Consumer demand for potatoes in Scotland during COVID-19 pandemic

Max Leslie and Cesar Revoredo-Giha[1]

Abstract

Potatoes are a beneficial component of a healthy Scottish diet, when cooked healthily without excessive and potentially harmful additives. However, in recent decades fresh potato preparation has declined accompanied with an increase in consumption of potato-based convenience foods that may be higher in fat, sugar, and salt additives. Reduced time allocated by households towards cooking from scratch was identified in the existing literature as a potential causal factor for the decline in fresh potato consumption. The purpose of this paper is to empirically evaluate using differences in differences and data from a home-scanner dataset whether the advent of COVID-19 marked a deviation from this long-term trend in fresh potato consumption by providing households with an additional time endowment for exclusively domestic tasks, including cooking. The results did not find differences in the consumption patterns.

Keywords: Potato demand, COVID-19 pandemic, quasi-experimental methods, difference in difference analysis, home-scanner data.

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1. Introduction

Potatoes have been a staple in Scottish cooking since their introduction to the British Isles in the 16th Century. Few of the Scottish population have not eaten potatoes in their lifetime, whether baked, boiled, mashed, roasted, fried or stewed. Stovies, potato scones, neeps and tatties, and rumbledethumps are just a few of the many famous, potato-based dishes from Scotland.

Potatoes are a beneficial component of a healthy Scottish diet, when cooked healthily without excessive and potentially harmful additives. The micronutrient content of potatoes remains relevant to public health in Scotland. Derbyshire (2018) found that, on average, adults in the UK were micronutrient deficient and lacked important minerals and vitamins in their diets. The predominant components of potato are water and polysaccharides (starch). However, despite Haynes et al. (2012) and Karpukhin & Keita (2020) finding variation between varieties, studies have demonstrated that potato tubers are a natural source of: (i) vitamin C, (ii) vitamins B1, B2 and B6, (iii) potassium, (iv) iron, (v) zinc, (vi) magnesium, (vii) folate, (viii) dietary fibre, and (ix) health-promoting phytochemicals, e.g., phenolics and carotenoids (Brown, 2005; Bethke & Jansky, 2008; Brown et al., 2008; Camire et al., 2009; Furrer et al., 2017; Beals, 2018). Weaver (2013) observed that potatoes are potentially the highest source of dietary potassium. These micronutrients are a vital component of a healthy diet and contribute towards prevention of various noncommunicable diseases.

The disparity between the high nutritional content of fresh potato crop and comparative unhealthy potato-based meals in Scotland results primarily from the cooking stage. Studies have indicated that the application of alternative cooking methods can significantly impact the micronutrient content of cooked potato (Blessington et al., 2010; Zaheer & Akhtar, 2016; Furrer et al., 2017; Robertson et al., 2018). Yang et al. (2016) found that micronutrient content is maximised when potatoes are roasted, baked, or microwaved. These findings are concurrent with recommendations from Fearne (1992) and Richards et al. (1997) that suggested microwaving as an effective technique for households to affordably prepare fresh potatoes at home. Bethke & Jansky (2008) and Robertson et al. (2018) both observed that, to minimise the potential risk of leaching of water-soluble minerals, potatoes ought to be boiled whole. Although potatoes are frequently peeled for aesthetic and/or textural reasons, Andre et al. (2016)

found that potato skins contain a significant proportion of the tuber's micronutrients and dietary fibre. The result of these findings indicate that Scottish public health policy must continue to focus educational directives towards improved methods of at-home potato preparation in addition to reducing relatively unhealthy flavour additives.

Currently, the potato-based products that are frequently consumed in Scotland are linked with increased risk of obesity and other diet-related negative health outcomes. Fresh potatoes, prior to cooking, are low in sodium, monosaccharides (sugars), and fats (Gibson & Kurilich, 2013). Fat, sugar, and salt additives are less harmful when combined in moderation. However, the food environment in Scotland, through a combination of consumer demand pressure and competitive producer output, contains potato-based products with high calorific density that generate negative externalities in consumption (Cummins & Macintyre, 2006). These externalities constitute socioeconomic costs to both households and the NHS that are relatively higher for lower-income groups. The Food Standards Agency in Scotland (FFS) have highlighted that the potato-based products most popular amongst Scottish consumers, e.g., oil-fried chips and crisps with flavourings, were too high in added fats, salts, and sugars (McLean et al., 2018). Further, Lacy & Huffman (2016), Zaheer & Akhtar (2016) and McFadden & Huffman (2017) all have emphasised that the presence of acrylamide, a potential carcinogen produced when potatoes are fried at very high temperatures, could indicate that these frequently consumed potato products are harmful regardless of additives. Given that chips and crisps are commonly consumed both inside and outside the home in Scotland, it must be acknowledged that potatoes in their currently consumed form are a significant contributor to overnutrition in Scotland. This is supported by Dogbe & Revoredo-Giha (2021) that found substitution by households away from fresh potatoes towards processed alternatives worsened expected dietary nutritional content.

The main motivation behind this paper is that in recent decades fresh potato preparation has declined inside the home alongside an increase in consumption of potato-based convenience foods that may be higher in fat, sugar, and salt additives. For the purpose of this study fresh potatoes sold at retail are defined as uncooked, whilst processed potatoes are higher convenience substitutes that are partially or entirely cooked. A commonly cited definition of "convenience" is provided by Traub & Odland (1979) which consider that it encompasses any fully or partially prepared foods in which

significant preparation time, culinary skills, or energy inputs have been transferred from the home kitchen to the food processor and distributor.

Government intervention to date has been ineffective at eliminating the negative impact trend on the consumption of fresh potatoes. The Scottish Government currently pursues multiple, interconnected policies to address food insecurity, food poverty, and poor dietary outcomes in Scotland. To some extent it has failed to pursue an appropriate, unified approach to contend the issues generated by the free market for potato consumption in Scotland.

Reduced time allocated by households towards cooking from scratch was identified in the existing literature as a potential causal factor for the decline in fresh potato consumption. Several papers have indicated that one of the effects of the COVID-19 pandemic has been to transfer time between activities liberating time for cooking (e.g., Griffiths et al., 2022).

The purpose of this paper is to empirically evaluate whether the advent of COVID-19 marked a deviation from this long-term trend in potato consumption by providing households with an additional time endowment for exclusively domestic tasks, including cooking. To that purpose this paper utilises a quasi-experimental approach and intends to evaluate the short-term impact of COVID-19 on the consumption of potatoes in Scotland.

The structure of this paper is as follows: it starts providing evidence about the evolution of fresh potato and processed potato consumption, followed by reasons advanced by the literature of behind these trends. Next section summarises the impacts of COVID-19 on the Scottish food environment. The following two sections outlines the empirical approach and presents and discuss the results. The final section concludes.

2. Decline in at-home fresh potato consumption

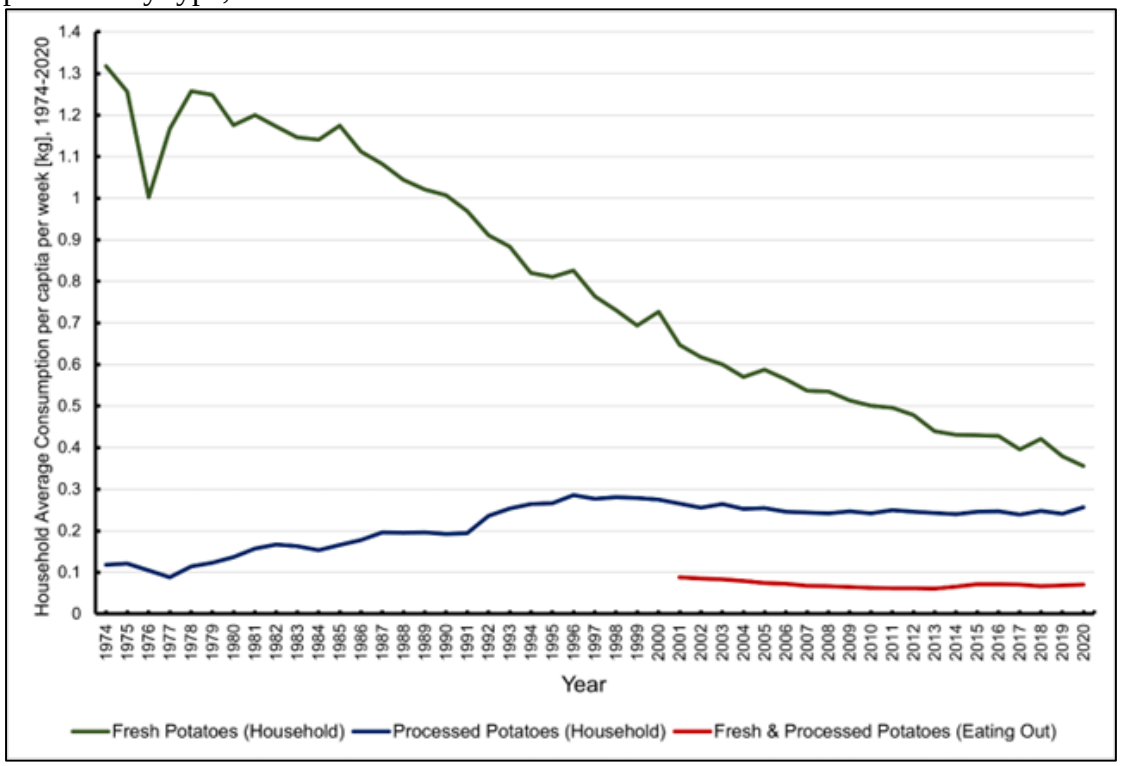
Fresh potatoes have decreased in popularity for home preparation amongst UK households over the last 50 years.[2] Survey data on average potato consumption in the UK, provided by the DEFRA Family Food dataset, are displayed in Figure 1.

As shown in Figure 1, fresh potato consumption in the UK has experience a sustained decline in recent decades, whilst the demand for processed potato alternatives increased

[2] As the consumption trends between UK and Scottish households are very similar (based on data since 2000), here information for the UK is presented as it is available since 1974.

to the late 1990s and has plateaued since. The continued decrease in fresh potato demand, without a sustained substitution towards processed potatoes or out-of-home consumption, supported the wider literature that an overall fall in the frequency of potato consumption has been observed in the UK.

Figure 1 – United Kingdom - Evolution of the average potato consumption per capita per week by type, 1974-2020.



Notes: Data collection for "Fresh & Processed Potatoes (Eating Out)" commenced in 2001. "Processed Potatoes" defined as including crisps, potato-based snacks, canned potatoes, oven chips and takeaway chips, and instant potato. "Processed Potatoes" included both frozen and unfrozen products.
Source: Own elaboration based on data provided by DEFRA.

Existing studies have evaluated possible explanations for the international decline in potato demand. Jones & Ward (1989) and McCracken & Marotz (1989) identified that increasing household monetary income, changing structure of the traditional workweek, and additional overtime pay are economic factors that have contributed towards a fall in home cooking of fresh potatoes. McCracken & Marotz (1989), Fearne (1992), Richards et al. (1997) and Fernqvist et al. (2015) all found that increased time devoted to wage labour, particularly with increased female participation in the labour force, reduced household time spent cooking potato dishes from fresh ingredients. This

effect was higher amongst individuals who valued the economic utility gained from cooking less.

It is important to note that the literature is unclear about the health and nutritional perception of potato, with studies finding contradicting results (McCracken & Marotz, 1989; Fearne, 1992; Richards et al., 1997; Stubenitsky & Mela, 2000; Jemison et al., 2008). Fearne (1992) and Monteleone et al. (1997) observed that respondents reported potatoes were comparatively "old fashioned" and "dull", respectively. This is supported by Richards et al. (1997) and Fernqvist et al. (2013), who found a strong substitution away from potatoes towards rice, pasta and bread as the primary sources of starchy carbohydrates for younger consumers. Changing consumer tastes have influenced the fall in potato consumption. Overall, it may be summarised that both economic and noneconomic factors have contributed to the change in fresh potato demand.

In contrast to fresh potatoes, processed potato products, i.e., potato-based convenience foods, have increased in popularity in the UK and Scotland. Increased demand for convenience in potato consumption has been observed in multiple studies (Jones & Ward, 1989; McCracken & Marotz, 1989; Guenthner et al., 1991; Fearne, 1992; Richards et al., 1997; Riley, 2010; Fernqvist et al., 2013). This is concurrent with the review provided by Plessz & Étilé (2018) that, despite greater media attention for professional and amateur cooking in recent decades, there has been a ubiquitous fall in time devoted to cooking from fresh ingredients in western economies. Richards et al. (1997) also found that consumers were less likely to adopt new technologies or improved preparation techniques to reduce time spent cooking fresh potatoes when the demand for leisure time increased. Additionally, there has been a general move away from consuming potato-based meals at home. Multiple studies have found that consumers find the greatest convenience in purchase of restaurant and takeaway meals (Jones & Ward, 1989; Guenthner et al., 1991; Darian & Cohen, 1995; Richards et al., 1997; Candel, 2001; Fernqvist et al., 2015). Increased affordability of out-of-home consumption has likely reduced retail demand for both fresh and processed potatoes, prior to the advent of COVID-19. Overall, existing evidence suggests that processed potato demand has increased partially as a result of reduction of consumer interest in cooking fresh potatoes.

The increasing allocation from fresh potatoes to convenience potato products can be understood using the time allocation model developed by Gary Becker and extended by

Gronau (Becker, 1965; Gronau, 1977), which is the theoretical framework for behind this study.

This theory on household decision-making on time distribution between market, nonmarket, and leisure activities has had a profound impact on many sectors within the economic literature. Becker countered previous economic approaches by weakening the assumption that households can only maximise utility through the allocation of time to wage labour or unpaid leisure/rest. Becker argued that households can allocate time to unpaid production of nonmarket goods that generate utility, including the preparation of home-cooked meals. Market goods, purchased with monetary income earned from traditional labour markets, therefore can be enhanced by home production or consumed directly. This adaptation generated a single budget constraint encompassing both the purchase price of commodities and time input required prior to consumption. Goods-intensive products require a higher monetary income but can be consumed with minimal time input by households. The opportunity cost of forgone wage earnings constitutes the shadow price of time assigned to household tasks by substituting towards time-intensive products (Reid, 1963; Griffiths et al., 2022). Existing studies, including Becker's original paper, have applied a similar theoretical framework to meal preparation within the home (Becker, 1965; Candel, 2001; Florkowski et al., 2000; Vernon, 2005; Jabs et al., 2006; Olsen & Mai, 2012).

The COVID-19 pandemic, the consequent lockdown and the disruption on the households' time allocation allows to test the importance of changes to time allocation within the household for food preparation and subsequent impact on potato consumption.

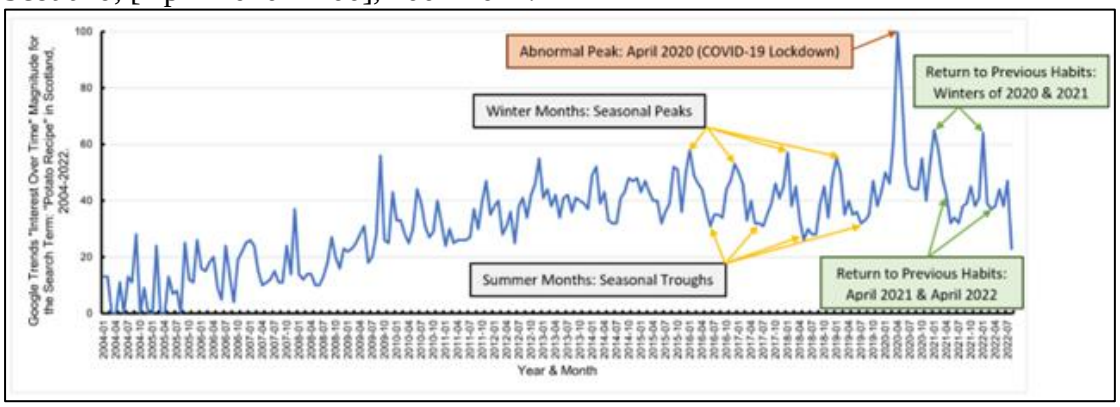
3. Impact of COVID-19 in Scotland

The COVID-19 epidemic has had a profound and predominantly negative impact on the Scottish economy. A contraction in economic growth, decline in social welfare and mental health, reported increases in food insecurity, and worsened dietary outcomes have been observed as some of the potential consequences in Scotland of the COVID-19 pandemic (The Scottish Government, 2020). The advent of COVID-19 may have exacerbated existing socioeconomic issues in Scotland resulting from the Brexit transition period. For the purpose of this study, preCOVID refers to the period before the arrival of COVID-19 in Scotland and postCOVID refers to the period thereafter (i.e., after March 2020).

To contend the rapid contagion of the disease throughout the population, governments throughout Europe, including the UK, implemented a series social protection policies including: (i) restrictions on non-essential travel, (ii) closure of non-essential businesses and schools, (iii) prevention of public and private gatherings, and (iv) recommendations to stay at home. Existing studies have analysed the response of food supply chains and consumer behaviour to this unanticipated shock to the food environment in both the UK and abroad (Bhutani et al., 2020; FSS, 2020; Pietrobelli et al., 2020; Romeo-Arroyo et al., 2020; Ruiz-Roso et al., 2020; Scarmozzino et al., 2020; Armstrong et al., 2021; Revoredo-Giha & Russo, 2021). This study contributes to the wider literature through attempting to obtain quantitative evidence that the advent of COVID-19 significantly impacted household purchases of potatoes in Scotland.

Preliminary observation highlighted that UK Government containment measures in response to the COVID-19 epidemic may have stimulated a short-term, immediate change to the established habits for home preparation of potatoes in Scotland. Figure 3 displays indexed time series data on the popularity of the search term "potato recipe" in Scotland on Google Search Engine, [April 2020 = 100], 2004-2022. "Potato recipe" was assumed to exclusively indicate demand for cooking of potatoes at home from fresh ingredients.

Figure 2 – Time Series of Google Trends Search Popularity for "Potato Recipe" in Scotland, [April 2020 = 100], 2004-2022.



Notes: Textboxes and arrows added by the author. The definition for "Interest Over Time" magnitude provided by Google: "Numbers represent search interest relative to the highest point on the chart for the given region and time. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. A score of 0 means that there was not enough data for this term."
Source: Own elaboration based on data provided by Google Trends.

Seasonality in the data indicated that Scottish households have typically preferred to cook potato-based dishes more during the winter months (November-March) than

during summer months (April-August). However, the contra-seasonal peak in April 2020 demonstrated a significant increase in interest (approximately 120% higher search frequency than prior April average) for domestic preparation of fresh potato dishes during the first COVID-19 lockdown period. This represented significant qualitative evidence in support of this study's primary objective to demonstrate that the postCOVID period marked a deviation from prior trends.

2. Empirical work

2.1 Data

This study utilised household consumer purchasing panel data sourced from Kantar Worldpanel within the timeframe, 01/01/2019 to 31/12/2020 for Scotland. Each participating household was uniquely identified by a numerical code that remained consistent over the timeframe. Households recorded their expenditure and quantity of food items purchased at retails outlets using a scanner to record the Universal Product Code of items purchased at retail.

From the 1,912 households in the dataset, data from 978 other households were removed to ensure that the households were observed before and after the COVID-19 episode (March-2020); this left 934 households for the analysis.

2.2 Methodology

The main investigated question in this paper is whether the labour market shocks during the COVID period impacted household time allocation and monetary resources for cooking fresh potatoes and/or convenience potato products.

The above question was investigated using a quasi-experimental method, i.e., differences-in-differences regression with nonretired households as the treatment group and retired households as the control group.

A basic two-period difference-in-differences model with equal treatment timing was selected, with NONRETIRED as the treatment group and RETIRED as the control group. It was assumed that exclusively NONRETIRED households were directly exposed to labour market shocks to satisfy the necessary conditions for this natural experiment.

A basic two-period theoretical model for average consumption of fresh potatoes per household for each subgroup is:

$$\overline{FRESH_{subgroup,t}} = \mu_0 + \mu_1 COVID_{subgroup,t} + \overline{\varepsilon_{subgroup,t}} \quad (1)$$

Where: $\overline{FRESH_{subgroup,t}}$ is the average quantity purchased, in kg, per capita per week of fresh potato products per household for group *subgroup* (*subgroup* = NONRETIRED, or RETIRED) in period *t* (*t* = 19, or 20), $COVID_{subgroup,t}$ is a binary variable (=1 when *t* = 20, =0 otherwise) and acts as a proxy for the impact of COVID-19 on households in each subgroup in 2020, and $\overline{\varepsilon_{subgroup,t}}$ is the average error term for group *subgroup* in period *t*. Equation (1) can be expressed for each period as (where 19 indicates the preCOVID and 20 the postCOVID period):

$$\overline{FRESH_{subgroup,19}} = \mu_0 \quad (2)$$

$$\overline{FRESH_{subgroup,20}} = \mu_0 + \mu_1 COVID_{subgroup,20} \quad (3)$$

Where $COVID_{subgroup,19}$, $\overline{\varepsilon_{subgroup,19}}$, and $\overline{\varepsilon_{subgroup,20}}$ equal zero and are omitted. Subtracting Equation (2) from equation (3) yields the average first-difference for each subgroup as follows:

$$\overline{\Delta FRESH_{subgroup}} = (\overline{FRESH_{subgroup,20}} - \overline{FRESH_{subgroup,19}}) \quad (4)$$

Which can be expressed for each subgroup as:

$$\overline{\Delta FRESH_{RETIRED}} = (\overline{FRESH_{RETIRED,20}} - \overline{FRESH_{RETIRED,19}}) \quad (5.a)$$

$$\overline{\Delta FRESH_{NONRETIRED}} = \left(\overline{FRESH_{NONRETIRED,20}} - \overline{FRESH_{NONRETIRED,19}}\right) \quad (5.b)$$

Where $\overline{\Delta FRESH_{NONRETIRED}}$ and $\overline{\Delta FRESH_{RETIRED}}$ are the average changes in consumption of fresh potatoes for NONRETIRED and RETIRED households, respectively. First-differencing controlled for household fixed effects. The estimator for the difference-in-differences was obtained by subtracting equation (5.a) from (5.b). The estimator for the difference-in-differences coefficient is:

$$\hat{\eta}_3^{diff-in-diff} = (\overline{\Delta FRESH_{NONRETIRED}} - \overline{\Delta FRESH_{RETIRED}}) \quad (6)$$

The coefficient η3 can be obtained and tested via the following estimator outlined by Wooldridge (2015):

$$\widehat{FRESH}_{\iota,t} = \eta_0 + \eta_1 COVID_t + \eta_2 NONRETIRED_i + \eta_3 COVID \cdot NONRETIRED_{i,t} + \varepsilon_{i,t} \quad (7)$$

Where: $\widehat{FRESH}_{\iota,t}$ is the estimation of the quantity purchased, in kg, per capita per week of fresh potato products for household *i* (*i* = 1, …, 934) in period *t* (*t* = 19, or 20), $COVID_t$ is a binary variable (=1 when *t* = 20, =0 otherwise) and controls for wider impact of COVID-19 on all households in 2020, $NONRETIRED_i$ is a binary variable (=1 if household is in the subgroup NONRETIRED, =0 otherwise) and controls for pre-existing differences in

preferences for fresh potatoes between the two subgroups, $COVID \cdot NONRETIRED_{i,t}$ is a binary interaction variable (=1 if household is in subgroup NONRETIRED and t = 20, =0 otherwise) and acts as a proxy for the impact of COVID-19 on wage labour markets in 2020, and $\varepsilon_{i,t}$ is the error term for household i in period t.

Estimator (7) controls for the time trend ($COVID_t$) and inter-subgroup difference ($NONRETIRED_i$) and so the coefficient η_3 isolates the impact of labour market shocks on the demand for fresh potatoes in the postCOVID period. Failure to reject the null hypothesis would indicate insufficient evidence from the data that labour market changes in Scotland significantly impacted the demand for fresh potatoes during the postCOVID period. Owing to considerable qualitative evidence on the increased interest in cooking from predominantly working-age households, the author predicted that η_3 would be positive. Equation (7) was adjusted to evaluate the impact of labour market shocks on the demand for processed potatoes as in (8):

$$\widehat{PROCESSED}_{i,t} = \upsilon_0 + \upsilon_1\, COVID_t + \upsilon_2\, NONRETIRED_i + \upsilon_3\, COVID \cdot NONRETIRED_{i,t} + \varepsilon_{i,t} \quad (8)$$

3. Results

A basic summary of the paired *t*-tests and difference-in-differences estimations for fresh and processed potato consumption is displayed in Table 1.

Table 1–Fresh and Processed Potato Consumption, Summary of Difference-in-Differences with No Additional Controls

	Panel A. Fresh Potato Consumption (*kg / per capita/ week*)			**Panel B. Processed Potato Consumption (*kg / per capita/ week*)**		
	pre-COVID (1)	**post-COVID (2)**	**Difference (post-pre) (3)**	**pre-COVID (4)**	**post-COVID (5)**	**Difference (post-pre) (6)**
subgroup = NONRETIRED	2.81	3.18	0.37***	1.48	1.70	0.23***
[*Treatment Group*]	(0.09)	(0.10)	(0.05)	(0.06)	(0.06)	(0.03)
subgroup = RETIRED	2.98	3.12	0.13	1.13	1.15	0.03
[*Control Group*]	(0.19)	(0.20)	(0.13)	(0.10)	(0.08)	(0.06)
Difference-in-differences			0.24			0.20
			(0.32)			(0.18)

Notes: pre-COVID (t = 19) defined as the 13 subperiods from 01/01/2019 to 31/12/2019. post-COVID (t = 20) defined as the 13 subperiods from 01/01/2020 to 31/12/2020. post-COVID period included subperiods prior to COVID-19 lockdown containment measures legally enforced to include impact of COVID-19 on food purchases prior to lockdown date, 26/03/2020, and ensure de-seasonalised data. Treatment group (*subgroup* = NONRETIRED) defined as households in LIFESTAGE(S) "1", "2", "3", "4", "5", and "6" (see Table 3). Control group (*subgroup* = RETIRED) defined as households in LIFESTAGE "7" (see Table 3). Potato consumption as average quantity [kg] purchased per capita per week at household level. Column (3) displays the results for paired *t*-tests for difference of means of FRESH between pre-COVID and post-COVID for NONRETIRED and RETIRED households, respectively, and the coefficient on the interaction term in Estimator (18). Column (6) displays the results for paired *t*-tests for difference of means of PROCESSED between pre-COVID and post-COVID for NONRETIRED and RETIRED households, respectively, and the coefficient on the interaction term in Estimator (21). Standard errors are in parentheses.

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Source*:* Own elaboration based on data provided by Kantar Worldpanel.

NONRETIRED households significantly increased the consumption of both fresh, $t(762) = -7.21$, $p < .01$, and processed, $t(762) = -7.74$, $p < .01$, potatoes during the postCOVID period. There was a non-significant increase in both fresh, $t(170) = -1.29$, $p = .20$, and processed, $t(762) = -0.43$, $p = .67$, potato consumption for RETIRED households. COVID-19 only significantly impacted potato demand for NONRETIRED households.

The full regression results for the difference-in-differences estimations are displayed in Table 2. There was a non-significant difference in the increase of fresh, $t(1,867) = 0.76$, $p = .45$, and processed, $t(1,867) = 1.11$, $p = .27$, potato consumption between the two subgroups. The coefficients of interest remained non-significant with the addition of controls for a possible substitution effect. These findings fail to confirm the prediction that labour market shocks in the postCOVID period significantly impacted NONRETIRED households' demand for potatoes in 2020.

Table 2 – Difference-in-Differences Regression Estimates, Fresh and Processed Potato Consumption

	Panel A. Dependent variable: FRESH		**Panel B. Dependent variable: PROCESSED**	
Independent Variable	**(1)**	**(2)**	**(3)**	**(4)**
CONSTANT	2.98 (0.20)	2.75 (0.21)	1.13 (0.12)	0.93 (0.12)
COVID	0.13 (0.29)	0.13 (0.28)	0.03 (0.16)	0.02 (0.16)
NONRETIRED	-0.17 (0.22)	-0.25 (0.22)	0.35 (0.13)	0.36 (0.13)
COVID▪NONRETIRED	0.24 (0.32)	0.20 (0.31)	0.20 (0.18)	0.19 (0.18)
Other controls	No	PROCESSED	No	FRESH
Number of Households	934	934	934	934
Observations	1,868	1,868	1,868	1,868
R-Squared	<0.01	0.02	0.02	0.03

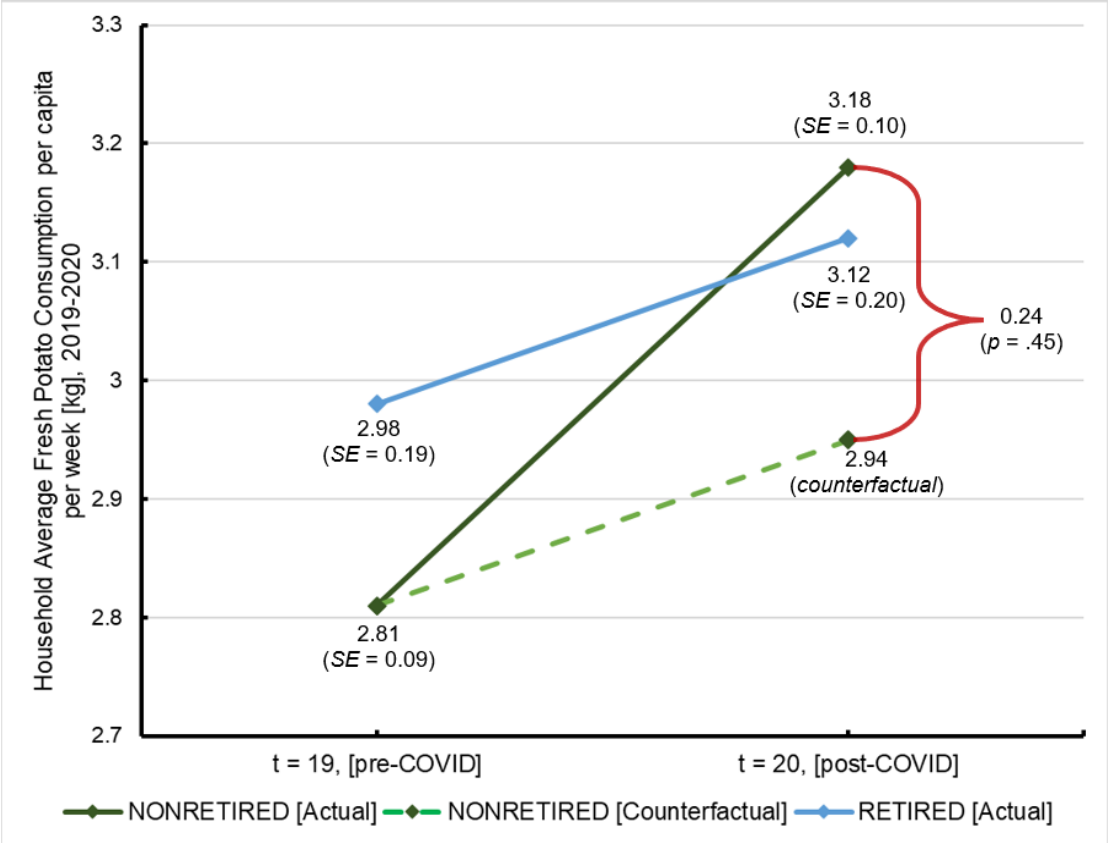
Notes: CONSTANT defined as the average of the dependent variable(s) for RETIRED subgroup in 2019, (pre-COVID). COVID defined as binary categorical variable; =1 for observations from 01/01/2020 to 31/12/2020 ($t = 20$), =0 for observations from 01/01/2019 to 31/12/2019 ($t = 19$). Post-COVID period included subperiods prior to COVID-19 lockdown containment measures legally enforced to include impact of COVID-19 on food purchases prior to lockdown date, 26/03/2020, and ensure de-seasonalised data. NONRETIRED defined as binary categorical variable; =1 for observations in treatment group, =0 for observations in control group. Treatment group defined as households in LIFESTAGE(S) "1", "2", "3", "4", "5", and "6" (see Table 3). Control group defined as households in LIFESTAGE "7" (see Table 3). Potato consumption defined as average quantity [kg] purchased per capita per week at household level. COVID▪NONRETIRED defined as binary interaction variable; =1 for observations in both post-COVID period and NONRETIRED subgroup, =0 otherwise. COVID▪NONRETIRED is the interaction term in Estimators (18) and (21) and corresponding values are the coefficients of interest for the difference-in-differences estimations. Columns (1) and (3) do not include control variables. Columns (2) and (4) include controls for possible substitution effect between fresh and processed potato consumption. Standard errors are in parentheses.

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Source: Own elaboration based on data provided by Kantar Worldpanel.

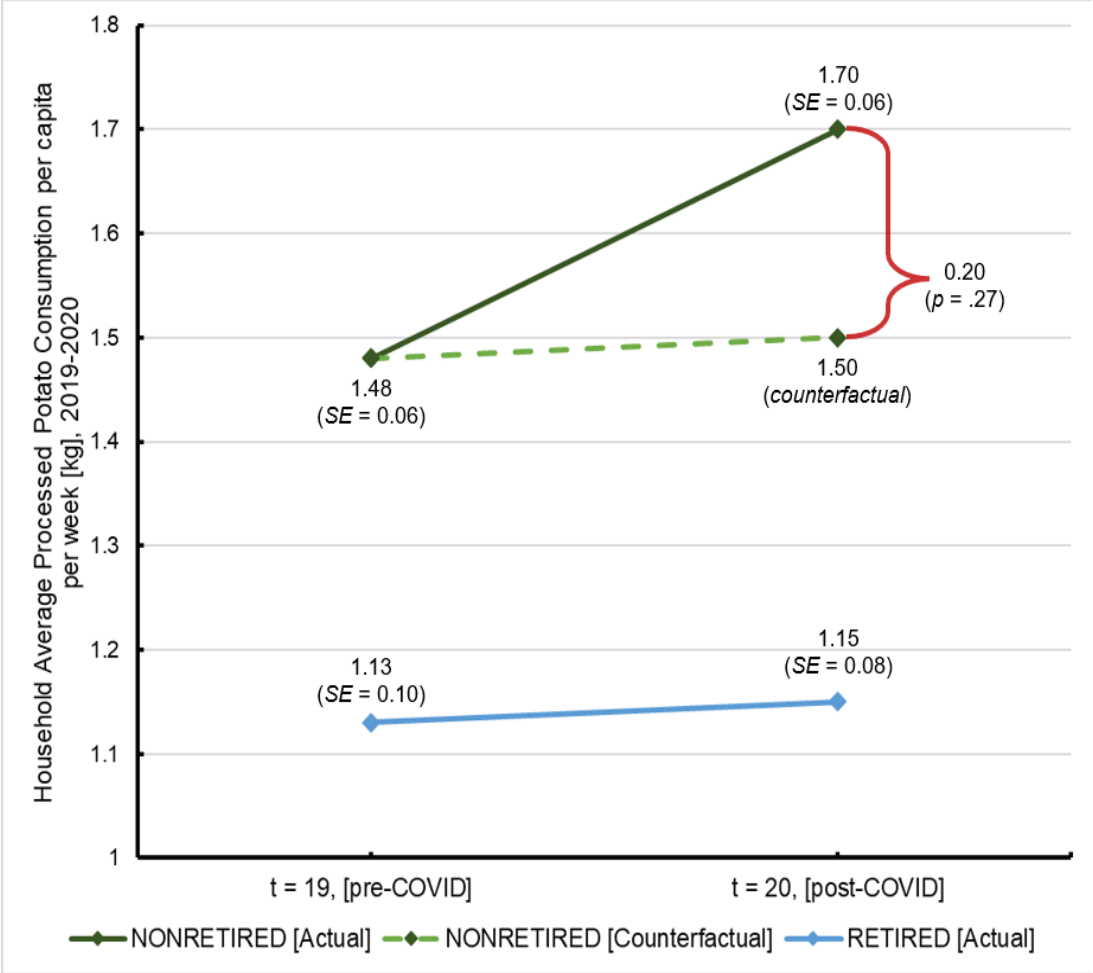
Graphical representations of the difference-in-differences estimations, with no controls, are shown in Figures 3 and 4. The dashed lines correspond to the counterfactual change in potato demand if the parallel trends assumption held. The model predicted that NONRETIRED households would have consumed on average, per capita per week, 2.94kg of fresh (7.5% less than observed) and 1.50kg of processed (11.8% less than observed) potatoes in 2020 if they had not been impacted by labour market changes. Graphical analysis alone could falsely conclude that there was a significant difference in the increase of potato consumption between the subgroups.

Figure 3 – Graphical Representation of Difference-in-Differences Estimation for Fresh Potato Demand, 2019-2020.



Notes: NONRETIRED defined as "Treatment Group" and RETIRED defined as "Control Group", see Section 3.4.2. SE defined as "Standard Error" for mean consumption of fresh potatoes in the calendar years 2019 (t = 19) and 2020 (t = 20) for NONRETIRED and RETIRED subgroups, see Table 11. Equal timing of impact of COVID-19 for both subgroups between 2019 and 2020. p defined as p-value for test of significance for the coefficient, η_3, for interaction term, COVID▪NONRETIRED, see Estimator (18). "Counterfactual" represents assumed expected change if NONRETIRED households had been impacted by COVID-19 equivalently to RETIRED households, based on the parallel trends assumption.
Source: Own elaboration based on data provided by Kantar Worldpanel.

Figure 14 – Graphical Representation of Difference-in-Differences Estimation for Processed Potato Demand, 2019-2020.



Notes: NONRETIRED defined as "Treatment Group" and RETIRED defined as "Control Group", see Section 3.4.2. SE defined as "Standard Error" for mean consumption of fresh potatoes in the calendar years 2019 (t = 19) and 2020 (t = 20) for NONRETIRED and RETIRED subgroups, see Table 11. Equal timing of impact of COVID-19 for both subgroups between 2019 and 2020. p defined as p-value for test of significance for the coefficient, ν3, for interaction term, COVID▪NONRETIRED, see Estimator (21). "Counterfactual" represents assumed expected change if NONRETIRED households had been impacted by COVID-19 equivalently to RETIRED households, based on the parallel trends assumption.
Source: Own elaboration based on data provided by Kantar Worldpanel.

4. Discussion and final remarks

Scottish households purchased significantly more fresh ($p < .01$) and processed ($p < .01$) potato products at retail in the postCOVID period compared with the preCOVID. Subject to the assumption that households may substitute between fresh and processed potato products to generate equivalent potato-based meals, there was no significant observed impact ($p > .10$) of a change in processed potato demand on fresh potato consumption.

Households purchased more of both forms of potato during the postCOVID. Difference-in-differences estimation provided inconclusive statistical support ($p > .10$)

in the predicted direction that working-age households demonstrated a greater interest, compared with retired counterparts, in cooking fresh potatoes and consuming high-convenience processed potato products in the postCOVID period. This result failed to empirically confirm considerable wider qualitative evidence and indicated the nonuniform impact of COVID-19 on households' behavioural responses.

Policy makers intent on improving public health in Scotland should focus household attention towards healthier potato preparation techniques and deter reliance on potato-based convenience snacking. Time constitutes a barrier to fresh potato consumption, particularly for working-age families and those with more children.

External support to encourage beneficial inclusion of potato in the Scottish diet may be necessary to ensure that potatoes remain an important contributor to multidimensional food security in Scotland. The free market alone may fail to adequately provide the best health outcomes from potato consumption.

Instead of relying on free market self-correction, the Scottish Government could provide clear educational support to communicate the nutritional value of healthily prepared potatoes to consumers. However, potatoes do not feature in NHS Scotland's recommendation of "5 fruits and vegetables a day", despite their high micronutrient content, because focus has been placed on their high calorie content (NHS, 2022). In the EatWell Guide developed by the UK Government and endorsed in Scotland, potatoes, despite being a vegetable, are displayed alongside grain-based foods owing to their high starch content.

The imagery of a bag of fresh potatoes and recommendation away from consumption of crisps may beneficially encourage substitution away from processed potato alternatives that have dominated the Scottish diet (Armstrong et al., 2009; Food Standards Agency in Scotland, 2018). Nevertheless, as fresh potatoes are prepared similarly to other vegetables, their exclusion from this category highlights possible contradictions between cooking and nutrition education. This raises concerns of whether the current food environment and public health policy, prior to the advent of COVID-19, have sufficiently and accurately endorsed the healthiest forms of potato preparation in Scotland.

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