional to the share of production by California food processors relative to the U.S., whereas for other industries, for example animal (except poultry) slaughtering (NAICS 311611), the export market share of California food processors is an order of magnitude greater than the market share of California food processors in the total value of U.S. shipments. For some industries, California food processing production as a share of total U.S. value of production is greater than the export share of California food processing production, and in some case it is smaller. This will tend to introduce bias in international leakage estimates applied to California-specific energy policy, because California exports reflect a greater value of shipments originating in states outside California in some industries than in others.

Table 2. Comparison of Food Processing Industries by California share of U.S. value of production and California share of U.S. exports.

NAICS code	Industry	CA market share of US production[1]	CA share of US exports[2]
311230	Breakfast cereal manufacturing	11.42%	8.00%
311421	Fruit and vegetable canning	24.70%	24.00%
311611	Animal (except poultry) slaughtering	3.73%	47.00%
311613	Rendering and meat byproduct processing	6.17%	12.00%
311615	Poultry processing	4.39%	9.00%
311911	Roasted nuts and peanut butter manufacturing	37.06%	30.00%
311919	Other snack food manufacturing	11.60%	25.00%
311999	All other miscellaneous food manufacturing	5.61%	32.00%

Source: (1) 2012 Economic Census of the United States

(2) Fowlie, Reguant and Ryan (2016)

Third, both import and export data based on California-only ports of entry will tend to overemphasize industries that trade predominantly with Pacific Rim countries, such as China, as opposed to other trade partners such as the EU. This introduces measurement error in the empirical model when not correcting for country-specific exchange rates. For example, if U.S. currency strengthens relative to the Yen, but weakens relative to the Euro, export (import) flows to (from) the EU will increase (decrease), while the opposite trade pattern would occur between the U.S. and Japan. Failing to account for regional exchange rate variation introduces bias in the international leakage estimates that cannot be absorbed by industry and time specific fixed effects.

C. Fixed Effects are Included at the 3-Digit NAICS Level, While the Leakage Analysis is Conducted at the 6-Digit NAICS Level

The unit of observation in the international leakage study is industry-year value of shipments at the 6-digit NAICS level. The model includes domestic and foreign energy prices, 3-digit NAICS fixed effects, year-sector (2-digit NAICS) fixed effects, domestic wage, domestic energy intensity, and domestic capital intensity. In such a model structure, estimation results will be biased if not controlling for omitted variables correlated to industry energy prices and the outcomes (total value of domestic production, total value of imports, total value of exports value added) that vary across 6-digit NAICS industries over time.

Given that many industry-specific features contributing to leakage are not formally controlled for in the international study, it is important to include industry-fixed effects at the 6-digit NAICS level to absorb industry-specific outcomes from variables omitted from the analysis. Instead, the international study relies on fixed effects at the 3-digit NAICS level. Because the desired unit of observation in the regressions is at the 6-digit level (and ideally would be at even higher levels), it would be preferable to include industry fixed effects at the comparable 6-digit level. Doing so is important, because some omitted variables could be constant over time at the 3-digit level, yet vary over time at the 6-digit level.

An important question is whether there exists in the data sufficient variation in energy costs to estimate leakage after incorporating 6-digit NAICS fixed effects. If the answer is yes, estimates from such model would be preferable. If the answer is no, then it is unclear how sufficient variance exists in the data to estimate leakage.

D. Unclear source of variation in energy prices

After controlling for all the variables in the model and fixed effects, the key underlying assumption is that the remaining variance in energy prices is exogenous. It is important to have an idea of where that variance could be coming from. The paper mentions measurement and approximation error as a possible source of variation in energy prices (p.28); what other examples of industry-specific, time varying sources could be generating (exogenous) variation in energy prices? Specifically, after conditioning on the variables included in the model and the fixed effects, what other sources could be generating variation in the energy prices that is independent of the outcomes (total value of domestic production, total value of imports, total value of exports value added)? Short of providing the necessary data for independent researchers to ascertain where the variation in energy prices is coming from, it would help to provide some specific examples of other factors that could be generating such (conditional) exogenous variation and to present some auxiliary results to confirm this intuition. Energy price variation is being exploited to estimate the parameters of interest, and thus it is important to have a better idea of where the variance is coming from.

E. Measures of precision are needed on elasticity estimates

Table 9 shows elasticity estimates with respect to energy price by 6-digit NAICS industry and Table 10 relies on these estimates to calculate leakage at a $10 allowance price. To understand how reliable these estimates are as the basis for policy, it is essential to provide some measure of the precision in which the estimated elasticities in Table 9 are calculated. Since these elasticities come from considering a large number of different specifications, the estimates lack straightforward interpretation in terms of precision. It is critical to have a measure of the variance or precision of these estimated numbers. Some possibilities to consider:

(1) Calculate a standard error distribution by bootstrapping the whole procedure (i.e., estimating the 192 specifications and calculating the elasticities for each bootstrap sample). This procedure would allow indication to be provided in the table on which elasticities are statistically different from zero and which are not.

(2) For each industry, show the 2.5th and 97.5th quantiles of the distribution of the elasticities over the 192 specifications considered (or the 5th and 95th quantiles).

(3) For each industry, indicate the frequency in which the elasticities are negative (or positive for the imports outcome) over the 192 specifications considered.

It would be a helpful diagnostic of the precision of elasticity estimates to provide a picture like Figure 7 (which simulates the impact of a $10 per metric Ton of CO2 Carbon Price) that shows the 2.5th and 97.5th quantiles (or the 5th and 95th quantiles) instead of the interquartile range.

Similarly, it would be helpful if Table 10—which contains the information from Figure 7—provided analogous measures of precision as discussed in possibilities (1)-(3) above regarding Table 9.

III. Specific Comments on the Domestic Study

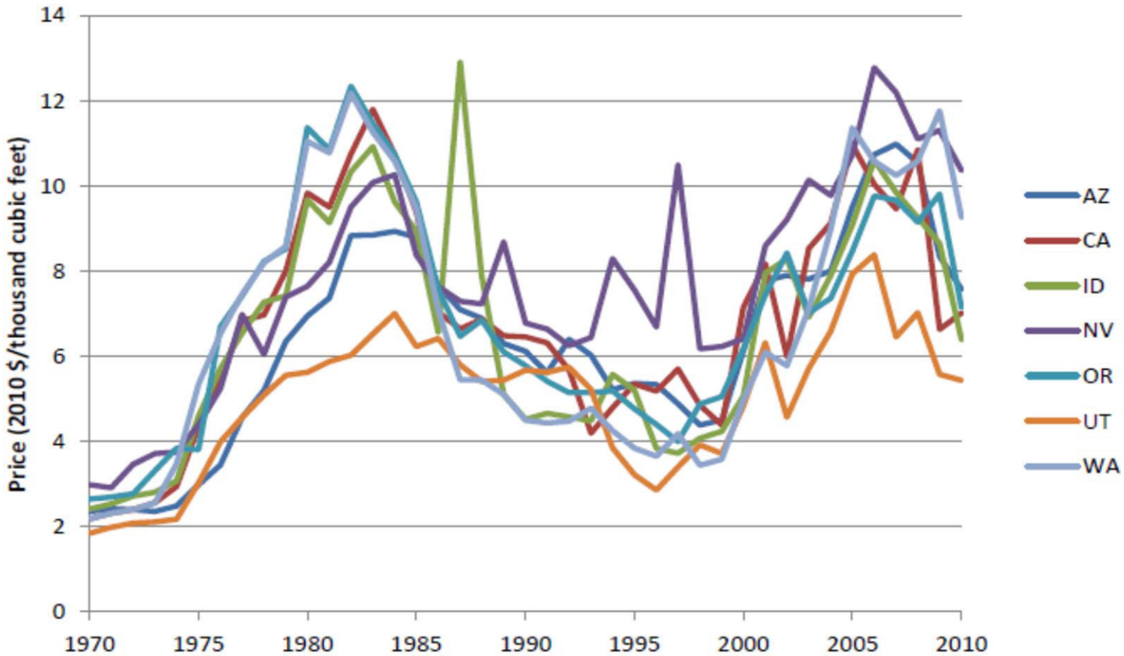
The basic empirical strategy in the domestic study is to use changes in relative domestic natural gas prices to predict changes in the value of shipments (the "output" variable), value-added, and employment between California plants and plants in other U.S. states. The paper uses energy prices for individual U.S. plants (electricity and gas) and plants at various distances (250, 500, and 1,000 miles) to estimate how changes in regional energy costs alter production levels at individual plants in the U.S. manufacturing industries at the 6-digit NAICS level.

A. Lack of Variation in Natural Gas Prices Across States

While the shale boom has produced a wedge between U.S. and domestic natural gas prices, natural gas prices within the U.S. tend to move together. The domestic leakage study has lots of data points; however, the variation in energy prices across states is much smaller than the variation in U.S. vs. rest of the world energy prices.

Figure 1 illustrates that the regional natural gas prices used in the domestic leakage study are highly correlated. The lack of variation in relative energy prices across states enhances the omitted variable problem, making it more important to control for other factors such as regional changes in raw material prices and the capacity of plants to expand following favorable changes in comparative advantage in energy-intensive industries.

Figure 1: Real Gas prices for Industrial Customers



Source: EIA, as reported by Grey, Linn and Morgenstern (RFF Domestic Leakage Study) at the ARB Workshop on May 18, 2016: http://www.arb.ca.gov/cc/capandtrade/meetings/20160518/rff-domestic-leakage-pres.pdf

After controlling for all the variables in the model and fixed effects, the key underlying assumption is that the remaining variance in energy prices is exogenous. It is important to have an idea of where that variance could be coming from. In other words, after conditioning on the variables included in the model and all the fixed effects, it is important to know what could be generating variation in the energy prices that is independent of the outcome (total value of shipments, value added, employment). Examples of specific phenomena that are producing the identifying variation should be provided. The variation in regional energy prices is the variation that is being exploited in the model to estimate the parameters of interest, and thus it is important to have an idea of where it may be coming from. Given the lack of substantial variation in energy prices across states that is evident in Figure 1, it is unclear whether there is sufficient variance in the outcomes and energy prices after including all those fixed effects and covariates. There is a need to document this, as there may be little variance left.

B. EVIDENCE IS NOT PROVIDED ON THE ROBUSTNESS OF THE MODEL ESTIMATES

The domestic leakage study includes no mention nor discussion on how standard errors are calculated. Are they robust? Are they clustered? At what level? This issue is critical, because failing to use panel-robust or panel bootstrap standard errors can lead to greatly underestimated standard errors and thus overestimated t-statistics, a problem that has been emphasized in the economics literature, (e.g., Bertrand et al., 2004; Cameron and Trivedi, 2005). [19]

It is also important to check for the presence of outlier observations in the data. Typically this type of panel data contains considerable outliers and it is well-known that models similar to the one used in this paper can be severely affected by them (e.g., Harbaugh et al., 2002; Ederington et al., 2005; Fowlie et al., 2016). [20] Further analysis is needed to implement common measures or approaches to detect outlier observations (e.g., Belsley et al., 1980; Cook and Weisberg, 1982; Hadi, 1994).[21] To inform on the robustness of model estimates to outliers in the data, it is common to present results after dropping outlier observations, or employ robust regression methods for which the estimated results are not appreciably affected by the presence of outliers (e.g., Belsley et al., 1980; Cook and Weisberg, 1982). Robust standard errors should be calculated and reported for all estimated parameters.

Of particular concern, several elasticities are estimated to be positive, and in several cases these positive values are statistically significant. For example, for gas prices in the short-run analysis (Table 2b), seven industries have statistically positive elasticities for all three of the outcomes analyzed (output, value added, employment), while eleven industries have statistically negative elasticities for all three outcomes. This is a troublesome result, as it suggests the estimated correlation between gas prices and the outcome variables may be simply spurious correlation due to omitted variable bias. This outcome points to potentially serious flaws in the estimates from the econometric model.

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19 Cameron, C. and P. Trivedi (2005). *Microeconometrics: Methods and Applications*. Cambridge University Press; Bertrand, M., E. Duflo, and S. Mullainathan (2004), "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics*, 119, 249-275.

20 Harbaugh, W.T., Levinson, A., Wilson, D.M. (2002), "Re-Examining the Empirical Evidence for an Environmental Kuznets Curve," *Review of Economics and Statistics*, 84: 541–551; Ederington, J., A. Levinson, and J. Minier (2005), "Footloose and Pollution-Free," *Review of Economics and Statistics* 87(1), 92–99. Fowlie et al., International Leakage Study.

21 Belsley, D.A., Kuh, E., Welsch, R.E. (1980). Regression diagnostics. New York: Wiley; Cook, R.D., Weisberg, S. (1982) Residuals and Influence in Regression. New York and London: Chapman and Hall; Hadi, A. S. (1994), "A Modification of a Method for the Detection of Outliers in Multivariate Samples," *Journal of the Royal Statistical Society. Series B (Methodological)*, 393–396.

A discussion should be provided as to why these particular industries could have positive elasticities. It would help to have a measure of "variance" or uncertainty in the simulation results. To this end, a bootstrap or Monte Carlo-type approach can be used to provide a sense of the uncertainty of the simulation predictions.

Additionally, it would be helpful to examine the sensitivity of the results to the particular functional form employed for the main estimation equation (the log-log form).

C. LABOR COST INDEX

The labor index cost included in the domestic leakage study is an average of two values: (1) plants in same state-industry as the plant; and (2) plants in neighboring states in the same industry. It would be preferable to divide this variable into two, distinct indices: labor cost in own state-industry and labor cost index in same industry in neighbor state. For the purpose of measuring leakage across state lines, it is important to control for the relative difference in labor costs across state lines (for the same reason that relative energy prices across states is important for leakage).

D. THE MODEL IS NOT APPROPRIATELY CALIBRATED TO MEASURE LEAKAGE FROM CALIFORNIA CLIMATE CHANGE POLICY.

The domestic leakage models estimated in equations (2) and (3) employ all plants in the US. Therefore, the proper interpretation of the estimated elasticities of a given outcome with respect to the price of energy are not in reality the elasticities for a representative plant in California, but rather the elasticities for a representative plant in the US. Importantly, it is not clear a priori whether the estimated parameters for the US provide a good estimate of the corresponding parameters for California. A superior basis for predicting domestic leakage from California manufacturing industries is to estimate the models (equations 2 and 3) using only observations from California.

E. THE DISTANCE MEASURE BETWEEN PLANTS MAY NOT BE SUFFICIENT TO ACCOUNT FOR CHANGES IN THE OUTCOME VARIABLES.

The distance between plants used to measure domestic leakage is not sufficient in many industries. For example, in the processing tomato industry, virtually all U.S. output is processed in California, Ohio, Indiana and Michigan, states further than 1,000 miles from California. Similarly, distances of 250 and 500 miles between plants is not sufficient to account for changes in food processor output for cheese, for which the main competitors for California cheese producers are in Texas, Idaho and Wisconsin.

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Taking random samples of “1,000 plants from each state” does not seem to be an appropriate sample design. It may be better to take a fixed percentage of plants from each state. States such as California may have many plants, while other states may have only a few plants in a given industry.

The procedure to define neighboring plants should take into account whether or not the neighboring plant is within the state. For example, for a given plant in California, a 250 mile radius may include only other California plants.

Sincerely,

Armando Levy Ph.D.
Principal