Study protocol: assessing the association between corporate financial influence and implementation of policies to tackle commercial determinants of non-communicable diseases: a cross-sectional analysis of 172 countries

Luke Nelson Allen, Simon Wigley, Hampus Holmer

ABSTRACT
Introduction There are many case studies of corporations that have worked to undermine health policy implementation. It is unclear whether countries that are more exposed to corporate financial influence are systematically less likely to implement robust health policies that target firms’ financial interests. We aim to assess the association between corporate financial influence and implementation of WHO-recommended policies to constrain sales, marketing and consumption of tobacco, alcohol and unhealthy foods.

Methods and analysis We will perform a cross-sectional analysis of 172 WHO Member States using national datasets from 2015, 2017 and 2020. We will use random effects generalised least squares regression to test the association between implementation status of 12 WHO-recommended tobacco, alcohol and diet policies, and corporate financial influence, a metric that combines disclosure of campaign donations, public campaign finance, corporate campaign donations, legislature corrupt activities, disclosure by politicians and executive oversight. We will control for GDP per capita, population aged >65 years (%), urbanisation (%), level of democracy, continent, ethno-linguistic fractionalisation, legal origin, UN-defined ‘Small Island Developing States’ and Muslim population (%) (to capture alcohol policy differences). We will include year dummies to address the possibility of a spurious relationship between the outcome variable and the independent variables of interests. For example, there may be an upward global trend in policy implementation that coincides with an upward global trend in the regulation of lobbying and campaign finance.

Ethics and dissemination As this study uses publicly available data, ethics approval is not required. The authors have no conflicts of interest to declare. Findings will be submitted to a peer-reviewed journal for publication in the academic literature. All data, code and syntax will be made publicly available on GitHub.

INTRODUCTION
Non-communicable diseases (NCDs) such as cancer, heart disease, diabetes and chronic obstructive pulmonary disease cause the majority of death and disability worldwide. This disease burden is largely preventable and in 2013 WHO identified a set of highly cost-effective policies and public health interventions that can be used to tackle common NCD risk factors. The full set of ‘Best Buy’ policies that target tobacco, alcohol and diet are presented in online supplemental appendix 1. This list of policies was endorsed by the 194 WHO Member States in 2013, and again in 2017. However, to date many countries have not implemented these policies. It has been hypothesised that one reason may be the influence of corporations, particularly on those policies which seek to limit the consumption of unhealthy goods. Indeed, a growing body of work describes the myriad channels through which corporations seek to undermine effective public health measures in this way. In 2016, Kickbusch et al defined the ‘commercial determinants of health’ as “strategies and approaches used by the private sector to promote products and choices that are detrimental to health”.

Although case studies are plentiful, there has been a paucity of empirical research to quantify the association between corporate influence and policy implementation.
Among the WHO Best Buy policies are 12 policies that target tobacco, alcohol, foods high in fats and salt, child-focused junk food marketing and marketing of breast milk substitutes. These policies designed to tackle the commercial determinants of NCDs were first endorsed in 2013. WHO monitors the implementation of these commercial policies through regular NCD country capacity surveys, completed by national ministries of health. WHO has produced three global progress monitor reports—in 2015, 2017 and 2020—providing country-level assessments of whether each of the 12 commercial policies has been ‘fully implemented’, ‘partially implemented’ or ‘not implemented’. Global reviews have found that while implementation is rising over time, over half of all NCD policies remain unimplemented.\(^4\)\(^6\)

This WHO data on commercial policy implementation provide a unique opportunity to examine whether indicators of corporate influence over policy-making processes are associated with implementation of key commercial policies, according to the three policy clusters delineated in box 1.

To elucidate the association between corporate influence and the implementation of commercial policies, in this exploratory analysis we will perform three sets of analyses:

1. To characterise implementation trends over time for tobacco, alcohol and food-related policies using descriptive statistics, with sub-analysis by geographical region and World Bank income group.
2. To assess the association between implementation of commercial policies (aggregate score) and a newly developed measure of corporate financial influence, controlling for a range of geopolitical variables using random effects generalised least squares (GLS) regressions. Sub-analyses will assess the association between:
   a. Country-level implementation of each of the three clusters (tobacco, alcohol, food) and corporate financial influence.
   b. Country-level implementation of each individual policy and corporate financial influence.
3. To identify countries with commercial policy implementation levels that are higher or lower than would be expected given their geopolitical characteristics; evaluated using our baseline regression model and a modified Bland-Altman chart.

We hypothesise that countries with the highest levels of corporate financial influence will have the lowest levels of policy implementation.

In a secondary analysis, we also aim to test whether the prevalence of smoking, alcohol use, hypertension, and adult and child obesity are respectively associated with implementation of tobacco, alcohol, salt, fat, and child marketing policies.

### METHODS AND ANALYSIS

This cross-sectional study will use observational data from a range of publicly available sources for the 194 WHO Member States for the years 2015, 2017 and 2020. All WHO Member States for which data were available will be included. This protocol has been prepared in alignment with the SPIRIT 2013 checklist for trial protocols.\(^12\)

#### Commercial policy implementation scores

Data on the implementation status of the 12 commercial policies (outlined in box 1) for all 194 Member States will be extracted from the 2015, 2017 and 2020 WHO NCD Progress Monitor reports and transcribed into a csv spreadsheet. Data will be double-checked by two authors. Full descriptions of each policy are available in online supplemental appendix 1. Following the approach of WHO and Allen et al., we will construct policy scores for each country, according 1 point for each fully implemented policy, 0.5 points for each partially implemented policy, and 0 points for non-implemented policies and those for which no data are available. We will construct an overall aggregate score for each country, ranging from 0 to 12, as well as policy cluster scores for tobacco (range 0–5), alcohol (range 0–3) and food (range 0–4).

#### Commercial financial influence

We aim to assess whether direct commercial financial influence—that is, payments to politicians and their parties (independent variable)—is associated with implementation of commercial NCD policies (dependent variable). While there are myriad examples of corporate actors using their financial clout to undermine NCD regulations, it is important to note that policy-making is a complex process and corporations do not universally seek to undermine effective NCD policies.

This analysis will focus on a narrow conceptual space concerning whether corporate actors wield outsized financial influence over policy-makers, meaning that the

---

**Box 1** Globally endorsed commercial policies from the WHO ‘best buys’

<table>
<thead>
<tr>
<th>Tobacco</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>⇒ Tobacco tax</td>
<td></td>
</tr>
<tr>
<td>⇒ Smoke-free places</td>
<td></td>
</tr>
<tr>
<td>⇒ Plain packaging and graphic warnings</td>
<td></td>
</tr>
<tr>
<td>⇒ Tobacco advertising bans</td>
<td></td>
</tr>
<tr>
<td>⇒ Tobacco mass media campaigns</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alcohol</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>⇒ Alcohol sales restrictions</td>
<td></td>
</tr>
<tr>
<td>⇒ Alcohol advertising bans</td>
<td></td>
</tr>
<tr>
<td>⇒ Alcohol tax</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diet</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>⇒ Salt reduction</td>
<td></td>
</tr>
<tr>
<td>⇒ Fat reduction</td>
<td></td>
</tr>
<tr>
<td>⇒ Child marketing restrictions</td>
<td></td>
</tr>
<tr>
<td>⇒ Restrictions on the marketing of breast milk substitutes</td>
<td></td>
</tr>
</tbody>
</table>

---
arguments and lobbying efforts of other non-commercial actors (such as public health advocates) are marginalised.\textsuperscript{18} The political science and global health literature consistently identify four regulatory areas in this space:\textsuperscript{6, 7, 9, 19-27}.

1. Campaign financing: Are there limits on campaign donations from companies and/or a requirement to publicly disclose the source and amount of donations whether there are limits on campaign donations from companies and/or a requirement to publicly disclose the source and amount of those donations?

2. Business and financial interests of politicians: Are there mandatory public disclosures of politicians’ financial and business interests?

3. Lobbying transparency: Are there mandatory public disclosures of lobbyists activities?

4. Enforcement: Is there an independent administrative or judicial body that has the capacity to enforce the above-listed financing limits and disclosure requirements?

As far as we are aware, there is not a single globally comparable indicator that combines these four domains to quantify the level of corporate financial influence in each country. As such, we performed a literature review to identify the most robust, globally comparable and conceptually aligned metric to use as the independent variable, reported in online supplemental appendix 2. The closest—Lima and Galea’s Corporate Permeation Index (CPI)—includes a wide variety of input variables, meaning that the scope of that metric extends well beyond the ability of corporations to directly influence the policymaking process.\textsuperscript{28} Rather, CPI captures “the extent to which corporations are embedded in the political, legal, social, economic and cultural fabric of a given country”. Furthermore, their CPI metric only covers 146 countries.\textsuperscript{28} While there was not a single composite indicator that captured commercial financial influence, our review did identify six individual proxies that were well aligned with three of the four regulatory areas (we were unable to identify an indicator of lobbying transparency with sufficient country coverage). These items all conceptually map to the political-commercial nexus, have strong internal and external validity, and cover 172 countries (22 microstates are excluded; see online supplemental appendix 3 for list).

Building on the work of Lima and Galea, we will use structural equation modelling (with full information maximum likelihood) in Stata to identify the latent factor underlying the six input indicators listed in box 2. This will enable us to create a new Corporate Financial Influence Index (CFII) that focuses on the interaction between politicians and commercial actors. While there are no direct indicators for lobbying currently available, it is reasonable to expect that the latent factor (the single underlying factor picked out by the factor analysis) behind the six included variables will capture lobbying activities. Having identified a single underlying factor, we will generate an index score for each country, ranging from zero (lowest level of corporate financial influence) to 100 (highest).

We describe the latent factor analysis procedure in more detail in online supplemental appendix 4.

Control variables

In assessing the association between CFII and commercial policy implementation, we will control for the following economic, cultural, historical, geographical and population factors: GDP per capita, population aged >65 years (%), urbanisation (%), level of democracy, continent, ethno-linguistic fractionalisation, legal origin, Small Island Developing States and Muslim population (%) to capture alcohol policy differences)—control variables derived from earlier work on international NCD policy implementation.\textsuperscript{4} We will include year dummies to address global trends in terms of the outcome variable and the independent variables of interest. For example, there may be an upward global trend in policy implementation that coincides with an upward global trend in the regulation of lobbying and campaign finance.

Statistical analyses

We will use descriptive statistics to characterise implementation trends over time for the commercial policies. We will present mean implementation scores for each WHO geographical region and World Bank income group.

We will perform the following three regression analyses:

Ia: Aggregate policy score
Total commercial policies (aggregate score for all 12 policies) regressed on CFII.

Ib: Policy clusters
Each commercial policy cluster (tobacco, alcohol, food) separately regressed on CFII.

Ic: Individual policies

Box 2-Indicators that capture different aspects of corporate financial influence

- Disclosure of campaign donations: Are there disclosure requirements for donations to national election campaigns? (Source: V-Dem dataset V.11.1)
- Public campaign finance: Is significant public financing available for parties’ and/or candidates’ campaigns for national office? (Source: V-Dem dataset V.11.1)
- Corporate campaign donations: Is there a ban on donations from domestic or foreign interests to political parties or candidates? (Source: IDEA. Political Finance Database, 2020 update)
- Disclosure by politicians: Do the law or regulations of the country require politicians to provide either financial and/or business interests disclosures and are the disclosures publicly available? (Source: Djankov et al\textsuperscript{26})
- Legislature corrupt activities: Do members of the legislature abuse their position for financial gain? (Source: V-Dem dataset V.11.1)
- Executive oversight: If executive branch officials were engaged in unconstitutional, illegal or unethical activity, how likely is it that a body other than the legislature, such as a comptroller general, general prosecutor or ombudsman, would question or investigate them and issue an unfavourable decision or report? (Source: V-Dem dataset V.11.1)
All 12 individual commercial policies separately regressed on CFII.

Our data set will span 3 years and up to 194 countries. Our regression analyses will use a random effects GLS specification in order to take into account variation both between and within countries over time; specifically, a matrix-weighted average of the between and within results. This will be implemented using the xtreg, re command in Stata. We will perform each regression with and without controls.

Identification of outliers
We will use the results from Ia and Ib to construct prediction-based Bland-Altman plots for 2020, plotting each country’s WHO-ascertained policy implementation score on the x-axis, and predicted score on the y-axis, based on the regression equation. We will set 95% limits of agreement to identify overperforming and underperforming countries.

Additional model
Risk factor prevalence and policy implementation
We will use the random effects GLS model to test whether commercial policy implementation is associated with the prevalence of the following risk factors at the national level:

i. Tobacco cluster aggregate score versus total smoking prevalence (ages 15+). 31
ii. Alcohol cluster aggregate score versus alcohol consumption per capita (ages 15+). 32
iii. Salt reduction policy score versus hypertension prevalence (ages 18+). 33 34
iv. Fat reduction policy score versus prevalence of body mass index (BMI >30) (ages 18+). 35 36
v. Child food marketing policy score versus prevalence of BMI >30 (ages <18). 37 38

Sensitivity analyses and robustness checks
We will repeat the three regression models using Lima and Galea’s CPI, 28 a version of CFII that includes the registration of lobbying activities (only available for 127 countries), and a further version of CFII that drops Djankov’s ‘disclosures by politicians’ data (only available for 2010). We will also repeat the three regression models and the additional risk factor prevalence regression using multiple imputation to address missing data, using Stata’s mi impute mvn and mi est commands.

We will repeat the regression models including level of corruption as a control variable as it is a potential confounder for CFII. We will use the Political Corruption Index from the V-Dem dataset, V.11.1. We will perform multiplicity tests for all regression models using Stata’s r hausman module.

We will produce variable and coefficient matrices for regression model Ia in order to check for collinearity, using Stata. Finally, we will perform the Robust Hausman test for random vs fixed effects using Stata’s r hausman module.

Data management and statistical principles
All raw data used in the study will be uploaded to GitHub and made publicly available. All analyses will be performed on Stata V.14.1 and R V.4.1.0. We will use a 0.05 level of statistical significance, cluster-robust standard errors, and report 95% CIs. We will follow the statistical analysis plan in online supplemental appendix 5, which was developed in line with the DEBATE reporting guidelines for observational studies. 35 We will upload our syntax online (https://github.com/drlukeallen/CDOH-policy-implementation).

Patient and public involvement
No patient involved.

Twitter Simon Wigley @sdwigley
Contributors LNA and SW conceived the study. Based on previous work by LNA, SW and HH, SW developed the literature review and analysis. LNA wrote the first draft. HH reviewed the methods and findings. LNA, SW and HH revised drafts and approved the final version. All authors had access to and reviewed all data.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/.

ORCID iDs
Luke Nelson Allen http://orcid.org/0000-0003-2750-3575
Simon Wigley http://orcid.org/0000-0001-9181-0129

REFERENCES
3 World Health Organization. Tackling NCDs: ‘best buys’ and other recommended interventions for the prevention and control of noncommunicable diseases. Updated (2017) appendix 3 of the global action plan for the prevention and control of...
18 OECD. Lobbying in the 21st century: transparency, integrity and access OECD; 2021.
28 Madureira Lima J, Galea S. The Corporate Permeation Index – a tool to study the macro social determinants of non-communicable disease. SSRN Popul Health 2019;7:100361.
Appendix 1

Full definitions of the commercial policies included in the WHO NCD progress monitors

Tobacco policy cluster

- 5a: Member State has implemented measures to reduce affordability by increasing excise taxes and prices on tobacco products
- 5b: Member State has implemented measures to eliminate exposure to second-hand tobacco smoke in all indoor workplaces, public places and public transport
- 5c: Member State has implemented plain/standardized packaging and/or large graphic health warnings on all tobacco packages
- 5d: Member State has enacted and enforced comprehensive bans on tobacco advertising, promotion and sponsorship
- 5e: (2017 and 2020 only) Member State has implemented effective mass media campaigns that educate the public about the harms of smoking/tobacco use and second-hand smoke

Alcohol policy cluster

- 6a: Member State has enacted and enforced restrictions on the physical availability of retailed alcohol (via reduced hours of sale)
- 6b: Member State has enacted and enforced bans or comprehensive restrictions on exposure to alcohol advertising (across multiple types of media)
- 6c: Member State has increased excise taxes on alcoholic beverages

Food policy cluster

- 7a: Member State has adopted national policies to reduce population salt/sodium consumption
- 7b: Member State adopted national policies that limit saturated fatty acids and virtually eliminate industrially produced trans-fatty acids in the food supply
- 7c: Member State has implemented the WHO set of recommendations on marketing of foods and non-alcoholic beverages to children
- 7d: Member State has legislation/regulations fully implementing the International Code of Marketing of Breast-milk Substitutes
Appendix 2

Literature review: Proxies for the commercial-political nexus

Background

We conducted a literature review to identify indicators that can be used to assess the extent to which commercial actors are able to directly influence the policy-making process. The central issue is not whether commercial interests can influence policy, but whether they have an outsized influence over policy-making due to their financial clout. The latter would grant them an advantage over non-commercial interest groups, including those advocating for public health measures to constrain the sale and marketing of unhealthy products. Much depends, therefore, on whether there are formal restrictions on the use of corporate resources to directly influence policy-makers.

The legal and political science literature on political financing and the role of interest groups is extensive. Similarly a large public health literature has emerged on the use of corporate resources to influence health policy. Based on these two literatures we identified four regulatory areas that affect the ability of commercial interests to use their greater financial resources to directly influence politicians and political parties and, thereby, the policy-making process:

1. **Campaign financing**: whether there are limits on campaign donations from companies and/or a requirement to publicly disclose the source and amount of those donations.

2. **Business and financial interests of politicians**: whether the financial and business interests of politicians must be publicly disclosed.

3. **Lobbying transparency**: whether the activities of lobbyists must be publicly disclosed.

4. **Enforcement**: whether an independent administrative or judicial body (e.g. electoral monitoring board, general prosecutor, etc.) has the capacity to enforce financing limits and disclosure requirements (i.e. 1-3).

It is important to note that most of the channels through which corporations can use their resources to influence policy-making do not involve corrupt incentives in the traditional sense (i.e. the offering of material incentives that personally benefit politicians). Lobbying activities and campaign donations typically do not provide material benefits to individual politicians. Campaign donations enhance the electoral chances of politicians and political parties, but individual politicians may only materially benefit if they embezzle those donations. Nevertheless, corrupt incentives remain one way in which...
commercial interests can gain unequal influence over policy. This is covered by the second regulatory area above.

We set aside the ability of corporations to indirectly influence policy-makers by shaping consumer preferences (via, for example, product advertising and media ownership) and, thereby, the policies that citizens support. Instead we focus on the ability of corporations to directly influence the decisions of policy-makers.

We aimed to construct a robust overall indicator that captures the level of regulation in each of these four areas. To achieve this, we sought to identify individual indicators for each regulatory area that could then be combined via factor analysis (see Appendix 4) to form a de novo composite indicator of corporate financial influence.

**Method**

**Search strategy**

To identify indicators of corporate influence over political decision-making aligned with the four domains listed above, we searched the following global political data collections on July 7th, 2021: Varieties of Democracy (V-Dem) data set, Quality of Government (QoG) standard data set, and Institute for Democracy and Electoral Assistance’s (IDEA) Political Finance Database. In addition, we searched the first 1,000 records of Google Scholar using the following broad search terms; ("disclosure" OR "transparency") AND ("politician" OR "lobbying" OR "donation" OR "campaign financing") AND "data". We limited the search to the years 2005-2021.

**Inclusion criteria**

We included metrics that met the following criteria:

- Conceptual alignment with the four regulatory areas noted above
- Global coverage: data available for an arbitrary threshold of >85% (>165) WHO Member States
- Data gathering methodology is publicly available and complete
- Data is comparable between countries

Two authors (SW and LA) independently reviewed each potential indicator for alignment with the inclusion criteria. Disagreements were resolved by discussion and - where necessary – arbitration by the third author (HH). The rationale for inclusion or exclusion was documented for each indicator.
Findings

Table 1 presents the set of relevant indicators that have global coverage, as well as the rationale for inclusion and the quality of the data gathering process in each case.
## Table 1

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
<th>Rationale</th>
<th>Source</th>
<th>Country coverage</th>
<th>Data gathering methodology publicly available and complete?</th>
<th>Data gathering method</th>
<th>Comparable between countries?</th>
<th>Scale</th>
<th>Years</th>
<th>Include/exclude</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Campaign finance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disclosure of campaign donations</td>
<td>To what extent are there disclosure requirements for donations to national election campaigns?</td>
<td>Absence of transparency increases the opportunity for commercial interests to influence politicians and political parties and, thereby, policy.</td>
<td>V-Dem Dataset v11.1 \textsuperscript{a} [variable name: v2eldonate]</td>
<td>172</td>
<td>yes</td>
<td>Coded by multiple country experts and converted to interval scale using Bayesian item response theory measurement model.</td>
<td>yes</td>
<td>Interval scale where the lowest score indicates the least disclosure and the highest score indicates the most disclosure.</td>
<td>2015, 2017, 2019</td>
<td>Meets inclusion criteria - include</td>
</tr>
<tr>
<td>Public campaign finance</td>
<td>To what extent is significant public financing available for parties’ and/or candidates’ campaigns for national office?</td>
<td>Greater public financing ameliorates the influence of large private donors on politicians and political parties and, thereby, policy-making.</td>
<td>V-Dem Dataset v11.1 \textsuperscript{a} [variable name: v2elpubfin]</td>
<td>172</td>
<td>yes</td>
<td>Coded by multiple country experts and converted to interval scale using Bayesian item response theory measurement model.</td>
<td>yes</td>
<td>Interval scale where the lowest score indicates the least public financing and highest score indicates the most public financing.</td>
<td>2015, 2017, 2019</td>
<td>Less direct, but still meets inclusion criteria - include</td>
</tr>
<tr>
<td>Corporate campaign donations</td>
<td>Is there a ban on donations from domestic or foreign interests to political parties or candidates?</td>
<td>Ban reduces the opportunity for commercial interests to influence politicians and political parties and, thereby, policy.</td>
<td>IDEA (2021)</td>
<td>180</td>
<td>yes</td>
<td>Expert coded based on laws, regulations, and reports. Aggregate score is the average of questions 1-4 listed under &quot;Bans and limits on private income&quot; in the IDEA database: 1. Is there a ban on donations from foreign interests to political parties? 2. Is there a ban on donations from foreign interests to candidates? 3. Is there a ban on corporate donations to political parties? 4. Is there a ban on corporate donations to candidates?</td>
<td>yes</td>
<td>Interval scale ranging from 0 to 1, where 0 represents no restrictions on donations from corporations and 1 represents the most restrictions on donations from corporations.</td>
<td>2019</td>
<td>Discussion around whether the foreign element for this composite marker excludes it. We decided to include on the basis that most foreign donations are likely to come from corporate actors.</td>
</tr>
</tbody>
</table>

### Disclosure of interests

| Disclosure by politicians | Do the law or regulations of the country require politicians to provide either financial and/or business interests disclosures and are the disclosures publicly available? | Absence of transparency increases the opportunity for commercial interests to influence politicians and political parties and, thereby, policy. | Djankov et al (2010) [variable names: disc_req and ft_pubprac_all] | 175 | yes | Expert coded based on laws, regulations, and information requests. Score is the sum of disc_req and ft_pubprac_all | yes | Ordinal scale: 0 Disclosure not required and not publicly available 1 Disclosure required or publicly available 1.5 Disclosure required but financial or business disclosures not publicly available. 2 Disclosure required and publicly available | 2010 | Data are quite old; however, this is a slow-moving domain. As such we decided to include, but run a sensitivity analysis that drops this variable from the latent factor analysis. |

---

### Legislature corrupt activities

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes/No</th>
<th>Detail</th>
<th>Source(s)</th>
<th>Year(s)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>To what extent do members of the legislature abuse their position for financial gain?</td>
<td>Yes</td>
<td>Willingness of politicians to accept material incentives for personal gain increases the opportunity for commercial interests to influence policy.</td>
<td>V-Dem Dataset v11.1⁴⁰ [variable name: v2lgcrpt]</td>
<td>172</td>
<td>Yes</td>
</tr>
<tr>
<td>Coded by multiple country experts and converted to interval scale using Bayesian item response theory measurement model.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interval scale where the lowest score indicates the most corruption and the highest score indicates the least corruption.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relevant to register lobbying activities</td>
<td>Yes</td>
<td>Expert coded based on laws and regulations.</td>
<td>IDEA (2021)⁴⁵; OECD (2021)⁴⁶; Chari et al (2019)⁴³</td>
<td>127</td>
<td>Yes</td>
</tr>
<tr>
<td>Dichotomous variable which takes the value of zero if there is no requirement to register lobbying activities, otherwise 1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relevant to register lobbying activities</td>
<td>Yes</td>
<td>Expert coded based on laws and regulations.</td>
<td>IDEA (2021)⁴⁵; OECD (2021)⁴⁶; Chari et al (2019)⁴³</td>
<td>127</td>
<td>Yes</td>
</tr>
<tr>
<td>Dichotomous variable which takes the value of zero if there is no requirement to register lobbying activities, otherwise 1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relevant to register lobbying activities</td>
<td>Yes</td>
<td>Expert coded based on laws and regulations.</td>
<td>IDEA (2021)⁴⁵; OECD (2021)⁴⁶; Chari et al (2019)⁴³</td>
<td>127</td>
<td>Yes</td>
</tr>
<tr>
<td>Dichotomous variable which takes the value of zero if there is no requirement to register lobbying activities, otherwise 1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relevant to register lobbying activities</td>
<td>Yes</td>
<td>Expert coded based on laws and regulations.</td>
<td>IDEA (2021)⁴⁵; OECD (2021)⁴⁶; Chari et al (2019)⁴³</td>
<td>127</td>
<td>Yes</td>
</tr>
<tr>
<td>Dichotomous variable which takes the value of zero if there is no requirement to register lobbying activities, otherwise 1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Lobbying transparency

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes/No</th>
<th>Detail</th>
<th>Source(s)</th>
<th>Year(s)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are lobbyists for commercial interests required to register their identity and the company they represent?</td>
<td>Yes</td>
<td>Absence of transparency increases the opportunity for commercial interests to influence politicians and political parties and, thereby, policy.</td>
<td>V-Dem Dataset v11.1⁴⁰ [variable name: v2lgcrpt]</td>
<td>172</td>
<td>Yes</td>
</tr>
<tr>
<td>Coded by multiple country experts and converted to interval scale using Bayesian item response theory measurement model.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interval scale where the lowest score indicates the most corruption and the highest score indicates the least corruption.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are lobbyists for commercial interests required to register their identity and the company they represent?</td>
<td>Yes</td>
<td>Absence of transparency increases the opportunity for commercial interests to influence politicians and political parties and, thereby, policy.</td>
<td>V-Dem Dataset v11.1⁴⁰ [variable name: v2lgcrpt]</td>
<td>172</td>
<td>Yes</td>
</tr>
<tr>
<td>Coded by multiple country experts and converted to interval scale using Bayesian item response theory measurement model.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interval scale where the lowest score indicates the most corruption and the highest score indicates the least corruption.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are lobbyists for commercial interests required to register their identity and the company they represent?</td>
<td>Yes</td>
<td>Absence of transparency increases the opportunity for commercial interests to influence politicians and political parties and, thereby, policy.</td>
<td>V-Dem Dataset v11.1⁴⁰ [variable name: v2lgcrpt]</td>
<td>172</td>
<td>Yes</td>
</tr>
<tr>
<td>Coded by multiple country experts and converted to interval scale using Bayesian item response theory measurement model.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interval scale where the lowest score indicates the most corruption and the highest score indicates the least corruption.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Enforcement

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes/No</th>
<th>Detail</th>
<th>Source(s)</th>
<th>Year(s)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>If executive branch officials were engaged in unconstitutional, illegal, or unethical activity, how likely is it that a body other than the</td>
<td>Yes</td>
<td>Indicates the likelihood that bans and disclosure requirements are enforced in practice.</td>
<td>V-Dem Dataset v11.1⁴⁰ [variable name: v2lgcrpt]</td>
<td>172</td>
<td>Yes</td>
</tr>
<tr>
<td>Coded by multiple country experts and converted to interval scale using Bayesian item response theory measurement model.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interval scale where the lowest score indicates the least oversight and the highest score indicates the</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If executive branch officials were engaged in unconstitutional, illegal, or unethical activity, how likely is it that a body other than the</td>
<td>Yes</td>
<td>Indicates the likelihood that bans and disclosure requirements are enforced in practice.</td>
<td>V-Dem Dataset v11.1⁴⁰ [variable name: v2lgcrpt]</td>
<td>172</td>
<td>Yes</td>
</tr>
<tr>
<td>Coded by multiple country experts and converted to interval scale using Bayesian item response theory measurement model.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interval scale where the lowest score indicates the least oversight and the highest score indicates the</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If executive branch officials were engaged in unconstitutional, illegal, or unethical activity, how likely is it that a body other than the</td>
<td>Yes</td>
<td>Indicates the likelihood that bans and disclosure requirements are enforced in practice.</td>
<td>V-Dem Dataset v11.1⁴⁰ [variable name: v2lgcrpt]</td>
<td>172</td>
<td>Yes</td>
</tr>
<tr>
<td>Coded by multiple country experts and converted to interval scale using Bayesian item response theory measurement model.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interval scale where the lowest score indicates the least oversight and the highest score indicates the</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)
legislature, such as a comptroller general, general prosecutor, or ombudsman, would question or investigate them and issue an unfavorable decision or report? most oversight.
We identified a total of six indicators that were methodologically robust, available for >80% of countries, internationally comparable, and conceptually aligned with the ability of commercial actors to influence policymakers. As we were only able to find lobbying transparency data for 127 countries that input indicator was set aside. However, it is reasonable to expect that the other three regulatory areas are correlated with the level of transparency in terms of lobbying activities. That is, polities that require the disclosure of campaign donations and business/financial interests are more likely to require disclosure by lobbyists. For the sake of robustness we will check whether our regression results are sensitive to the inclusion of the lobbying transparency indicator during the construction of the CFII.
Appendix 3

List of 22 microstates not covered by the V-Dem data

- Andorra
- Antigua and Barbuda
- Bahamas
- Belize
- Brunei Darussalam
- Cook Islands
- Dominica
- Micronesia
- Grenada
- Kiribati
- Saint Kitts and Nevis
- Saint Lucia
- Monaco
- Marshall Islands
- Niue
- Nauru
- Palau
- San Marino
- Tonga
- Tuvalu
- Saint Vincent and the Grenadines
- Samoa

Appendix 4

Latent Factor Analysis

Structural equation modelling (SEM), with full information maximum likelihood, will be used to identify the latent variable underlying the six selected input indicators. The factor loadings will be checked to ensure they are statistically significant and of sufficient magnitude. In addition, goodness of fit statistics will be used to check whether the latent variable is sufficiently related to the input variables. The model will then be used to produce a factor score reflecting the level of corporate financial influence over
policy-making in each country. Those scores will then be rescaled to range from 0 (least corporate influence) to 100 (most corporate influence). The factor analysis will be carried out using the State command –SEM, method(mlmv) –.
References
29 Lima JM, Galea S. The Corporate Permeation Index – A tool to study the macrosocial determinants of Non-Communicable Disease. *SSM - Popul Health* 2019; 7: 100361.


Appendix 5

Statistical analysis plan

Administrative information

1. Title: Implementation of policies to tackle the commercial determinants of non-communicable diseases from 2015 to 2020: a cross-sectional analysis of 172 countries exploratory analysis
2. SAP version: Version 1.0 (July 1 2021)
3. SAP Revisions:
4. Roles and responsibility:
   i. Person writing SAP: Simon Wigley and Luke Allen
   ii. Senior statistician responsible: Simon Wigley
   iii. Chief investigator: Luke Allen

Introduction

5. Background and rationale:

A growing body of work describes the myriad channels through which corporations seek to undermine effective public health measures to constrain the sale and marketing of unhealthy commodities. [1–6] Although case studies are plentiful, there has been a paucity of empirical research to quantify the association between corporate influence and policy implementation.

All 194 World Health Organization (WHO) Member States have endorsed a set of 12 policies that target tobacco, alcohol, foods high in fats and salt, child-focused junk food marketing, and marketing of breastmilk substitutes. These policies designed to tackle the ‘commercial determinants’ of non-communicable diseases (NCDs) were first endorsed in 2013.

WHO monitors the implementation of these commercial policies through regular NCD country capacity surveys, completed by national ministries of health. WHO has produced three global progress monitor reports – in 2015, 2017, and 2020 [7–9] – providing country-level assessments of whether each of the 12 commercial policies has been ‘fully implemented’, ‘partially implemented’, or ‘not implemented’.
This WHO data on commercial policy implementation provides a unique opportunity to examine whether indicators of corporate influence over policymaking processes are associated with implementation of key commercial policies, according to the three policy clusters delineated in Box 1.

Box 1: Commercial policies in three ‘policy clusters’

**Tobacco**
- Tobacco tax
- Smoke free places
- Tobacco packaging
- Tobacco advertising bans
- Tobacco mass media

**Alcohol**
- Alcohol sales restrictions
- Alcohol advertising bans
- Alcohol tax

**Food**
- Salt reduction
- Fat reduction
- Child marketing restrictions
- Marketing of breast milk substitutes

6. Objectives:

In this exploratory analysis we aimed to provide a summary of international implementation trends over time, develop a composite corporate financial influence index (CFII), and perform three sets of regression analyses assess the association between:

1. Overall country-level implementation of all 12 commercial policies (aggregate score) and CFII.
2. Country-level implementation of each of the three clusters and CFII.
3. Country-level implementation of each individual policy and CFII.
4. Country level prevalence of risk factors (tobacco use, alcohol use, hypertension, obesity, and child obesity) and each of the respective policies.
We hypothesise that countries with higher levels of corporate financial influence will have the lowest levels of policy implementation.

Study methods
7. Study design: cross-sectional study based on observational data

Statistical principles
8. Confidence intervals and p-values.
   i. Level of statistical significance: 0.05
   ii. Confidence interval to be reported: 95%
   iii. Adjustment for multiplicity: see 32 below

Study sample

Data gathering and construction
10. Extract policy scores from NCD Progress Monitors for 2015, 2017 and 2020. [7–9]
11. Construct composite scores for all 12 commercial policies and each commercial policy cluster (tobacco, alcohol and food policies).
12. Assemble risk factors from various sources: adult obesity, child obesity, hypertension, alcohol consumption, and smoking prevalence.
13. Assemble control variables from various sources: GDP per capita, % urban population, % population aged 65+, level of democracy, % Muslim, legal origin, ethno-linguistic fractionalization, Small Island Developing States, and continent.
14. Construct ‘Corporate Financial Influence’ index using latent factor analysis, using structural equation modelling in Stata with FIML.
15. Exclude variables that encompass less than 165 of 194 countries.
16. Log transform variables that are right-skewed.
17. Use data from 10-16 to construct a panel for the years 2015, 2017, and 2019 for 172-194 countries.

Model specification
18. Random effects GLS regressions: captures between country effects and within country effects [using Stata’s xtreg, re command].
19. Confounding covariates: include control variables to address economic, cultural/historical, geographic, and population factors that may be driving the results.
20. Time trends: include year dummies to address the possibility of a spurious relationship between the outcome variable and the independent variables of interests.
Regression analyses

22. Random effects GLS regression I: total commercial policies (aggregate score for all 12 policies) regressed on CFII (with and without control variables) [using Stata’s xtreg, re command].

23. Random effects GLS regression II: each commercial policy cluster (tobacco, alcohol, and food) separately regressed on CFII (with and without control variables) [using Stata’s xtreg, re command]

24. Random effects GLS regressions III: All 12 individual commercial policies separately regressed on CFII (with and without control variables) [using Stata’s xtreg, re command]

25. Construct prediction-based Bland-Altman plots for 2019 using the results from 22 and 23.

Additional analysis

26. Random effects GLS regressions IV: tobacco, alcohol, fat, child food marketing, and salt policies separately regressed on corresponding risk factors (with and without control variables) [using Stata’s xtreg, re command]

27. Interaction model: examine whether the association between democracy and commercial policies is conditioned by level of CFII. [using Interflex command in R][10]

Robustness/ sensitivity checks


29. Repeat 22, 23, 24, and 27 using CFII constructed:
   (i) Without disclosure by politicians (because data for that variable is only available for year 2010)
   (ii) With registration of lobbying activities (which is only available for 127 countries)

30. Repeat 22, 23, 24, and 26 using multiple imputation to address missing data [using Stata’s mi impute mvn and mi est commands]

31. Repeat 22, 23, 24, and 27 including level of corruption as a control variable (potential confounder for CFII).

32. Collinearity checks: Variable and coefficient correlation matrices for 22.

33. Multiplicity tests for regressions [using Stata’s wyong module]

34. Robust Hausman test for random vs. fixed effects [using Stata’s rhausman module]

Statistical software

35. Stata version 14.1 and R version 4.1.0

References for SAP

1 McKee M, Stuckler D. Revisiting the Corporate and Commercial Determinants of Health. 


11 Madureira Lima J, Galea S. The Corporate Permeation Index – A tool to study the macrosocial determinants of Non-Communicable Disease. SSM - Popul Health 2019;7:100361.