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**UK Public Health Responsibility Deals – can they nudge consumers towards healthier diets?**

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## **UK Public Health Responsibility Deals – can they nudge consumers towards healthier diets?**

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### **Abstract**

*The UK Government's Responsibility Deals (Food Network) seeks to promote healthier dietary choices by consumers through food industry-led product reformulation initiatives enhancing the availability of healthier foods. Such public-private partnerships based on voluntary action from the food industry are part of the “nudge” agenda and are seen as preferred alternatives to more intrusive regulatory and fiscal interventions in food product markets. This paper develops a framework to assess the potential effectiveness of Responsibility Deals in influencing the population level intakes of energy and nutrients. Our analysis finds that Responsibility Deals, even if wholeheartedly adopted by the food industry, may not necessarily lead to significant reductions in population level energy and nutrient intakes. This is because the effect of product reformulation initiatives is mediated by consumer response to these initiatives both within and across major food product groups. Our results suggest that the major role for Responsibility Deals lies not in “nudging” consumers towards healthier dietary choices, but rather in reversing or halting the trends in food product nutrient composition changes over the last two decades that have rendered adherence to recommended dietary guidelines more difficult for consumers.*

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## Introduction

Faced with the increasing incidence of obesity and diet related non-communicable disease, European Governments are attempting to use a range of interventions to facilitate healthier dietary choices (Hawkes, 2013). Fiscal interventions in food markets (such as the levy of a tax on saturated fats or sugars to discourage their consumption) or regulatory interventions that proscribe certain types of food products tend to be unpopular and controversial as they are seen as paternalistic restrictions on consumer choice. Empirical studies also appear to suggest that fiscal measures like ‘fat taxes’ may be blunt instruments for influencing nutrient intakes by consumers and could be potentially regressive (Tiffin and Arnoult, 2011). Given consumer and industry resistance to ‘intrusive’ fiscal or regulatory measures, there appears to have been a shift in emphasis towards behavioural interventions aimed at ‘nudging’ consumers towards healthier eating. An important element of these interventions has been public-private partnerships, involving voluntary food-industry led product reformulation initiatives to enhance the availability of healthier food products. Such voluntary initiatives could elicit significant “buy-in” from major food industry players, especially if these are offered as alternatives to fiscal and regulatory measures that industry would be keen to avoid.

In the UK, the Department of Health’s Responsibility Deal Food Network (Jebb, 2012) has garnered more than 400 industry partners that have committed themselves to the development of healthier food products. The Food Network<sup>1</sup> has launched pledges focusing on salt reduction, calorie reduction, removal of trans-fats and calorie labelling on menus. The implicit premise underlying the Responsibility Deals is that enhanced availability of healthier food product options will be associated with reduced intake of energy and better conformity to recommended dietary guidelines for nutrient intakes. There is, however, very little empirical evidence on how patterns of overall energy and nutrient intakes of consumers respond to these initiatives. The choice of low calorie/nutrient options by consumers need not necessarily be associated with a reduced overall calorie/nutrient intake. Even when consumers opt for the healthier options made available as a consequence of the Responsibility Deals, the impact on overall energy/nutrient intakes still depends on how consumers respond in terms of the quantity consumed of healthier product options and the modifications that they make in the consumption of other food products. This paper develops a framework to examine the potential impact of product reformulation initiatives derived from Responsibility Deals on the patterns of overall energy and nutrient intakes.

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<sup>1</sup> See <https://responsibilitydeal.dh.gov.uk/category/food-network/> . The Public Health Responsibility Deals involve a number of “networks”. In addition to the Food Network, they include the Alcohol Network, the Physical Activity Network and the Health at Work Network.

## **Previous Literature**

Evaluating the impact of product reformulation initiatives on population level energy and nutrient intakes poses a number of challenges, which may explain why empirical studies in this area have been relatively sparse (Heart Foundation, 2012). Assessing the impact of product formulation initiatives is difficult as they are generally implemented with other public health initiatives such as nutrition awareness or information campaigns. Changes in population level energy/nutrient intakes depend on changes in the nature, quantum and nutrient composition of food products consumed. Changes in food product demand are influenced by the changes in socio-demographic determinants and food product prices. This makes it difficult to isolate the contribution of product reformulation to changes in energy/nutrient intakes. A limited number of studies have, however, demonstrated the population level impacts of product reformulation initiatives. Studies in Finland (Laatikainen et al., 2006; Pietinen et al., 2008) have shown that a reduction in average salt intake of 3 grams/day in the period 1979-2002 has resulted from reformulation of processed foods in conjunction with mandatory labelling of sodium and a public awareness campaign. A five year intervention in Mauritius to replace palm oil as the principal cooking medium with soybean oil saw a decrease of 3.5% in energy derived from saturated fat, an increase of 5.5% in energy derived from polyunsaturated fats and significant reductions in cholesterol levels (Uusitalo et al., 1996). In the UK, a reduction of 0.9 grams in daily salt intake in the population between 2000 and 2008 has been attributed to the reformulation of products and consumer awareness campaigns (National Centre for Social Research & Human Nutrition Research, 2008; Food Standards Agency, 2009; Wyness, Buttriss and Stanner, 2012). Given the challenges in isolating the effects of product reformulation strategies, empirical studies have tended to rely on dietary modelling to:

- (1) Assess the potential impact of product reformulation on food supply (e.g., reduction in salt or saturated fat use through the reformulation of products). (Fear, Gibbons and Anderson, 2004; L'Abbe et al., 2009; Mozaffarian, Jacobson and Greenstein, 2010; Ratnayake, L'Abbe and Mozaffarian, 2009; Webster, Dunford and Hawkes, 2011; Yach, Lucio and Barroso, 2007; Young and Swinburn, 2002).
- (2) Assess the potential impact of product reformulation on health (e.g., cardiovascular health). (Cobiac, Vos and Veerman, 2010; L'Abbe et al., 2009; Webster, Dunford and Hawkes, 2011; Ratnayake, L'Abbe, Farnworth et al., 2009; Mozaffarian and Clarke, 2009)
- (3) Assess the cost-effectiveness of campaigns to reduce nutrient intakes (or improve dietary choices) in terms of the savings in health costs over the long term. (Cobiac,

Vos and Veerman, 2010; Appel, 2006, He and MacGregor, 2010; Barton et al., 2011; Bibbins-Domingo et al., 2010, Cappuccio et al., 2011; Karppanen and Mervaala, 1996; Karppanen and Mervaala, 2006; Joffres et al., 2007; Selmer et al., 2000; Mohan and Campbell, 2009; Murray et al., 2009; Appel, 2009; He et al., 2010).

Randomised Control Trials (RCTs) to assess dietary impacts of product reformulation (where one group is exposed to reformulated products while the control group is not) may be inappropriate (in terms of feasibility or ethical considerations) in the context of free-living populations. Moreover, RCTs may not provide insight into how free-living populations are likely to respond to product reformulation initiatives.

### **Approach to Assessment of Product Reformulation Impacts**

Reformulation of food products varying their energy and nutrient composition has been an ongoing process in the food industry, even independently of Responsibility Deals. If we examine the nutrient composition of food products in a country, say a decade apart, we are likely to find significant changes in the nutrient composition of several product categories. For example, we are likely to find a decline in the fat content of milk consumed since the 1990s reflecting the increasing use of skimmed milk by consumers in place of full-fat or semi-skimmed milk. To assess the potential impacts of Responsibility Deals, we analyse population level changes in energy/nutrient intakes associated with product reformulations taking place over time. For the UK, using data from the two National Diet and Nutrition Surveys a decade apart, we examine the changes in the distribution of energy and nutrient intakes over this period, which are attributable to changes in the quantity of food products consumed and the nutrient composition of food products. We decompose the change in energy/nutrient intakes into “covariate” or quantity effects (i.e., changes on account of the quantity of food products consumed) and “coefficient” or structural effects (i.e., changes on account of the nutrient composition of food products). The covariate or quantity effects will reflect the influence of socio-demographic determinants of food product demand, the prices of food products and public health information campaigns. The coefficient effects isolate the contribution of product reformulation to changes in energy/nutrient intakes. The decomposition of changes in energy/nutrient intakes into quantity and product reformulation effects is then used to construct counterfactual distributions of energy/nutrient intakes – i.e., the distribution of energy/nutrient intakes that would prevail for a given pattern of product reformulation. The comparison of the actual and counterfactual distributions of energy/nutrient intakes provides a measure of the potential impact of product reformulation on population energy/nutrient intakes. As explained below, an important advantage of the method adopted is that it allows the impact of product formulation to vary along the entire distribution of energy/nutrient intakes. The impact of

product reformulation on those consuming high levels of energy/nutrients (and hence prone to obesity or diet-related disease) could be very different from the impact on those whose diets are in compliance with the UK recommended dietary guidelines (Department of Health, 1991).

### **Data and Variables**

We use data from UK's National Diet and Nutrition Surveys (NDNS) for 2000-01 and 2010-11. The NDNS-2000-01 (ONS, 2005) was part of a programme of periodic diet and nutrition surveys and collected diet and nutrition information from a nationally representative sample of 2251 adults aged 19-64 years. The NDNS-2010-11 is part of a rolling annual programme of national diet and nutrition surveys started in 2008-09 (Bates, Lennox and Swan, 2010) with a nationally representative sample of nearly 1000 respondents each year. (NDNS-2010-11 has 950 respondents, however, in our analysis we only used the data for adults aged 19-64 years for comparison with NDNS 2000-01). The surveys collected detailed information on foods consumed (at home and outside the home) based on 4/7<sup>2</sup> day food diaries maintained by the respondents. The surveys also collected social and demographic information at the household and individual level and information on anthropometry, health parameters and physical activities of the respondents. The foods consumed by the respondents are grouped into 16 aggregated food group categories, 60 main food categories and over 7000 food products. In addition to the quantity consumed (weight or volume) of each food product, the data set provides nutrient conversion factors for each food item covering a total of 51 macro and micronutrients. A number of "derived variables" are also provided such as the total energy and nutrient intakes, share of different macro nutrients in energy intake, consumption of fruits and vegetables, salt, fibre and cholesterol – which are relevant to the recommended dietary guidelines for the UK.

Our analysis was carried out at the level of aggregated food groups which are listed in Table-1 below.

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<sup>2</sup> NDNS-2000-01 was based on 7 day diaries while NDNS-2010-11 was based on 4 day diaries.

**Table-1: Aggregate categories of food products in National Diet and Nutrition Surveys**

Product Group	Description
P1	Cereals and Cereal Products
P2	Milk and Milk Products
P3	Eggs and Egg Dishes
P4	Fat Spreads
P5	Meat and Meat Products
P6	Fish and Fish Dishes
P7	Vegetables inc Potatoes
P8	Savoury Snacks
P9	Fruit
P10	Sugar Preserves and Confectionery
P11	Non-Alcoholic Beverages
P12	Alcoholic Beverages
P13	Miscellaneous
P14	Dietary Supplements
P15	Artificial Sweeteners

## Methods

We examined the effects of product reformulation on (1) total energy intake (2) total fat intake and (3) total sugar intake at the population level. We used a quantile regression (QR) (Koenker, 2005) approach to model energy, fat or sugar intake as a function of the consumption of different food products (aggregated food groups). The QR equation estimated was:

$$Y_{i\tau} = \alpha_{i\tau} + \beta_{i1\tau}X_1 + \beta_{i2\tau}X_2 + \beta_{i3\tau}X_3 + \dots + \beta_{i15\tau}X_{15} + \varepsilon_{\tau}$$

where  $Y$  = percapita daily intake and  $i$  indexes energy, fats or sugars

$X_1 \dots X_{15}$  = quantities of product groups P1 to P15 consumed in grams

$\tau$  denotes the quantiles and  $\varepsilon$  denotes the error term.

In the above equation, the coefficients  $\beta_{i1} \dots \beta_{i15}$  represent the energy or nutrient (fat or sugar) content of the product group per gram (e.g., kcal/gm, fats/gm or sugars/gm) in the given quantile of the outcome variable. It should be noted that for any given food product, the energy/nutrient composition is fixed. The variation across individuals arises on account of the differences in product choices within each product group. For instance, the fat content of the aggregate product group “Milk and Milk Products” for an individual depends on the



choice of products within that group. The coefficient for any product group therefore, reflects the choice of products within that product group. The QR method allows the effect of explanatory variables to vary along the range of the outcome variable – daily energy/fat/sugar intake in this case. For any product group, the differences in the coefficients across quantile will reflect differences in product choices within that group – individuals in the upper quantiles of energy/fat/sugar consumption may be making very different product choices within product group than individuals in the lower quantiles.

The QR results give us the conditional quantile effects of changes in aggregate food group consumption patterns on energy/fat/sugar intakes. The coefficient of any variable (e.g., “Milk and Milk Products” consumed in grams) at different quantiles gives us the effect of a unit change in the variable on the outcome variable (energy/fat/sugar intake) at the relevant quantile of the outcome variable (daily energy/fat/sugar intake), *holding all the other covariates constant at their median level*. The QR coefficients do not convey the unconditional quantile effects, i.e., the effect of a unit change in the variable when the covariates (other aggregated food group products consumed) are distributed as in the sample, or when their distribution changes in a particular way (e.g., when products in a particular category are reformulated). From an evaluation perspective, it is this unconditional quantile effect that we are interested in when assessing the impacts of product reformulation. We use a counterfactual decomposition exercise using the method suggested by Machado and Mata (2005) to examine changes in the distribution of daily energy/fat/sugar intake if (1) individual product groups are reformulated and (2) if different combinations of product groups are reformulated. The counterfactual decomposition exercise does not convey the effect of every individual in the population switching to reformulated products (which is the kind of insight gained from intervention studies or RCTs). Instead, it tells us what the population distribution of energy/fat/sugar intake is likely to be if the consumption pattern of the entire population were to be similar to that of a sub-population that uses reformulated products. The dietary adjustment process does not proceed by replacing all products in the consumers’ baskets with healthier (reformulated) alternatives, but rather through the adoption of the consumption pattern of a sub-population that uses reformulated products. Such a dietary adjustment process may be more appropriate for assessing the impact of reformulation on free-living populations in response to public health initiatives like the Responsibility Deals, rather than the (controlled) dietary changes imposed in intervention studies. The counterfactual decomposition is carried out in two stages. In the first stage we generate an aggregate decomposition of changes in energy/fat/sugar intakes between 2000-01 and 2010-11 into covariate (quantity) and coefficient (nutrient composition or reformulation) effects. In the second stage we carry out a

detailed decomposition exercise that identifies the contribution of individual product groups to changes in energy/fat/sugar intakes over the two time periods.

## Results

The changes in the energy, fat and sugar composition of major product groups between 2000-01 and 2010-11 are summarised in Table-2 below:

**Table-2: Changes in energy and nutrient composition of major food product groups between 2000-01 and 2010-11 in the UK**

	2000-01			2010-11			Percentage change between 2000-01 and 2010-11		
	Kcal/gm	Total fat/gm	Total sugar/gm	Kcal/gm	Total fat/gm	Total sugar/gm	Kcal/gm	Total fat/gm	Total sugar/gm
Cereals and cereal products	2.413	0.057	0.078	2.442	0.056	0.077	1.2%	-0.6%	-0.8%
Sugar preserves and confectionery	3.992	0.092	0.796	4.028	0.119	0.725	0.9%	29.7%	-8.9%
Non-alcoholic beverages	0.048	0.000	0.012	0.072	0.000	0.018	49.6%	0%	54.1%
Alcoholic beverages	0.451	0.000	0.024	0.495	0.000	0.025	9.9%	4.0%	4.7%
Milk and milk products	0.758	0.041	0.054	0.829	0.045	0.062	9.3%	10.3%	13.6%
Eggs and egg dishes	2.069	0.159	0.016	1.842	0.139	0.008	-11.0%	-12.4%	-51.6%
Fat spreads	6.318	0.693	0.007	6.281	0.695	0.003	-0.6%	0.2%	-61.5%
Meat and meat products	1.888	0.105	0.015	1.988	0.106	0.011	5.3%	1.6%	-28.5%
Fish and fish dishes	1.661	0.083	0.005	1.771	0.085	0.007	6.7%	2.6%	22.9%
Vegetables inc potatoes	0.926	0.033	0.024	0.860	0.027	0.026	-7.1%	-18.4%	4.8%
Savoury snacks	5.228	0.350	0.025	4.979	0.307	0.027	-4.8%	-12.4%	8.7%
Fruit	0.570	0.004	0.128	0.602	0.004	0.137	5.7%	-9.1%	6.9%
Miscellaneous	0.991	0.061	0.058	1.068	0.058	0.075	7.8%	-4.3%	30.1%
Dietary supplements	2.061	0.096	0.090	1.872	0.179	0.065	-9.2%	85.8%	-27.2%
Artificial sweeteners	0.227	0.000	0.057	0.031	0.000	0.008	-86.3%		-85.9%

\*Shaded cells show decline in energy/fat/sugar density in 2010-11 in relation to 2000-01.

Source: Calculated from NDNS-2000-01 and NDNS-2010-11

Table-2 shows that among major<sup>3</sup> food product groups, only three product groups– Eggs and Egg Dishes, Savoury Snacks and Vegetables including Potatoes – have shown any significant decline in energy density over the ten year period from 2000-01 to 2010-11. The energy density of all other major food groups has increased. Non-alcoholic beverages have shown a striking 50% increase in energy density (per gm) over this period. When we examine fat density, we find that three product groups – Eggs and Egg Dishes, Vegetables including Potatoes and Savoury Snacks, have shown a decline in fat density (per gm). In terms of sugar density, three product groups - Sugar Preserves and Confectionery, Fat Spreads, Meat and Meat Products – have shown a decline (however, it should be noted that Fat Spreads and Meat and Meat Products have only a very small/miniscule sugar content). For a number of product groups, fat density and sugar density appear to have moved in opposite directions, which may account for the relatively marginal changes in energy density. Eggs and Egg Dishes is the only food product category to witness a decline in both fat and sugar density. Sugar Preserves and Confectionery, which have witnessed an 8.9% decline in sugar density have simultaneously seen a 29.7% increase in fat density. Similarly, Savoury Snacks, which have witnessed an 18.4% decline in fat density, have at the same time seen an increase of 4.8% in sugar density. “Milk and Milk Products” has witnessed an increase in both fat and sugar density. This may appear surprising because it is known that a large proportion of consumers have switched to lower fat milk over the last two decades. It should be noted that changes in nutrient density at the product group level reflect not only changes in the nutrient composition of individual products within that group, but also changes in product choices made by consumers within that group. Thus, even if an individual product (e.g., milk) is reformulated to have lower fat density, the fat density of the product group can increase if consumers shift to higher fat density products within that product group (e.g., to greater consumption of cheese or ice creams within “Milk and Milk Products”). Overall, changes in the nutrient composition of major food product groups in the UK over the decade from 2000-01 to 2010-11 appear to have been characterised by relatively small changes in energy density, with nutrient density changes for fats and sugars often moving in opposite directions. Therefore, in assessing the potential effects of product reformulation on nutrient intakes, the question of what goes in when one nutrient is reduced is an important one. Even if the food industry reformulates individual products with lower energy **and** fat/sugar densities, the expected reduction in population level intakes of energy/nutrients may not happen if the product mix chosen by consumers within a product group shifts towards higher energy/nutrient density products (or if they increase quantities consumed while shifting to healthier options).

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<sup>3</sup> That is, product groups excluding “Miscellaneous”, “Dietary Supplements” and “Artificial Sweeteners” which we classify as minor groups.

## Decomposition Results

Table-3 presents the results of the aggregate decomposition exercise using the Machado and Mata (2005) procedure. Changes in energy, fat and sugar intakes between NDNS-2000-01 and NDNS-2010-11 are decomposed into quantity effects and product reformulation (changes in nutrient composition) effects at different quantiles of the distribution of the energy and fat/sugar intakes. Between 2000-01 and 2010-11, energy intake per capita has declined by 11.4% (10<sup>th</sup> quantile) and 14.1% (75<sup>th</sup> quantile) in different quantiles. This decline can be seen as the consequence of quantity and reformulation effects. While the quantity effect has led to a decline in energy consumption (ranging from 24.49% to 16.02% across quantiles), the reformulation effect has actually contributed to an **increase** in energy consumption. What this means is that over the period of a decade, while consumers have reduced their intakes of food products, the decline in energy consumption that would be associated with this reduction has been offset by the increasing energy density of the products consumed. It is also interesting that product reformulation effects of increasing energy consumption are much larger in the lower quantile of energy consumption than in the upper quantiles. The increasing energy density of products consumed has made a relatively small contribution to increasing energy intakes in the upper quantiles, which are likely to be characterised by excessive energy intakes (and hence proneness to obesity and diet-related disease). A similar pattern is observed in the case of fat and sugar intakes, where reduction in intakes via the quantity effects are offset by product reformulation effects (increasing fat/sugar density of products consumed). The reformulation effects in the case of fat intake are larger than in the case of energy intakes and are the largest in the case of sugar intakes. Again, the reformulation effects for fat and sugar are relatively smaller in the upper quantiles – suggesting that increased fat/sugar density of products has made a relatively small contribution to increases in the fat/sugar intakes at the upper end of the distribution likely to be characterised by excessive fat/sugar intakes.

**Table-3: Contribution of quantity and product reformulation effects to changes in energy and nutrient intakes**

Energy intake (Kcal per capita per day)					
Quantile	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>
2000-01	1215.55	1492.07	1875.91	2301.75	2708.71
2010-11	1077.24	1317.40	1618.42	1977.71	2376.41
Difference	-138.31	-174.67	-257.48	-324.04	-332.30
Percent	-11.4%	-11.7%	-13.7%	-14.1%	-12.3%
Quantity effect	-24.49%	-24.56%	-23.27%	-19.64%	-16.02%
Reformulation effect	13.11%	12.85%	9.54%	5.56%	3.75%
Total fat intake (gms per capita per day)					
Quantile	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>
2000-01	39.22	52.38	69.44	87.95	109.91
2010-11	36.66	46.80	60.54	76.76	94.43
Difference	-2.55	-5.58	-8.90	-11.19	-15.48
Percent	-6.5%	-10.7%	-12.8%	-12.7%	-14.1%
Quantity effect	-24.49%	-24.56%	-23.27%	-19.64%	-16.02%
Reformulation effect	17.98%	13.90%	10.45%	6.92%	1.93%
Total sugar intake (gms per capita per day)					
Quantile	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>
2000-01	48.27	67.54	95.99	126.46	156.92
2010-11	48.93	66.50	89.46	117.66	146.37
Difference	0.65	-1.05	-6.53	-8.80	-10.55
Percent	1.4%	-1.6%	-6.8%	-7.0%	-6.7%
Quantity effect	-24.49%	-24.56%	-23.27%	-19.64%	-16.02%
Reformulation effect	25.84%	23.01%	16.47%	12.68%	9.30%

The above analysis suggests that although healthier options for a wide range of food products have been a visible phenomenon on supermarket shelves in the UK, the overall trends in nutrient composition of products in the decade from 2000-01 to 2010-11, have actually contributed to an increase in energy, fat and sugar intakes and may not have served to promote healthier diets and conformity to dietary guidelines. The results of the detailed decomposition exercise (not yet available) can provide further insights into the contribution of changes in nutrient composition of specific product groups to changes in nutrient intakes. The detailed decomposition exercise can also be used to assess how energy/fat/sugar intake distributions can be expected to shift as consumers switch to reformulated (healthier) options in one or more product categories.

### Conclusions

In this paper, we have examined trends in consumption and nutrient composition of food products for a period that is prior to the introduction of Responsibility Deals – and it is quite possible that Responsibility Deals may accelerate the pace of reformulation of food products

by the industry. The analysis, however, does provide a number of useful insights for assessing the potential impacts of Responsibility Deals on energy and nutrient intakes at the population level. A key insight from the results is that Responsibility Deals are not really required to nudge consumers to shift to healthier diets – rather, they are required to reverse/halt the trends in nutrient composition changes in food products that have contributed to increase in energy and nutrient intakes, even as consumers have been reducing their intakes of food products. In fact, the gains from improved dietary behaviour of consumers (e.g., through reduction in intakes) has been offset to a considerable degree (if not thwarted) by the changing nutrient composition of products offered to them. Responsibility deals, even if they lead to a flurry of reformulated (healthier) food product offerings by the industry will not necessarily lead to reduced population level intakes of energy and nutrients. This is because the impact of product reformulation is mediated by consumer response to the products offered, which may involve changes in quantities consumed of the healthier options and changes in product choices within and across product groups. The consumer response to product reformulation can be better understood by counterfactual simulations based on nutrient intakes of sub-populations consuming reformulated products rather than through intervention studies that replace products in consumer baskets with healthier alternatives. Product reformulation has had a much smaller effect in the upper quantiles of energy/nutrient intakes which are likely to be characterised by excessive intakes and susceptibility to obesity or diet related disease. Nutrient composition changes in food products appear to have the largest impact on the lower quantiles of energy and nutrient intake distributions – that is, increasing the energy and nutrient intakes of consumers who are more likely to have been in closer conformity to recommended dietary guidelines. Therefore, before Responsibility Deals can be seen as instruments for nudging consumers towards healthier diets, the negative impacts of ongoing nutrient composition trends will need to be countered.

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