Exporting Pandemics: Free Trade Agreements and the Global Diffusion of Unhealthy Behaviours

Pepita Barlow

Nuffield College



Thesis submitted for the degree of Doctor of Philosophy in Sociology

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Abstract

This thesis is about the causes of unhealthy behaviours, and the role of Free Trade Agreements (FTAs) in shaping them. Unhealthy behaviours include smoking, harmful alcohol consumption, and excess caloric intake. Sociologists have primarily investigated the causes of these behaviours with reference to individuals' socio-economic and local environmental characteristics. Yet these determinants may, in turn, be shaped by a society's macro-economic and political institutions, including FTAs. FTAs are major policy instruments that are increasingly being used to promote cross-border trade and investment. In doing so, FTAs may unintentionally foster the cross-border diffusion of unhealthy behaviours and constrain governments' abilities to regulate them. However, scholars' understanding of whether and how these impacts prevail is limited: most prior analyses precluded causal conclusions, whilst more rigorous statistical analyses of FTAs primarily focussed on economic outcomes. In this thesis I address these gaps. In the first empirical chapter I used a natural experiment design to evaluate whether entering into an FTA with the US corresponded to a rise in caloric intake in Canada. In a second analysis I used the synthetic control method to disentangle the specific clauses within FTAs that lead to dietary changes. In a third study I created a new dataset

to investigate how FTAs might constrain governments' abilities to introduce regulations aimed at preventing unhealthy behaviours. These empirical chapters advance previous analyses of FTAs and unhealthy behaviours by providing more robust evidence to infer a causal effect of FTAs and by elucidating their pathways to impact. They also make two broader, inter-related contributions to social scientific scholarship. First, my findings demonstrate the importance of FTAs for sociologists' understanding of the causes of unhealthy behaviours. Second, my thesis shows that FTAs can have detrimental consequences for a society's well-being in ways that are often overlooked in economic FTA evaluations.

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Chapter 1. Introduction

1.1 Overview

This thesis is about the causes of unhealthy behaviours, and the role of Free Trade Agreements (FTAs) in shaping them. Unhealthy behaviours include tobacco smoking, harmful alcohol consumption, and excess caloric intake (WHO 2013). Epidemiologists widely recognize that, at the individual level, repeatedly engaging in these behaviours is unhealthy as they can increase the risk of developing multiple chronic Non-Communicable Diseases (NCDs), such as obesity, cardiovascular disease, lung disease, and cancer (Lim et al. 2012). Unhealthy behaviours and related diseases can also have wider social repercussions as they can affect the material and emotional well-being of those afflicted and their families (Jaspers et al. 2015; Maier and Lachman 2000). They are also expensive to treat and can contribute to productivity losses (Bloom, Cafiero, et al. 2011; Bloom, Chisholm, et al. 2011).

The risks associated with unhealthy behaviours have risen exponentially in recent years as these behaviours have proliferated on a global scale (Forouzanfar et al. 2015; Popkin, Adair, and Ng 2012; Popkin and Hawkes 2016). There is therefore a growing impetus to prevent them and better understand their diverse causes (Beaglehole et al. 2011). Sociologists have primarily investigated these causes with reference to individuals' socio-economic and neighbourhood characteristics (Pampel, Krueger, and Denney 2010; Sommer et al. 2015). However, the causes of unhealthy behaviours may, in turn, be shaped by a society's macro-economic and political institutions, including FTAs.

FTAs are economic instruments that are increasingly being used to reduce barriers to cross-border trade and investment (Baldwin 2011). There were 22 in force in 1990, rising to over 270 in 2016 (WTO 2016b). FTAs are designed to promote international integration and economic growth but, in doing so, they may unintentionally foster the cross-border diffusion of unhealthy behaviours (Friel, Hattersley, and Townsend 2014; Hawkes et al. 2010). In addition, FTAs could constrain governments' abilities to prevent unhealthy behaviours as they contain rules that could be invoked to delay, alter, or prevent the introduction of regulations targeting the overconsumption of harmful food, beverage, and tobacco products (Koivusalo, Schrecker, and Labonté 2009; Schram et al. 2017).

Prior scholarship investigating the impact of FTAs on unhealthy behaviours was largely inconclusive. Previous studies analysing these links precluded causal conclusions, and many pathways to impact remain unstudied, whilst more rigorous statistical analyses of FTAs focussed primarily on their economic consequences. In this thesis I address these gaps by using quasi-experimental methods and collecting new data to investigate the impact of FTAs on unhealthy diets and policy implementation to prevent the consumption of harmful food, beverage, and tobacco products.

In this chapter I contextualise the focus and contributions of the thesis. I first review the motivations and approaches in traditional sociological accounts of unhealthy behaviours. Next, I discuss certain limitations to this approach in order to demonstrate the potential theoretical value of investigating how a society's macro-economic and political institutions – including FTAs – influence unhealthy behaviours. I then summarise the remaining chapters of the thesis.

1.2 Background

1.2.1 The global diffusion and consequences of unhealthy behaviours

Repeatedly engaging in unhealthy behaviours such as smoking, harmful alcohol consumption, and excess caloric intake can all increase the risk of developing multiple illnesses known as chronic Non-Communicable Diseases (NCDs). These include cardiovascular disease, obesity, type 2 diabetes, and cancer (WHO 2015). NCDs are often distinguished from 'communicable' diseases – such as influenza and tuberculosis (TB) – which are primarily caused by viruses, bacteria, fungi, or protozoa. However, it is not transmissibility per se that differentiates these different types of diseases. It is instead the precise mechanism of transmission, as NCDs can also be spread via communicative mechanisms, such as social networks (Allen and Feigl 2017).

NCDs were once regarded as 'diseases of affluence' found only in high-income, Westernised societies where high-calorie diets, harmful alcohol use, and tobacco consumption were more common (McKeown 1988; Trowell and Burkitt 1981). However, this misconception is increasingly outdated as these behaviours and associated diseases have proliferated on a global scale over the past 40 years (Ezzati et al. 2002, 2005). For example, smoking prevalence among men was highest in Central and Eastern Europe and in parts of East and Southeast Asia in 2010 (WHO 2011a). In addition, many low- and middle-income countries have the extra burden of unhealthy behaviours and associated 'diseases of poverty' (McKeown 1988), such as the over-use of infant milk formula in place of breastfeeding, which can contribute to malnutrition (Victora et al. 2016). Thus, NCDs were among the leading causes of death worldwide in 2016, claiming as many as 40 million lives (70% of all deaths) in that year; whilst many occurred due to malnutrition, the proportion of deaths attributable to tobacco, unhealthy diets, and excess alcohol consumption is rising rapidly (WHO 2017a).

Several studies, mainly from high-income countries, have shown that lower socio-economic status (SES) groups with lower incomes and less education are more likely to engage in unhealthy behaviours and so are especially susceptible to their harmful consequences (Sommer et al. 2015). These behaviours are therefore an important contributor to overall disparities in health and longevity between the most and least advantaged socio-economic groups (Di Cesare et al. 2013). This has significant social consequences. Of course, NCDs substantially reduce the quality and length of life of the individuals diagnosed with these illnesses. But they can also affect the material livelihood of the children and partners of those who die prematurely (Jaspers et al. 2015; Maier and Lachman 2000). Unhealthy behaviours and related NCDs can also undermine macro-economic prosperity: they are expensive to treat and can lead to productivity losses due premature deaths and NCD-related disabilities among persons of working age (Bloom, Chisholm, et al. 2011). Macroeconomic simulations conducted by the World Economic Forum (WEF) suggest a cumulative output loss due to NCDs of US$47 trillion between 2010 and 2030, a loss equivalent to 75% of global GDP in 2010 (US$63 trillion) (WEF 2009).

1.2.2 Determinants of unhealthy behaviours

The global diffusion, uneven distribution, and harmful consequences of unhealthy behaviours have prompted scholars from across the social and medical sciences to investigate their diverse causes. Sociologists, for their part, have investigated the determinants of these behaviours and their concentration in lower SES groups with reference to diverse social, economic, demographic, and local environmental factors (Pampel et al. 2010; Sobal 2011; Sommer et al. 2015). Many of these accounts primarily focused on 'micro-' and 'meso-' social determinants,

which explain individual behaviours with reference to an individual's characteristics and their interactions with other individuals, organizations, and local communities (Bilton et al. 2002a).

For example, scholars have shown how a mother's educational attainment influences whether and for how long they breastfeed their children (Cleland and Van Ginneken 1988; Frost, Forste, and Haas 2005), how job loss can lead individuals to consume more alcohol and tobacco (Goldman-Mellor, Saxton, and Catalano 2010; Roelfs et al. 2011), and how the proximity of a child's school to fast-food outlets increases their tendency to consume too many calories (Pearce, Bray, and Horswell 2017). Each of these associations may be mediated by a range of material, psycho-social, and cultural-behavioural mechanisms, which influence individual decisions through their impact on individuals' opportunities, responses to stress, and the social acceptability of different choices (Beckfield et al. 2015).

Micro- and meso-sociological accounts of unhealthy behaviours have proved fruitful for understanding why they are more common among lower SES individuals. However, this approach is not without theoretical deficiency as certain aspects of unhealthy behaviours cannot be fully understood with reference to micro- and meso-social explanations alone. First, the extent to which the micro- and meso-social determinants of unhealthy behaviours arise and exert an influence on behaviour differs markedly between societies and across historical contexts. For example, the composition and total number of calories in individuals' diets are heavily influenced by the local availability and prices of different foods (Hawkes et al. 2015), but these two aspects of the 'food environment' vary substantially between countries and historical periods. As Swinburn et al. (2011b) noted, an 'obesogenic' food environment that encouraged unhealthy diets and obesity was established in the United States (US) from the

early 1970s onwards (Swinburn et al. 2011). This entailed a marked rise in the quantity and reduction in the cost of calories and refined carbohydrates, sugars and fats in the US food environment following technological and policy changes that fostered "a revolution in the mass preparation of food" (Cutler, Glaeser and Shapiro 2003:94).

Several other Western, industrialised societies experienced similar food-system changes in the post-war era. However, the timing and extent of this transformation varied from country-to-country. For example, Bleich et al. (2008) found that the number of calories that were available and likely consumed increased by approximately 720 kilocalories per person per day (kcal/ capita/ day) in the US between 1970 and 2002. Meanwhile, in Canada, calorie availability increased much later, from the early 1990s, and by approximately 510 kcal/ capita/ day, whilst in the United Kingdom (UK) this increase was a relatively modest 190 kcal/ capita/ day, and began in the mid-1980s (Bleich et al. 2008).[1]

This variation raises the question: what causes the determinants of unhealthy behaviours – such as 'obesogenic' food environments – to arise in some societal and historical contexts, but not others? Micro-and meso-sociological accounts of unhealthy behaviours do not provide an answer to this question. As the epidemiologist Geoffrey Rose famously noted, investigating the causes of disease and related behaviours within a pre-defined country-context – such as genetic and socio-economic factors – can help locate individuals within a society's distribution of disease exposure (Rose 1985). But Rose observed that there may be substantial variation in the shape and position of this distribution of disease exposure between societies, due to "a

[1]See the 'Data sources and measurement' and 'Limitations' sections of Chapter 3 of this thesis for further discussion of the relationship between calorie availability and intake.

mass influence acting on the population as a whole" (Rose 1985:458). Thus, Rose concluded, studies of individual-level causes of diseases and their determinants – such as NCDs and unhealthy behaviours – may paint an incomplete account of their causes by overlooking the possible importance of a society's characteristics. Such characteristics may, in turn, shape these lower-level determinants and so constitute what Marmot called the 'root causes' or 'causes of the causes' of disease (Marmot 2007).

Sociologists interested in contextual variation in the social determinants of health and health inequalities have made similar observations. For example, Beckfield et al. (2015) and Olafsdottir and Beckfield (2011) noted that micro- and meso-social explanations can help us to understand inter-individual differences in health-behaviours and health outcomes within a pre-defined societal context (Beckfield et al. 2015; Olafsdottir and Beckfield 2011). However, the authors argued that such accounts are of more limited utility in explaining why some of these individual-level determinants should vary in their occurrence and influence in different contexts, as they "do not problematise" or seek to explain this variation (Beckfield et al. 2015:230).

A second aspect of unhealthy behaviours that cannot be fully understood with reference to micro- and meso-sociological explanations is the persistence of these behaviours over time. This is potentially puzzling as there is growing scientific evidence showing how low-cost interventions can prevent unhealthy behaviours. Such interventions, recommended by the WHO as the cost-effective 'best buys' for discouraging unhealthy behaviours, include the provision of nutritional information on infant milk formula packages, food and beverage

labelling requirements, plain tobacco packaging legislation, and soft-drink and alcohol advertising restrictions (WHO 2010a, 2010b, 2011b).

Of course, scientific evidence about the low-cost and effectiveness of interventions in preventing unhealthy behaviours does not guarantee their implementation. For example, political commitments also play a role (Geneau et al. 2010). And yet there is also growing political commitment to prevent unhealthy behaviours and related diseases. For example, in September 2011 members of the United Nations (UN) signed the UN Political Declaration on the Prevention and Control of NCDs (UN 2011, 2015b). This recognized "the primary role and responsibility of Governments in responding to the challenge of non-communicable diseases" (UN 2011:2), and committed to introducing the regulations recommended by the WHO. Later, in September 2015, 193 countries adopted the UN Sustainable Development Goals, which committed to preventing unhealthy diets, tobacco consumption, and harmful alcohol use, and included a target to reduce mortality from NCDs by one third by 2030 (UN 2015a).

However, there is little evidence that governments have followed through with their commitments to prevent NCDs by implementing the full range of cost-effective food, beverage and tobacco regulations that can achieve their goals (Horton 2017; WHO 2017a).[2] Why, then,

[2] For example, a 2017 report by the WHO monitored progress towards implementing the 'best buys' it recommends in 194 WHO member states. It concluded that "Since the 2011 High-level Meeting, governments have made many political commitments to prevent and control NCDs. Progress, however, has been insufficient and highly uneven. Unless political leaders accelerate commitments to take national action at the third UN High-level Meeting in 2018, the current rate of decline in premature death from NCDs will not meet the SDG target, leading to significant GDP losses and impoverishing millions of people through long-term healthcare costs" (WHO 2017:5).

do unhealthy behaviours persist, despite political commitments and the availability of cost-effective solutions for preventing them? Whilst there are likely to be many possible explanations, they cannot be found in micro- and meso-social accounts of unhealthy behaviours. Again, such accounts can aid our understanding of inter-individual differences in health-behaviours and related outcomes within a pre-specific societal context (Beckfield et al. 2015; Olafsdottir and Beckfield 2011; Rose 1985). But such accounts are of more limited utility in explaining the persistence of unhealthy behaviours as they do not problematise this phenomenon – including the factors that account for limited policy implementation to prevent them.

1.2.3 The political economy of unhealthy behaviours

In order to fully understand what causes unhealthy behaviours and their persistence it may therefore be necessary to look beyond traditional micro- and meso-sociological approaches to consider how these behaviours may be influenced by a wider range of factors. One possibility is that a society's macro-economic and political institutions also play a role by shaping the determinants of unhealthy behaviours and policy implementation to prevent them. This 'political economy' approach goes a step beyond micro- and meso-sociological frameworks by emphasising how the determinants of health can, in turn, be "produced, literally and metaphorically, by the structures, values and priorities of political and economic systems" (Krieger 2011:167).

Whilst empirical sociological research on unhealthy behaviours has focused primarily on micro- and meso-social factors, political economy perspectives have a long tradition in the sociology of health more broadly (Krieger 2011; Olafsdottir and Beckfield 2011). Marx and

Engels, for example, argued that workers' exposure to the unsanitary social conditions that contributed to premature mortality during the Industrial Revolution was fundamentally attributable to industrial capitalism and its underlying political inequities (Marx 1964, and Engels [1984] 2001, cited in Collyer 2015). More recently, sociologists have investigated the possible health impacts of a wide range of institutions. Examples include analyses of the role of rapid privatisation policies in driving the post-communist mortality crisis (Stuckler, King, and McKee 2009), the impact of social spending on the relationship between job loss and mental health (Drydakis 2015; Vahid Shahidi, Siddiqi, and Muntaner 2016), and the influence of immigration policies on immigrants' self-reported health (Bakhtiari, Olafsdottir, and Beckfield 2018).

Many of these policies, reforms and institutions are ostensibly economic phenomena as they are affected by economic resources, oriented towards achieving economic goals, and often evaluated with respect to their economic consequences. However, economic policy-making does not occur in a vacuum. It is sustained and influenced by political organizations (Meyer et al. 1997), interest-group organization and mobilization (Berry and Wilcox 2018), and resource and power asymmetries within (Mills 1956) and between societies (Dobbin, Simmons, and Garrett 2007), among other factors. Economic policy choices therefore reflect a constellation of political influences and inequities (Bilton et al. 2002b). Analyses of the health impacts of policies, reforms, and regimes therefore take a 'political economy' approach by calling attention to how exposure to the determinants of health – such as unhealthy behaviours – can be influenced both by a society's macro-economic institutions and by the political interests and inequities which shape them (McNamara 2017).

Conceptual frameworks of the policy process, grounded in other sub-disciplines in sociology and political science, also highlight how such institutions can affect policy implementation to prevent unhealthy behaviours. These frameworks emphasise how scientific evidence and political commitments are only two among many factors affecting a government's ability or willingness to implement a policy. For example, Bilton et al. noted that "policy changes require not only some means to implement them, but also ways of preventing, marginalising or defeating resistance" (Bilton et al. 2002:297). Such resistance may be created by other governments and organized groups with a stake or 'vested interest' in the impact of the policy (Kingdon and Thurber 2010; Sabatier and Mazmanian 1980; Sabatier and Weible 2007). And, as Ottersen et al. (2014) observed, macro-economic institutions can expose governments to the influence of these vested interests on public health policies, such as a government's plans to implement food, beverage and tobacco regulations that prevent unhealthy behaviours.

1.2.4 FTAs and unhealthy behaviours

One understudied macro-economic and political institution that has been widely claimed to exert an influence on unhealthy behaviours is Free Trade Agreements (FTAs) (Friel, Hattersley, et al. 2013; Friel et al. 2014; Labonte and Schrecker 2007; Stuckler et al. 2012; Thow and Hawkes 2009). FTAs are partially oriented towards achieving economic goals: they are designed to promote trade, investment and economic growth by reducing barriers to cross-border trade and investment (Baier and Bergstrand 2007, 2009). However, the design and implementation of FTAs is also shaped by diverse political interests and inequities. These include, for example, the interests of organized businesses lobbying for tariff reductions, bureaucrats working in state trade departments, and a government's geo-political goals (Dür, Baccini, and Elsig 2014; Fairbrother 2014).

Public health scholars have long debated whether and how FTAs – and the political forces which shape them – could impact on health, including unhealthy behaviours, through myriad and complex pathways. One possibility is that they increase a society's exposure to the determinants of unhealthy diets. This can occur as they promote transnational trade in unhealthy foods enriched with salt, sugar and fat, thereby fostering the cross-border diffusion of 'obesogenic' food environments (Hawkes et al. 2010; Moodie et al. 2013; Thow 2009). Another possibility is that FTAs constrain governments' abilities to implement policies that prevent unhealthy diets, tobacco consumption, and harmful alcohol use. This could happen as they contain clauses which are invoked to dispute programmes targeting these behaviours (Blouin, Chopra, and van der Hoeven 2009; Friel et al. 2014).

A debate about whether and how these impacts actually prevail has received increasing attention in recent years as the number of FTAs being negotiated and ratified has risen at an unprecedented rate (WTO 2016b). Coinciding this rise, economists have rigorously analysed and debated whether and how FTAs yield effects on a multitude of phenomena. This economic scholarship has shown how FTAs can yield certain improvements in a country's economic welfare by reducing living costs, raising wages in some sectors, and promoting economic growth (Anderson and van Wincoop 2004; Baier and Bergstrand 2009, 2007; Dür et al. 2014; Pierce and Schott 2016). Economists have also identified important challenges to making valid causal inferences about FTA effects – and potential ways to address them (Baier and Bergstrand 2009; Rodriguez and Rodrik 2000; Trefler 2004).

Yet, rigorous statistical research evaluating the impacts of FTAs on unhealthy behaviours – together with their broader health consequences – is conspicuous by its absence from this

empirical literature. As I show in Chapter 2, most prior studies of FTAs and unhealthy behaviours precluded causal conclusions, and many of their possible impacts and associated mechanisms remain unstudied. It therefore remains contestable whether and how the possible impacts of FTAs on unhealthy behaviours actually occur in practice.

In this thesis I address these gaps by analysing whether and how Canada's trade deals with the US impacted on Canadian diets (Chapters 3 and 4) using quasi-experimental methods, and by creating and analysing a new dataset of challenges to food, beverage and tobacco regulations at the World Trade Organization (WTO) (Chapter 5). Below I describe these analyses in more detail and summarise the conclusions and overall contributions of this thesis.

1.3 Summary of thesis chapters

In the next chapter of this thesis (Chapter 2) I present a framework and systematic review summarising the links between FTAs, health determinants, and health outcomes. This broad review contextualizes and justifies the specific focus of my thesis on unhealthy behaviours. I describe how numerous studies have outlined the possible health consequences of FTAs, but little is currently known about which, whether and how each of these outcomes actually prevail. Instead, many prior studies in this literature were theoretical commentaries and summaries, whilst rigorous empirical evaluations of FTAs focussed on their economic consequences and challenges to making valid causal inferences about their impacts (Dür et al. 2014). I therefore conducted a systematic review of studies investigating the health impact of FTAs. I also evaluated the methodological quality of studies in this field and conducted a co-citation analysis to assess the extent of cross-disciplinary fertilisation.

The results from my systematic review in Chapter 2 show that unhealthy behaviours were the main focus of previous scholarship on the health impact of FTAs. Previous studies found that implementing FTAs and related policies was consistently associated with increased sales and consumption of processed foods and sugar-sweetened beverages. However, most studies precluded definitive conclusions of causality. In addition, previous studies analysed a narrow range of outcomes and treated FTAs as a 'black box' because they did not investigate the specific clauses within FTAs that correlated with observed dietary changes. In addition, there were no systematic quantitative studies investigating whether and how trade rules are used to influence food, beverage and tobacco regulations, largely due to a dearth of suitable data. Finally, co-citation patterns showed low co-citation between public health and economics, illustrating potential for greater cross-disciplinary fertilisation and the insights that can flow from it. A revised version of this systematic review, co-authored with Martin McKee, Sanjay Basu, and David Stuckler, was published in 2017 in *Globalization and Health*.

The next three empirical chapters of the thesis address some of the gaps I identified in Chapter 2. In Chapter 3 I evaluate the impact of a US FTA on a previously unstudied unhealthy dietary behaviour which plays a critical role in causing obesity and related NCDs: caloric intake. To address the challenges to causal inference I identified in my systematic review I analyse a unique natural experiment, the 1989 Canada-US Free Trade Agreement (CUSFTA), using fixed-effects regression models and the synthetic control method. I also model potential weight gain from changes to caloric intake following CUSFTA and study potential mediating mechanisms by analysing coinciding trends in US trade and investment in the Canadian food and beverage sector. A revised version of this paper, co-authored with

Martin McKee and David Stuckler, was published in 2018 in the *American Journal of Preventive Medicine.*

Next, in Chapter 4, I seek to open the 'black box' of FTAs in an analysis of tariff reductions in the North American Free Trade Agreement (NAFTA), 1994. I study the impact of changes to tariffs on an especially harmful form of sugar, High-Fructose Corn Syrup (HFCS), on Canadian consumption of this syrup. I again use the synthetic control method to evaluate the impact of tariff changes in NAFTA, and I investigate potential mediating pathways by studying trends in US exports of HFCS. A revised version of this paper, co-authored with Martin McKee, Sanjay Basu, and David Stuckler, was published in 2017 in the *Canadian Medical Association Journal.*

In Chapter 5 I turn to another possible impact of FTAs on unhealthy behaviours: how they can affect the ability of states to implement regulations aimed at preventing the overconsumption of harmful food, beverage and tobacco products. As previous studies of this potential pathway were limited by a dearth of suitable data, I created and analysed a new dataset of informal challenges to food, beverage and tobacco regulations among WTO members. Drawing on a thematic analysis of minutes from 71 WTO meetings, 1995 to 2016, I describe the frequency and scope of informal trade challenges, analyse the economic characteristics of the countries raising and defending them, and summarize four examples that illustrate their potential influence. A revised version of this paper, co-authored with Ronald Labonte, Martin McKee, and David Stuckler, was published in 2018 in *PLoS Medicine.*

Finally, in Chapter 6 I discuss the main findings, conclusions, contributions, and limitations of this thesis. I summarise how the empirical chapters advance previous studies of FTAs and unhealthy behaviours by showing more robust evidence of a causal effect of FTAs and by elucidating their pathways to impact. I then discuss two broader, inter-related contributions of my thesis to social scientific scholarship. First, I argue that my thesis demonstrates the importance of FTAs for sociologists' understanding of unhealthy behaviours as they can help us to better understand what causes them and why they persist. Second, my findings about the impact of FTAs on unhealthy behaviours show that FTAs can have detrimental consequences for a society's well-being in ways that are often overlooked in economic impact evaluations. Thus, I argue that my findings serve as a cautionary note to temper the view, portrayed by some economists, that policies which increase trade and investment necessarily translate into improvements in a society's welfare (Anderson and Wincoop 2003; Bhagwati 2004; Dollar 2001; Norman 1990). I then build on these conclusions to review the policy implications of my findings. Finally, I outline the limitations and outstanding questions that arise from my analyses and discuss potential directions for future research.

Chapter 2. Background and systematic review

2.1 Introduction

In the Introduction of this thesis I noted that FTAs could shape the determinants of unhealthy behaviours and policy implementation to prevent them. They can, for example, encourage unhealthy, high-calorie diets by increasing transnational trade in calorie dense foods and their ingredients (Thow 2009). In addition, FTAs could undermine governments' abilities to implement policies that address unhealthy behaviours as they contain clauses which are invoked to dispute and over-turn policies designed to prevent the overconsumption of harmful food, beverage and tobacco products (Friel et al. 2014).

Numerous studies have outlined these possible consequences of FTAs, together with a wider range of impacts on health determinants and outcomes (Blouin et al. 2009; Friel et al. 2014). Yet a majority of this scholarship was theoretical commentaries and summaries, whilst rigorous empirical evaluations of FTAs focussed primarily on their economic consequences. This economic scholarship has shown how FTAs can lead to certain improvements economic welfare by reducing living costs, raising wages in some sectors, and promoting economic growth (Anderson and van Wincoop 2004; Baier and Bergstrand 2009, 2007; Dür et al. 2014; Pierce and Schott 2016). Economists have also identified important challenges to making valid causal inferences about FTA effects – and potential ways to address them (Baier and Bergstrand 2009; Rodriguez and Rodrik 2000; Trefler 2004).

What is missing from this literature is a comprehensive understanding of whether and how the possibly causal relationships between FTAs and unhealthy behaviours – together with their broader health consequences – actually prevail. In this chapter I address these gaps. I describe the evolution and content of FTAs and summarise their possible impacts on health-determinants and related outcomes. I then conduct a systematic review of empirical studies in this field. I qualitatively synthesise study findings, evaluate the methodological quality of this literature, and analyse cross-disciplinary citation patterns. Whilst unhealthy behaviours have been a key focus of existing reviews and commentaries outlining the health consequences of FTAs, this review considers their broader health consequences and mediating pathways to contextualise and justify the specific focus of chapters 3-5 in this thesis.

2.2 Context and theoretical framework

2.2.1 FTAs: evolution and scope

FTAs are macro-economic policy instruments that are signed by two or more countries and are designed to promote international integration and economic growth by reducing barriers to cross-border trade and investment (Baldwin 2011). As shown in Figure 2.1, the number of FTAs in force has grown exponentially in recent decades, rising from 22 in 1990 to over 270 in 2016 (WTO 2016a). This rise occurred following repeated disagreements about how to extend the scope and scale of trade barrier reductions among World Trade Organization (WTO) members (Baldwin 2011; Mansfield and Milner 1997; Rodrik 2011). The WTO is an international organization established in 1994 that co-ordinates the rules of trade between member countries. Upon accession, WTO members sign a suite of agreements designed to reduce trade costs, such as tariffs, a type of trade tax, as well as non-tariff barriers, such as

quotas on imports and exports (WTO 2015c). Subsequent FTAs built and expanded upon these measures to include 'WTO-plus' provisions that remove further trade and investment barriers (Horn, Mavroidis, and Sapir 2010).

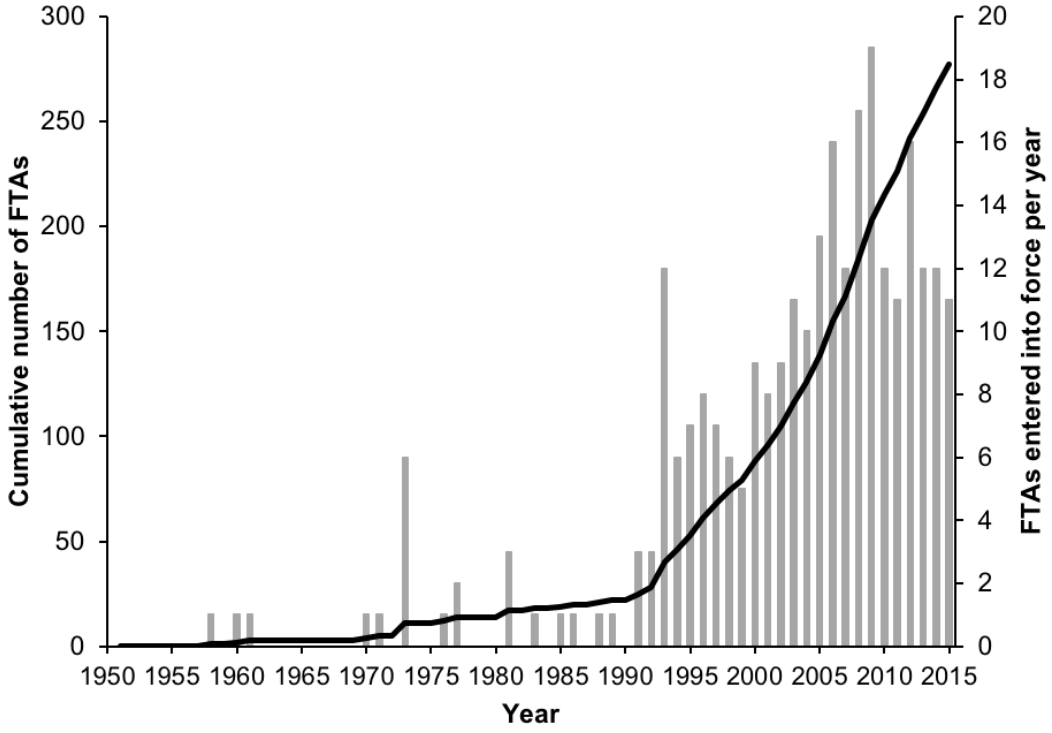


Figure 2.1 Number of FTAs entered into force, 1950-2016.
Notes: Data from World Trade Organization Database of Preferential Trade Agreements, 2016. See Bibliography for full reference.

The additional 'WTO-plus' measures contained in FTAs vary both in the range of trade and investment policy changes they mandate and in their 'depth' - that is, the extent to which the agreement "requires states to depart from what they would have done in its absence" (Downs, Rocke, and Barsoom 1996:383). However, there is considerably homogeneity in FTA sub-clauses: for example, most include provisions affecting tariffs, competition, product standards, non-tariff barriers, dispute settlement, intellectual property rights, foreign direct investments, and procurement by public authorities. In addition, several FTAs, such as the North American Free Trade Agreement (NAFTA), served as templates for subsequent

agreements (Baccini, Dür, and Haftel 2015). Thus, a computerised analysis of the content of 211 FTAs by Allee and Elsig (2015) identified considerable textual overlap in their content, with almost a quarter (22.2%) taking at least 70% of their text from a single previous FTA (Allee and Elsig 2015). These similarities make it possible to hypothesise the typical effects of FTAs on health-determinants and outcomes.

2.2.2 Possible impacts of FTAs on health-determinants and outcomes

Figure 2.2 summarizes the possible health impacts of trade and investment barrier reductions mandated by FTAs, via diverse pathways. Following Krieger's (1994) proposal to integrate political, social and biologic epidemiological frameworks, the left panel in Figure 2.2 portrays how the links between FTAs and health operate at multiple levels. These start from the contextual, societal factor, an FTA, which shapes social and environmental determinants of disease. These then affect health outcomes through their impact on proximal 'risk' factors, which increase the likelihood of disease and injury, as well as 'protective' factors that reduce the negative impact of risk factors (Krieger 1994). The framework in Figure 2.2 focuses on three main intermediate pathways that shape these risk and protective factors: production, consumption, and health-services and policy. This integrates the pathways previously identified by Labonte and Schrecker (2007), Blouin et al. (2009), and Friel et al. (2015). Below I briefly summarise each of these pathways, described in more detail where relevant in the subsequent chapters of this thesis.

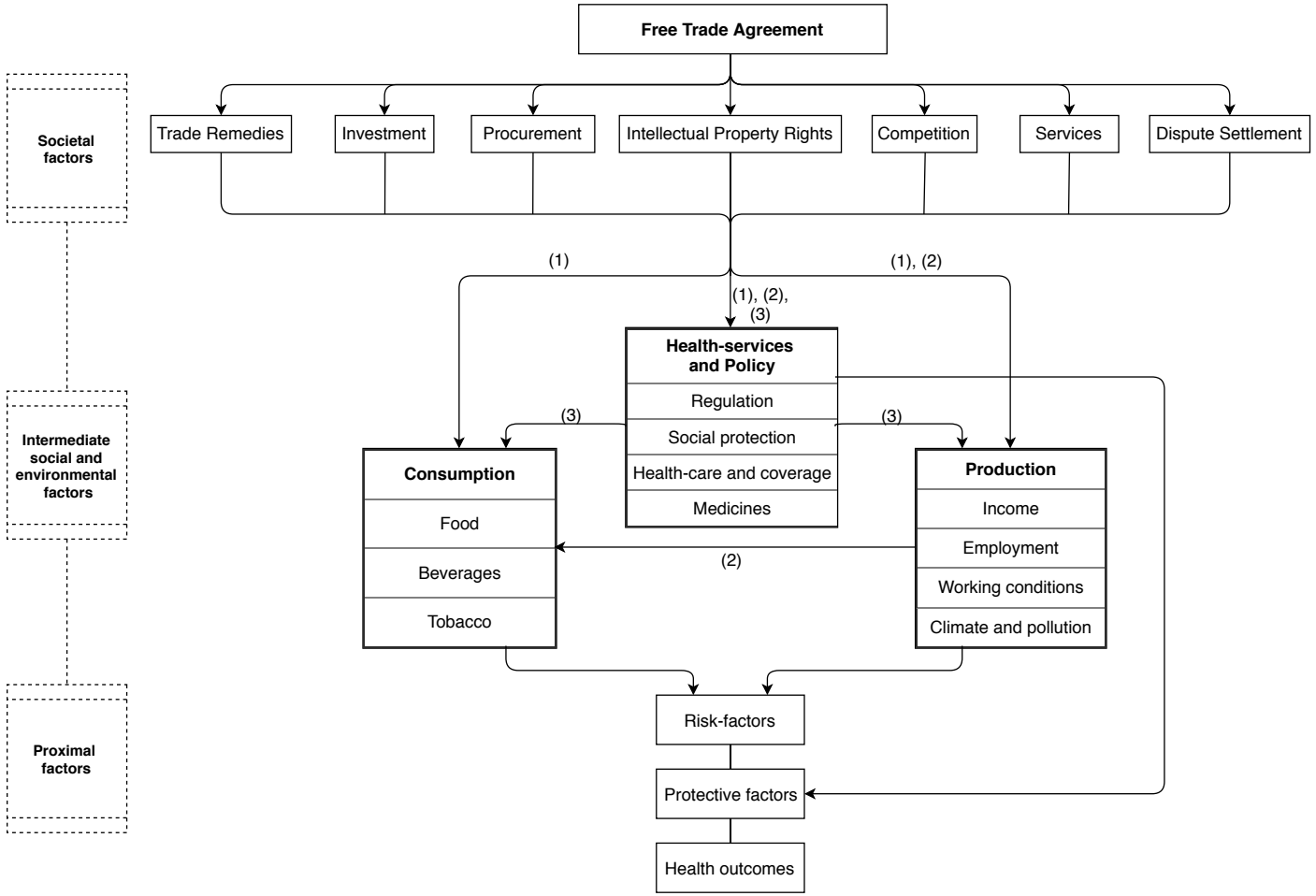


Figure 2.2 Potential effects of FTAs on health determinants and outcomes.
Notes: Numbers 1-3 identify whether outcomes and pathways are linked indirectly via changes to (1) trade flows, (2) foreign direct investment flows (FDI), or (3) directly via RTA clauses. Relevant FTA provisions were identified from Dur and Baccini (2014).

First, increased importation and foreign investment in domestic production of food, beverages and tobacco can alter consumption of these products in a country after it reduces trade and investment barriers. This can occur via changes to the determinants of consumption of these products, including prices, availability, and marketing (Brownson, Haire-Joshu, and Luke 2006). Changes to these determinants can increase unhealthy behaviours where they entail more widespread availability, intensified marketing efforts, and lower prices of calorie dense processed foods rich in salt, sugar and fat; soft-drinks, alcoholic beverages, tobacco; and the ingredients used to manufacture these products. This is most likely to occur when countries partner with other countries that are home to internationally competitive companies that specialise in the production of unhealthful products, such as the United States (Stuckler et al. 2012).

Such a rise in unhealthy behaviours following an FTA can then lead to a rise in diseases related to the over-consumption of these products, including overweight, obesity, type 2 diabetes, and cancer. However, changes to consumption may not necessarily entail a rise in unhealthy behaviours – and related health-outcomes – when partner countries do not competitively produce tobacco, unhealthy foods, caloric soft-drinks, and alcohol. They may also yield beneficial consequences for nutritional quality if partner countries trade competitively in nutritious foods, such as fruits, grains, and vegetables. This could, for example, increase the affordability of nutritious goods, and reduce under-nutrition and related health outcomes, such as infant survival rates (Owen and Wu 2007).

Second, FTAs can alter the scope and scale of production in a range of sectors through trade, FDI, and subsequent competition with domestic firms. This can impact incomes, insecurity,

working conditions, and employment which, in turn, can influence both physical and mental health (Benavides et al. 2000; Paul and Moser 2009). Individuals' wages and employment status can also impact on unhealthy behaviours indirectly via these changes to production. For example, income rises can increase demand for calorie dense food and beverages, whilst job losses associated with increased competition and changes to an economy's industry structure following an FTA could increase individuals' alcohol and tobacco consumption (Compton et al. 2014; Mossakowski 2008).

Third, FTAs may impact on health-services and public policy. FTAs may promote trans-national trade in medical products and treatments, leading to an improvement in clinical outcomes and greater health-services coverage (Smith 2004). They may also increase tax revenues by raising incomes (Baunsgaard and Keen 2010), enabling the expansion of health-services and other public services that are associated with better health and longevity, such as education. In addition, FTAs could limit 'policy space': "the freedom, scope, and mechanisms that governments have to design, choose, and implement public policies in order to fulfil health-related priorities and aims" (Koivusalo et al. 2009). They may do so as they contain rules that governments or businesses invoke to delay, alter, or prevent the introduction of policies designed to protect public health. For example, World Trade Organization (WTO) members are obliged to design new regulations and policies that do not introduce 'unnecessary trade costs' because the stated objective of the measure could be achieved with a less costly alternative (WTO 2015b). Similar clauses are contained in other FTAs (Dür et al. 2014).

Governments or businesses can invoke such clauses and initiate formal proceedings, overseen by a judge, to decide whether the regulation is actually consistent with the FTA's rules. These formal dispute settlement procedures may mandate a change, delay or even the reversal of such a policy. The clauses may also be invoked in less formal settings, outside of courts. For example, a business or government could cite the rules in a meeting with policy-makers, arguing that a proposed regulation designed to prevent unhealthy behaviours violates an FTA's policy-making rules (Ottersen et al. 2014). Such an informal 'challenge' to a regulation can lead to 'regulatory chill' effects whereupon countries to delay, alter or repeal a regulation in order to avoid the costs of a formal dispute (Koivusalo et al. 2009). Finally, the nature and presence of such regulations – or their absence – can, in turn, also impact the scope and scale of production and consumption of the products they affect.

2.3 Previous reviews

Numerous studies have outlined these possible consequences of FTAs (Blouin et al. 2009; Friel et al. 2014; Koivusalo et al. 2009; Labonte and Schrecker 2007; Schram et al. 2017). Yet a comprehensive understanding of these possible impacts is currently limited, for three main reasons. First, previous systematic reviews of this scholarship did not scrutinise several important outcomes and pathways. For example, one previous review evaluated the effects of trade and FDI on health systems (Smith 2004), a second investigated non-nutritive health outcomes (Burns, Jones, and Suhrcke 2016), and a third evaluated the effects of FTAs on food environments (Friel, Hattersley, et al. 2013). These reviews did not include several possible consequences of FTAs, including policy-making and tobacco and alcohol consumption. Other reviews of FTAs which did include these additional outcomes were

summaries, theoretical overviews, and policy commentaries (Friel et al. 2014; Gleeson and Friel 2013; Hawkes et al. 2010; Legge, Sanders, and McCoy 2009; McNamara 2017; McNeill et al. 2017). These may not incorporate the full scope of findings in this field as they did not use systematic literature search methodologies.

Second, research investigating the links between FTAs and unhealthy behaviours span single country, post-reform case studies (Hughes and Lawrence 2005) to rigorous quasi-experimental analyses (Schram et al. 2015). However, previous reviews and commentaries did not evaluate study methodologies, making it unclear to what extent causal conclusions can be drawn from existing scholarship. This is especially important here as evaluations of the economic consequences of FTAs have identified a series of empirical and methodological challenges pertinent to their investigation. They have emphasised, for example, that FTAs and the trade liberalisation policies they encompass are often implemented alongside other market-oriented policies, such as market deregulation and privatization, and in response to major macroeconomic transformations, such as recessions (Baier and Bergstrand 2009, 2007; Büthe and Milner 2008; Rodriguez and Rodrik 2000). They also noted that FTAs are often implemented in response to other factors that make trade and investment more profitable, such as cultural similarities and having similar economic development levels. As these factors can influence unhealthy behaviours (Cecchini 2014; Popkin et al. 2012), it is necessary to address these potential confounders in order to make valid causal inferences.

Finally, previous studies and commentaries reviewed analyses of the health impact of trade and investment flows as well as policies. However, economic evaluations of FTAs and related policies have documented considerable heterogeneity in their impacts on trade, investment

and economic growth (Dür et al. 2014; Rodriguez and Rodrik 2000). Thus, conclusions from studies of the impact of trade and investment on unhealthy behaviours may not apply to trade and investment policies like FTAs because, as McNamara noted, doing so "conflates trade liberalisation for its presumed outcomes" (McNamara 2017:11). Thus, it is unclear to what extent the findings from previous reviews apply to FTAs and the policies they encompass (Burns et al. 2016; Friel, Hattersley, et al. 2013; Smith 2004).

In the remainder of this chapter I address these gaps by systematically reviewing quantitative studies of the health impact of FTAs, the trade liberalisation policies they encompass, and corresponding pathways. I conduct a qualitative synthesis of study findings, evaluate the methodological quality of this literature, and assess co-citation patterns to evaluate the degree of cross-disciplinary knowledge incorporation.

2.4 Methods

2.4.1 Study selection criteria

I conducted my systematic review according to widely used PRISMA guidelines set out in Moher et al. (2009) (see Appendix 2.1 for full PRISMA checklist). Figure 2.3 shows my study identification, screening and exclusion procedures. First, I searched Web of Science, Scopus, PubMed, EMBASE, and Global Health Online on 19 January 2016 for articles published since 1960. Following the methodology of Friel and colleagues (2013) I used terms that captured studies of trade and investment policies that were not analysed in the context of a specific FTA but are common components of many agreements. Appendix 2.2 describes my search operators in detail. This initial search identified 7,802 papers. To ensure completeness

I reviewed the bibliographies of commentaries and book chapters and searched the websites of relevant international organisations including the World Health Organisation (WHO) and WTO, identifying an additional 6 studies.

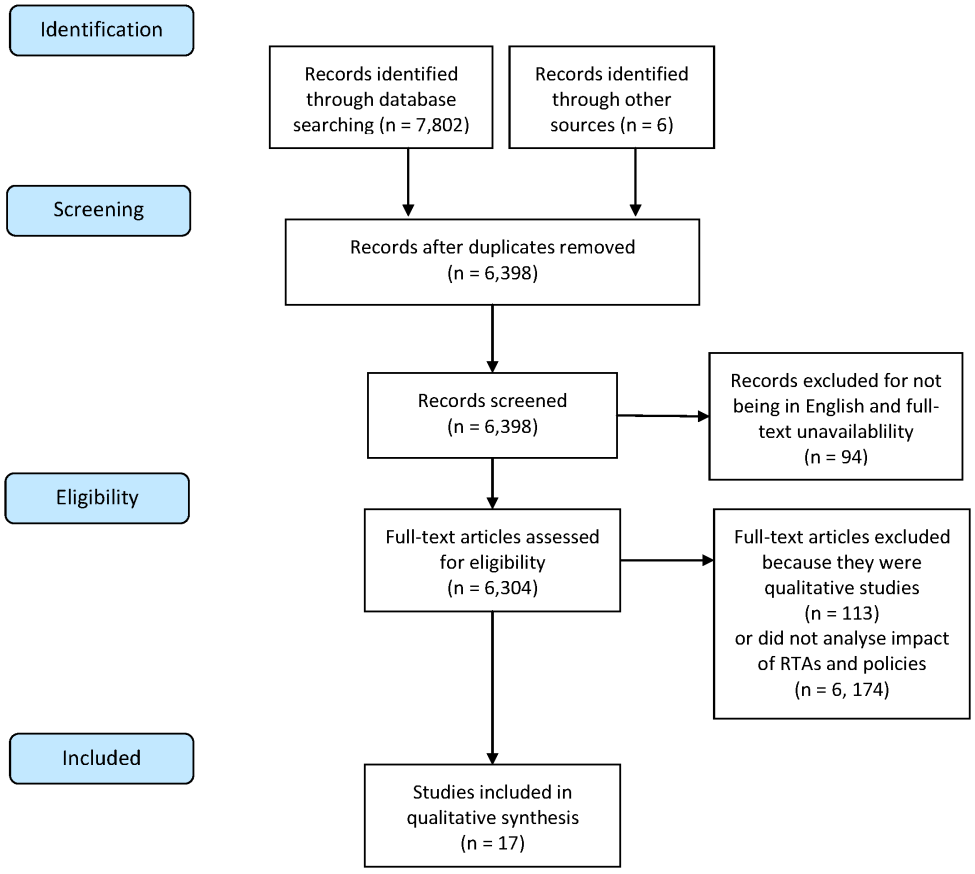


Figure 2.3 PRISMA diagram showing study identification procedures.
Notes: Flow diagram based on PRISMA guidelines set out in Liberati et al. 2009. See Appendix 2.1 for full PRISMA checklist.

Out of 7,808 studies identified per the methods above I excluded duplicates (n = 1,410 studies), non-English studies (n = 90 studies), those which were not full articles (n = 4 studies), analyses which did not study the health effects FTAs or trade policies (n = 6,174 studies), and qualitative case studies (n = 113 studies). I then extracted details of the study's title, author(s), countries, years, unit of analysis, research question, study design, trade policy

measurement, method of analysis, main results, and conclusions. I then grouped study findings into three categories of outcomes: i) food, beverage and tobacco consumption, ii) access to medicines, and iii) overall health outcomes.

2.4.2 Quality assessment

To rate methodological quality I used the Quality Assessment Tool from the Effective Public Health Practice Project (Thomas, Ciliska, and Dobbins 2004). This tool provides a standardized means for assessing study quality by scoring analyses between 1 ('strong') and 3 ('weak') on six methodological components, measuring the strength of: (1) study design, (2) addressing selection bias, (3) addressing other confounders, (4) data collection, (5) data analysis, and (6) reporting (Craig et al. 2012). For example, quasi-experimental studies which mimic a randomized control trial are coded as having a 'strong' study design, whilst multi-country multivariate studies have a 'fair' design, and post-intervention, single country case studies are scored as 'weak'.

2.4.3 Network co-citation analysis

Bibliometric analyses of reference lists can improve our understanding of a research area and possible ways to improve it by indicating the extent to which concepts, theories, methods, and findings from disparate fields are incorporated or overlooked elsewhere (van Eck and Waltman 2010; Evans and Foster 2011; Stuckler et al. 2015; Trinquart, Johns, and Galea 2016). This is especially important for studies of FTAs and unhealthy behaviours as the prospective links between FTAs and health integrate findings from disparate disciplines, and because important methodological considerations have been emphasised in other social

scientific fields. I therefore analysed co-citation patterns to identify the degree of cross-disciplinary fertilisation in included studies.

Co-citation measures the frequency with which two sources are cited together by other documents and is a proxy for whether insights from different fields are being acknowledged collectively (van Eck and Waltman 2010). To map co-citation patterns I extracted readily available citation data from PubMed and Web of Science and applied network-mapping and clustering procedures developed by van Eck and Waltman using VOSViewer software (van Eck and Waltman 2010). To conduct this clustering analysis I first identified a list of journals that had published papers which were referenced at least 5 times by the studies included in my review.[3] Co-citation of journals in this list is then captured in a matrix, where each cell c_{ij} refers to the number of times a paper in journal i is cited in a paper that also cites a paper in journal j; this is normalized according to the total number of citations of journal i and j. The network-graphing algorithm developed by van Eck and Waltman (2010) then maps the spatial locations of each journal by minimizing the Euclidean distances between journal pairs, whilst also ensuring that journals with higher values of c_{ij} are mapped closer to one another. The algorithm also identifies journal communities or 'clusters' which have similar co-citation patterns; these are colour coded on the network map.[4]

[3] I identified comparable co-citation patterns when setting this minimum to 2 and 10 citations. However, these networks were comparatively sparse (min. 2) and dense (min. 10 citations), making it more difficult to clearly discern co-citation patterns from the visualisations created by VOSViewer.

[4] Waltman and van Eck's clustering procedure for identifying communities with similar co-citation patterns is a variant of the widely applied procedure developed by Newman and Girvan (2004). This identifies a cluster classification schemewhich maximises the difference between the observed number of co-citations within an assigned subgroup and the number that occur when co-citations are assigned randomly in the network (Newman and Girvan 2004; Waltman, Van Eck, and Noyons 2010).

2.5 Results

2.5.1 Study characteristics

Searches and exclusion identified 17 quantitative research articles, which are summarised in Table 2.1. Eleven studies analysed the impact of FTAs on changes to the availability and consumption of food, tobacco and beverages. One study analysed the associations between FTAs and health-services and policy via changing access to pharmaceuticals. Six studies analysed associations of FTAs and trade policies with health outcomes, including rates of under-five and maternal mortality, life expectancy, cardiovascular disease incidence, and Body Mass Index (BMI), derived from the ratio of an adult's weight to their height.

Table 2.1 Previous studies of FTAs, health-determinants, and outcomes

Source	**Countries studied**	**Years**	**Analysis**	**Category**
Bozorgmehr and San Sebastian, 2014	22 high TB-burden countries	1990-2010	Multivariate	Health outcomes (TB and HIV incidence)
Chaloupka and Laixuthai, 1996	10 Asian countries	1970-1991	Multivariate	Tobacco consumption
Chatterjee et al., 2011,	India	1990-2006	Bivariate	Food consumption
De Vogli et al., 2014	127 low-, middle- and high-income countries	1980-2008	Multivariate	Health outcomes (BMI)
Drope and Chavez, 2014	9 Southeast Asian countries	1999-2012	Bivariate	Tobacco consumption
Goryakin et al., 2015	56 low- and middle-income countries	1991-2009	Multivariate	Health outcomes (BMI)
Hawkes, 2007	Central America (Honduras, El Salvador, Nicarague, Costa Rica, Guatemala), India, South Africa, Bangladesh, Uganda	various	Bivariate	Food consumption

Hawkes, 2010	Brazil, Argentina, Indonesia, Malaysia, China and India	1990-2005	Bivariate	Food consumption
Schram et al., 2013	48 Sub-Saharan African countries	1995-2012	Bivariate	Food and beverage consumption
Schram et al., 2015	Vietnam and The Philippines	1999-2013	Natural experiment	Beverage consumption
Sharif et al., 2008	Pakistan	1993-2005	Multivariate	Health outcomes (mortality)
Stuckler et al., 2012	80 low- and middle-income countries	1997-2010	Multivariate	Beverage consumption
Tausch, 2015	99 low-, middle- and high-income countries	1970-2005	Multivariate	Health outcomes (mortality)
Thow and Hawkes, 2009	Honduras, Costa Rica, Guatemala, El Salvador, Nicaragua	1990-2006	Bivariate	Food consumption
Thow and Snowdon, 2010	10 Pacific Island countries	1961-2005	Bivariate	Food consumption
Umana-Pena et al., 2014	WTO member countries	1995-2010	Multivariate	Health outcomes (mortality)
Yamabhai et al., 2011	Thailand	2006-2013	Bivariate	Health-services and policy

Notes: See main text for study identification procedures and a full description of study methods and results. See Bibliography for full references.

2.5.2 Food, beverage and tobacco consumption

Among the eleven studies in this category, six were bivariate analyses, four were multivariate analyses, and one used a quasi-experimental design. Overall, implementing FTAs and associated policies was correlated with increased imports and consumption of edible oils,

staple grains, meats, processed foods, and sugar-sweetened beverages. Studies of tobacco consumption reported contrasting results.

2.5.2.1 Diets and food

Five bivariate analyses identified increased imports, supply, sales and consumption of processed foods, edible oils, and meats after reducing tariffs on these products. For example, Chatterjee et al. identified an 111% increase in edible oil imports and a 12.5% rise in processed food consumption in urban areas in India after tariffs were reduced on these products as part of a larger package of reforms implemented in the 1990s (Chatterjee, Rae, and Ray 2011). A further four studies also identified increases in the supply of animal products, processed foods and staple grains – such as rice and cereals – in the period after tariff reductions on these products in Central America, Latin America, Africa, the Pacific, and Southeast Asia (Hawkes et al. 2010; Thow, Heywood, et al. 2015; Thow and Hawkes 2009).

Two multivariate studies analysed the associations between trade agreements and the consumption of staple grains, processed foods, and sugar-sweetened beverages. Schram et al. used structural equation modelling to analyse the association between the economic dimension of the KOF (Konjunkturforschungsstelle Swiss Economic Institute) globalisation index and per capita sales of multiple food products in 48 Sub-Saharan African countries 1995-2012. This dimension of the KOF index is a composite measure of both restrictions and flows of trade and investment (Dreher 2006). The authors' identified a positive correlation between this index, foreign investment inflows, and imports of high-sugar and energy-dense foods, grocery retail sales, and total per capita food supplies (Schram, Labonte, and Sanders 2013). Sharif et al. (2008) analysed the effect of the 1994 Uruguay round of trade liberalisation

agreements (enforced via the WTO) on changes to the production and consumption of wheat and rice in Pakistan, 1993-2005, and identified a subsequent rise in the wholesale price of rice and wheat production and a corresponding reduction in demand for these products (Sharif et al. 2008).

2.5.2.2 Beverages

One multivariate study by Stuckler et al. analysed the association between entering into FTAs with the United States and soft-drinks sales in 50 low- and middle-income countries, 1997-2010. They found that countries with US FTAs had 63.4% higher levels of soft-drink consumption per capita compared with countries without US FTAs (Stuckler et al. 2012). Another study analysed the effects of FTAs on soft-drinks sales using quasi-experimental methods. Schram et al. (2015) analysed a natural experiment in Vietnam and the Philippines to evaluate the effect of joining the WTO on sugar-sweetened beverage sales. The authors found that after Vietnam removed trade restrictions to join the WTO, the growth rate of soft-drink sales per capita rose 4.6L per annum faster in Vietnam compared with the Philippines (Schram et al. 2015).

2.5.2.3 Tobacco

A bivariate study by Drope et al. analysed the association between changes to cigarette tariffs and per capita cigarette consumption in Southeast Asia in 1999 and 2012, and reported no statistically significant association (Drope and Chavez 2014). In a multivariate analysis, Chaloupka et al. estimated cross-national longitudinal fixed-effects models to study the association between removing tobacco industry protections – including tariffs – and cigarette consumption in 10 Asian countries, 1970-1992. The authors estimated that removing the

protections increased per capita cigarette consumption by nearly 10% by 1991 (Chaloupka and Laixuthai 1996).

2.5.3 Health-services and policy

I identified one study which analysed the impact of trade barrier reductions on health-services and policy. Yambhai et al. (2011) analysed the effects of granting import licenses for seven generic equivalents of domestically patented drugs in Thailand, 2002-2008. The authors calculated differences between extrapolated pre-intervention and observed post-intervention rates of access to the drugs in order to estimate that an additional 84,158 patients received access and 12,493 quality-adjusted years of life (QALYs) were gained due to the reforms (Yamabhai et al. 2011).

2.5.4 Health outcomes

Six studies analysed the effects of FTAs and trade policies on health outcomes, including rates of under-five and maternal mortality, life expectancy, tuberculosis incidence, Body Mass Index (BMI), and cardiovascular disease incidence. All six studies used multivariate statistical methods. Overall, implementing trade liberalisation policies and trade agreements was linked with higher BMIs and cardiovascular disease incidence, but there was no consistent association with under-five and maternal mortality, life expectancy and tuberculosis incidence.

Turning first to mortality and life expectancy, Umana-Pena et al. (2015) asked whether there was an association between these outcomes and liberalisation in the service sector in WTO

member countries, 1994-2010. In cross-sectional regression models, higher levels of service sector liberalisation were associated with lower maternal and infant mortality rates, and longer life-expectancy, but greater liberalisation between 1995 and 2010 was not associated with greater changes in under-5 mortality, maternal mortality, or life expectancy (Umaña-Peña et al. 2014). In contrast, Tausch et al. studied the association between the economic globalisation dimension of the KOF index and infant mortality rates in 99 low-, middle- and high-income countries, 1970-2005, finding that greater restrictions on FDI and trade were associated with higher rates of infant mortality (Tausch 2015).

Bozorgmehr et al. (2014) analysed the association between TB incidence and four trade policy indicators: WTO membership, duration of membership, the trade and investment dimensions of the KOF index, and the Freedom House Economic Freedom index in 22 high-TB burden countries, 1990-2010. The authors find WTO member countries had significantly higher TB incidence rates compared with non-members. Results for the three other indicators were not statistically significant (Bozorgmehr and San Sebastian 2014).

Turning to studies of BMI and cardiovascular disease, Goryakin et al. reported a positive association between a woman's probability of being overweight and a country's degree of globalisation, measured using the economic, political and social dimensions of the KOF index. The authors used multi-level longitudinal models combining country- and individual-level data in 56 low- and middle-income countries, 1992-2009. The authors found that the association between BMI and globalization was stronger for social and political dimensions of the KOF index compared with the economic dimension (Goryakin et al. 2015). In addition, De Vogli et al. estimated longitudinal fixed-effects models in a sample of 127 countries, 1980-

2008, and also report a positive association between the economic globalization dimension of the KOF index and a country's mean BMI (De Vogli 2011). Finally, the studies of processed food and beverage consumption by Stuckler et al. (2012) and Schram et al. (2013) also reported a positive association of implementing FTAs with rates of cardiovascular disease, and population overweight and obesity prevalence (Schram et al. 2013; Stuckler et al. 2012).

2.5.5 Co-citation analysis

Included studies were published most frequently in 'Globalization and Health' (3 studies) with the remainder spread across journals in public health and social science (10 studies), book chapters (2 studies) and policy institute reports (2 studies) (see Appendix 2.4). Figure 2.4 shows the results from my analysis of journal co-citation patterns.

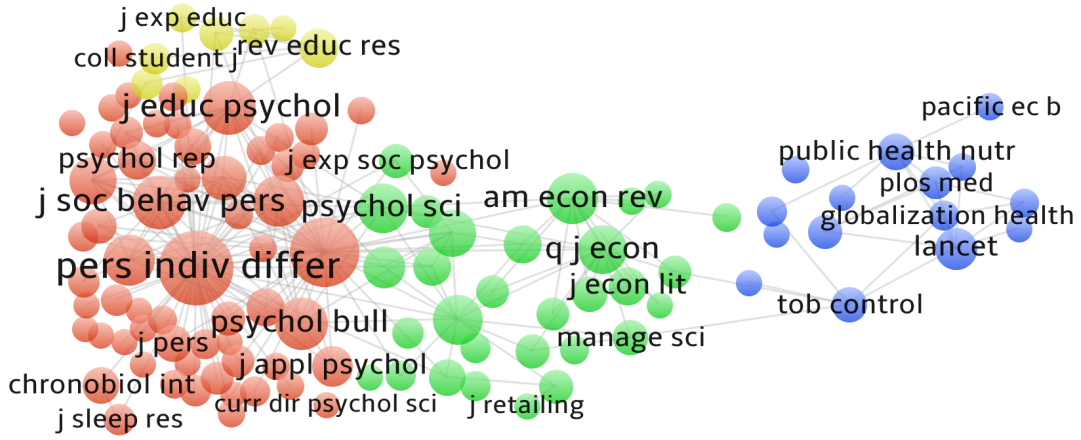


Figure 2.4 Literature co-citation patterns
Notes: Map shows co-citation patterns of the 117 journals cited at least 5 times within the studies we reviewed. Node size corresponds to the number of citations, lines correspond to the existence of a citation in either direction, and distance between nodes corresponds to the tendency for studies to be cited together by other studies.

Figure 2.4 shows four co-citation clusters in psychology (red), education (yellow), economics (green), and public health (blue) journals. There is a strong tendency for co-citation of studies in psychology and education, and psychology and economics, but a weaker tendency for co-citation between public health and economics.

2.5.6 Methodological quality assessment

Out of the seventeen studies included in my review, fifteen analysed repeated cross-sections of country-level data, one study analysed cross-sectional regional and firm-level data, and one study analysed repeated cross-sectional individual level data. Eight studies used bivariate time-series designs using only post-reform data, eight used multivariate regression, and one analysed a quasi-natural experiment.

Figure 2.5 shows the results from the full quality assessment of included studies. Overall, six out of seventeen studies were rated as 'strong' on overall methodological quality and risk of bias; eight studies were rated as 'moderate', and three studies were rated as 'weak'. In addition, trade and investment policy measures varied in specificity and studies with stronger study designs used measures with weaker specificity. Five post-reform bivariate studies analysed product-specific changes in FTA policies, such as the tariff rate. Five multi-variate and quasi-experimental studies constructed dichotomous indicators of whether a country had implemented a specific FTA or not. Three studies measured changes to a trade or investment policies affecting multiple products and sectors, such as the mean tariff rate, and a further five studies used an index, including four which used the economic globalisation component of the KOF index.

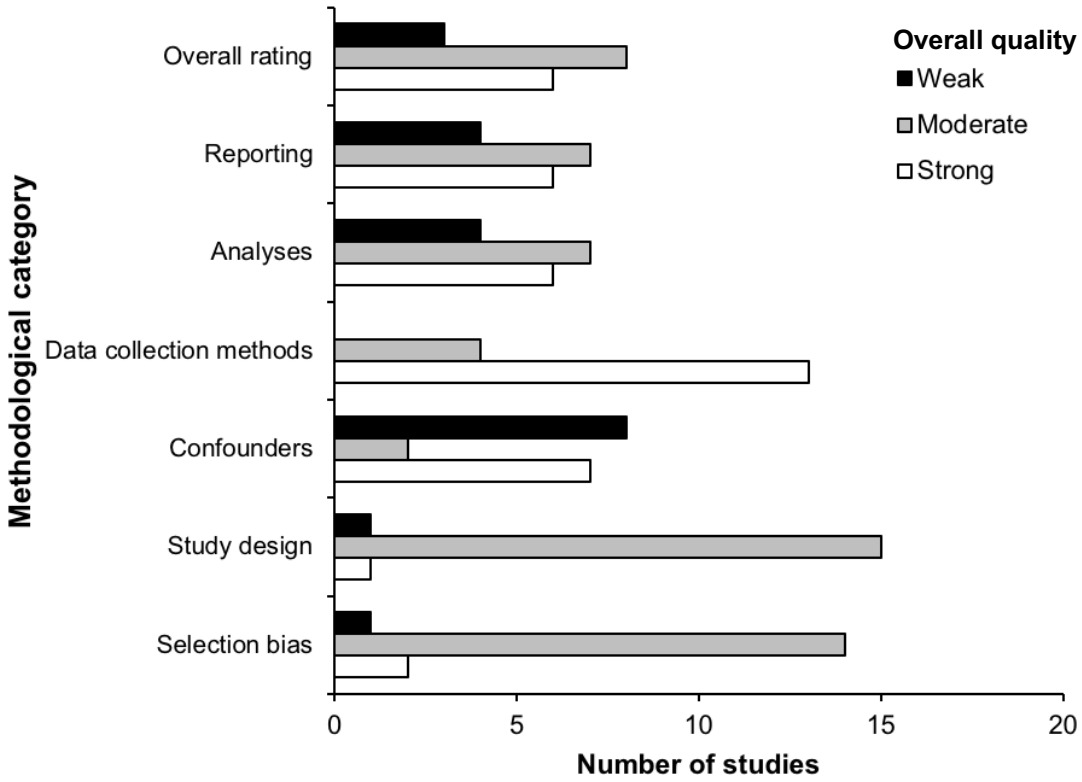


Figure 2.5 Methodological quality assessment
Notes: Studies reviewed = 17. Studies were evaluated using an adapted version of the Quality Assessment Tool developed by the Effective Public Health Practice Project (Thomas et al. 2004). See Appendix 3 for full details.

2.6 Discussion

This review has produced five main findings. First, implementing FTAs and related policies were associated with increased sales and consumption of processed foods, staple grains, and sugar-sweetened beverages. Second, granting import licenses for domestically patented drugs was correlated with increased access to pharmaceuticals. Third, implementing trade agreements and associated policies was correlated with higher cardiovascular disease incidence and higher BMIs, whilst correlations with tobacco consumption, under-five mortality, maternal mortality, tuberculosis, and life expectancy were inconclusive. Fourth, the methodological quality of the studies was predominately 'weak' or 'moderate' (11 out of 17

studies), and studies with stronger study designs used trade policy measures with weaker specificity. Finally, there was weak co-citation between public health and economics.

This review has a number of limitations. Due to heterogeneity in measurement methods, research designs, and outcome variables it was not possible to perform a meta-analysis or calculate pooled effect sizes. Further, I restricted my analysis to quantitative studies in order to evaluate the evidence of causal effects, yet qualitative studies can also provide additional insights into the precise mechanisms through which FTAs might affect peoples' health and the contexts, meaning and importance attached to those changes.

I also identified multiple limitations in existing studies. First, the majority of studies that examined the consequences of FTAs on food, beverage and tobacco consumption and access to pharmaceuticals was post-reform case studies and bi-variate, interrupted time-series analyses. There is possible omitted variable bias, since trade agreements are often implemented as a consequence of, or alongside, other factors which can also affect unhealthy behaviours (Baier and Bergstrand 2009, 2007; Büthe and Milner 2008; Cecchini 2014; Rodriguez and Rodrik 2000; De Vogli, Kouvonen, and Gimeno 2014).

Second, studies with stronger methodological designs tended to analyse the effects of trade agreements and policies using measures with weak specificity. For example, the economic globalisation component of the KOF index, used in four multi-variate studies, can vary as a consequence of changes to both flows and restrictions on trade and investment (Dreher 2006). It is therefore unclear whether observed associations were a result of trade flows or policy since, as I noted in the Introduction to this chapter, the impact of the latter cannot be

inferred directly from the former (McNamara 2017; Rodriguez and Rodrik 2000). An alternative approach, frequently used in multi-variate studies, was to construct a dichotomous indicator of implementing an FTA. This is advantageous as it captures policy implementation rather than its presumed consequences. However, this approach also has a disadvantage: it treats FTAs as a 'black-box', meaning that it is unclear which policies within FTAs accounted for observed associations.

Third, the mechanisms that mediated the relationships between FTAs and the outcomes in each study were seldom explored. Studies which analysed mediating mechanisms predominantly focussed on the role of trade, potentially overlooking the importance of investment. Fourth, there was a strong reliance on country-level data, limiting a full understanding of the social groups in whom the health effects of FTAs were concentrated. Fifth, my co-citation analysis identified opportunities for greater incorporation of findings from other social scientific disciplines, such as the methodological considerations and empirical findings identified in economic analyses of FTAs.

Finally, there are several possible impacts of FTAs that I identified in my framework but were unexamined in existing studies. This includes the possible benefits and harms to health due to changes to caloric intake – which is an important determinant of body weight and related health outcomes – as well as dietary composition, alcohol consumption, employment, job security, and policy-making (Beaglehole and Yach 2003; Blouin et al. 2009; Evans et al. 2001; Friel et al. 2014). The absence of systematic quantitative studies of the impact of FTAs on policy-making via informal 'challenges' that invoke trade rules in an attempt to influence policy outside of courts is an especially notable omission in this literature given its prominence

in existing theoretical debates (Friel et al. 2014; Thow, Snowdon, et al. 2015; Weiss, Middleton, and Schrecker 2015). This is likely attributable to the absence of available data for performing such an analysis of informal challenges which are, by their very nature, difficult to identify and enumerate.

2.7 Conclusions

Taken together, the results from this review show that unhealthy behaviours – especially diets – were the main focus of previous scholarship on the health impact of FTAs. Previous studies found that implementing FTAs and related policies was consistently associated with increased sales and consumption of processed foods and sugar-sweetened beverages. However, most studies precluded definitive causal conclusions. In addition, previous studies analysed a narrow range of outcomes compared with the full scope of possible effects. Prior studies also treated FTAs as a 'black box' because they did not investigate the specific clauses within FTAs that correlated with dietary outcomes. Furthermore, there were no systematic quantitative studies of how trade rules are invoked to influence food, beverage and tobacco regulations, largely due to a dearth of available data. Finally, co-citation patterns showed low co-citation between public health and economics, illustrating potential for greater cross-disciplinary fertilisation and the methodological and empirical insights that flow from it. The next three empirical chapters of this thesis seek to address some of these gaps.

2.8 Appendix

Appendix 2.1 PRISMA checklist

Section/topic	#	Checklist item	Reported from page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	17-26
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	n/a (included in published version)
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	17-26
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	17-26
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	n/a
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	26-27

Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	26-27
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	26-27; Appendix 3
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	26-27
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	26-27
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	27-28
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	28
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	n/a
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	27-28
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	28-29
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	28-29
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	30-31
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	30-31
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	31-35

Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	31-35
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	n/a
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	43-44
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	36-38
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	38-40
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	38-40
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	38-41
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	n/a (included in published version)

Source: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6).

Appendix 2.2 Systematic review database search terms

Boolean operators were used to combine the below search terms:
Search terms
trade liberalisation; liberalization
investment liberalisation; liberalization
trade agreements; agreement
investment agreements; agreement
bilateral; bi-lateral agreements; agreement
multilateral; multi-lateral; agreements; agreement
preferential trade agreement; PTA
trade and investment agreement; TIA
regional trade agreement; RTA
trade policy; policies
investment policy; policies
globalisation
globalization
regionalism
multilateralism
multinationalism
economic integration

health
health service; health-service; health-services
healthcare; health-care

food
nutrition
alcohol
tobacco

social policy
social protection
health policy

disease
chronic disease
chronic diseases
non-communicable disease
non-communicable disease
NCD
NCDs

Appendix 2.3 Sources of previously published empirical studies

Journal, book or report title	Number of studies	Category
Globalization and Health	3	Globalization and Health
Globalisation, agriculture and development: perspectives from Asia-pacific	1	Book chapter
Trade, food, diet, and health: perspectives and policy options	1	Book chapter
NBER working paper 5543	1	Empirical study for policy report
WHO Commission on Social Determinants of Health report	1	Empirical study for policy report
Critical Public Health	1	Public health
Health Policy and Planning	1	Public health
International Journal of Health Planning Management	1	Public health
PLoS Medicine	1	Public health
Progress in Cardiovascular Diseases	1	Public health
Public Health Nutrition	1	Public health
Tobacco Control	1	Public health
Pakistan Development Review	1	Social science
Social Science and Medicine	1	Social science
PLoS One	1	Multidisciplinary
Total	17	

Chapter 3. Do Free Trade Agreements with the United States lead to a rise in caloric intake? Evidence from a natural experiment in Canada

3.1 Introduction

In the previous chapter I showed that most previous studies of FTAs and unhealthy behaviours – including diets – analysed a narrow range of outcomes and precluded causal conclusions. In this chapter I address these limitations in the context of a unique natural experiment arising from the exceptional circumstances leading to the implementation of the Canada-US Free Trade Agreement (CUSFTA) in 1989. Using fixed-effects regression models and the synthetic control method I test the hypothesis that CUSFTA corresponded to a rise in calorie availability and likely intake in Canada. I study potential mechanisms by analysing coinciding trends in US trade and investment in the Canadian food and beverage sector and model the possible impact of changes to caloric availability on body weights using data from the Canadian Health Promotion Survey.

The results from my analysis show that calorie availability was approximately 170 kilocalories per capita per day (kcal/ capita/ day) higher and grew, on average, by approximately 35 kcal/capita/day more per year in Canada following CUSFTA, compared with comparison units. US investment in the Canadian food and beverage sector increased by approximately $1.82 billion after CUSFTA, and changes to US investment preceded changes to calorie availability at consistent 5-year intervals throughout the post-CUSFTA period. Finally, I estimate that the rise in caloric intake attributable to CUSFTA would lead to an average weight-gain of between 1.8-12.2kg depending on an individual's sex, physical activity levels

and the assumed pass-through from calorie availability to consumption. These findings show how US FTAs can contribute to the diffusion of unhealthy diets that pertain in the US by fostering higher calorie consumption in partner countries. This underscores the importance of FTAs for understanding the root causes of unhealthy, high-calorie diets. It also shows how US FTAs can have a detrimental impact on an aspect of a society's well-being – its risk of developing NCDs – by encouraging higher caloric intake, which plays a critical role in causing obesity.

3.2 Background and theoretical framework

3.2.1 Caloric intake and obesity

Repeatedly consuming too many calories can contribute to a wide-range of diseases. Perhaps the most widely-recognised such condition is obesity, conventionally diagnosed when the ratio of an adult's weight to their height, or 'Body Mass Index' (BMI), exceeds 30 kilograms (kg) per metre-squared (WHO 2017b). This can, in turn, lead individuals to develop a range of NCDs including cardiovascular disease, type-2 diabetes, and cancer. Such risks, whilst less severe, can also apply to those who are overweight, with a BMI of 25-30 kg/m^2, as a majority of obesity-related illnesses arise from the excess fat that can also accumulate overweight persons (ibid).

In 2016, 39% (1.6 billion) adults aged 18 years and over were overweight and 13% (650 million) were obese globally (Ng et al. 2016). These figures represent a 3-fold increase in global rates of overweight and obesity since 1975. This rise occurred in almost every country in the world in the post-war era, although the rate and timing of this increase varied markedly between populations. This variation is illustrated in Figure 1, which shows how the proportion

of adults aged 15 or over who were obese differed among high-income countries and over time, 1990-2015. Rates of overweight and obesity also vary within societies. Studies of socio-economic disparities in obesity have consistently shown that there is a strong, negative association of socio-economic status (SES) with body-weight among women, and a weaker, less consistent relationship among men (McLaren 2007).

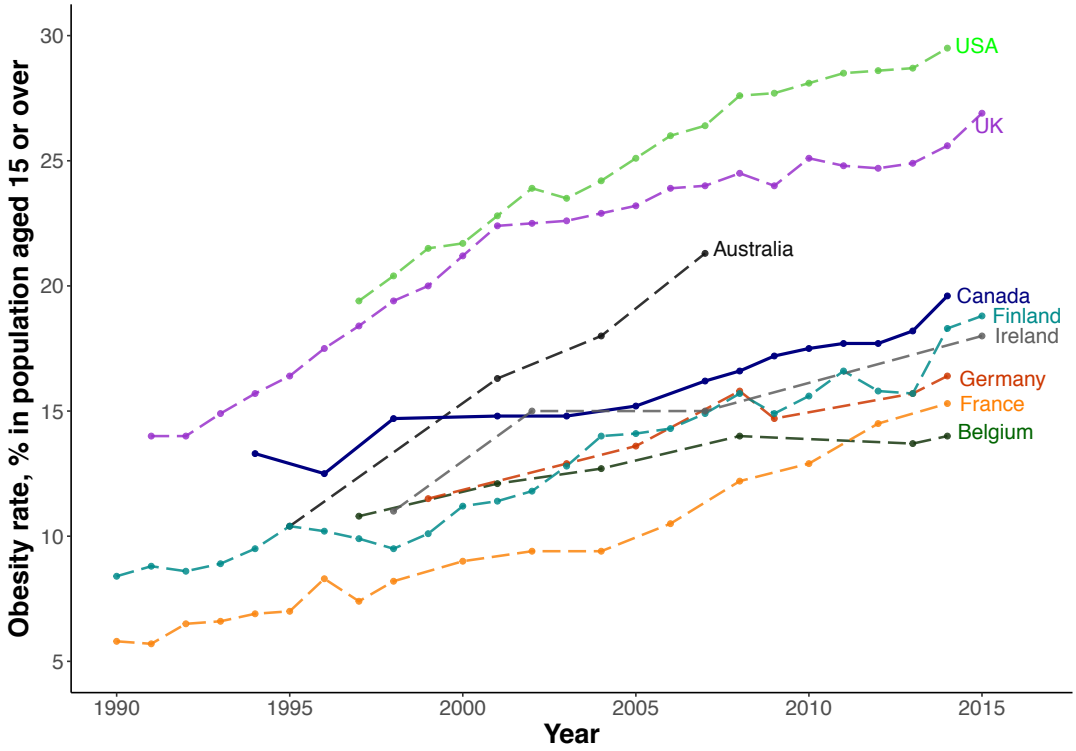


Figure 3.1 Obesity rates among adults aged 15 or over in select countries, 1990-2015
Notes: Data are from the Organization for Economic Co-Operation and Development (OECD 2016). The OECD calculates obesity rates using self-reported weight and height data from available national health surveys. This data is standardized by the OECD and used to calculate BMI and obesity rates (BMI $>$ 30 kg/m2). Many countries lack consistently measured longitudinal height and weight data, hence the limited number of countries shown here.

The rise and inequitable distribution of overweight and obesity have led scholars from diverse disciplines to investigate their causes. As McKinnon et al. observed, these causes "are simultaneously straightforward and complex" (McKinnon et al, 2009:352). Weight gain is the result of an imbalance between energy intake (usually measured in kilocalories) and energy

expenditure. This balance has "clearly been positive for many people" (McKinnon et al, 2009:352), leading to weight gain. Lower energy expenditure due to increasing rates of urbanization, car use, and employment in sedentary occupations can explain a proportion of within-population and cross-national differences in body weights at a fixed point in time (GBD Collaborators 2017). However, these societal changes often preceded the global increase in overweight and obesity (Rodgers et al. 2018; Swinburn et al. 2011). Reviews of the relative contribution of energy intake and expenditure to energy imbalance have therefore concluded that consuming more and excess calories has been at least as influential as declining energy expenditure in leading to rising rates of overweight and obesity since the 1970s in many high-income, industrialised, Western societies (Bleich et al. 2008; Hall et al. 2011; Scarborough, Burg, et al. 2011; Slater et al. 2009; Swinburn, Sacks, and Ravussin 2009).

What, then, causes excess caloric intake? The underlying causes are likely to arise from a complex array of factors. For example, a systematic review and meta-analysis of biological studies identified 22 genes that were consistently correlated with suppressed appetite regulation and so increased risk of high calorie intake (Walley, Blakemore, and Froguel 2006). However, genetic factors cannot fully account for total variation in caloric intake, especially differences between social groups, societies and historical contexts. This is because invoking genetic factors to explain these aspects of variation would imply implausibly large differences in genetic predisposition between socio-economic groups, societies and historical contexts (Rodgers et al. 2018).

Sociologists have therefore investigated how diverse social, economic and environmental factors also lead individuals to consume unhealthy, high calorie diets. They have shown, for example, how poverty, low educational attainment, low incomes, community deprivation and

geographic barriers to accessing cheap, nutritious food can all lead individuals to consume too many calories (Sobal 2011). Scholars working at the intersection of the health and social sciences more broadly have identified how additional factors that characterise an 'obesogenic environment' encourage high calorie intake and obesity. These factors include the low prices, heavy marketing, and the widespread availability of beverages and processed foods that are high in sugar, salt and fat (Cohen and Babey 2012; Roberto et al. 2015). These specific products play an important role in contributing to high calorie intake as low prices encourage high consumption, and these products tend to be calorie dense, leading people to unknowingly consume too many calories (Drewnowski and Specter 2004). The high palatability of processed foods and sugar-sweetened beverages can also encourage further food and beverage consumption and, quite possibly, addiction (Garber and Lustig 2011; Lustig, Schmidt, and Brindis 2012). Furthermore, drinking caloric beverages can contribute to increased caloric intake as it is rarely compensated for by an equivalent reduction in food consumption (Ludwig, Peterson, and Gortmaker 2001).

While this approach to understanding the social causes of dietary behaviours has provided invaluable insights into the factors that lead individuals to consume excess calories, it primarily focuses on micro- and meso-social determinants of unhealthy diets. As I noted in the Introduction of this thesis, such accounts cannot fully explain societal and temporal variation in exposure to the determinants of unhealthy diets, such as the substantial inter-societal variation in the extent and timing of exposure to the 'obesogenic' food environment. Macro-level factors, rooted on a society's macro-economic and political institutions, could also play a role, thereby constituting what Marmot called the 'root causes' of dietary behaviours (Marmot 2007).

3.2.2 US FTAs and caloric intake

As I mentioned in Chapters 1 and 2, FTAs have long been described as a macro-economic and political institution that can alter a society's dietary behaviours, including calorie intake (Cutler, Glaeser, and Shapiro 2003; Friel et al. 2014; Labonte and Schrecker 2007). They may do so by reducing barriers and increasing trade and investment in a range of sectors, including the food and beverage industry (Friel, Hattersley, et al. 2013; Friel et al. 2014; Labonte and Schrecker 2007; Schram et al. 2017). As summarised in Figure 2, these changes can subsequently alter the affordability, availability, marketing and desirability of food and beverage consumption, with consequences for dietary composition and the number of calories that people consume.

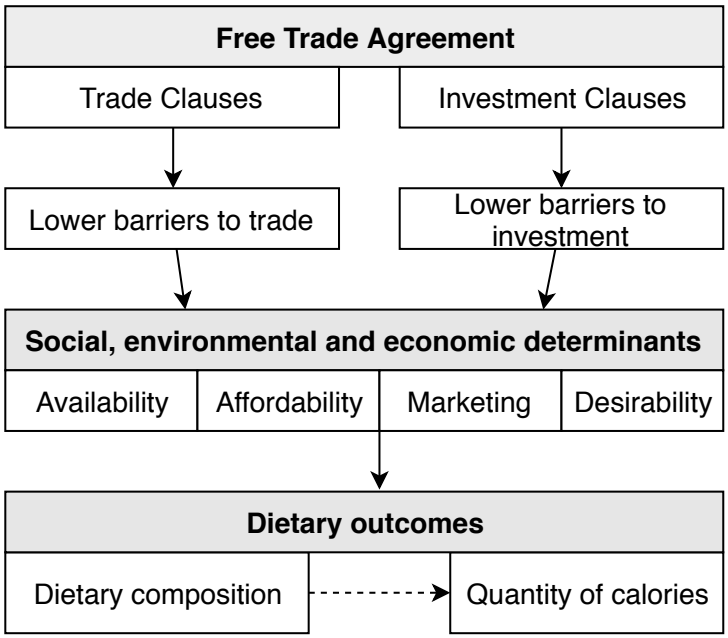


Figure 3.2 Mechanisms linking FTAs to dietary outcomes
Notes: Adapted from Labonte and Shrecker (2007), Friel et al. (2013), Friel et al. (2015), and Schram et al. (2017). Dashed line from dietary composition to quantity of calories conveys how a rise in the proportion of calorie dense foods in an individual's diet can contribute to a rise in caloric intake.

FTAs can boost food and beverage trade as they contain clauses that require countries to reduce trade barriers. By facilitating imports these changes can lead to increased competition, lower prices, and so increase the 'affordability' of food and beverages, whilst also altering 'availability': the convenience, diversity and overall quantity of food and products that are available for consumption (Roberto et al. 2015). FTAs can also change domestic food and beverage production if barriers and disincentives to foreign investment (such as lack of investor protection against unfair taxes) in this sector are removed, increasing availability by introducing new products or expanding the quantity of existing products they can purchase. Rising investment can also lead to lower prices that increase affordability through, for example, investment in automation or larger-scale production facilities.

In addition, domestic food and beverage producers may respond to the increase in competition arising from rising trade and investment by setting lower prices, again increasing affordability. Trade and foreign investment in other sectors may also act to increase wages and boost employment, increasing incomes and affordability. This can also alter tastes and preferences – or the 'desirability' – of food and beverages, shifting consumption away from staple grains towards increased consumption of calorie dense food and beverages (Popkin 2001). Desirability may also rise via increased marketing and promotion of food and beverage products following an FTA. For example, domestic producers may intensify their marketing campaigns in response to increased competition from abroad, whilst foreign producers are likely to increase their marketing efforts as they look to increase sales of their products in the partner country. In addition, consumption may become more desirable via additional through channels, including increased exposure to foreign cultures that appeal to or generate preferences for innovative or fashionable foreign food and beverage products.

These changes to peoples' diets are likely to vary over time and within populations. Temporally, changes may take time to accrue due to the time needed to build or expand production facilities, co-ordinate distribution networks, increase production and the supply of inputs, and build new sales outlets (Gerring and Thacker 2008; Krugman, Obstfeld, and Melitz 2011). Within populations, lower SES groups with less education and lower incomes may be more sensitive to price changes and may lack awareness of the harms to health from consuming too many calories (Pampel et al. 2010). In addition, McLaren notes that a thinner body may be more socially valued among women compared with men, leading to limited caloric intake, but this may be more materially viable for women in higher SES strata (McLaren 2007). Thus, women pay closer attention to restricting calorie intake, but lower SES women are less able to do so (ibid). Changes to dietary behaviour may therefore be concentrated in lower SES individuals, and changes to aggregate dietary outcomes could be driven by changes in this group. In addition, the SES gradient in these effects may be stronger among women than men.

Whether or not FTAs ultimately lead individuals to consume more or excess calories is not inevitable. When a country enters an FTA with another country or countries with a less competitive food sector it is less likely to experience a rise in food and beverage imports or investment and associated changes to availability, affordability, marketing, and desirability. However, where a country was unable to produce enough food of before the FTA, the agreement could lead to higher caloric intake that does not exceed caloric expenditure.

Entering into an FTA is nevertheless more likely to lead to a rise in net caloric intake in a given country when it has adequate food supply before the FTA and when it enters an agreement with the US. The US food environment is often described as 'obesogenic' (Giskes

et al. 2011; Swinburn, Egger, and Raza 1999). US food and beverage corporations are highly competitive as they operate on a large-scale and benefit from generous US farming subsidies (Guthman 2011). Large scale production and subsidies have led to the low cost and oversupply of corn, sugar and wheat, enabling US firms to set low prices and expand production of the highly-processed, high-calorie, highly fattening and highly palatable convenience foods and beverages which contain these ingredients, such as cakes, cookies, soda, and potato chips (ibid). These specific products are often calorie dense, highly palatable, and are heavily marketed by US corporations. An increasing quantity or proportion of these in an individual's diet could therefore make a rise in caloric intake especially likely (Garber and Lustig 2011; Ledikwe et al. 2006; Stuckler and Nestle 2012).

3.3 Literature review

My systematic review of quantitative studies evaluating the impact of FTAs on health outcomes and mediating pathways in Chapter 2 of this thesis showed that previous studies examining the possible link between FTAs and unhealthy diets, including high caloric intake, were methodologically and substantively limited. Below I describe these limitations in more detail.

Methodologically, previous studies were primarily within-country, post-reform case studies or cross-national comparative analyses that did not address important challenges to causal inference when evaluating the impact of FTAs (Baker et al. 2016; Hawkes et al. 2010; Schram et al. 2015; Stuckler et al. 2012; Thow and Hawkes 2009). First, FTAs are often implemented in response to major macroeconomic transformations, such as recessions (Trefler 2004). Second, FTAs are often implemented in response to factors that influence whether two

countries form an FTA (Baier and Bergstrand 2009). These factors include cultural similarities, including sharing a common language, and sharing a land border, being geographically close to one another, and having similar economic development levels (ibid). Third, FTAs are often ratified alongside other market-oriented policies, such as deregulation and privatization (Wacziarg and Welch 2008).

However, macroeconomic recessions and market-oriented reforms can also influence diets (Cecchini 2014; De Vogli et al. 2014). Furthermore, it is plausible that the factors that predict FTA formation could lead to high levels of calorie intake in the absence of an FTA. For example, cultural similarities with the US could lead countries to enter a US FTA but they could also reflect similarities in food preferences that otherwise lead to high calorie intake. In addition, cultural similarities, geographic proximity and similar levels of economic development could encourage FTA formation but also encourage higher trade and investment between countries. Again, this could impact diets through trade and investment in the food and beverage sector, even in the absence of an FTA. Previous studies did address these methodological challenges.

Another methodological complication lies in identifying the appropriate pre- and post FTA period. There is often a delay of several years between when an FTA is agreed and when it is implemented, and governments regularly implement several policy changes mandated in FTAs before the agreement is officially in force (Baier and Bergstrand 2009). Food and beverage markets may therefore change after the agreement is announced, but before the FTA is officially in force, in response to early policy changes or in anticipation of lower, more certain future trade and investment arrangements. This early response creates ambiguities in deciding the appropriate pre- and post-FTA cut-off and, as the authors acknowledged,

previous study findings may be sensitive to period specification decisions (Baker et al. 2016; Schram et al. 2015).

Finally, one mechanism through which FTAs are hypothesised to impact on diets is through increased investment and imports in the food and beverage sector. Existing studies that evaluated these potential mechanisms used relatively crude measures of trade and FDI that captured overall import or investment levels as a proportion of GDP (Baker et al. 2016; Schram et al. 2013; Stuckler 2008; Stuckler et al. 2012). However, these measures may capture changes to trade and FDI in other sectors. Other studies evaluated sector- or product-specific changes to trade, overlooking the potential role of investment (Clark et al. 2012; Mendez Lopez et al. 2017; Schram et al. 2015; Stuckler et al. 2012). This limits a full understanding of the causal relationship between FTAs and unhealthy diets as the hypothesized mechanisms from cause to outcome were only partially scrutinized (Morgan and Winship 2007).

Substantively, previous statistical analyses of FTAs and diets focussed on a narrow range of outcomes as they examined changes to sugar-sweetened beverage sales (Baker et al. 2016; Mendez Lopez et al. 2017; Schram et al. 2015; Stuckler and Nestle 2012). For example, Schram et al. (2015) evaluated the effect of joining the WTO upon sales of sugar-sweetened beverages in Vietnam. The authors found that after Vietnam removed trade restrictions to join the WTO, the growth rate of sugar-sweetened beverage sales per capita rose 4.6 litres per annum faster in Vietnam compared with the Philippines which did not enter the WTO in the study period (Schram et al. 2015). These findings are consistent with an earlier study by Stuckler et al. which reported that per capita soft-drink sales were 63.4% higher in low- and middle- income countries with US FTAs compared with countries without US FTAs (Stuckler et al. 2012). (Hall et al. 2011).

Previous studies have therefore identified how FTAs can contribute to a rise in unhealthy dietary behaviours by increasing sales and likely consumption of a specific product: sugar-sweetened soft-drinks. However, as my theoretical framework has shown, the impact of FTAs on dietary outcomes may broader in scope, as they can also impact on caloric intake. Understanding the consequences of FTAs for caloric intake is especially important as it plays an important role in the aetiology of obesity.

In this chapter I address these limitations by analysing a unique natural experiment, the 1989 Canada-US Free Trade Agreement (CUSFTA). I test the hypothesis that CUSFTA increased caloric availability and likely intake in Canada, and that these changes were potentially mediated by increased US exports and investment in the Canadian food and beverage sector.

3.4 Methods

3.4.1 A natural experiment in Canada

Dunning (2012) identified three characteristics of a natural experiment. First, exposure to the intervention (here the FTA) and control must be 'as-if' random. In this way, it simulates a randomised trial. It differs, however, in that assignment of the intervention is outside the control of the researchers. Second, the statistical models must be credible so that differences between intervention and control groups are not attributable to confounders, and, third, the case must have substantive relevance (Dunning 2012). Below I describe how my analysis of CUSFTA shares these characteristics – and so addresses several methodological limitations in previous research.

On 1 January 1989 the Canada-US Free Trade Agreement, 'CUSFTA', came into force. CUSFTA required both the US and Canada to reduce barriers to trade and investment in most sectors of the economy, including the food and beverage industry, over a 10-year period, beginning in January 1989 and ending in January 1999 (Appendix 3.1). The North American Free Trade Agreement, NAFTA, which came into force on 1 January 1994, later subsumed CUSFTA. NAFTA changed few trade arrangements between the US and Canada as these were covered by CUSFTA.

Economic analyses of FTAs describe how CUSFTA is in many ways a unique natural experiment (Breinlich 2015; Trefler 2004). First, unlike most FTAs, CUSFTA was not part of a larger package of reforms or implemented in response to a macroeconomic crisis, making it is possible to isolate its effects from these changes (ibid). It is also well-isolated from two other determinants of dietary changes in Canada in the post-war period: the rise in canola oil production, beginning in 1976 (Casséus 2009; Slater et al. 2009), and changes to sales taxes that were implemented in 2013 (Domingue and Soucy 2000; Jeffery 2013).

Second, the pre- and post-FTA periods are clearly demarcated, and, third, CUSFTA was unanticipated. This is because the fate of CUSFTA was decided by the Canadian general election in 1988. This so-called 'Free Trade Election' was very closely contested and centred on whether or not to implement CUSFTA (Brodie 1989). One side was pro-CUSFTA and the other against. No-one could be certain who would win – and so whether CUSFTA would be implemented – until the outcome of the election in November 1988. This created a distinct pre- and post-FTA cut-off, addressing issues created by potential anticipatory effects or the implementation of FTA clauses before the agreement was officially in force.

Fourth, CUSFTA's implementation was 'as-if' random. The trade deal's implementation was contingent on the outcome of the November 1988 election. But the victory of the pro-CUSFTA party was a quasi-random event: most Canadians voted for parties that opposed CUSFTA, but the pro-CUSFTA party secured a marginal victory and implemented the FTA as they won a majority of votes in two provinces which, due to Canada's electoral formula, elected more seats than the remaining eight Canadian provinces combined (Bowles 2008). CUSFTA was also implemented almost immediately after the election on 1 January 1989. Thus, CUSFTA was not implemented in 1989 in direct response to characteristics that predict FTA formation.

Finally, CUSFTA is substantively relevant. It was a landmark trade deal that was used as a blueprint for many subsequent FTAs, especially those between the US and other countries (Allee and Elsig 2015). The circumstances surrounding CUSFTA's implementation therefore characterize the FTA as a substantively relevant, 'as-if' random policy experiment that can be isolated from important potential confounders. This augments the credibility of inferences from my statistical models, which are also designed to address potential confounding, as described in further detail below.

3.4.2 Data and measurement

Table 3.1 summarizes the data sources and variables used in my analysis. I estimate the impact of CUSFTA on Canadian diets using annual calorie availability, or 'supply', data from United Nations Food and Agricultural Office Statistics Office, FAOSTAT (FAO 2014). This captures the total quantity of food and beverages available for human consumption in kilocalories ('kcal') per capita per day. Annual availability is calculated as the sum of imports

and domestic production, less exports, estimated wastage, and stocks carried over from the previous period, in kilograms. These are converted into kcal per person based on standardized nutritional measurements and UN population data, and then divided by 365 to construct a daily estimate.

Calorie availability is an indicator of the number of calories in a society's food environment and is a widely used proxy for consumption (Bleich et al. 2008; Clark et al. 2012; Slater et al. 2009; Swinburn et al. 2011). It has several strengths compared with survey-based measurements. It is more widely available than individual survey measures, which were not available in Canada or on a cross-national basis during the study period. Furthermore, unlike survey measures, calorie availability estimates are not subject to recall or social approval biases which can be especially problematic with regards to food and beverage consumption (Harper and Hallsworth 2016; Miller et al. 2008).

I sourced data on country-level covariates of calorie availability from the World Bank World Development Indicators 2015 Edition (World Bank 2015). Trade and investment data were from the US Bureau of Economic Analysis (USBEA 2016) and the US Department of Agriculture (USDA 2016). Body weight and height data used for my weight change models were based on data from the Canadian Health Promotion Survey in 1990 when data were first available (Statistics Canada 1990).

Table 3.1 Summary of variable definitions and data sources

Variable	Measure	Source
Calorie availability	Kilocalories per capita per day	United Nations Food and Agricultural Organisation Statistics Office (FAOSTAT), Food Balance Sheets, 2016
GDP per capita	Gross Domestic Product (GDP) per capita, measured in constant 2005 US dollars and adjusted for differences purchasing power	World Bank, World Development Indicators, 2015
Urbanization	Proportion of the total population living in urban dwellings as a percentage of the overall population	World Bank World Development Indicators, 2015
US-Canada food and beverage trade	US food exports to Canada and Canadian food exports to the US measured at current prices in millions of US dollars	United States Department of Agriculture (USDA), Global Agricultural Trade System, 2016
US investment in the Canadian food industry	US investment position in the food and beverage industry in Canada on a historical-cost basis in millions of US dollars	United States Bureau of Economic Analysis (BEA), US Direct Investment Abroad, 2016
Weight, by sex, among 40-year-old men and women	Mean self-reported weight, in kg	Statistics Canada, Canadian Health Promotion Survey, 1990
Height, by sex, among 40-year-old men and women	Mean self-reported height, in kg	Statistics Canada, Canadian Health Promotion Survey, 1990

Notes: See Bibliography for full references.

3.4.3 Fixed effects models

To estimate the impact of CUSFTA on calorie availability I estimated a fixed-effects regression model comparing changes to calorie availability in Canada with comparison countries, 1978-2006. This multi-country specification spanning 29 years is an extension of widely used difference-in-differences (DID) approach comparing changes in the outcome in a treated unit and one untreated unit, over two periods. Incorporating multiple countries helps to overcome the possibility that my results are driven by unobserved differences between Canada and a given comparison unit by enabling me to adjust for multiple country fixed-effects. Incorporating multiple time periods enabled me to adjust for time-trends and address the possibility that my results are driven by unobserved contextual differences between time-periods (Angrist and Pischke 2009). The model is given by equation 3.1:

$$(3.1)\quad Y_{it} = \alpha_0 + \gamma_i + \beta D_{it} + \theta X_{it} + \lambda T_t + \epsilon_{it}$$

Where Y_{it} is calorie availability in country i at time t; α_0 is the intercept; γ_i is the country-specific fixed-effect capturing unobserved, time-invariant factors like cultural and language similarities, sharing a common border, and geographic distance which vary between countries and may impact trade, investment, FTA formation and diets. β is my coefficient of interest capturing the impact of CUSFTA. It is estimated using a dummy variable for treatment status, where D=1 in Canada during the post-CUSFTA period 1989-2006, and D=0 otherwise. X_{it} is a vector of covariates with coefficients in the vector ϑ. Following previous studies my models control for Gross Domestic Product per capita and urbanisation rates (Mendez Lopez et al. 2017; Popkin et al. 2012; Schram et al. 2015; Stuckler 2008). Higher GDP per capita can predict the formation of an FTA with the US (which has high GDP levels) and increase calorie intake by increasing individuals' incomes, preferences, and

opportunities for consuming calorie dense foods (Drewnowski and Darmon 2005; Drewnowski and Popkin 1997). Urbanisation is also included as dense networks of consumers provide economies of scale for producers, including fast-food outlets and restaurants that serve calorie-dense meals, thereby increasing calorie intake (Popkin 1999; Schram et al. 2013). My models also adjust for linear time trends, captured in coefficient λ , which controls for unobserved time-varying factors that were constant across countries and led to periodic increases calorie availability over time. ϵ_{it} is the error term.

The coefficient β in equation 3.1 above models the impact of CUSFTA on the level of calorie availability in Canada. It is also possible that CUSFTA altered the annual growth rate of calorie availability in addition to the level. To assess this I estimated an additional model with a CUSFTA *x* year interaction term, per equation 3.2:

$$(3.2)\ Y_{it} = \alpha_0 + \gamma_i + \beta_1 D_{it} + \lambda T_t + \beta_2 T_t . D_{it} + \theta X_{it} + \epsilon_{it}$$

Where β_2 captures the impact of CUSFTA on annual growth in calorie availability; all other terms are as in Equation 1. I estimated all models in R using cluster-robust standard errors grouped at the country level to account for within-country correlation in the errors.

3.4.4 Sample and period specification

I conducted my analysis in the period 1978-2006, beginning when calorie availability and covariate data were available for all countries in my sample and ending before the onset of the financial crisis in 2007-2008 as this created widespread fluctuations in many OECD countries' macro-economic circumstances and population diets (Cecchini 2014).

In order to estimate the impact of CUSFTA on calorie availability it is necessary to compare changes in Canada with its counterfactual: how calorie availability would have evolved in Canada had it not entered the FTA. However, it is not possible to directly observe this counterfactual. A valid comparison country or countries that approximate this counterfactual should match on key parameters, not have received the US Free Trade Agreement 'treatment', have available data, and exhibit parallel trends in the outcome variable in the period preceding the treatment (Angrist and Pischke 2009). Figure 3.3 summarizes how I applied these criteria.

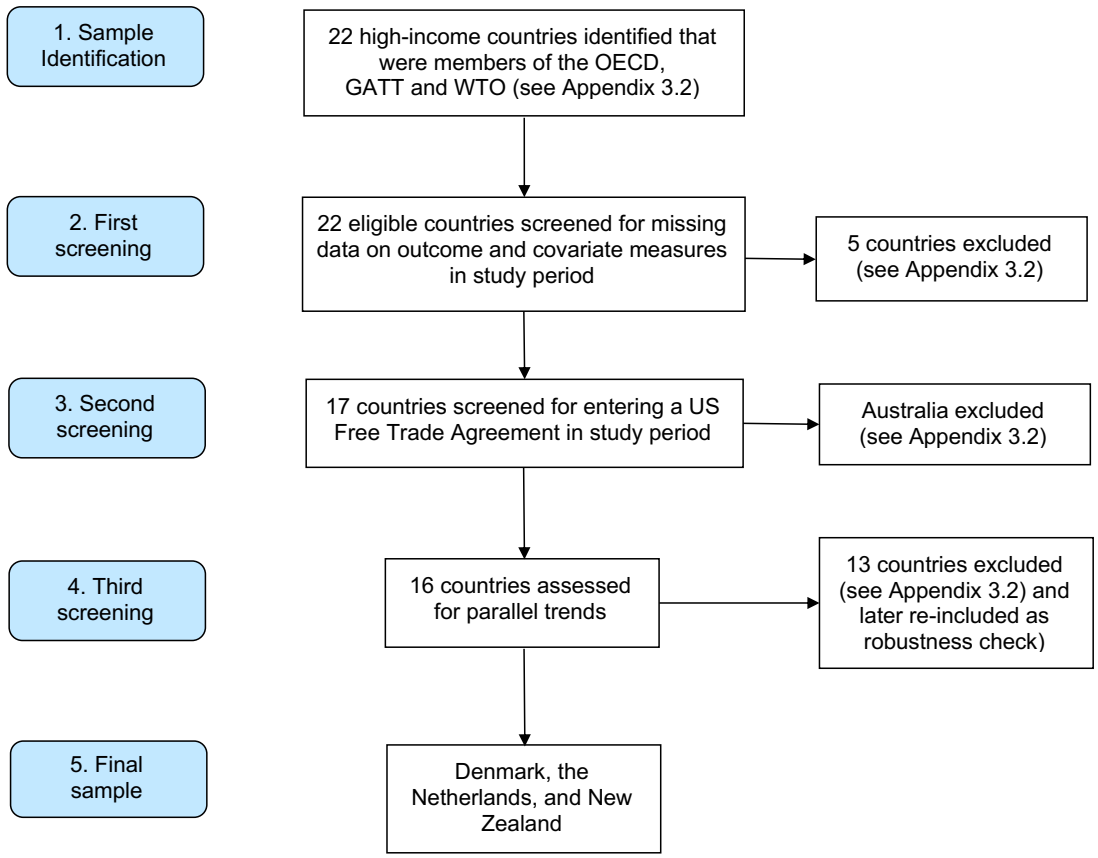


Figure 3.3 Comparison country selection procedures

First, I restricted the sample of potential comparison countries to 22 countries which, like Canada, had high-income levels, were members of Organization for Economic Co-Operation and Development (OECD), the General Agreement on Tariffs and Trade (GATT) at the

beginning of the study period in 1978 and, from 1995, the World Trade Organization (WTO). The OECD is an international organization, primarily comprising developed countries, that was founded in 1961 to stimulate economic progress, social well-being, and openness to trade (OECD 2018). The GATT was the WTO's precursor and was a legal agreement between members with an overall purpose of promoting international trade by reducing or eliminating trade barriers, such as tariffs and quotas. These restrictions to the sample of potential comparison countries therefore ensured that countries were structurally comparable with Canada in terms of both levels of economic and social development and openness to trade.

Second, I screened countries for data availability, excluding countries with incomplete calorie availability or covariate data in the study period. Third, I excluded countries which also received the 'treatment', that is, they entered an FTA with the US in the study period. Fourth, I screened countries for whether trends in calorie availability were parallel with trends in Canada in the pre-CUSFTA period 1978-1988. This restriction is important as it strengthens the credibility of an assumption implicit in inferences from my fixed-effects models: that calorie availability in Canada would have followed similar trends to those observed in comparison countries had Canada not entered CUSFTA. Here, I judged calorie availability trends as being 'parallel' to Canada if, like Canada, calorie availability i) fluctuated slightly in the period 1978-1983 with no overall growth or decline, ii) grew by within 20% of the 200 kcal/ capita/ day rise observed in Canada, 1984-1986, and iii) declined by within 20% of the 90 kcal/ capita/ day decline observed in Canada just before CUSFTA, 1987-1988. In the fifth stage countries meeting all three criteria were included in the analytical sample: Denmark, the Netherlands, and New Zealand.

Figure 3.4 plots normalized trends in calorie availability in Canada and comparison countries and shows that comparison countries had similar trends to Canada before CUSFTA. Appendix 3.2 lists the countries I identified as potential comparisons and the reason for each country's exclusion. I also conducted two additional sensitivity analyses in which I included in the sample all countries whose calorie availability trends were marginally above or below the aforementioned thresholds for identifying parallel trends, or which met two out of my three trend criteria. The results from these additional analyses, presented in the 'Results' section, show that my results were not sensitive to my sample selection procedure.

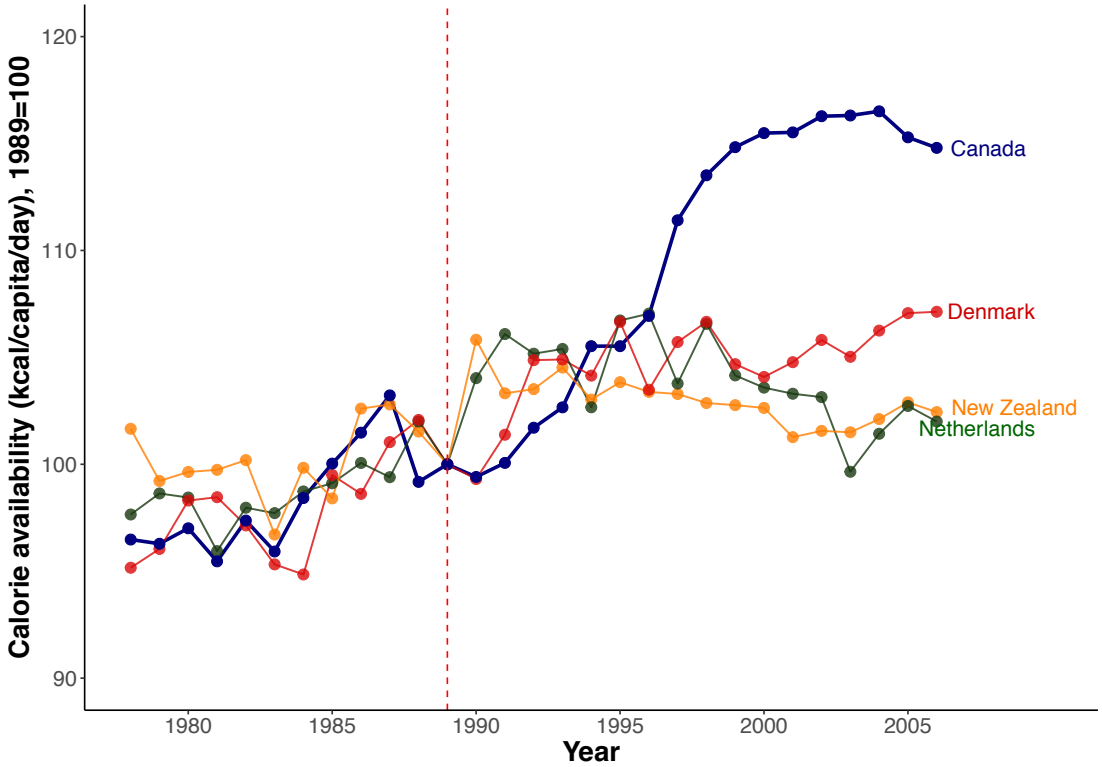


Figure 3.4 Calorie availability in Canada and comparison Countries, 1975-2006
Notes: Data from the United Nationals Food and Agricultural Office (2016).

3.4.5 Synthetic control analysis

Inferences from fixed-effects regression models can be sensitive to the parallel trends assumption, are model dependent, and often extrapolate beyond the bounds of what is observed in the data (Angrist and Pischke 2009; King and Zeng 2006). In addition, they implicitly assume that differences between Canada and comparison countries can be captured by covariates included in the regression model, whereas Canada and comparison countries could differ in other ways which might impact calorie availability and so account for my results (Acemoglu et al. 2016). I addressed these limitations and assessed whether these issues could impact my conclusions by re-estimating the impact of CUSFTA using the synthetic control method (Abadie and Gardeazabal 2003). The synthetic control method estimates the outcome in a counterfactual unit from a weighted combination of outcomes in similar countries. The algorithm selects comparison countries and assigns them weights by identifying the combination of countries and weights that minimizes the difference between the characteristics of the combined 'synthetic control' unit and Canada in the period before the intervention, per equation 3.3:

$$(3.3)\ \sum_{1}^{k} v_k(X_{1k} - X_{0k}W)^2$$

Where X_{1k} is a vector of pre-specified variables k = 1,...,k, in Canada, X_{0k} is a vector of variables k in the un-treated countries, and v_k is a vector of variable weights that reflects the predictive power of each variable. The synthetic control algorithm iterates through all possible combinations of country weights, W, and identifies the combination of countries and weights, W*, that minimizes the difference between the value of predictors of the weighted combination of countries, $X_{0k}W$, and in Canada, X_{1k}, in the period before the treatment. This algorithm assigns greater importance to matching on variables with higher predictive power

on the outcome.[5] Thus, this algorithm results in a synthetic control unit that resembles Canada as closely as possible in the pre-CUSFTA period in terms of calorie availability predictors. The effect of CUSFTA, δ, is then estimated by calculating the average difference between the outcome in the treated country, Canada, and its counterfactual synthetic control, across all years t in the post-treatment period T_1, per equation 3.4:

$$(3.4)\ \delta = \frac{1}{T_1}(Y_{1t} - \sum_{j=1}^{J} W^* Y_{jt})$$

Where Y_{1t} is the outcome in Canada at time t and the synthetic control counterfactual, w* Y_{it}, is the outcome in a weighted combination of comparison units i=1,...n, using the optimal weights identified per equation 3.3.

I first estimated this model using my original sample. As this model is not restricted by the parallel trends assumption, I then expanded the sample to include the countries that did not meet my parallel trends check when applying my sample-selection criteria for my fixed-effects models. This expanded sample comprised 16 countries: Austria, Denmark, Finland, France, Germany, Greece, Italy, Japan, The Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, the United States, and the United Kingdom.

The variables used for matching countries with Canada to estimate the synthetic control are meant to be predictors of the outcome variable, rather than covariates of the FTA and the outcome as in my fixed-effects regression models (Abadie, Diamond, and Hainmueller 2015).

[5] 'Predictive power' is captured in the predictor weights v_k, which minimize the mean squared prediction error of the model in the pre-treatment period.

Thus, in addition to the variables included in my fixed-effects specification I incorporated additional predictors that were available in comparison countries in the time period and can impact calorie availability, dietary preferences, and consumption: inflation, GDP growth, and the proportion of the population in each age group 0-14, 15-64, and over 65 years old (Cooke and Wardle 2007; Wansink, Cheney, and Chan 2003). All additional predictors were sourced from the World Bank World Development Indicators, 2015 edition (World Bank 2015).

Following recommendations in previous synthetic control analyses I also adjust for the impact of time-invariant unobserved differences between countries that could impact diets by including lagged values of the outcome variable, calorie availability, at fixed at 5 year intervals before CUFSTA was implemented i.e. in 1978, 1983, and 1988 (Abadie and Gardeazabal 2003). As Abadie et al. (2015:4) state, "matching on pre-intervention outcomes helps control for unobserved factors and for the heterogeneity of the effect of the observed and unobserved factors on the outcome of interest". In other words, Canada and its synthetic counterpart could only produce similar levels and trajectories in calorie availability in the pre-intervention period if they were alike in both observed and unobserved calorie availability predictors. Thus, unlike my fixed-effects models, this specification can also adjust for time-varying unobserved differences between Canada and treated countries.

One limitation of the synthetic control approach is that standard inference testing techniques are not suitable for assessing the significance of the results. Following suggestions by Abadie and colleagues I use placebo tests to compute pseudo p-values (Abadie et al. 2015). This approach assigns a dummy treatment to all other countries in the sample that did not actually enter CUSFTA. Pseudo p-values are then calculated as the proportion of effect estimates that are at least as large as the one in the treated unit. There are no rules-of-thumb for

evaluating significance levels. Instead, the pseudo p-values have the interpretation of the proportion of effect sizes that are at least as large as the calculated treatment effect if the treatment were assigned to all un-treated countries in the data. Larger proportions would undermine my confidence that the observed effect is indeed driven by CUSFTA.

3.4.6 Additional analyses

I then evaluated potential mechanisms linking CUSFTA to changes in calorie availability by estimating changes in US investment and trade with the Canadian food and beverage sector before and after the agreement. As data were not available in comparison countries in the study period I calculated these changes by estimating an interrupted time-series regression model with a dummy for the pre- (D=0) and post-CUSFTA (D=1) period.

To put the substantive significance of my estimate of the impact of CUSFTA on calorie availability into perspective I also simulated the impact of the estimated changes to calorie intake on individuals' body weight using widely applied models developed by Hall and colleagues (Hall & Jordan 2008). These dynamic models estimate weight-gain in 'steady state' following a change in caloric intake given an individual's initial height, weight and their physical activity levels. This model also accounts for a variety of physiological adaptations that occur following initial weight gain, such as increases in the expenditure of energy due to the energetic costs of maintaining the newly created tissue, as well as metabolic differences according to body fat composition and its variation by sex (Hall and Jordan 2008).

To model weight-gain I used baseline weight and height data from the Canadian Health Promotion Survey (HPS). This is first available in 1990, just after CUSFTA was implemented

(Statistics Canada 1990). I estimated the mean weight and height among 40-year old Canadian men and women in the HPS sample and used a freely available Excel package provided by Hall and Jordan (2008) to model the impact on body weight from the change in calorie intake attributable to CUSFTA. My estimate of this change in caloric intake is the coefficient of CUSFTA from my fixed-effects models of changes to calorie availability. As it is plausible that less than 100% of the change in calorie availability translated into intake, I also estimated weight-gain assuming 50% pass-through from availability to intake. I estimate these models separately for men and women, and according to two physical activity scenarios: low levels of physical activity, equivalent to walking 2.2 miles a day at 3-4 miles per hour (mph), and high levels of physical activity, equivalent to walking 17 miles a day at 3-4 mph.

Finally, I conducted a series of additional analyses to test the consistency of my results across alternative sample and model specifications and evaluate the extent to which my findings could be deemed attributable to the impact of CUSFTA.

3.5 Results

3.5.1 Estimated CUSFTA effect

Figure 3.4 above plots normalized trends in calorie availability in Canada and comparison countries, 1978-2006. The figure shows that the availability of calories increased in Canada after CUSFTA was implemented: calorie availability rose from 3,028.5 kcal/capita/day in 1988 just before CUSFTA was implemented to 3,491.0 kcal/capita/day in 2006. Thus, calorie availability was on average 343.1 (95% CI: 294.3 to 391.9) kcal/capita/day higher in Canada after CUSFTA compared with before CUSFTA.

Table 3.2 summarizes the results from my fixed-effects regression models which estimate the impact of CUSFTA on calorie availability in Canada. The table shows that CUSFTA was associated with a 170.2 (95% CI: 73.0 to 267.5) kcal/ capita/ day increase in calorie availability in Canada after adjusting for covariates.

Table 3.2 Estimated effect of CUSFTA on calorie availability

Variable	Model 1	Model 2	Model 3
CUSFTA	343.1*** (294.3 to 391.9)	194.0*** (119.2 to 268.7)	170.2*** (73.0 to 267.5)
US$100 increase in GDP per capita			1.1 (-0.03 to 2.3)
1% increase in rate of urbanisation			17.1 (-6.5 to 40.8)
Controls for fixed effects?	Yes	Yes	Yes
Controls for time trends?	No	Yes	Yes
Country-years	116	116	116
Adjusted R^2	0.37	0.64	0.65
AIC	1,446.0	1,379.6	1,379.2
BIC	1,462.5	1,398.9	1,403.9

Notes: AIC: Akaike information criterion; BIC: Bayesian information criterion. *p<0.1; **p<0.05; ***p<0.001; 95% confidence intervals in parentheses. Models were estimated using cluster-robust standard errors grouped at the country level. Results from the Hausman test firmly rejected the null hypothesis of independence between the random effects estimate and the error term, favouring the fixed effects over the random effects estimator.

Table 3.3 summarizes the results from my fixed-effects regression models which estimate the impact of CUSFTA on calorie availability growth in Canada. The table shows that the annual calorie availability growth rate was, on average, 35.7 (95% CI: 28.1 to 43.4) kcal/capita/day higher in Canada compared with comparison countries, after adjusting for covariates. The Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) are lowest in the in the covariate-adjusted models (Model 2) in Table 4 compared with other models in

Table 4 and the models in Table 3, indicating that the covariate-adjusted growth rate is a more parsimonious model capturing variability in calorie availability – albeit moderately so (Burnham and Anderson 2004).

Table 3.3 Estimated effect of CUSFTA on annual calorie availability growth

Variable	Model 1	Model 2
CUSFTA	-8.78 (-85.9 to 68.3)	45.6 (-31.9 to 123.1)
CUSFTA *x* Time	27.2*** (20.6 to 33.8)	35.7*** (28.1 to 43.4)
US$100 increase in GDP per capita		-0.05 (-0.001 to -0.3)
1% increase in rate of urbanisation		-0.42 (-0.6 to -0.2)
Controls for fixed effects?	Yes	Yes
Controls for time trends?	Yes	Yes
Country-years	116	116
Adjusted R^2	0.78	0.81
AIC	1,326.4	1,312.5
BIC	1,348.5	1,340.5

Notes: AIC: Akaike information criterion; BIC: Bayesian information criterion. *p<0.1; **p<0.05; ***p<0.001; 95% confidence intervals in parentheses. Models were estimated using cluster-robust standard errors grouped at the country level. Results from the Hausman test firmly rejected the null hypothesis of independence between the random effects estimate and the error term, favouring the fixed effects over the random effects estimator.

Panel A in Figure 3.5 shows that US investment in the Canadian food and beverage industry increased substantially after CUSFTA. US FDI in this sector was on average $1,822 million (95% CI: 1,179 to 2,464) higher in the period 1989-2006 after CUSFTA compared with before CUSFTA. Changes to FDI preceded changes to calorie availability at a consistent 5-year interval throughout the post-CUSFTA period: the rise in US FDI began immediately after barriers to investment were reduced when CUSFTA came into force in 1989, and 5-years before calorie availability started rising. The rise in FDI stopped when the final reductions

to investment barriers were made in 1999, and 5-years before calorie availability stopped rising.

Food and beverage trade between Canada and the US also increased after CUSFTA, in both directions (Panel B, Figure 3.5). Canadian food and beverage imports from the US were $5,258 million (95% CI: 4,895 to 5,622) higher after CUSFTA. For the first 5 years after CUSFTA, Canada was a net exporter of food and beverage products to the US, and from 1995 onwards Canada was a net importer.

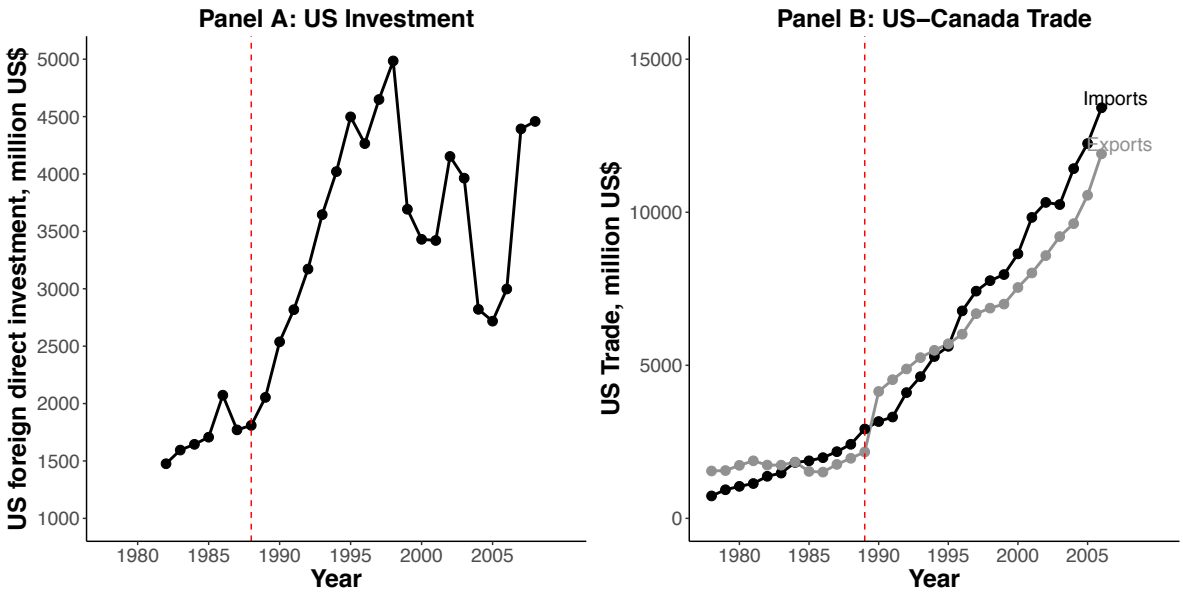


Figure 3.5 US trade and investment in Canada's food and beverage sector, 1978-2006
Notes: Investment data are from the US Bureau for Economic Analysis (2016). Trade data are from the US Department of Agriculture (2016). See Bibliography for full references.

Table 3.4 shows the results from my weight-gain models. The table shows that estimated changes to calorie intake due to CUSFTA could lead to a steady-state weight gain of between 1.8-9.3kg for men and 2.0-12.2kg for women aged 40 depending on their physical activity levels and assumed pass-through from calorie availability to intake.

Table 3.4 Estimated increase in body weight by sex and physical activity level

		Estimated weight gain in kg from an additional:	
Physical activity level	**Sex**	**170 kcal/ capita/ day**	**85 kcal/ capita/ day**
Low[a]	Female	12.2	4.4
High[b]	Female	5.3	2.0
Low[a]	Male	9.3	3.9
High[b]	Male	4.0	1.8

Notes: a: equivalent to walking 2.2 miles a day at 3-4 miles per hour (mph); b: equivalent to walking 17 miles a day at 3-4 mph. Figures show the estimated increase in body weight once body weight reaches a steady state, i.e. after accounting for the dynamic physiological adaptations that occur during weight gain. Weight gain figures are based on average weight and height, by sex, among 40-year olds in the Canadian Health Promotion Survey, 1990.

3.5.2 Robustness checks and synthetic control models

Here I present the results from additional analyses that test the robustness of my results in alternative sample and model specifications. Inferences from my fixed-effects regression models may be sensitive to my sample selection criteria, including my procedures for identifying countries with 'parallel trends' in calorie availability in the pre-CUSFTA period. To test this I first re-estimated my models after incorporating countries that were marginally above or below my thresholds for inclusion, as well as all OECD countries with available data. The results from these two additional specifications are presented in Appendix 3.3. In these models the coefficient of CUSFTA was at least 40.0 kcal/ capita/ day larger than my original specification, suggesting that any bias introduced by my sample selection procedures led to a conservative effect estimate.

In addition, my estimate of the effect of CUSFTA could be sensitive to the inclusion of any specific country in my analytic sample. For example, idiosyncratic factors or changes in comparison countries could have led to depressed levels or changes in calorie availability, creating upward bias in my estimate of the effect of CUSFTA. I evaluated this possibility by conducting a 'leave-one-out' analysis in which I iteratively omitted each country from the

sample and re-estimated the fixed-effects model in each case. Figure 3.6 shows that in all sample specifications CUSFTA was associated with a statistically significant increase in calorie availability of at least a 123.5 (95% CI: 24.3 to 222.7) kcal/ capita/ day.

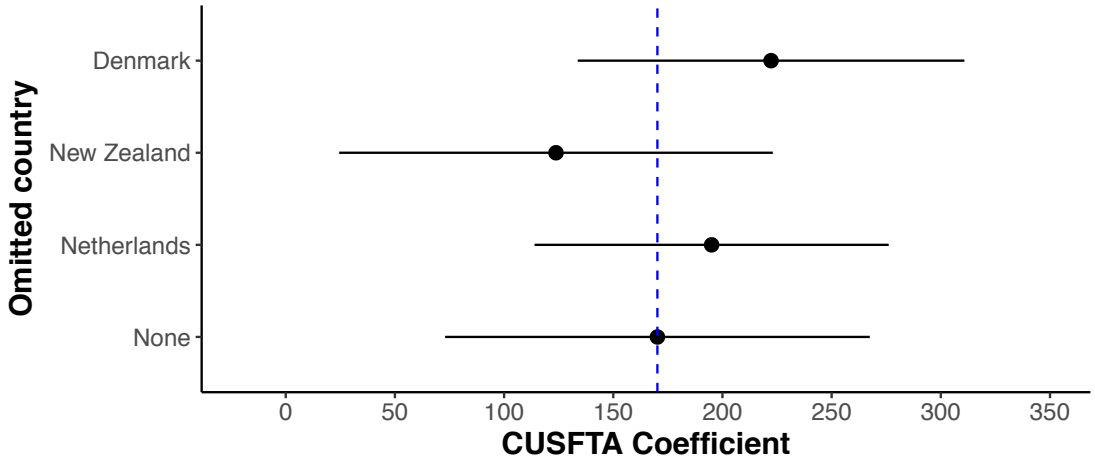


Figure 3.6 CUSFTA effect leave-one-out analysis
Notes: Figure shows estimated effect of CUSFTA (and confidence intervals) after omitting the country on the y-axis. Vertical dashed blue line shows results from my original analysis omitting no countries.

Table 3.5 and Figure 3.7 show the results from my synthetic control analysis of the impact of CUSFTA which sought to address limitations in my fixed-effects regression models. Table 3.5 and Figure 3.7 show that the results from my synthetic control analysis were consistent with my fixed-effects models: calorie availability was, on average, approximately 170 kcal/ capita/ day higher than the synthetic control in the post-CUSFTA period. The pseudo p-values in Table 3.5 also show that the effect of CUSFTA in Canada exceeded the 'placebo' effect in other countries in both samples. This bolsters confidence that my results are not attributable to unobserved changes in the post-CUSFTA period that took place in all countries. Appendix 3.4 shows that this analysis reduced differences in characteristics between Canada and the counterfactual, which suggests that my results are not attributable to large differences in the characteristics of Canada and comparison countries.

Table 3.5 Impact of CUSFTA on calorie availability in Canada: synthetic control results using fixed-effects sample and full OECD sample

	Fixed-effects sample	Full OECD sample
Effect on calorie availability level	171.5	249.1
Effect on annual calorie availability growth	24.8	29.5
Pseudo p-value[a]	1/4 = 0.25	1/15 = 0.07

Notes: a: Note that the p-values presented here do not have the standard interpretation; see Methods section for details of the synthetic control method including methods for estimating p-values and their appropriate interpretation.

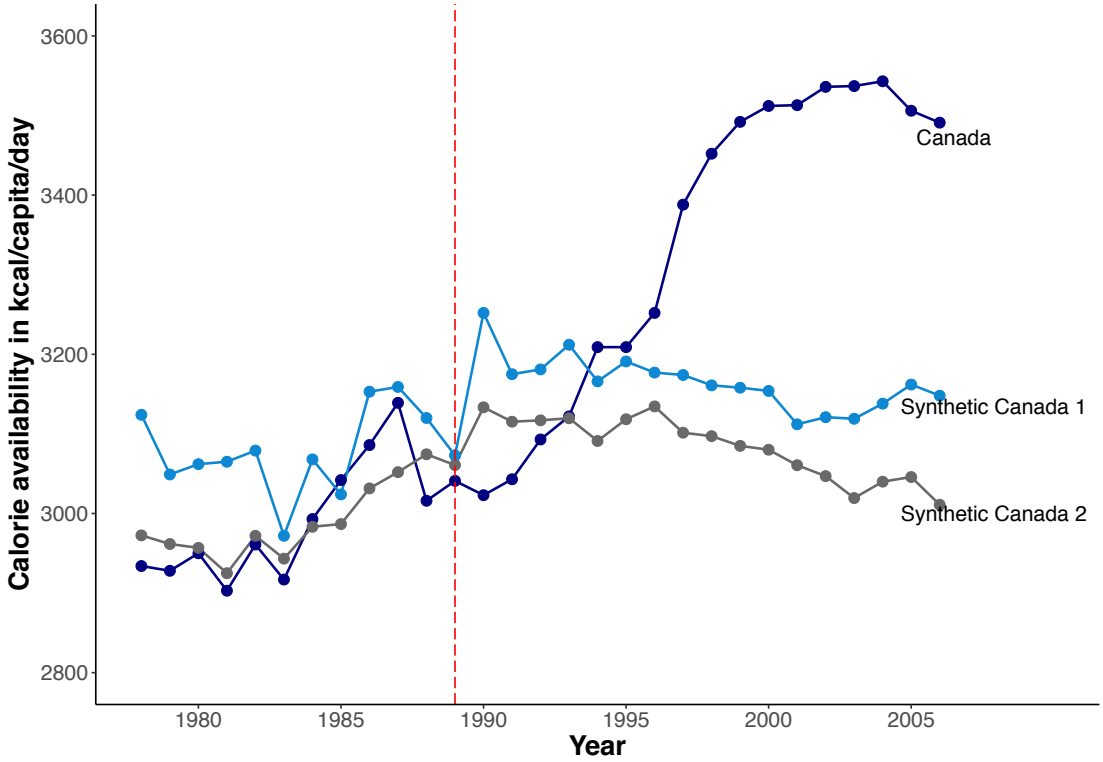


Figure 3.7 Trends in calorie availability in Canada and synthetic controls.

3.5.3 Alternative explanations

Here I evaluate possible alternative explanations for my findings. It is possible that my findings can be attributed to the influence of unobserved, time-varying contextual changes in Canada. If this were the case, we might observe greater periodic changes in calorie availability in Canada compared with comparison countries even in the absence of the 1989 FTA. To evaluate this I performed an 'in-time' placebo analysis. I re-assigned the coding of my CUSFTA variable to the middle of the pre-CUSFTA period, 1981, and then re-estimated the fixed-effect models in the 1978-1988 period. Confidence in the validity of my estimate of the effect of CUSFTA from my main models would dissipate if I estimated a similar effect of CUSFTA in a period when CUSFTA did not occur. However, as shown in Appendix 3.4, the estimated effect of the in-time placebo CUSFTA was -5 kcal/ capita/ day (95% CI: -92.1 to 82.0) and this estimate was not statistically different from zero at the 5% level.

Another alternative explanation for the post-CUSFTA rise in calorie availability is that it was attributable to a recovery from a 'pre-intervention dip' (Heckman and Smith 1999) in which US businesses delayed FDI and exports until after the FTA in order to benefit from lower trade and investment costs after CUSFTA's implementation. To assess this I followed recommendations in Bertrand et al. (2004) by re-estimating the CUSFTA effect in a model that excluded observations 2 years either side of CUSFTA (Bertrand, Duflo, and Mullainathan 2004). As shown in Appendix 3.4, this resulted in an effect estimate for CUSFTA that was 80 kcal/ capita/ day higher than my main analysis, suggesting that a pre-intervention decline did not lead to an upward bias in my effect estimate.

Finally, calorie availability in Canada began rising 5 years after CUSFTA was implemented. This is consistent with a hypothesised time delay in the impact of the FTA, as it takes time

for companies to co-ordinate production networks and increase supply (Levine and Rothman 2006; Owen and Wu 2007). However, it could be ventured that my findings are alternatively attributable to the implementation of the North American Free Trade Agreement (NAFTA) between Canada, the US and Mexico, on 1 January 1994. Whilst NAFTA did not substantially alter trade arrangements between the US and Canada, one possibility is that NAFTA increased calorie availability by facilitating increased food and beverage trade with Mexico. If this were the case we would expect to observe a marked post-NAFTA rise in net imports from Mexico of caloric food and beverages. Appendix 3.5 plots trends in Canada-Mexico trade in 19 major food groups (UNCTAD 2018). None of the figures presented in Appendix 3.5 show a marked rise in food imports that coincided the rise in calorie availability in Canada and occurred immediately after NAFTA. In addition, Appendix 3.6 shows that following NAFTA's implementation Canada was a net exporter to Mexico of products that tend to be calorie dense and so contribute to high calorie intake, such as beverages, sugars and confectionary (Prentice and Jebb 2003).

A second possibility relating to the role of NAFTA is that it led to a reduction in Canadian employment because Canadian workers were now competing with cheaper Mexican employees, leading jobs to be offshored to Mexico, or because Canadian producers were now competing with cheaper imports from Mexico. This could have led to declining incomes among those experiencing job loss and an associated rise in unhealthy dietary behaviours, including high calorie intake (Darmon and Drewnowski 2008; Drewnowski and Darmon 2005). If this were indeed the case we would expect to observe a decline in employment in Canada in the period after NAFTA that exceeded changes in comparison countries and coincided the rise in calorie availability. Appendix 3.7 plots trends in employment in Canada and the OECD comparison countries included in my analysis (ILOSTAT 2018). The figures presented

in Appendix 3.7 do not show any marked changes in employment on aggregate or in any specific sector that coincided the rise in calorie availability following CUSFTA and which exceeded changes in comparison countries.

3.6 Discussion

3.6.1 Main findings

My analysis has shown that calorie availability was approximately 170 kilocalories per capita per day (kcal/ capita/ day) higher and grew, on average, by approximately 35 kcal/capita/day more per year in Canada following CUSFTA, compared with comparison units. This rise in calorie availability coincided with a $1,820 (95% CI: 1,180 to 2,460) million increase in US investment in the Canadian food and beverage industry, and changes to investment preceded changes to calorie availability at consistent 5-year intervals in the post-CUSFTA period. US food and beverage exports to Canada also grew by $5,258 million (95% CI: 4,895 to 5,622). In addition, I estimated that the rise in caloric intake after CUSFTA could lead to an average weight gain of 1.8-9.3kg for men and 2.0-12.2kg for women who were 40 years old, depending on their physical activity levels and assumed pass-through from calorie availability to intake. The results from additional analyses showed that these findings were robust to alternative explanations and were consistent across different model and sample specifications.

My analysis suggests that CUSFTA altered dietary behaviour substantially in Canada by increasing calorie availability and likely intake. This suggests high-calorie intake among Canadians in the post-CUSFTA period was partially rooted in the country's 1989 trade deal with the US as it shaped the determinants of dietary behaviours in ways that encouraged

individuals to consume more calories, thereby fostering the cross-border diffusion of the unhealthy, high-calorie diets that pertain to the US. Furthermore, I have argued that changes to calorie intake may have been concentrated in – and potentially driven by – lower SES individuals, especially women (Sommer et al. 2015). My analysis therefore illustrates how examining the influence of a country's FTAs can help us to better understand the root causes of high calorie diets and, quite possibly, their socio-economic stratification. These conclusions show the importance of FTAs for sociologists' understanding of unhealthy, high calorie diets, as they can help us to better understand their root causes. They also show how US FTAs can have a detrimental impact on an aspect of a society's well-being – its risk of developing NCDs – because they can encourage higher caloric intake, which plays a critical role in causing obesity.

My findings are also consistent with previous, narrower studies of FTAs and diets which found that trade agreements, especially with the US, are associated with rising sales of sugar-sweetened beverages (Friel, Hattersley, et al. 2013). My analysis advances this scholarship in three important ways. First, I found more robust evidence to infer a causal impact of FTAs on diets. Unlike previous analyses, the exceptional circumstances surrounding CUSFTA's implementation provided a unique quasi-experimental setting that led to 'as-if' random implementation, helped isolate CUSFTA from contemporaneous changes, and sharply demarcated the pre- and post-intervention periods. Second, I found evidence that CUSFTA impacted upon the number of calories that were available and likely consumed in Canada. This study therefore builds on previous, narrower studies of FTAs and soft-drinks sales by showing how FTAs and related trade policies can influence another substantively important dietary outcome: caloric intake (Baker et al. 2016; Mendez Lopez et al. 2017; Schram et al. 2015).

The estimated rise in caloric intake and its estimated impact on weight gain are consistent with observed increases in obesity rates among Canadian adults, rising from 5.6% to 14.7%, 1985-2003 (Katzmarzyk 2002). However, the rise in caloric intake after CUSFTA could not necessarily be deemed sufficiently 'high' or 'in excess' to contribute to rising obesity in Canada if calorie availability had been insufficient before CUSFTA, or had physical activity increased in parallel. Yet the former did not apply: overall calorie availability exceeded average estimated energy demands in 1984 before CUSFTA came into force (Slater et al. 2009). Furthermore, Bleich et al. (2008) reported that the rise in obesity in Canada from 1990-2002 was entirely attributable to a 510 kcal/ capita/ day rise in calorie availability over the period, as declines in physical activity pre-dated the 1990s. CUSFTA was associated with a rise in calorie availability of at least 170 kcal/ capita/ day. This figure constitutes ~33% of the 510 kcal increase in calorie availability that Bleich and colleagues reported was 100% responsible for the rise in obesity, 1990-2002. This suggests that CUSFTA may have contributed to up to ~33% of the rise obesity during the period by 'pushing up' caloric availability and intake.

Finally, existing studies of FTAs and related liberalisation policies have emphasised the role of trade rather than investment in mediating their consequences. My analysis showed that US investment in the Canadian food and beverage sector increased immediately after CUSFTA. Investments are likely to take time to translate into increased production, sales and calorie availability due to the time needed to establish or expand production facilities, co-ordinate supply-chains and distribution networks. This could explain why calorie availability in Canada began rising 5 years after the rise in FDI began immediately after CUSFTA, and stopped rising 5 years after the rise FDI stopped. Whilst other mechanisms may have also played a role, the delayed response of changes to calorie availability to US

FDI at a consistent interval throughout the post-CUSFTA period suggest that investment partially mediated the rise in calorie availability (Morgan and Winship 2007).

3.6.2 Alternative explanations

It is possible that one or more major events or policy changes occurred simultaneously or after CUSFTA in Canada and so account for my results. However, the timing of two determinants of dietary changes in Canada that were previously identified in this literature did not coincide the rise in caloric availability observed in my study. The first factor was the rise in canola oil production in Canada (Casséus 2009; Slater et al. 2009). This rise in oil production is unlikely to account for my findings as it began in 1976, 13 years before CUSFTA was implemented, and was stable from the early 1980s (Casséus 2009). It therefore occurred well before the rise in calorie availability identified in my analysis.

The second factor was a series of changes to sales taxes that were ratified in 1991 and effectively reduced the overall tax rate paid by food and beverage producers (Domingue and Soucy 2000; Jeffery 2013). Although this could be expected to increase calorie available by increasing profitability and production in the food and beverage sector, the tax was not implemented until 1997-2013 (ibid). The rise in calorie availability identified in my study therefore pre-dates the implementation of the sales tax changes.

Calorie availability in Canada began rising 5 years after CUSFTA was implemented, introducing uncertainty into any inferences about the impact of CUSFTA on calorie availability as other post-CUSFTA changes could also have played a role. However, this time delay is consistent with a hypothesised time delay in the impact of the FTA, as it takes time

for companies to co-ordinate production networks and increase supply (Levine and Rothman 2006; Owen and Wu 2007). In addition, depressed calorie availability in the early 1990s and a delayed rise in calorie availability thereafter could be attributable to a macro-economic recession and recovery in those years. However, this affected all countries in my sample to similar degrees, whereas calorie availability increased only in Canada (Crafts and Toniolo 1996; Trefler 2004; Wilson, Dungan, and Murphy 1994).

A further possible argument referred to earlier in my analysis is that the rise in calorie availability in Canada can be attributed to NAFTA's implementation, in 1994. For example, NAFTA may have led to a rise in food and beverage imports and investment from the US. However, NAFTA changed few investment and trade arrangements between Canada and the US as they were already covered in CUSFTA. Indeed, my analysis showed that US trade and investment in Canada increased following CUSFTA, in 1989, rather NAFTA, in 1994. This is consistent with previous analyses showing an impact of CUSFTA – rather than NAFTA – on bi-lateral trade between the US and Canada, including in the food and beverage sector (Huffbauer and Schott 1993; USDA 2015).

Alternatively, NAFTA may have led to a rise in Canadian food and beverage imports and investment from Mexico. However, my additional analyses showed that there was no marked rise in food imports from Mexico that coincided the rise in calorie availability in Canada and occurred immediately after NAFTA, suggesting that this explanation is unlikely. In addition, Mexican direct investment in Canada totalled $200-$300 million, 1991-2011, but did not change appreciably after NAFTA (Gauthier 2012). I was unable to identify any data source which disaggregated these investment figures by sector in the pre- and post-NAFTA period. It is possible NAFTA led to a rise in Mexican investment in the Canadian food and beverage

sector. Yet a 2016 report by the FAO noted that between 2003 and 2014, 89% FDI in the Canadian food and beverage sector originated from other developed countries, which excludes Mexico, with 74% from the US and 6.2% from France (figures showing Mexican FDI in Canada were not presented in this list of largest investors in this sector and the original data are not freely available) (Fiedler and Iafrate 2016). Data from the International Trade Centre also show that of the 6,069 foreign businesses operating the Canadian food and beverage sector, only 13, or 0.21%, were registered in Mexico in 2013 (ITC 2018). These figures suggest that Mexico is not a major investor in the Canadian food and beverage sector, making it less likely that my findings are attributable to an increase in Mexican FDI in the Canadian food and beverage sector following NAFTA.

It could nevertheless still be argued that NAFTA led to the displacement of workers from jobs in import-competing sectors, leading to lower rates of employment among those working in these sectors. This could have led to a rise in unhealthy dietary behaviours, including high calorie intake, which are potentially associated with these deteriorating economic circumstances (Darmon and Drewnowski 2008; Drewnowski and Darmon 2005). However, the link between unemployment and a rise in unhealthy diets is ambiguous, with previous studies reporting contrasting results (Cawley and Ruhm 2011). In addition, aggregate unemployment did not increase as a consequence of CUSFTA (Faux 2001),[6] and there were not any marked

[6] One especially contentious aspect of the debate about NAFTA's impact on Canadian employment concerns its role in contributing to the decline in the manufacturing sector. The EPI report by Faux (2001) noted that employment in manufacturing and other import-competing sectors declined in Canada between the late 1980s and early 1990s, but stabilised from the mid-1990s onwards. This decline in employment therefore pre-dated the rise in calorie availability in Canada. It also mirrored declines in manufacturing employment in other OECD countries and, as Gaston and Trefler (1997) concluded, does not appear to be largely attributable to CUSFTA. Instead, the early 1990s recession and wider structural changes (such as skill-biased technological changes) were more influential.

changes to sector-level employment that coincided or immediately preceded the rise in calorie availability in Canada, or which exceeded changes to employment in other OECD countries in the same period. This is consistent with previous studies of CUSFTA which did not identify substantial employment effects (Gaston and Trefler 1997). Canadian employment trends are therefore inconsistent with the argument that NAFTA-induced job losses led to a rise calorie availability which surpassed other OECD countries.

3.6.3 Limitations

This analysis has several limitations that I have attempted to address. It is not feasible to conduct a fully randomized experiment to assess the effects of FTAs on dietary outcomes. In situations where experimental manipulation of the intervention is unfeasible, as is the case with FTAs, the natural experiment design used in this study is recommended as the best available means for evaluating causal effects (Craig et al. 2012). Yet, quasi-experimental identification is not possible without assumptions. My models assume that the causing factor, CUSFTA, did not affect the control observations directly or indirectly, the stable unit treatment value assumption, 'SUTVA'. It may be that CUSFTA had an indirect effect on other countries by diverting investment and trade with the US from Canada's competitors, meaning my effects are attributable to depressed trade, investment and, consequently, low calorie availability levels in comparison countries. However, this may be unlikely as previous analyses of trade agreements, including CUSFTA, reported modest, statistically insignificant trade diverting effects (Baier and Bergstrand 2009, 2007). As noted by Cavallo et al., inferences from multi-country comparisons are also less likely to be influenced by this limitation as effect estimates do not rely on a comparison single country (Cavallo et al. 2013), such as Canada's closest trade competitor.

A further limitation common to quasi-experimental studies is that my models estimate only the aggregate impact of CUSFTA without identifying the mechanisms of transmission, including which specific policies within FTAs led to changing diets and whether they changed availability, affordability, marketing, and/or desirability. In addition, my synthetic control models assume that the relationships between (observed and unobserved) predictors and calorie availability are the same in the pre- and post-CUSFTA period. Whilst I have conducted a thorough investigation of several possible alternative explanations for my findings, it remains possible that the rise in calorie availability following CUSFTA is attributable to an unknown change that took place in Canada between 1989 and 1994 and which altered this functional relationship.

Calorie availability is also an imperfect measure of caloric intake due to difficulties in estimating wastage and home production. Nevertheless, calorie availability is often used as a proxy for consumption and it has several strengths compared with survey-based measurements: it is more widely available and is not affected by recall or social approval biases (Bleich et al. 2008; Harper and Hallsworth 2016; Miller et al. 2008).

Furthermore, my fixed-effects regression models adjust for GDP per capita and urbanization, which were plausibly impacted by CUSFTA. However, the attenuation of the CUSFTA effect estimate when I incorporated these variables in my models suggests that the inclusion of these variables may have led to conservative estimates. The results from my analysis may also have limited external validity due to Canadian idiosyncrasies and contextual factors at the time CUSFTA was implemented. However, my results may still be informative, as CUSFTA was a blueprint for subsequent FTAs and remains so today (Allee and Elsig 2015).

Finally, limited data availability precluded a direct analysis of the impact of calorie availability on health outcomes and their socio-economic stratification as comparative, individual-level data were not available in Canada until several years after CUSFTA. Previous studies have found that the rise in obesity in Canada that was observed during the study period was highest among individuals with lower incomes, less education, and among women (OECD 2016). It is therefore possible that CUSFTA contributed to socio-economic and gender differences in high caloric intake and obesity. Future research should assess whether my findings about the impact of US FTAs are generalizable across country contexts, their overall health impacts, and their socio-economic stratification.

3.7 Conclusions

Notwithstanding these limitations, the results from this chapter show that CUSFTA likely increased calorie availability and intake in Canada. Consequently, exposure to the determinants of excess caloric intake among Canadians in the post-CUSFTA period appears to be partially rooted in Canada's 1989 trade deal with the US as it fostered the cross-country diffusion of unhealthy, high calorie diets. These conclusions show the importance of FTAs for scholars' understanding of unhealthy, high calorie diets, as they can help us to better understand their root causes. They also show how US FTAs can have a detrimental impact on an aspect of a society's well-being – its risk of developing NCDs – by encouraging higher caloric intake, which plays a critical role in causing obesity.

3.8 Appendix

Appendix 3.1 Summary of Canadian trade and investment policy changes mandated by CUSFTA and effective from 1 January 1989

Policy	Description
Tariffs	Complete elimination of tariffs on US imports over 10 years, except for tariffs on imports from 3rd parties
Quotas and restrictions	Prohibition of restrictions and quotas on export quantities, export taxes and subsidies
Standards and regulations	Standardized product and environmental regulations
National treatment	US businesses in Canada are subject to the same regulatory conditions as domestic firms, including social responsibility regulations, taxation, and admission and establishment procedures
Investment protection	Rules that protect foreign investors from 'expropriation': a government policy that *de facto* substantially reduces a firm's profits, unless the measure is designed to serve the public interest, is not discriminatory, or the investor is compensated for the losses suffered
Dispute settlement	Commonly agreed procedures for settling disputes over investment expropriation

Source: Text of the Canada-US Free Trade Agreement.

Appendix 3.2 Potential comparison countries and reason for exclusion

Country	Excluded?	Exclusion Criteria
Denmark	No	
Netherlands	No	
New Zealand	No	
Austria	Yes	Not parallel trends
Finland	Yes	Not parallel trends
France	Yes	Not parallel trends
Germany	Yes	Not parallel trends
Greece	Yes	Not parallel trends
Italy	Yes	Not parallel trends
Japan*	Yes	Not parallel trends
Norway*	Yes	Not parallel trends
Portugal	Yes	Not parallel trends
Spain*	Yes	Not parallel trends
Sweden	Yes	Not parallel trends
UK*	Yes	Not parallel trends
US*	Yes	Not parallel trends
Australia	Yes	US FTA in 2002
Switzerland	Yes	Missing data
Luxembourg	Yes	Missing data
Ireland	Yes	Missing data
Iceland	Yes	Missing data
Belgium	Yes	Missing data

Notes: Asterisk * denotes borderline case with near-parallel trends. These countries included in results presented in the second column of the table in Appendix 3.3.

Appendix 3.3. Estimated effect of CUSFTA on calorie availability in Canada with additional comparison countries: fixed-effects regression results

Variable	Original sample	Original sample plus near-parallel trends	All OECD countries
CUSFTA[a]	170.2*** (73.0 to 267.5)	211.7*** (33.5 to 397.9)	256.9*** (143.3 to 370.5)
US$100 increase in GDP[b] per capita	1.1 (-0.03 to 2.3)	0.6 (-0.7 to 2.1)	0.3 (-1.1 to 1.7)
1% increase in rate of urbanisation	17.1 (-6.5 to 40.8)	-9.9 (-43.3 to 23.4)	-6.8 (-36.8 to 23.15)
Controls for fixed effects?	Yes	Yes	Yes
Controls for time trends?	Yes	Yes	Yes
Country-years	116	261	493
Adjusted R^2	0.62	0.48	0.61

Notes: a: Canada US Free Trade Agreement. b: Gross Domestic Product. *p<0.1; **p<0.05; ***p<0.001; 95% confidence intervals in parentheses. Models were estimated using cluster-robust standard errors grouped at the country level. *Notes:* Models were estimated using cluster-robust standard errors grouped at the country level.

Appendix 3.4. In-time placebo analysis and test for impact of pre-intervention dip

Variable	In-time placebo	Pre-intervention dip
CUSFTA[a]	-5.0 (-92.1 to 82.0)	248.1*** (137.2 to 358.9)
US$100 increase in GDP[b] per capita	1.6 (-0.3 to 3.6)	1.13 (-0.01 to 2.2)
1% increase in rate of urbanisation	16.5 (-17.5 to 50.4)	6.4 (-18.0 to 30.9)
Controls for fixed effects?	Yes	Yes
Controls for time trends?	Yes	Yes
Country-years	44	100
Adjusted R^2	0.35	0.67

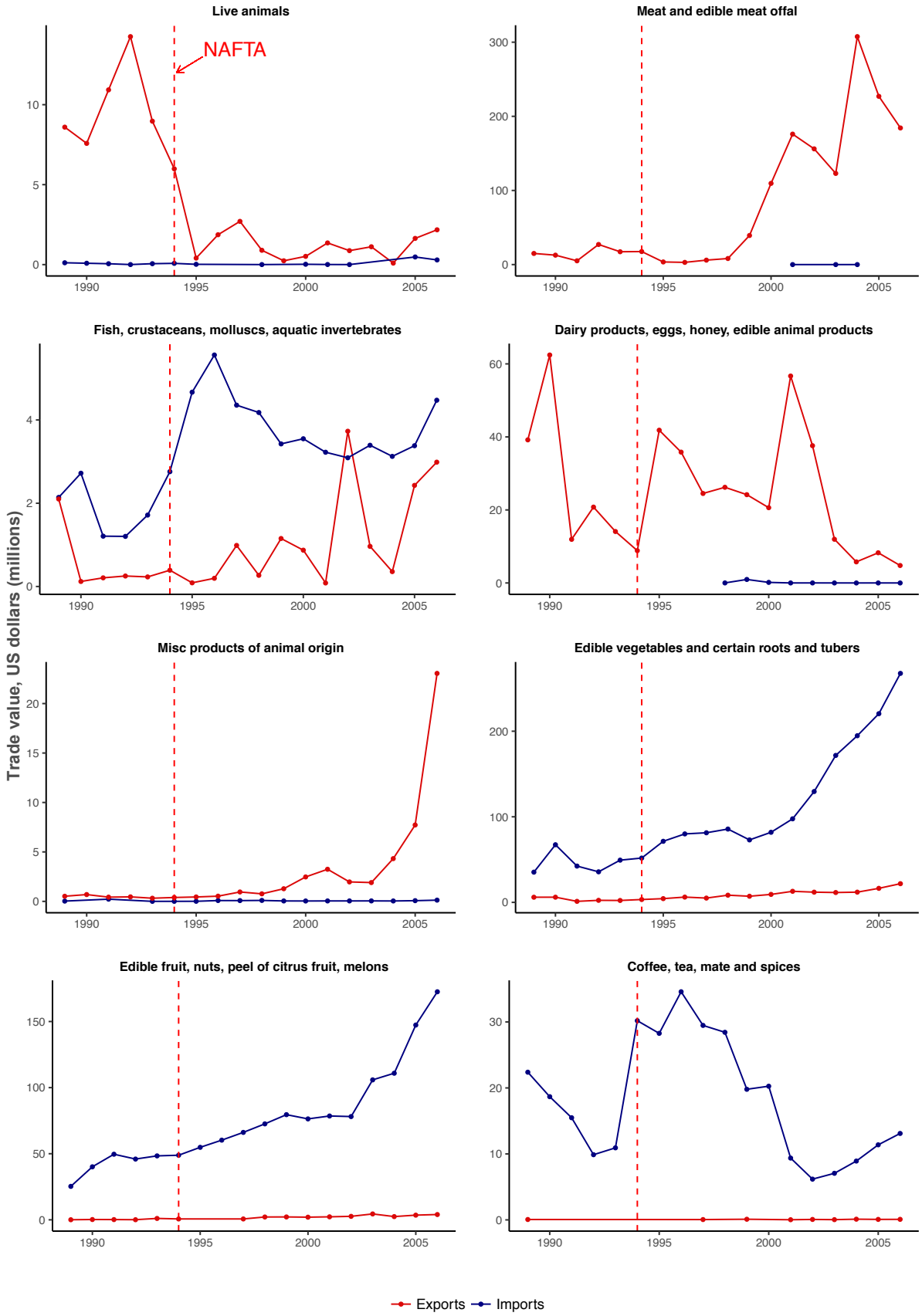
Notes: a: Canada US Free Trade Agreement. b: Gross Domestic Product. *p<0.1; **p<0.05; ***p<0.001. 95% confidence intervals in parentheses.

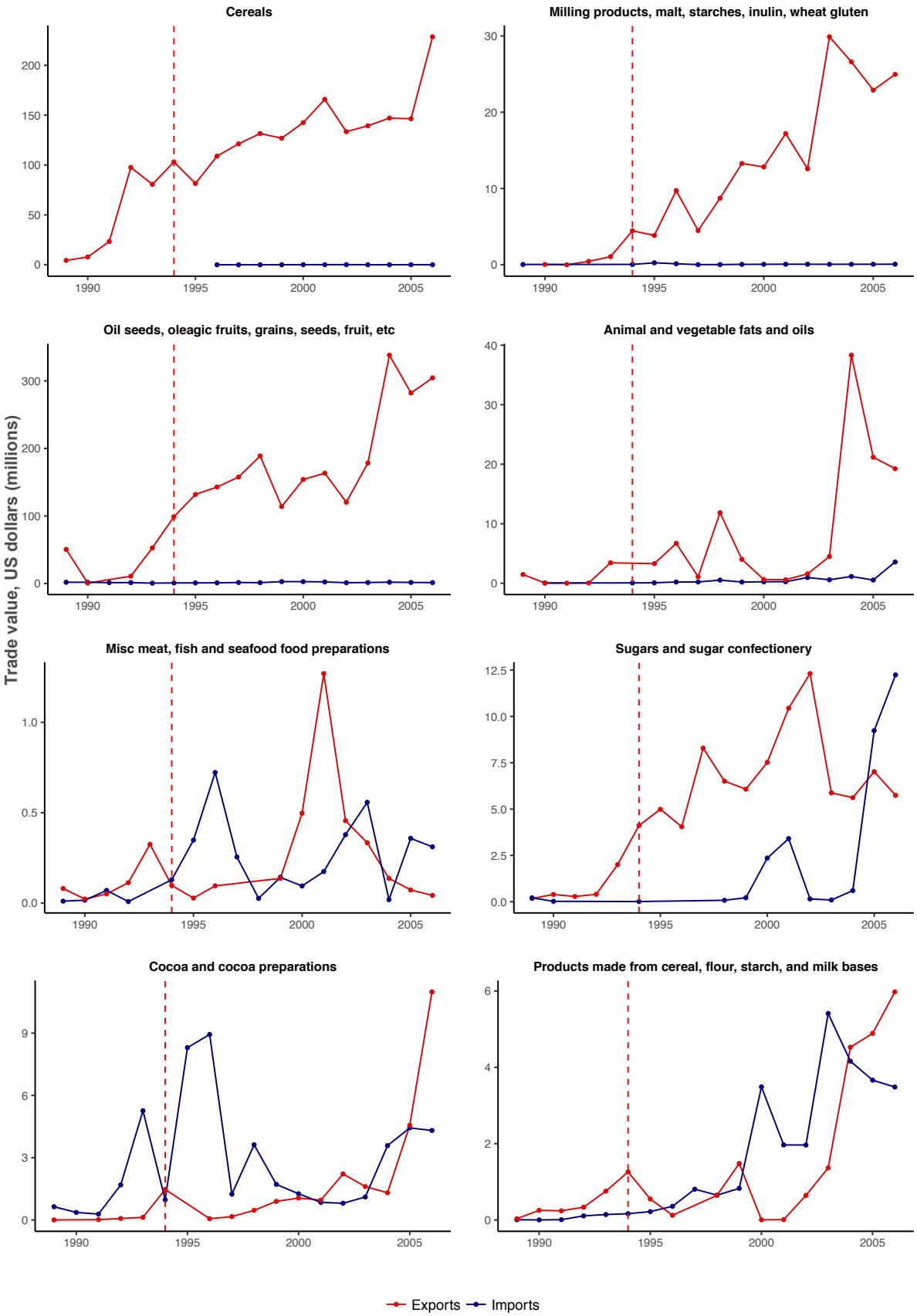
Appendix 3.5 Pre-CUSFTA predictor means and weights

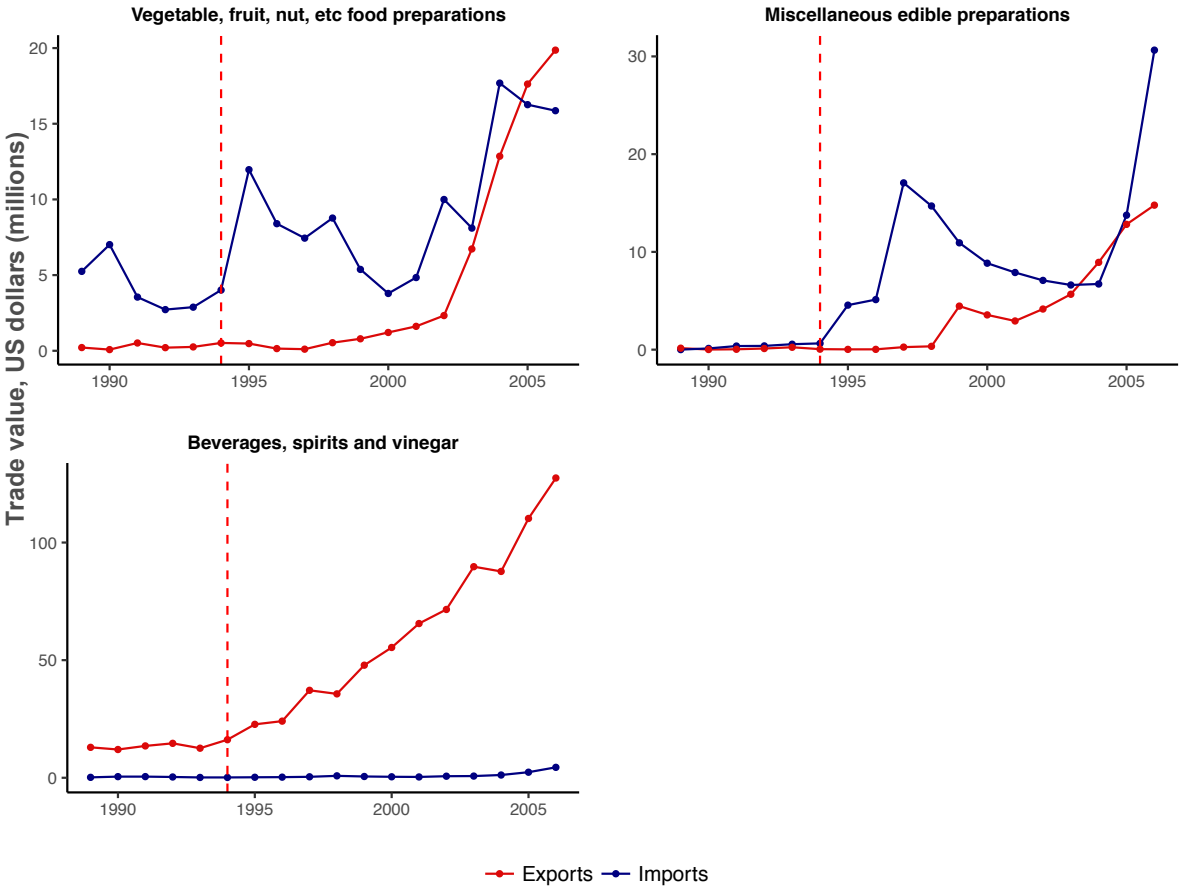
Predictor	Canada	Main sample (mean)	Synthetic Canada 1: main sample	Synthetic Canada 2: OECD sample
GDP growth	2.0	1.96	1.6	2.4
GDP per capita	25,222.6	29,644.42	19,925.7	22,559.6
Urbanization	37.4	30.84	25.0	35.0
Inflation	6.5	7.28	12.4	6.2
Population aged < 14	22.0	21.73	25.7	23.1
Population aged 15-64	68.1	65.29	64.2	66.5
Population aged > 65	9.9	12.99	10.1	10.4
Calories in 1978	2,934.0	3,113.50	3,124.0	2,972.5
Calories in 1983	2,917.0	3,062.50	2,972.0	2,943.3
Calories in 1988	3,016.0	3,177.00	3,120.0	3,074.4
Calories in 1983	2,917.0	3,062.50	2,972.0	2,943.3
Calories in 1988	3,016.0	3,177.00	3,120.0	3,074.4

Notes: See Table 3.1 for variable measures. In the main sample synthetic Canada is estimated entirely from data in New Zealand. In the OECD sample synthetic Canada is estimated from a weighted combination of Japan (33%), New Zealand (32%), the Netherlands (20%), and Portugal (15%).

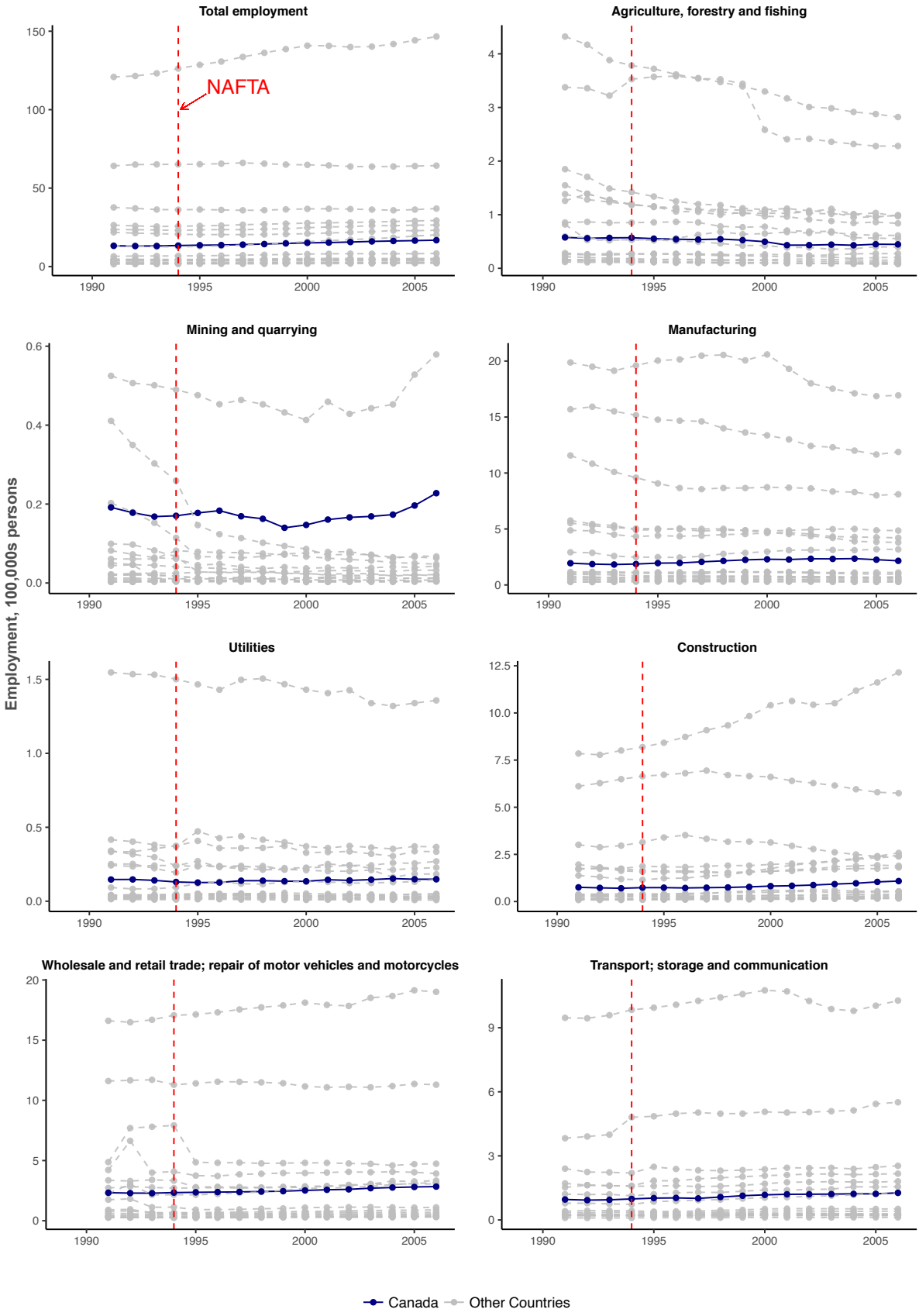
Appendix 3.6 Canadian food trade with Mexico

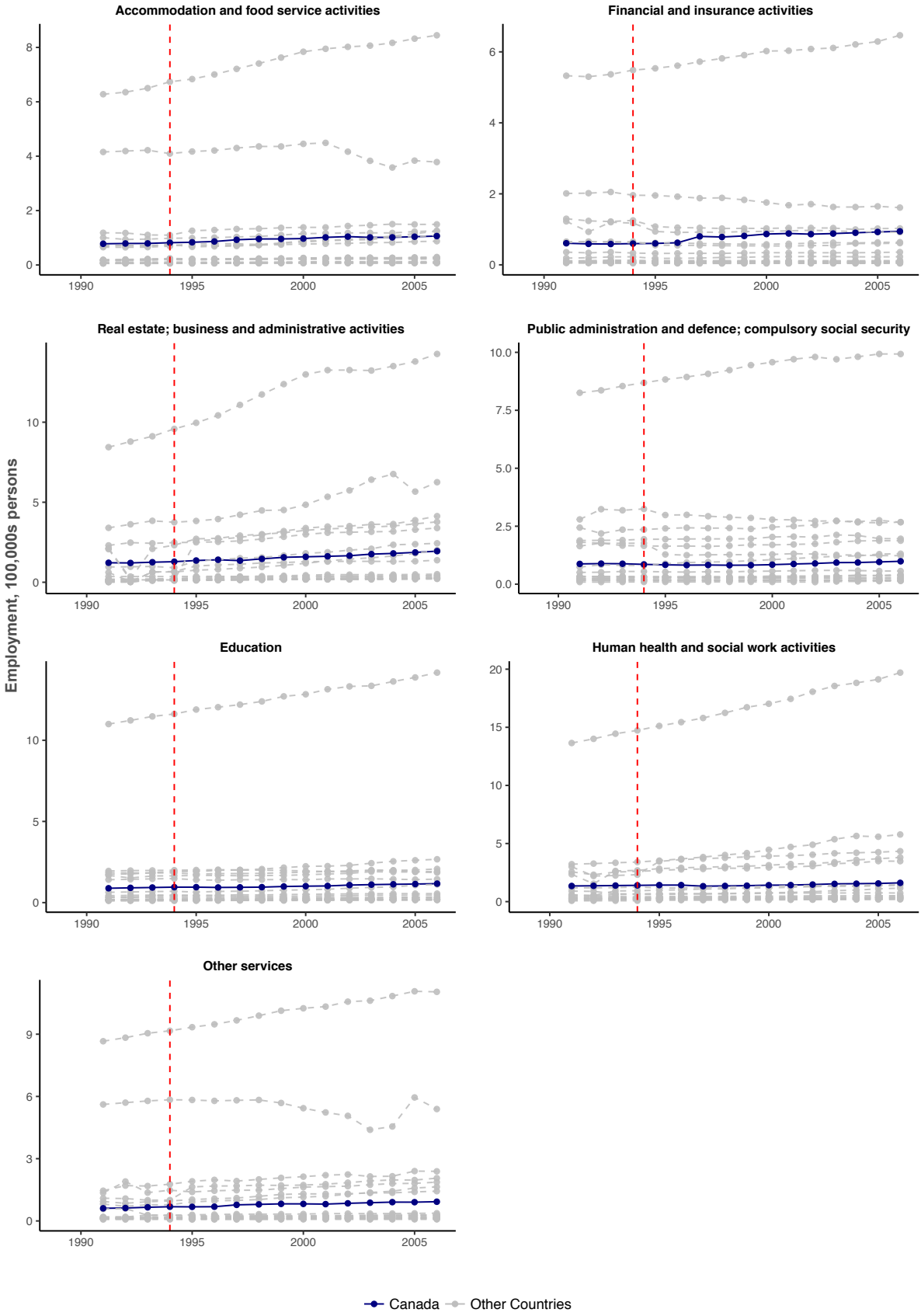



Cereals
Milling products, malt, starches, inulin, wheat gluten
Oil seeds, oleagic fruits, grains, seeds, fruit, etc
Animal and vegetable fats and oils
Misc meat, fish and seafood food preparations
Sugars and sugar confectionery
Cocoa and cocoa preparations
Products made from cereal, flour, starch, and milk bases
Trade value, US dollars (millions)
1990
1995
2000
2005
Exports
Imports


Vegetable, fruit, nut, etc food preparations
Miscellaneous edible preparations
Beverages, spirits and vinegar
Trade value, US dollars (millions)
0
5
10
15
20
0
10
20
30
0
50
100
1990
1995
2000
2005
Exports
Imports

Appendix 3.7 Sector-level employment in Canada and OECD comparison countries




Accommodation and food service activities
Financial and insurance activities
Real estate; business and administrative activities
Public administration and defence; compulsory social security
Education
Human health and social work activities
Other services
Employment, 100,000s persons
1990
1995
2000
2005
Canada
Other Countries

Chapter 4. How do FTAs alter dietary behaviours? A quasi-experimental analysis of tariff reductions on high-fructose corn syrup in Canada

4.1 Introduction

In this chapter I seek to disentangle the specific mechanisms through which FTAs lead to dietary changes. As I showed in my systematic review in Chapter 2, scholars' understanding of these mechanisms is currently limited for at least two reasons. First, prior studies (including my analysis in Chapter 3) used dichotomous FTA indicators in order to evaluate their effects, making it unclear precisely which clauses within FTAs lead to dietary changes. Second, prior studies of FTAs analysed changes to the quantity of calories (Chapter 3) and soft-drinks consumed, on average, in a society (Baker et al. 2016; Mendez Lopez et al. 2017; Schram et al. 2015). Yet it is also plausible that FTAs affect dietary composition due to the changing use of ingredients in food and beverage production.

Here I address these limitations by analysing a unique policy experiment in which taxes or 'tariffs' on US imports of an especially harmful type of sugar, High-Fructose Corn Syrup (HFCS), were withdrawn in Canada, 1994-1998, within an existing system of free trade in goods. I use the synthetic control method to analyse the impact of these tariff reductions, mandated by the 1994 North American Free Trade Agreement (NAFTA), on the availability and likely consumption of this syrup in Canada. I also investigate potential mediating pathways by analysing trends in US exports of HFCS between 1994 and 2006, and I evaluate whether increased availability of HFCS changed the composition and overall quantity of sugar that was available and consumed in Canada. The results from my analysis show that

tariff reductions in NAFTA coincided with an increase in the supply of caloric sweeteners including HFCS of approximately 45.1 kilocalories per capita per day in Canada, 1994-2006. However, this rise in the supply of caloric sweeteners including HFCS was offset by a decline in cane and beet sugar supply, whilst HFCS accounted for an increasing proportion of total sugar and sweetener supply. Net Canadian imports of beverage syrups also doubled in the period after NAFTA.

These findings suggest that NAFTA led to an increase in HFCS availability and consumption in Canada by lowering tariffs. They also identify a previously unrecognized mechanism through which FTAs can alter diets: a 'hazardous substitution effect', in which manufacturers replace less hazardous food ingredients with more hazardous ingredients – like HFCS – that are subject to lower tariffs. Thus, inharmonious tariff reductions in US FTAs can lead to a change in dietary composition and the cross-border diffusion of hazardous ingredients that are common in the US. This illustrates how examining the precise configuration of tariff reductions in FTAs can help us to better understand the root causes of unhealthy dietary composition. It also shows how US FTAs can have a detrimental impact on an aspect of a society's well-being – its risk of developing NCDs – by encouraging a rise in the consumption of hazardous commodities.

4.2 Background

When governments ratify FTAs they agree to implement diverse trade and investment policy changes. For example, Dür and Baccini coded the content of all FTAs that entered into force between 1945 and 2009 and identified as many as 100 sub-categories of clauses which required changes to product standards and regulations, tariffs and quotas, intellectual property rights,

competition rules, and dispute settlement procedures (Dür et al. 2014). These clauses are all designed to facilitate cross-border trade and investment, and so each clause could, theoretically, account for changes to a society's diets after an FTA is implemented. Previous studies of FTAs and diets were unable to disentangle this complexity. As I demonstrated in my systematic review in Chapter 2, most prior studies of FTAs and diets used dichotomous treatment indicators (Baker et al. 2016; Schram et al. 2015; Stuckler et al. 2012), making it unclear precisely which clauses within FTAs account for observed dietary changes. Studies that opened this 'black box' and attempted to identify the impact of the specific policy changes mandated in FTAs, such as product specific tariff reductions, were primarily within-country post-reform case studies that precluded causal conclusions (Friel, Hattersley, et al. 2013; Hughes and Lawrence 2005).

A second limitation pertaining to more rigorous, statistical analyses is that they primarily analysed how FTAs could alter the number of calories (Chapter 3) and soft-drinks that are sold and likely consumed in a country following a trade deal (Baker et al. 2016; Schram et al. 2015). By doing so, these prior studies showed how FTAs, especially with the US, can encourage individuals to consume a larger quantity of calories and sugar-sweetened soft-drinks. Yet it is plausible that trade and investment policies mandated in US FTAs encourage unhealthy diets by affecting another outcome – dietary composition – due to the changing use of ingredients in food and beverage production. This is substantively important as unhealthy diets that contribute to NCDs consist of both of an excess quantity of calories and soft-drinks, and of an unbalanced, unhealthy composition characterised by high proportions of unhealthy ingredients and products (Nicklas et al. 2001).

Here I address these gaps by analysing a unique policy change in which taxes or 'tariffs' on US imports of High-Fructose Corn Syrup (HFCS) to Canada were withdrawn within an existing context of liberalised trade in goods. HFCS is an especially harmful form of sugar that is added to a range of manufactured food products in the US, such as carbonated drinks, cereals, baked goods, desserts, ice cream, condiments and confectionary (Duffey and Popkin 2008). Its hazardous properties derive from its fructose content. Consuming excess fructose can lead to high blood pressure; it encourages the conversion of excess carbohydrate into fatty acids and storage of fat, especially in the liver; it contributes to insulin resistance; it stimulates a 'hedonic pathway' in the brain that creates habituation and possibly dependence; and it may also contribute to premature ageing, cognitive decline, and cancer (Lustig 2010; Lustig et al. 2012). Whilst almost all forms of sugar contain fructose, making them "toxic" (Lustig 2010:27), it is relatively abundant in HFCS. HFCS can therefore be more harmful than other sugars, especially those derived from canes and beets which have a lower fructose content (ibid).

The relatively low cost of HFCS following tariff reductions could encourage manufacturers to add it to food and beverages when they would have otherwise added sugar in lower quantities or omitted it entirely. Manufactures may choose to do so as HFCS has several desirable properties: it is soluble and cheap, and so easier and more economical to add to food and beverages than alternative cane and beet sugars, and it is thick and glossy, which consumers are find appetizing (White 2014). This has potential implications for dietary quality by leading both to a net increase in the quantity of sugar consumed and to a rise in the proportion of harmful HFCS in individuals' diets.

In this paper I test the hypothesis that lower tariffs on HFCS following NAFTA led to increases in the supply and likely consumption of HFCS in Canada. I also investigate potential mediating pathways by analysing trends in US exports of HFCS between 1994 and 2006, and I evaluate whether increased availability of HFCS changed the composition and overall quantity of sugar consumed in Canada. The next section describes the data and modelling procedures I used in my analysis.

4.3 Methods

4.3.1 Study setting

On 1 January 1994 Canada entered the North American Free Trade Agreement (NAFTA) with the US and Mexico. NAFTA left the majority of trade arrangements between the US and Canada unchanged as the two countries had already reduced them following CUSFTA. Most of Canada's trade and investment policy commitments to the US were therefore copy-pasted directly from CUSFTA to NAFTA. Yet Canada's tariff schedule in NAFTA included a subtle change to the way it taxed imports of food and beverage 'preparations' containing HFCS, as summarised in Table 4.1. These 'preparations' are pre-flavoured HFCS mixes that are added to beverages, cakes, biscuits, ice-cream, cereals, and confectionary (White 2014).

Table 4.1 Canadian tariff changes introduced by NAFTA

Product	Pre-NAFTA tariff rate	Tariff change
Food and beverage preparations containing HFCS	5% of import value	Tariff removed in five equal annual stages beginning on 1 January 1994 and ending on 1 January 1998.

Source: Tariff Schedule of the North American Free Trade Agreement (NAFTA), Chapter 3 and Annex 302.2.

Before NAFTA, a long-standing dispute over US subsidies to sugar farmers had prevented Canada and the US from agreeing to lower their tariffs on sugar and sugar-containing products (Pearson 2011). Whilst this disagreement primarily concerned cane and beet sugars, CUSFTA had not distinguished between sugars made from cane and beets and other types of sugar like HFCS. Consequently, all forms of raw sugar and products derived primarily from sugar – such as food and beverage preparations – were subject to a collective 5% tariff.

However, the tariff schedule in NAFTA distinguished between products derived from cane and beet sugar and those derived from HFCS. Consequently, Canada's 5% tariff on food and beverage 'preparations' containing HFCS was gradually removed by 1% each year between 1994 and 1998, whilst tariffs on pure cane and beet sugar and syrup preparations containing cane and beets all remained in line with the original 1989 tariff schedule (Government of Canada 1989, 1994).

4.3.2 Synthetic control analysis

Valid causal inference about the impact of NAFTA involves comparing HFCS availability in Canada following the 'treatment', NAFTA, with its counterfactual: how HFCS availability would have evolved in Canada in the period after NAFTA, had it not actually implemented the FTA (Morgan and Winship 2007). This counterfactual is not directly observable, and so I approximate this counterfactual from a weighted combination of similar countries. I select countries and their weights using the synthetic control method. As I mentioned in Chapter 3, the synthetic control algorithm identifies a combination of countries and weights that create a counterfactual unit that resembles the treated country as closely as possible in the

pre-treatment period. It achieves this by identifying a vector of weights W* that minimises the quantity in formula 4.1:

$$(4.1)\ \sum_{1}^{k} v_k(X_{1k} - X_{0k}W)^2$$

Where X_{1k} is the value of variable k in the treated country, Canada, X_{0k} is a vector containing the values of variable k for the un-treated comparison units with weights in the vector W, and v_k is a vector of weights that reflects the predictive power of each variable. The algorithm iterates through all possible combinations of W and identifies the combination of countries and weights, W*, that minimizes the squared sum of the difference between value of predictors in the weighted combination of countries, $X_{0k}W$, and in Canada, X_{1k}, before the treatment.

The predictive power of each variable, captured in $v_{k,}$ is also considered when minimizing this difference so that variables with higher predictive are assigned greater importance. These predictor weights are identified by the synthetic control algorithm by finding the vector v_k that produces a synthetic control unit that best reproduces the trajectory of HFCS availability in Canada in the years before NAFTA, i.e. it has the smallest prediction error, measured as the RMSPE, per equation 4.2:

$$(4.2)\ \text{RMSPE} = \frac{1}{T_0}\sqrt{(Y_{1t} - \sum_{j=1}^{J} W^* Y_{jt})^2}$$

Where T_0 is the number of years in the pre-NAFTA period, Y_{1t} is the outcome in the treated country, Canada, in year t, and the synthetic control outcome, W* Y_{jt}, is the weighted

combination of outcomes in comparison units j=1,...,J, according to weights W* identified above.[7]

The effect of NAFTA, δ, is then estimated by calculating the average difference between the outcome in Canada and its synthetic counterpart over all years t in the post-NAFTA period, T_1, per equation 4.3:

$$(4.3)\ \delta = \frac{1}{T_1}\left(Y_{1t} - \sum_{j=1}^{J} W^* Y_{jt}\right)$$

As I mentioned in Chapter 3, the synthetic control method has multiple advantages for evaluating policy effects compared with fixed-effects regression models, which are commonly used in the policy evaluation literature (Angrist and Pischke 2009). First, inferences based on fixed-effects regression models are sensitive to the parallel trends assumption (ibid). However, I was not able to identify a country or countries which had parallel trends in HFCS availability to Canada before NAFTA, meaning that effect estimates based on fixed-effect regression models would lack sufficient validity for inferring a NAFTA effect. Second, a challenge to inferences from fixed-effects regression models is that units that do and do not receive a treatment can also differ in time-varying unmeasurable ways that might also account for changes in the outcome. However, the synthetic control method can overcome inferential issues associated with unobserved time-varying factors that are correlated with

[7] As minimizing Equation 2 to identify the optimal v_k depends on W* but the optimal weights W* depend on v_k, the synthetic control algorithm solves Equations 1 and 2 using a 'nested' two-step procedure. In the first step the algorithm finds the optimal W* for every possible vector of predictors weights v_k, (the 'inner' optimization problem), per Equation 1. From the list of vectors v_k associated with weights W* the algorithm then selects the set of predictor weights v_k that minimizes the RMSPE (the 'outer' optimization problem), per Equation 2.

the outcome, including factors which led a unit to adopt or 'select into' the treatment, when pre-treatment outcomes are introduced as predictors in the model. This applies even in the absence of a 'natural experiment', as characterised by Dunning (Abadie and Gardeazabal 2003; Dunning 2012). Finally, the synthetic control method can overcome additional issues associated with the modelling assumptions in fixed-effects regressions (Acemoglu et al. 2016; King and Zeng 2006), as I discussed in detail in Chapter 3.

4.3.3 P-values, inference and additional analyses

As mentioned in Chapter 3, a limitation of the synthetic control approach is that standard techniques are not suitable for assessing the statistical significance of effect estimates due to the small sample size. Following suggestions by Abadie and colleagues I again used an 'in-space' placebo test to compute p-values (Abadie, Diamond, and Hainmueller 2010). I assign a fake treatment to countries that did not enter NAFTA by coding the dummy for NAFTA as 1 in that country from 1994 onwards, and 0 otherwise. Pseudo p-values are then calculated as the proportion of effect sizes that are at least as large as the one in Canada. Larger p-values would undermine confidence that my effect is indeed attributable NAFTA rather than unobserved factors that occurred simultaneously or after the FTA and also led to changes in HFCS availability in other countries. However, large effect estimates in un-treated countries could also be indicative of poor model fit, creating large discrepancies between the treated country and synthetic control in both the pre- and post-NAFTA period, but little change in the size of this discrepancy post-NAFTA (Abadie et al. 2010; Acemoglu et al. 2016; Billmeier and Nannicini 2013). Following Cavallo and colleagues I account for this when calculating p-values by dividing the post-NAFTA effect by the pre-NAFTA RMSPE in each country (Cavallo et al. 2013).

Finally, I performed a series of placebo analyses and additional robustness checks to test the sensitivity of my results to my sample and model specification and to evaluate possible alternative explanations for my results.

4.3.4 Variable definitions, data sources, and model specification

Table 4.2 summarises the variable definitions and data sources used in my analysis. My models incorporate a dichotomous indicator of the presence of NAFTA-mandated tariffs, coded as 1 in Canada from 1994 onwards, and 0 otherwise. My indicator of HFCS consumption comes from annual supply data from United Nations Food and Agricultural Office Statistics Office, FAOSTAT (FAO 2014). The FAOSTAT database details total food supply for human consumption in kilo-calories ('kcal') per capita per day. The data are disaggregated into different food categories, and the supply of HFCS products for which tariff reductions in NAFTA were applicable is captured in FAOSTAT's measure of caloric sweeteners. This measure also captures additional syrups whose tariffs were unchanged in NAFTA: fructose, glucose, and molasses, although the category is not disaggregated further. Cane and beet sugars are included in a separate category.

The variables used for matching countries with Canada to estimate the synthetic control are meant to be predictors of the outcome: HFCS supply and likely consumption. I selected relevant predictors based on previous studies of population dietary behaviours, including consumption of sugar and sugar-sweetened products (Basu et al. 2013; Popkin 1993; Popkin and Hawkes 2016; Schram et al. 2015; Stuckler et al. 2012). I incorporate three proxies for disposable income - GDP per capita, GDP growth, and the rate of inflation - which can all affect consumption levels through their impact on incomes, purchasing power, and dietary

preferences (Drewnowski and Darmon 2005; Drewnowski and Popkin 1997). I also include urbanisation as more dense networks of consumers in urban areas provide economies of scale for producers, including fast-food outlets and restaurants that serve sweetened calorie-dense meals (Popkin 1999; Schram et al. 2013; Stuckler 2008). Since energy needs and dietary preferences may vary by age and possibly sex I also included a measure of the proportion of the population that was female and in each age group 0-14, 15-64, and over 65 (Cooke and Wardle 2007; Wansink et al. 2003).

Consumption of sugars, including HFCS, could also be influenced by cultural and geographic factors that encourage and/or facilitate certain dietary preferences and behaviours, including consumption of proteins, fresh fruits, and vegetables in place of manufactured food products containing HFCS (Willett 2006). Following Basu et al. I account for this by incorporating a series of nutritional controls using the FAOSTAT food balance sheets (Basu et al. 2013). This captures total availability of food and beverages in categories other than sugars and caloric sweeteners: meat, fish, dairy, cereals, pulses, oils and oil crops, vegetables, fruit, nuts and alcohol. Finally, I incorporate pre-treatment caloric sweetener availability levels to address unobserved confounding, as discussed above. I follow Abadie and colleagues by incorporating lagged availability values at fixed five-year intervals before NAFTA, i.e. in 1993, 1988, and 1983 (Abadie et al. 2010; Abadie and Gardeazabal 2003).

Table 4.2 Summary of variable definitions and data sources

Variable	Measure	Source
Supply of caloric sweeteners, cane and beet sugars, and total sugars	Kilocalories per capita per day	UN Food and Agricultural Organisation Statistics Office (FAOSTAT)
US exports of HFCS beverage and other sugar syrups to Canada	Net exports (exports to Canada less imports and re-exports to the US)	US Department of Agriculture (USDA)
GDP per capita and GDP growth	Measured in constant 2005 US dollars and adjusted for differences purchasing power	World Bank World Development Indicators (WDIs) (2015 edition)
Urbanisation	Percentage of the total population living in urban dwellings	World Bank WDIs (2015 edition)
Inflation	Annual growth rate of the GDP implicit deflator: the ratio of GDP in current local currency to GDP in constant local currency	World Bank WDIs (2015 edition)
Population age structure	Population between the ages 0 to 14, 15-64 and over 65 as a percentage of the total population	World Bank WDIs (2015 edition)
Population sex ratios	Female as percentage of the total population	World Bank WDIs (2015 edition)
Availability of meat, fish, dairy, cereals, pulses, oils and oil crops, vegetables, fruits, nuts and alcohol	Kilocalories per capita per day	UN Food and Agricultural Organisation Statistics Office (FAOSTAT)

Notes: See Bibliography for full data source references.

4.3.5 Total sugar consumption and trade in HFCS

After estimating the effect of NAFTA on the availability of caloric sweeteners including HFCS I evaluate whether these changes also contributed to a rise in total sugar consumption. Again I use data from FAOSTAT to plot trends in the availability of all sugars and potential substitute cane and beet sugars. I also use data from the United States Department of Agriculture (USDA) Global Agricultural Trade System (GATS) database (USDA 2016) to examine whether changes to tariffs on food and beverage syrups containing HFCS coincided

a rise US exports of this product. These data capture imports and exports of food and beverage syrups containing HFCS between the US and Canada. I calculate net exports to Canada by subtracting imports from Canada from exports to Canada between 1994 and 2006. These data were unfortunately not available on cross-national basis or in the pre-NAFTA period.

4.3.6 Sample and period specification

Comparison units are meant to provide an appropriate approximation to the counterfactual outcome in Canada because they share common characteristics but did not enter NAFTA. I first identified a possible 'donor pool' of comparison countries that, like Canada, were members of the Organization for Economic Co-operation and Development (OECD), made the same tariff commitments when joining the newly-founded World Trade Organization (WTO) in 1995, were previously members of the General Agreement on Trade and Tariffs – the WTO's precursor – but did not enter a US FTA during the study period. As in Chapter 3, this way of restricting the sample ensured un-treated comparison countries were structurally similarity in terms of economic and social development and their global trading arrangements. I then excluded countries with missing data, yielding a donor pool of 16 high-income countries: Austria, Denmark, Finland, France, Germany, Greece, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Switzerland, the United Kingdom, and the United States. Appendix 4.1 shows a list of omitted OECD countries and reasons for their exclusion.

I restricted my analysis to the years 1982-2006, beginning when predictor and caloric sweetener availability data were available in all comparison countries in my sample. The

study period ends in 2006, 12 years after the tariffs began to fall and 8 years after the final stage of tariff reductions in 1998. This cut-off allowed me to capture the full tariff reduction period and a delayed impact of tariff reductions, whilst minimising potential bias from the influence of post-NAFTA changes that may have affected the availability and consumption of products containing HFCS, such as the 2007-08 global financial crisis and subsequent recession (Cecchini 2014).

Below I present the results from my analyses. I summarise the results from my synthetic control models and my p-value estimates, compare trends in the supply of caloric sweeteners with changes to cane and beet sugars and total sugars, and describe trends in US exports of HFCS beverage syrups. I then present additional robustness checks and sensitivity analyses. All analyses were performed in R.

4.4 Results

4.4.1 Synthetic control analysis

Table 4.3 shows a list of countries in the donor pool and their weights in constructing the synthetic control. The synthetic control is a weighted combination of the Netherlands (49.2%), Spain (15.0%), New Zealand (14.3%), Japan (9.8%), Greece (8.1%), the US (3.3%), and the UK (0.3%). All other countries receive zero weights.

Table 4.3 Synthetic control countries and weights

Country	Weight
Netherlands	0.492
Spain	0.150
New Zealand	0.143
Japan	0.098
Greece	0.081
United States	0.033
United Kingdom	0.003
Austria	0.000
Denmark	0.000
Finland	0.000
France	0.000
Germany	0.000
Italy	0.000
Norway	0.000
Portugal	0.000
Sweden	0.000

Notes: The pool of synthetic control donor countries includes all 16 OECD and GATT/ WTO members with available data that did not enter a US FTA during the study period. See methods for full description of donor pool identification procedures and the algorithm used to select country weights.

Table 4.4 shows the mean values of the predictors in Canada and synthetic Canada, their weights, and an equally weighted sample mean. The table shows that the values of predictors in synthetic Canada more closely resemble Canada than the sample mean, especially for predictors with relatively high predictor weights. Overall, the total weighted difference (calculated according to Equation 1) between the value of predictors in Canada and the equally weighted sample mean was 8.5 times larger than the difference between Canada and the unequally weighted synthetic control unit. Thus, synthetic Canada more closely resembled Canada in the pre-NAFTA period compared with an equally weighted sample mean.

Table 4.4 Pre-NAFTA predictor means and weights

Variable	Canada	Synthetic Canada	Sample mean	Predictor weight
Caloric sweeteners, 1988	23.00	23.09	31.25	0.17
Pulses availability	36.08	31.18	25.87	0.14
Caloric sweeteners, 1993	19.00	22.29	34.25	0.12
Fish availability	31.92	46.18	56.14	0.10
Oil availability	404.17	415.62	391.22	0.05
Proportion aged 15-64	68.21	67.46	66.56	0.05
Fruit availability	115.00	127.98	116.96	0.05
Caloric sweeteners, 1983	18.00	15.60	22.31	0.04
Vegetable availability	81.50	76.99	71.47	0.04
Alcohol availability	128.17	171.48	190.48	0.04
Nuts availability	19.67	21.08	22.47	0.04
Inflation	3.99	4.89	6.40	0.04
Meat availability	357.58	373.76	379.15	0.03
GDP per capita	26,502.35	24,623.56	26,180.60	0.02
Proportion female	50.38	50.68	51.11	0.02
Proportion aged >65	10.71	12.12	13.73	0.02
Urbanisation	38.72	19.56	27.34	0.02
Proportion aged <14	21.08	20.42	19.71	0.01
Cereals availability	652.50	717.47	819.82	0.01
Dairy availability	367.83	456.89	436.72	0.01
GDP growth	367.83	456.89	436.72	<0.01

Notes: See Table 4.2 for description and data source for each variable.

Figure 4.1 plots trends in the supply of caloric sweeteners in Canada and the synthetic control between 1982 and 2006. In Canada the daily per capita supply of caloric sweeteners including HFCS rose from an average of 20.2 kcal/ capita/ day in the pre-NAFTA period to an average of 72.0 kcal/ capita/ day in post-intervention period, an increase of 51.1 kcal/ capita/day. The rise in caloric sweeteners persisted for every year that tariffs were reduced, 1994-1998, and then stopped rising after the final year of tariff reductions in 1998 and when tariffs were zero.

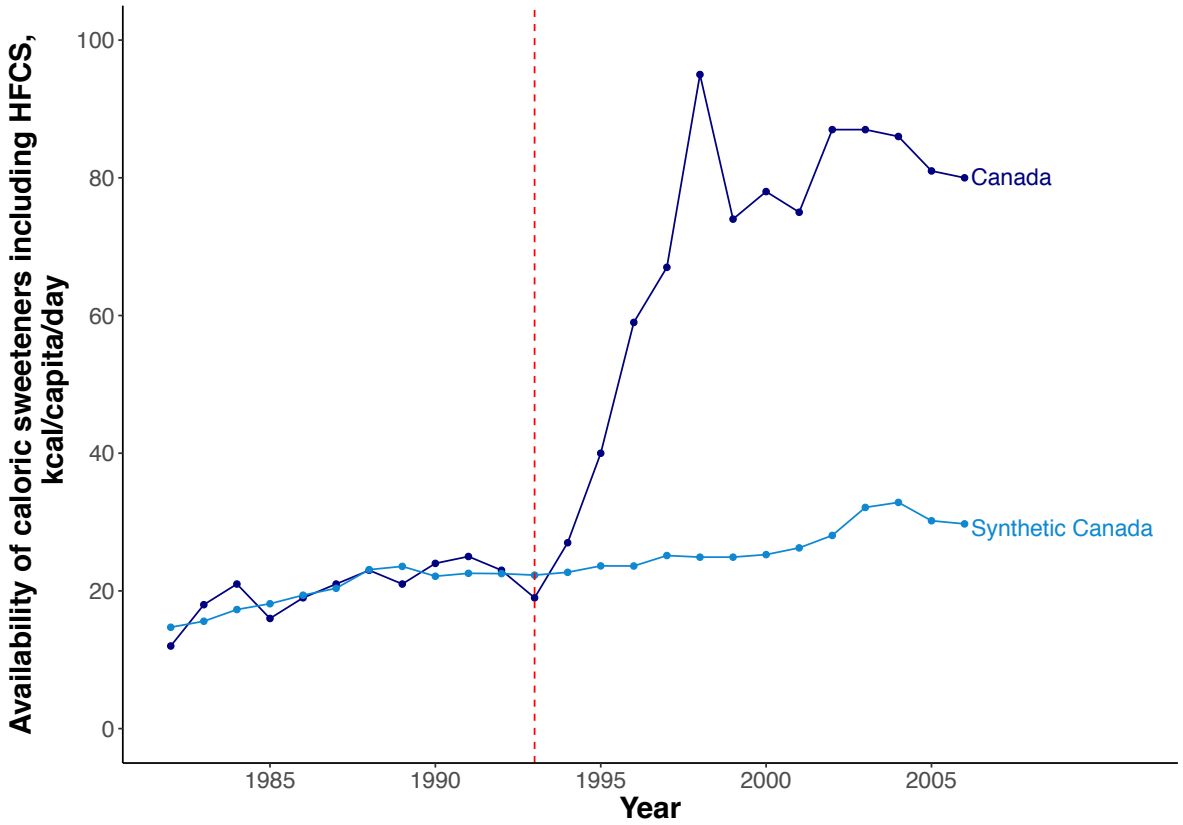


Figure 4.1 Supply of caloric sweeteners including HFCS, 1982-2006
Notes: vertical line shows when NAFTA was implemented on 1 January 1994.

My estimate of the effect of NAFTA is given by the mean difference between the availability of caloric sweeteners including HFCS in Canada and its synthetic counterpart in the post-NAFTA period. In the synthetic control unit, trends in the supply of caloric sweeteners including HFCS closely resembled trends in Canada in the pre-NAFTA period, 1982-1993. However, in the post-NAFTA period, from 1994, the two diverged substantially: supply accelerated in Canada whereas the increase in supply in synthetic Canada was relatively modest. On average, supply of caloric sweeteners was 45.1 kcal per capita per day higher in Canada compared with synthetic Canada in the post-NAFTA period, 1994-2006.

My estimate of the statistical significance of the NAFTA effect estimate is given by the proportion of 'in space' placebo effects that are at least as large as the effect in Canada, after adjusting for differences in model fit (RMSPE). Larger proportions would suggest that the post-NAFTA rise in HFCS availability compared with the synthetic control was also observed in comparison countries. This would undermine my confidence that the post-NAFTA rise in Canada is actually attributable to the trade agreement. Figure 4.3 plots the ratio of the NAFTA effect to the pre-intervention RMSPE in Canada and comparison countries. The figure shows that this quantity is much higher in Canada than any comparison country. Thus, the pseudo p-value estimate is 1/17. In other words, if one were to pick a country at random from the sample, the chances of obtaining an RMSPE-adjusted NAFTA effect estimate as large as the one observed in Canada would be 1/17, or approximately 5.9%.

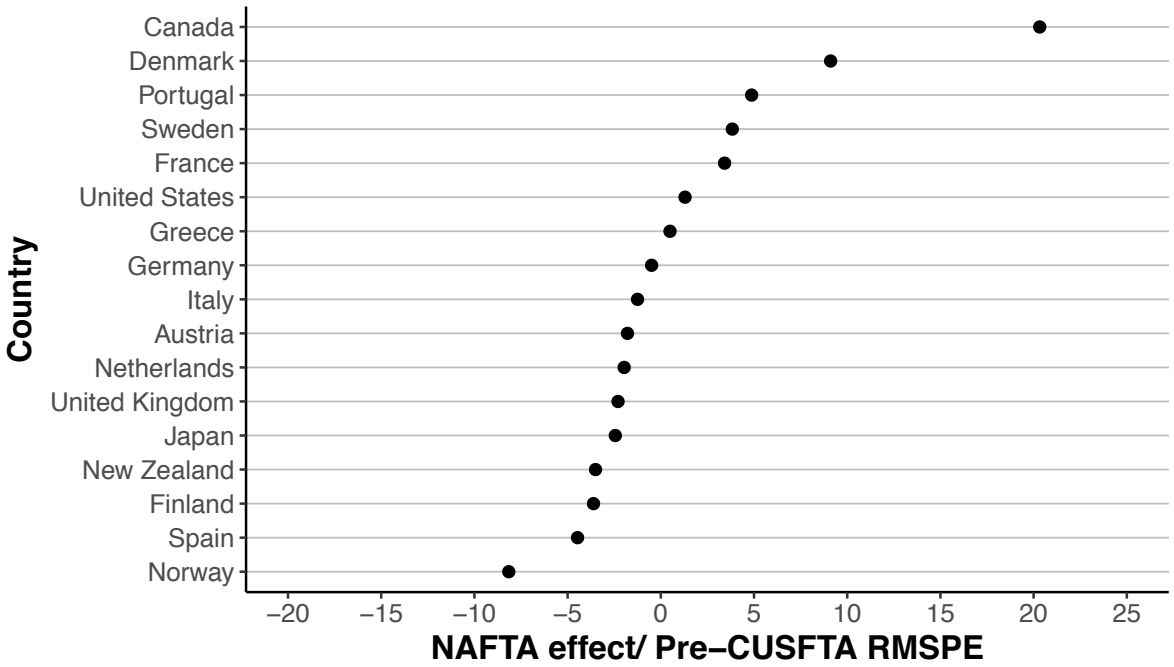


Figure 4.3 Post-NAFTA effect/pre –NAFTA effect in Canada and control countries
Notes: 'Fake' NAFTA effects are calculated by re-coding the NAFTA dummy to 1 in the country and re-estimating the synthetic control and associated effect. Canada is excluded from the comparison pool when estimating these effects. Taking the ratio of the effect size to the pre-NAFTA RMSPE ensures that effect estimates comparisons are not confounded by differences in model fit.

4.4.2 Substitute sugars and total sugar consumption

A question arising from the results presented thus far is whether rising HFCS consumption (proxied by availability) translated into higher overall sugar availability and consumption. Panel A in Figure 4.4 plots trends in cane and beet sugar availability and total sugar availability (cane and beet sugars plus caloric sweeteners including HFCS) in Canada, 1982-2006. Panel B plots trends in the availability of each sugar type as a proportion of total sugar availability in the same period.

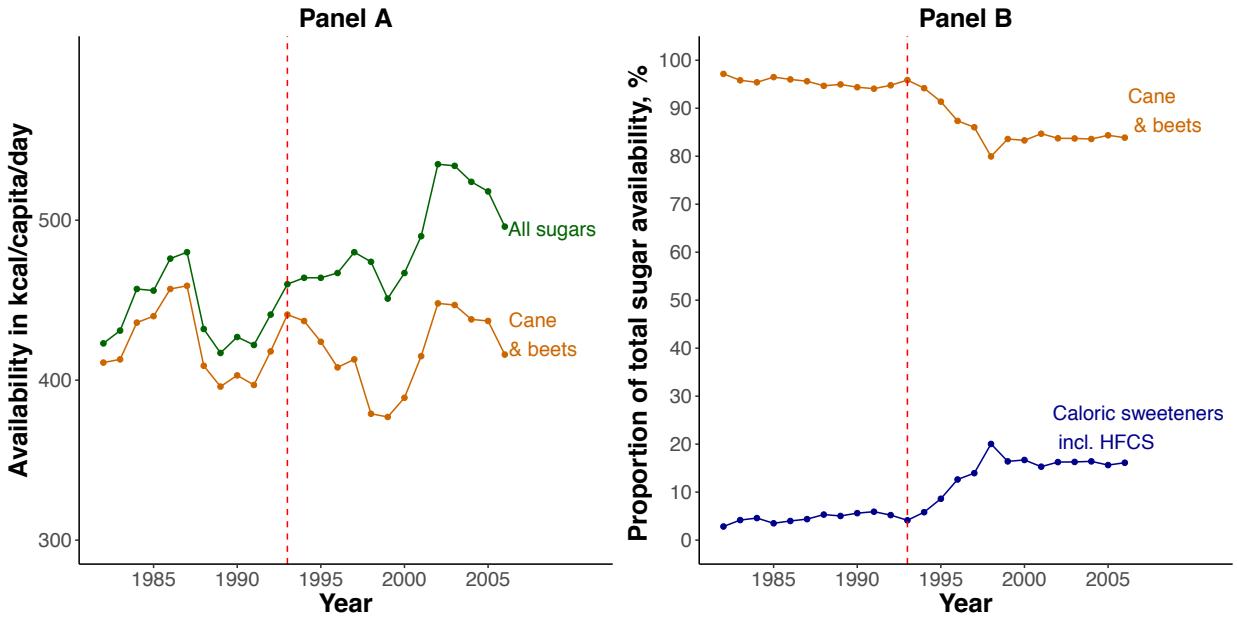


Figure 4.4 Trends in sugar consumption by type in Canada, 1982-2006

Between 1982 and 1993 the supply of all sugars followed trends in the supply of cane and beet sugars; the difference between these two is the supply of caloric sweeteners including HFCS and this difference remained stable at ~20 kcal/ capita/ day throughout this pre-NAFTA period. However, during the period from 1994 to 1998, the 55 kcal/ capita/day rise in the supply of caloric sweeteners including HFCS in Canada was offset by a decline in the supply of cane and beet sugars of 58 kcal/ capita/ day. Consequently, the supply of all sugars remained relatively stable between 1994 and 1998. Supply of caloric sweeteners

including HFCS constituted a rising proportion of total supply in this period, rising from 5.8% in 1994 to 20.0% in 1998, whilst cane and beet sugars constituted a declining proportion, falling from 94.2% in 1994 to 80.0% in 1998, as shown in Panel B of Figure 3.4.

From 1998 onwards, after the last stage of NAFTA-mandated tariff reductions and when supply of caloric sweeteners including HFCS stopped rising (per Figure 3.1), the supply of total sugars increased to 2002 and fell thereafter, once again following trends in cane and beet sugars.

4.4.3 HFCS imports from the US

Table 4.5 shows that net Canadian imports of food and beverage syrups approximately doubled in the period when NAFTA-mandated tariff reductions were implemented (1994-1998).

Table 4.5 Canadian imports of beverage mixes from the US, metric tonnes, 1994-2000

Year	All syrup mixes	HFCS mixes	HFCS mixes as proportion of total, %
1994	8,283.60	7,929.90	95.7%
1995	8,686.90	8,644.40	99.5%
1996	10,147.90	10,140.80	99.9%
1997	10,313.20	10,293.10	99.8%
1998	15,438.70	15,436.30	100.0%
1999	16,090.50	16,087.10	100.0%
2000	16,062.00	16,060.40	100.0%
2001	17,660.80	17,660.80	100.0%
2002	16,898.80	16,898.80	100.0%
2003	13,529.20	13,528.60	100.0%
2005	10,647.60	10,647.60	100.0%
2006	11,151.40	11,129.60	99.8%

Notes: Data not available pre-1994 as the data are not disaggregated into different types of syrups pre-1994. *Source*: United States Department of Agriculture Foreign Agricultural Service (USDA 2016).

Beverage syrup mixes made from HFCS rose from 7,132 metric tonnes (MT) in 1994 to a peak of 17,660.8 MT in 2001 before falling to 11,151.4 MT in 2006. During this period beverage mixes made from HFCS constituted an increasing proportion of total beverage syrup imports, rising from 95.7% in 1994 to 99.8% in 2006.

4.4.4 Placebo tests and additional analyses

Here I present the results from additional analyses designed to evaluate possible alternative explanations for my findings and to check whether my results were sensitive to my sample and model specification decisions. First, it is possible that my results are sensitive to the inclusion of a specific country in the donor pool and the precise combination of country weights, W*, identified by the synthetic control algorithm. For example, it could be that unobserved changes or policies in one or more comparison countries with non-zero weights led HFCS to remain lower than in Canada. This would mean that the estimated effect of NAFTA is not actually attributable to tariff reductions on HFCS; instead the effect would be attributable to the causes of low HFCS availability in comparison countries.

To test this I iteratively re-estimated the baseline model to re-construct synthetic Canada, omitting in each iteration one of the comparison countries. Figure 4.5 displays the results from this 'leave-one-out' analysis. Panel A replicates Figure 4.1 under alternative sample specifications, and Panel B shows the distribution of effect estimates in these alternative sample scenarios. Both panels in Figure 4.5 show that the results of my original analysis are fairly robust to the exclusion of countries from my sample. The leave-one-out synthetic control that shows the smallest effect of NAFTA is the one that excludes Japan, but even this estimate is only slightly lower than the estimated effect from my main models, as the

associated effect estimate was 34.4 kcal/ capita/ day. However, many leave-one-out specifications yield a higher effect estimate than my main models (up to 51.4 kcal/ capita day), and Panel B in Figure 4.5 shows that the mean and median effect estimates across the leave-one-out specifications were both larger than my original effect estimate. This suggests that my original sample specification and associated weights did not create upwards bias in my estimate of the effect of NAFTA on HFCS availability.

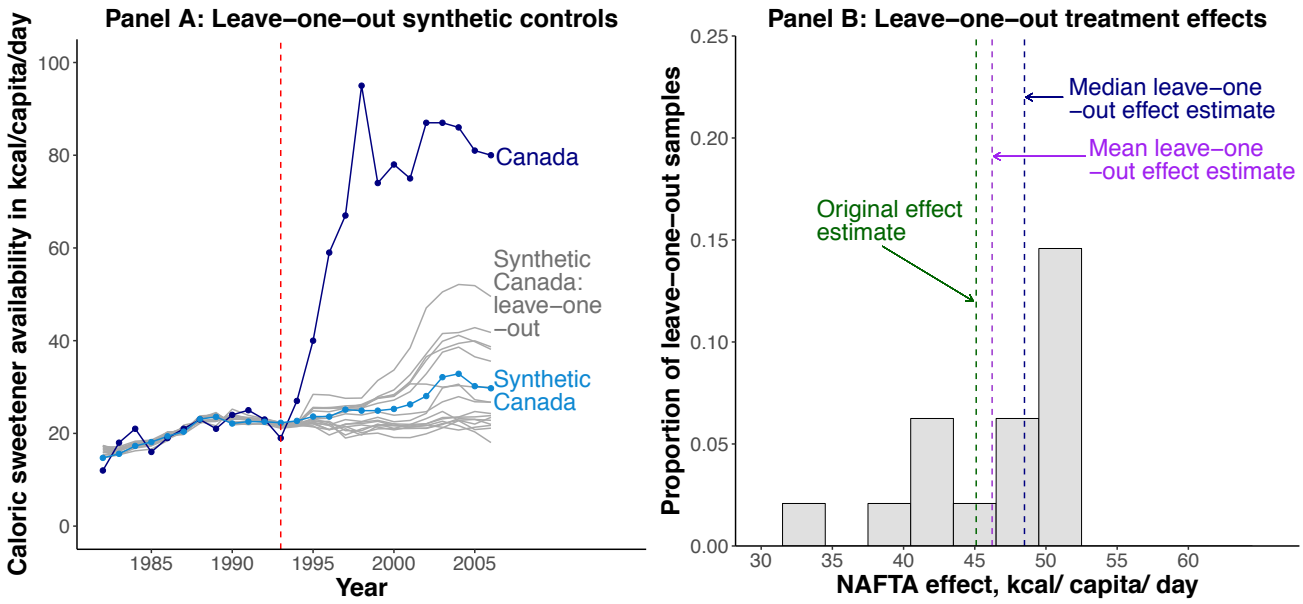


Figure 4.5 NAFTA effect leave-one-out analysis

Second, it is possible that my results are attributable to Canadian idiosyncrasies that would have led to periodic rises in HFCS availability in Canada, even in the absence of NAFTA. For example, if I found that trends in HFCS availability in Canada diverged from synthetic Canada in an earlier time period, when NAFTA was not implemented, my confidence that the estimated effect of NAFTA is actually attributable to the 1994 FTA would greatly diminish. To test this I conducted an 'in-time' placebo analysis in which I re-coded the NAFTA dummy to 1 in the middle of the pre-NAFTA period, 1988, and estimated the effect of this 'fake' NAFTA up to the year before NAFTA was actually implemented, 1993. The

first row ('Test 1') in Table 4.6 shows the results of this placebo study. Compared with the results from the 'actual' implementation of NAFTA, this fake NAFTA did not have a large effect on the availability of caloric sweeteners including HFCS in Canada.

Table 4.6 Additional placebo and sensitivity analyses

Test	NAFTA effect, kcal/ capita/ day	Pre-NAFTA RMSPE	Pseudo p-value
1) In-time placebo	-1.26	1.51	$8/17 \approx 0.47$
2) Within-Canada: bananas	0.45	1.67	$9/17 \approx 0.60$
3) Within-Canada: dairy products	1.73	2.15	$13/17 \approx 0.87$
4) Predictors: incl. cereal yields[a]	44.9	3.85	$1/9 \approx 0.11$
5) Predictors: incl. corn subsidies[b]	39.7	4.43	$1/8 \approx 0.13$
6) Sample: no EEA countries	45.3	2.93	$1/3 \approx 0.33$
7) Sample: All countries	55.3	1.27	$1/46 \approx 0.02$
Original model	45.1	1.57	$1/17 \approx 0.06$

Notes: EEA: European Economic Area. See text for full description of each test. a: measured as kilograms of cereals produced per hectare of harvested land. Data from the OECD-FAO Agricultural Outlook database (OECD-FAO 2015). Cereals include wheat, rice, maize, barley, oats, rye, millet, sorghum, buckwheat, and mixed grains. Excludes cereal crops harvested for hay or harvested green for food, feed, or silage and those used for grazing. b: Total of monetary value of transfers to cereal production expressed as a share of GDP. Data from the OECD Producer and Consumer Support Estimates database (OECD 2017).

Third, it is possible that the increase in the supply of caloric sweeteners including HFCS is not attributable NAFTA but instead attributable to unobserved changes that occurred simultaneously or after NAFTA and led to a rise in the supply of all food products in Canada. To test this possibility, I conducted two within-Canada placebo analyses. I re-estimated the effect of NAFTA on the supply of two products which were not subject to tariff changes in NAFTA: bananas and dairy products. Bananas were already tariff free before NAFTA, whilst tariffs on dairy products remained in place following NAFTA (Government of Canada 1994). If my results were driven by unobserved changes in Canada that coincided or followed NAFTA, we would expect to also observe a rise in the supply of these products. However, as

shown in Tests 2 and 3 in Table 4.6, NAFTA had a no effect on the supply of bananas and dairy products which were not subject to tariff changes.

Fourth, it is possible that my results are sensitive to my choice of predictors. There are two variables that could potentially affect HFCS availability that I did not include in my main specification as data were only available for a small number of countries and time periods: 1) crop yields (including corn), which are influenced by the weather and agricultural technology, and 2) government subsidies for corn production, which incentivise the production and use of corn-derived HFCS over other sugars (Credit Suisse 2013). I therefore estimated two additional models in which I incorporated these variables as predictors to evaluate whether my decision to omit them influenced my findings.

Tests 4 and 5 in Table 4.6 show that in both cases the estimated effect of NAFTA had the same sign and a similar magnitude to the estimate in my main analysis, suggesting that the omission of these two variables did not qualitatively alter my results. However, the synthetic control algorithm was less able to identify a closely matched synthetic control in these models. This is as evident in the higher prediction error (pre-NAFTA RMSPE), shown in the third column of Table 4.6, and in the larger differences in predictors in Canada and the synthetic control, shown in Appendix 4.3. This suggests that these models produced a synthetic control that was a less valid comparison with Canada than the synthetic control in my main models. This supports my decision to exclude these variables in favour of a model with higher predictive power and qualitatively similar results.

Sixth, it is possible that the inclusion of countries in the European Economic Area (EEA) in my sample led me to under-estimate caloric sweetener supply in synthetic Canada – and over-

estimate the NAFTA effect – due to an EEA quota that limits HFCS production (European Commission 2017). To evaluate this I re-estimated my models after excluding EEA members from the sample of comparison countries. Test 6 in Table 4.6 shows that the exclusion of EEA members did not substantively affect my results: the rise in the supply of caloric sweeteners including HFCS was 45.3 kcal/ capita/ day higher in Canada than in synthetic Canada after NAFTA. Again, the RMSPE is higher in this alternative model, supporting my decision to include EEA countries in favour of a model with greater predictive power and a more valid synthetic control comparison.

Seventh, although tariffs on other sugars which are included in the caloric sweetener category remained in place following NAFTA, it could be argued that the rise in exports of these sugars accounted for the rise in the availability of caloric sweeteners including HFCS. However, Appendix 4.3 shows that US exports to Canada of the other types of sugar included in the caloric sweetener category – molasses, pure fructose, and glucose – did not coincide the rise in supply of caloric sweeteners including HFCS following NAFTA.

Finally, I originally restricted the sample of comparison countries to other high-income countries that, like Canada, were members of the OECD, GATT and WTO. However, Billmeier and Nanicini (2013) noted that there is a trade-off between restricting comparison groups to ensure structural similarity and including all countries with available data. On the one hand, restricting the sample to structurally similar countries improves the validity of synthetic control analyses by avoiding "far-fetched country comparisons" (Billmeier and Nanicini 2013: 989). On the other hand, this restriction comes at a cost: the reduced sample size can limit the choice of possible synthetic control units. This increases the pre-treatment

RMSPE and reduces the power of the test, making the synthetic control comparison and associated results less valid.

To address this I follow Billmeier and Nanicini (2013) in conducting an additional analysis in which I included in the sample all 46 countries with available data during the study period that did not enter a US FTA. As shown in Table 4.6 (Test 7), incorporating additional countries reduced the pre-NAFTA RMSPE from 1.57 to 1.23 and increased the estimated NAFTA effect. The increase in the estimated NAFTA effect in the model with a lower pre-NAFTA RMSPE from 45.1 to 55.3 kcal/ capita/ day suggests than any increase in prediction error arising from my decision to analyse a restricted sample may have created downward bias in my estimate of the effect of NAFTA.

4.5 Discussion

4.5.1 Main findings

My analysis has shown that the elimination of a 5% tariff on US imports of HFCS food and beverage preparations in NAFTA was associated with a 45.1 kcal/ capita/ day increase in the supply of caloric sweeteners including HFCS in Canada. The rise in supply of caloric sweeteners including HFCS began immediately after NAFTA was implemented in 1994 and stabilized once tariffs were fully removed in 1998. However, this rise in the availability of caloric sweeteners including HFCS was fully offset by a decline in the supply of sugars made from cane and beets, so that total sugar supply remained relatively stable between 1994 and 1998. Consequently, caloric sweeteners including HFCS constituted an increasing proportion of this total, rising from 5.8% to 20.0% in this period. US exports of HFCS food and beverage preparations also increased after NAFTA and constituted an increasing proportion of total

food and beverage syrup preparation exports. These findings were robust to placebo studies and additional sensitivity analyses.

My findings suggest that tariff changes in NAFTA altered the composition of Canadian sugar consumption by encouraging the consumption of hazardous HFCS in place of relatively less hazardous cane and beet sugars. This suggests that the causes of the hazardous composition of Canadian sugar consumption in the post-NAFTA period were partially rooted in the structure of tariff changes agreed in the country's 1994 trade deal with the US as it fostered the cross-country diffusion of hazardous HFCS. Furthermore, age-adjusted estimates of socio-economic differences in dietary quality in Canada show that less educated individuals tend to consume more of the 'ultra-processed' food and beverages that contain HFCS, such as pre-prepared desserts, ice-creams, and sugar-sweetened soft-drinks (Moubarac 2017). This suggests that less educated individuals may have been relatively more exposed to the substitution of cane and beet sugars for more hazardous HFCS following NAFTA. Thus, NAFTA may have contributed to the marked socio-economic disparities in HFCS-related diseases – including obesity and diabetes – that exist in Canada (OECD 2016).

These conclusions illustrate how examining the structure of tariff reductions in a country's trade deals can help us to better understand the root causes of unhealthy dietary composition and, quite possibly, its socio-economic stratification. This demonstrates the importance of the structure of tariffs in FTAs for scholars' understanding of the root causes of unhealthy diets. In addition, these conclusions show how US FTAs can have a detrimental impact on an aspect of a society's well-being – its risk of developing NCDs – because they encourage a rise in the consumption of hazardous commodities and unhealthy dietary composition.

My findings are also consistent with previous studies, including Chapter 3 of this thesis, which showed that entering into FTAs, especially with the US, can create food environments that are more similar to the unhealthy 'obesogenic' environment in the US (Clark et al. 2012; Schram et al. 2015). This analysis also builds on prior scholarship in three important ways. First, I isolated a specific mechanism through which FTAs can impact diets: changes to import tariffs. I have shown that a modest and potentially inconspicuous change to tariffs on a hazardous commodity in an FTA can precipitate a change to the composition of a society's diets, thereby worsening dietary quality by increasing consumption of the hazardous commodity. Second, my analysis provides more robust evidence of a causal impact of tariff changes. Unlike previous studies of product-specific trade policies, I analysed the impact of tariff changes using a quasi-experimental approach that more rigorously addressed inferential issues created by potential confounding.

Third, I identified that the rise in HFCS supply did not lead to a rise in total sugar supply as the rise in caloric sweeteners including HFCS between 1994 and 1998 was offset by a coinciding decline in cane and beet sugar supply. This suggests that tariff changes in NAFTA increased Canadian's exposure to the risks associated with higher HFCS consumption specifically, rather than higher consumption of sugar overall. Consequently, tariff reductions on relatively more hazardous commodities in US FTAs appear to alter diets through a previously unrecognized pathway: a 'hazardous substitution effect', in which producers replace less hazardous ingredients (like cane and beet sugars) for potentially more hazardous ingredients (like HFCS) that are widely used in the US and are subject to lower tariffs in the FTA.

4.5.2 Limitations

My study has several limitations that I have attempted to address. First, I analysed changes to availability of one specific product in a single developed country. Whilst this may limit the generalizability of my findings to other products and contexts, my narrow, focussed approach enabled me to parse the specific policies linking FTAs to dietary outcomes and the precise nature of subsequent dietary changes.

Second, data limitations prevented me from fully testing how US exports responded to tariff changes as this information was not available in the pre-NAFTA period or in comparison countries. Yet, the data that were available show that high-fructose food and beverage syrups constituted an increasing proportion of total US food and beverage syrup exports in the post-NAFTA period. Net US exports of dextrose, glucose, maltose syrup and molasses – which are also recorded in the caloric sweeteners category – were unchanged. In addition, the rise in the supply of caloric sweeteners including HFCS persisted for every year that tariffs were reduced (1994-1998) and stopped rising immediately after tariffs were zero. This means that the termination of the tariff reduction treatment was associated with an interruption in the estimated treatment effect. These findings support the argument that the rise in the supply of caloric sweeteners including HFCS was attributable to tariff reductions on food and beverage preparations containing HFCS (Craig et al. 2018; Morgan and Winship 2007).

Third, it is possible that one or more significant events took place in Canada at the same time as NAFTA and so accounted for my findings. However, I did not identify an impact of NAFTA on the supply of banana and dairy products which were not subject to tariff changes in NAFTA, which suggests once again that tariff reductions in NAFTA – rather than other contextual changes – accounted for my findings.

Another important consideration is the role of declining beet sugar production in Canada. Since 1961 there has been a decline in beet sugar production, which could be expected to coincide an increase in the supply and consumption of alternative sweeteners, including HFCS, by leading to a rise in the price of beet sugars (Statistics Canada 2008). Yet, beet sugar production began declining over 30 years before NAFTA, whilst the supply of caloric sweeteners suddenly increased sharply after 1994 when NAFTA was implemented. In addition, my 'in-time' placebo analysis did not identify a divergence in the supply of caloric sweeteners including HFCS in Canada from synthetic Canada in the earlier period when supply of beets was falling. This suggests that the decline in beet production is unlikely to account for my findings.

A further important consideration is the possible impact of changes to the general sales tax (GST), passed into law in 1991. As I noted in Chapter 3, the GST affected the way taxes were applied to food and beverage products (Domingue and Soucy 2000; Jeffery 2013). It effectively reduced the overall tax rate paid by food and beverage producers, including those who widely use HFCS, and so could increase profitability and production in the food and beverage sector, leading to a rise in HFCS availability. Yet, most provinces did not implement the changes until 1997-2013, so the rise in caloric sweetener supply identified in my study pre-dates the implementation of the tax changes (Jeffery 2013).

Fourth, my models assume that the causing factor, NAFTA, did not affect the control observations directly or indirectly, the stable unit treatment value assumption, 'SUTVA'. It may be that NAFTA had an indirect effect on other countries by diverting trade with the US from Canada's competitors, meaning my effects are attributable to depressed HFCS imports in comparison countries and its impact on their caloric sweetener availability levels.

However, this may be unlikely as previous analyses of trade agreements, including NAFTA, reported only modest, statistically insignificant trade diverting effects (Baier and Bergstrand 2009, 2007). As noted by Cavallo et al., multi-country comparisons are also less likely to suffer this drawback compared with other policy evaluation frameworks as the effect estimates do not rely on a comparison single country (Cavallo et al. 2013).

Fifth, the results from my analysis may have limited external validity due to Canadian idiosyncrasies and contextual factors at the time NAFTA was implemented. In addition, my results are likely to depend on the comparative advantage of the US relative to Canada in HFCS production. My results may nevertheless be informative, as NAFTA was a blueprint for subsequent FTAs (Dür et al. 2014; Trefler 2004). In addition, my synthetic control models assume that the relationships between (observed and unobserved) predictors and HFCS availability were the same in the pre- and post-NAFTA period. It remains possible that an unknown contextual change occurred following NAFTA which altered this functional relationship and accounts for my findings.

I was also unable to test the implications of changing HFCS consumption for health outcomes, as the data required to examine these consequences were not available in the study period. These effects are debated, although there is some evidence that the corn and soft- drink industries distorts evidence of the harms from HFCS (Lipton 2014; Stanhope et al. 2015; White 2014). Finally, data limitations also precluded an analysis of the socio-economic stratification of changing diets and related health outcomes. Future research should address these limitations.

4.6 Conclusions

These limitations notwithstanding, my analysis suggests that lower tariffs on HFCS following NAFTA increased the supply and likely consumption of HFCS in Canada, via a 'hazardous substitution effect'. This suggests that the unhealthy composition of sugar consumption in Canada in the post-NAFTA period is partially rooted in the structure of tariff reductions in the country's 1994 trade deal with the US as it fostered the cross-country diffusion of HFCS use in place of less hazardous sugars. These conclusions show how examining the precise configuration of a country's tariffs – as mandated by FTAs – can help us to understand the root causes of unhealthy dietary composition. This demonstrates the importance of FTAs – and the tariff changes they mandate – for scholars' understanding of the causes of unhealthy diets. It also shows how US FTAs can have a detrimental impact on an aspect of a society's well-being – its risk of developing NCDs – because they foster a rise in the consumption of hazardous commodities.

4.7 Appendix

Appendix 4.1. Potential comparison countries and reason for exclusion

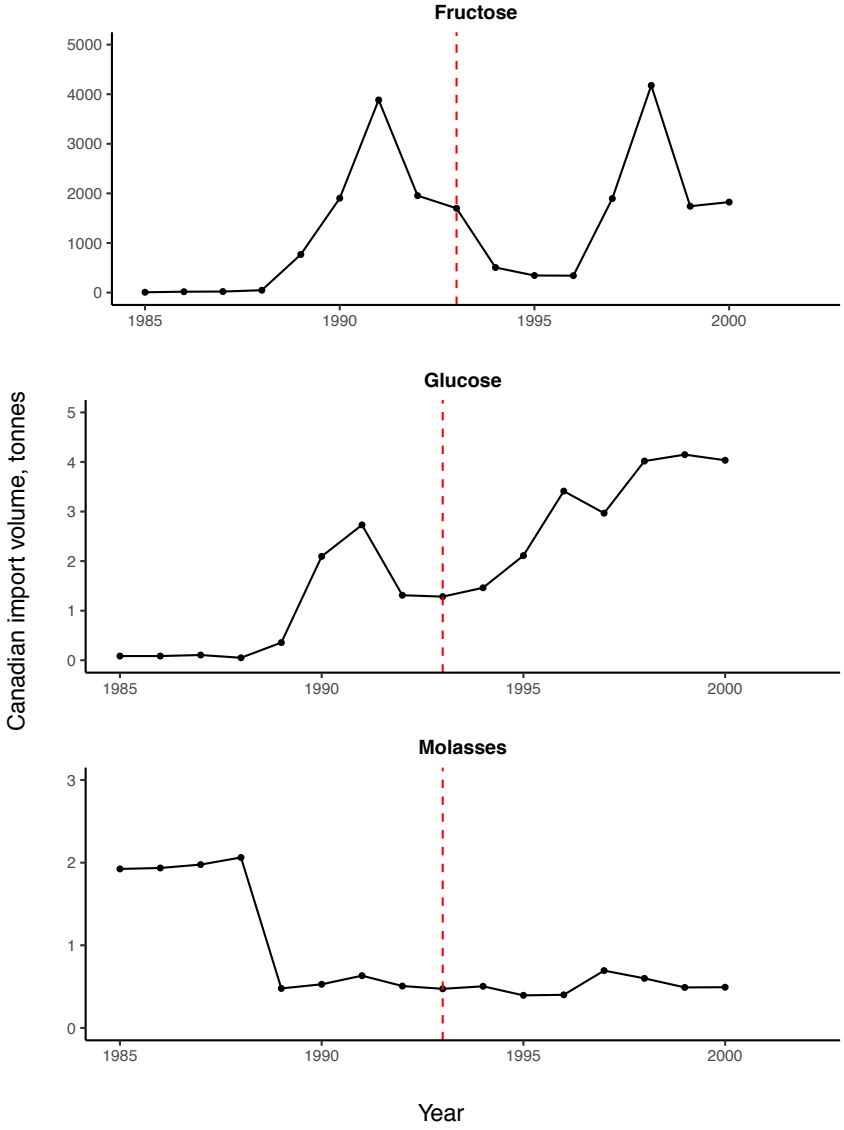
Country	Excluded?	Reason for exclusion
Australia	Yes	US FTA in 2002
Belgium	Yes	Missing data
Iceland	Yes	Missing data
Ireland	Yes	Missing data
Luxembourg	Yes	Missing data
Switzerland	Yes	Missing data
Austria	No	
Denmark	No	
Finland	No	
France	No	
Germany	No	
Greece	No	
Italy	No	
Japan	No	
Netherlands	No	
New Zealand	No	
Norway	No	
Portugal	No	
Spain	No	
Sweden	No	
UK	No	
US	No	

Appendix 4.2 Pre-NAFTA predictor means: alternative specifications

Variable	Canada	Synthetic control in main specification	Synthetic control including corn subsidies	Synthetic control including crop yields	Synthetic control with all countries
Caloric sweeteners, 1988	23.00	23.09	94.00	22.19	22.88
Pulses availability	36.08	31.18	20.70	30.12	34.98
Caloric sweeteners, 1993	19.00	22.29	86.00	22.52	21.39
Fish availability	31.92	46.18	199.17	61.20	64.96
Oil availability	404.17	415.62	286.92	443.30	407.92
Proportion aged 15-64	68.21	67.46	68.90	67.54	65.23
Fruit availability	115.00	127.98	53.10	132.07	134.02
Caloric sweeteners, 1983	18.00	15.60	86.00	15.95	16.32
Vegetable availability	81.50	76.99	76.92	84.97	79.25
Alcohol availability	128.17	171.48	153.00	155.26	122.24
Nuts availability	19.67	21.08	7.00	26.78	19.63
Inflation	3.99	4.89	1.36	7.24	29.29
Meat availability	357.58	373.76	149.17	338.20	310.33
GDP per capita	26,502.35	24,623.56	26,617.88	25,099.32	23,733.10
Proportion female	50.38	50.68	50.92	50.71	50.48
Proportion aged >65	10.71	12.12	11.15	12.84	11.04
Urbanisation	38.72	19.56	57.16	26.42	37.57
Proportion aged <14	21.08	20.42	19.95	19.61	23.73
Cereals availability	652.50	717.47	1,166.80	841.09	937.96
Dairy availability	367.83	456.89	130.17	484.32	384.39
GDP growth	0.81	1.75	3.39	1.58	2.41
Corn subsidies	8.40	n/a	13.10		
Crop yields	2,348.12			5,181.8	

Notes: See main text table 2 for data sources and measurement.

Appendix 4.3 Trends in Canadian imports of molasses, pure fructose, and glucose



Notes: vertical line shows when NAFTA was implemented on 1 January 199

Chapter 5. Is there a 'hidden hand' of influence on Non-Communicable Disease prevention at the World Trade Organization?

5.1 Introduction

A large and growing body of research has identified that a range of low-cost regulations are effective in preventing unhealthy behaviours and the chronic NCDs associated with them (Bloom, Chisholm, et al. 2011). These include nutrition labelling, taxes, and advertising restrictions applied to alcoholic drinks, sugar-sweetened beverages, and tobacco products (WHO 2010a, 2010b, 2011b). There is also increasing political commitment to implement these measures in order to prevent unhealthy behaviours and so address certain NCDs such as malnutrition, cardiovascular disease, liver disease, and cancer (WHO 2015). For example, the UN Sustainable Development Goals, adopted by 193 countries in September 2015, included a target to reduce mortality from NCDs by one third by 2030 (UN 2015a). This followed on from the UN Political Declaration on the Prevention and Control of NCDs, signed in September 2011 (UN 2011, 2015b). However, there is little evidence that governments have followed through with these commitments by fully implementing regulations that can achieve their goals (Horton 2017; WHO 2011a, 2017a). What explains this?

In Chapter 1 I argued that answering this question may require moving beyond traditional approaches to understanding unhealthy behaviours in medical sociology with an analysis of how macro-economic and political institutions, like FTAs, influence the policy process. I noted that conceptual frameworks grounded in other sub-disciplines in sociology and in

political science may shed light on this process by highlighting that policy implementation can be influenced by a range of factors, including vested political and economic interests (Bilton et al. 2002b; Geneau et al. 2010; Kingdon and Thurber 2010; Sabatier and Mazmanian 1980; Sabatier and Weible 2007). For example, one long-standing argument is that governments invoke rules in Free Trade Agreements (FTAs) to formally dispute and subsequently alter food, beverage and tobacco regulations targeting NCD prevention if they affect a government's interests or those of the businesses they represent (Thow, Snowdon, et al. 2015). Governments may invoke these rules to challenge and influence policy in informal settings, outside of courts, creating incentives for governments to delay, alter or repeal a regulation in order to avoid the costs of a formal dispute (Koivusalo et al. 2009).

In Chapter 2 I showed that systematic empirical scrutiny of this pathway to influence on food, beverage and tobacco regulations is currently limited, largely due to a dearth of available data. This precludes a comprehensive understanding of exactly when, by and against whom, and how often trade rules are actually invoked and influence food, beverage and tobacco regulations. In this chapter I address these limitations. I constructed and analysed a new dataset of challenges to food, beverage and tobacco regulations among 122 countries at the World Trade Organization (WTO) Technical Barriers to Trade Committee. Drawing on 1,496 pages of the minutes from 71 WTO committee meetings, 1995-2016, I thematically analysed the scope, frequency, and country characteristics of informal trade challenges. I also summarized four examples of challenges followed by policy changes in order to elucidate how these challenges may yield their influence.

The results from this analysis show that governments face increasing pressure to design food, beverage and tobacco regulations that other countries will deem consistent with trade rules, and that analyses based on formal disputes are likely to under-state the scale, scope, and power asymmetries that characterize trade-related influence on food, beverage and tobacco regulations. These findings underscore the importance of FTAs for scholars' understanding of the persistence of unhealthy behaviours, as FTAs can impact on policy implementation to prevent them. They also show how FTAs can have a detrimental impact on an important determinant of a society's well-being – its ability to prevent NCDs – by constraining the ability of governments to prevent the consumption of harmful food, beverage and tobacco products.

5.2 Background

5.2.1 Trade rules and NCD prevention: formal pathways

It has long been debated whether governments invoke rules in Free Trade Agreements (FTAs) to prevent other governments from introducing food, beverage and tobacco regulations that prevent the overconsumption of these products (Friel, Hattersley, et al. 2013; Friel et al. 2014; Weiss et al. 2015). Governments may do so because the costs created by such regulations come into conflict with their country or businesses' political and economic interests (Thow, Snowdon, et al. 2015). This broad debate centres on binding and enforceable treaties that include rules that are designed to minimise barriers to trade and investment in food, beverage and tobacco products. Such rules are contained in a range of FTAs, including the World Trade Organization (WTO) and its suite of trade agreements and procedures for

resolving state-state disputes, and regional or free trade agreements between at least two countries and which import much of the WTO treaties and then add further liberalization components (so-called 'WTO plus' measures) and chapters to resolve disputes between investors and states.

For example, World Trade Organization (WTO) members are obliged to design new regulations and policies that are consistent with the rules set out in the Technical Barriers to Trade (TBT) Agreement (WTO 2015b). The WTO is an intergovernmental organization that co-ordinates the rules of trade between its members. It comprised 164 countries in July 2017, with 21 countries awaiting accession (WTO 2017d). Countries which join the WTO sign a series of accession agreements, including the Technical Barriers to Trade (TBT) Agreement. This agreement is binding on all members of the WTO and states that new measures must not introduce 'unnecessary trade costs' because the stated objective of the measure – such as protecting public health – could be achieved with a less costly alternative. In addition, governments must ensure that measures do not discriminate against foreign products (in favour of domestic producers), or between foreign producers (for example, by favouring one country over another). The TBT Agreement also strongly encourages the use of international 'standards' for regulations, as set out by other inter-governmental bodies (WTO 2013c).[8] Finally, members must meet certain transparency obligations, described as a

[8] There is no definitive list of these 'international standards' and the WTO notes that deciding which ones are relevant is, ultimately, a "matter of subjective judgment" (WTO 2013:6). They include the standards, guides and recommendations that are set out by a range of other international bodies such as the European Committee for Standardisation (CEN), WHO Framework Convention on Tobacco Control (FCTC), FAO/WHO Codex Alimentarius Commission (Codex), and World Health Organization (WHO).

"cornerstone" (WTO 2015: 24) of the TBT Agreement, by informing other members of the details of any new regulation that might affect trade costs.

Several scholars have argued that WTO members could invoke the rules set out in the TBT Agreement in ways that restrict 'policy space', or "the freedom, scope, and mechanisms that governments have to design, choose, and implement public policies in order to fulfil health-related priorities and aims" (Koivusalo et al. 2009). This may happen because the TBT Agreement enables foreign governments to dispute health policies enacted by another government that they think violate the TBT Agreement, and formal dispute settlement procedures may mandate a change, delay or even the reversal of such a policy.

Perhaps the most well-known and recent such dispute is the Australian Tobacco Plain Packaging case. In 2011 the Australian Parliament approved legislation that mandated plain cigarette packaging in an attempt to reduce the rate of smoking in Australia (Government of Australia 2017). The governments of Ukraine, Honduras, Cuba, Indonesia, and the Dominican Republic subsequently initiated a series of cases arguing that the Australian government was breaching its trade obligations with the WTO. Philip Morris Asia, a tobacco firm, also launched a case arguing that Australia was breaching its obligations under a 1993 investment treaty with Hong-Kong (Miles and Geller 2017).

Ottersen and colleagues argued that differences in the willingness and capacity of states to defend a policy in such a dispute could lead to substantial asymmetries in the ability of states to implement their desired food, beverage and tobacco regulations (Ottersen et al. 2014).

Their argument drew on world-systems theory (Wallerstein 1983) which posits that interactions within international institutions reflect and reproduce pre-existing structures of domination between countries by serving as "vehicles for power politics" (Hafner-Burton 2005:4) or as "boards of directors for ruling states" (Boswell and Chase-Dunn 2000: 238). This may apply in the case of formal trade disputes at the WTO as developed countries have greater economic resources to devote to the administrative and legal costs of a dispute and a larger capacity to suffer the consequences of a loss (Ottersen et al. 2014). In noting this possibility Lindeque and McGuire observed that the two WTO members that used WTO dispute settlement procedures most often between 1995 and 2004 were the US and EU as "Brussels and Washington have the capacity and resources to see a dispute through to the bitter end" (Lindeque & McGuire 2007:735).

There is, however, an ongoing debate about whether FTAs actually influence food, beverage and tobacco regulations targeting NCD prevention and whether this process is characterised by economic power asymmetries. The TBT Agreement recognizes a government's right to pursue a range of 'legitimate' policy objectives, including the protection of human health, even if the regulation increases trade costs (WTO 2015b). In practice, only a few disputes overturning food, beverage and tobacco regulations have occurred to date. For example, in June 2018 the judges overseeing the dispute about Australia's plain packaging decided in Australia's favour, ruling that the regulation was consistent with WTO rules (Miles 2018). In addition, Mitchell and Voon (2011) evaluated whether WTO rules cohere with the WHO's recommended food, beverage and tobacco regulations. They identified 6 formal trade disputes about alcoholic beverage taxes (n = 3) and tobacco production and marketing regulations (n

= 4) between 1990 and 2010 (see Appendix 5.1).[9] The authors noted that numerous examples exist of countries implementing such measures without a dispute, whilst only a small number of disputes bearing on alcohol and tobacco have occurred (Mitchell and Voon 2011). Legal scholars Gostin (2008) and Bloche (2002) similarly observed that judges presiding over a range of health-related disputes at the WTO frequently ruled in favour of the government implementing the legislation, partially to avoid criticisms of judicial overreach in to domestic policy space (Bloche 2002; Gostin 2008).

Furthermore, several scholars have observed that the rules-based approach to resolving international trade disputes at the WTO serves to ameliorate – rather than reflect – power asymmetries between richer and poorer sates (Chorev 2005). This may happen because WTO disputes are resolved via third party adjudication and adherence to formal rules rather than diplomatic negotiations, thereby making the advantages associated with economic and political resources less salient (Chorev 2005). Indeed, the disputes reviewed in Mitchell and Voon's analysis did not display a clear pattern of power asymmetries associated with economic development: low- and middle-income countries raised as many disputes as higher income countries, and low- and middle-income countries raised more disputes against higher income countries (n=2, Ukraine et al vs. Australia and Indonesia vs. USA) than *vice versa* (n=1, USA vs. Thailand).

[9] One dispute concerning Armenia related to an excise tax that affected both alcohol and cigarettes, hence the total number of products affect is 7, whilst the number of disputes is 6. See Appendix 5.1 for further details.

5.2.2 Trade rules and NCD prevention: a 'hidden hand' of influence?

The conclusions from the scholarship presented above suggest that WTO rules may provide sufficient flexibility for introducing food, beverage and tobacco regulations to prevent NCDs, that there is little evidence that they actually lead to disputes followed policy changes, and that these disputes are not characterised by economic power asymmetries. This evidence primarily focussed on formal disputes. An institution's rules and regulations can, however, be used to influence its members' behaviour if members monitor and sanction one another's conformity to rules in informal settings, outside of courts (Scott 2008). Studies of the influence of trade rules on policy space for preventing unhealthy behaviours have therefore contested that attempts to invoke the rules to challenge and influence policy may also extend beyond formal dispute-resolution settings (Friel et al. 2014).

Indeed, actors involved in a disagreement can face strong incentives to avoid a formal dispute following any threat, suggestion or indication that such a dispute might occur. As Drezner noted in a study of another dispute resolution mechanism, economic sanctions, a threat can create strong incentives for a government to change their course of action because implementing sanctions incurs substantial costs (Drezner 2003). Whilst sanction threats may successfully yield an influence, most of these cases are covert: one more often observes cases in which these threats fail and so result in the actual imposition of formal sanctions. Drezner therefore described this pathway as a "hidden hand" (Drezner 2003:643) of influence. He argued that failing to consider this pathway to influence may lead scholars to under-specify the mechanisms through which sanctions yield an influence and underestimate the number of cases of successful influence. In addition, analyses of sanctions that are ultimately imposed

is likely to be limited by selection bias: they are unlikely to represent the full scope of outcomes as they are only likely to actually be imposed when stakes in the outcome are especially high for either or both parties, limiting external validity (ibid).

The costs associated with formal trade disputes may also lead accounts of their incidence, power dynamics, and outcomes to under-specify the mechanisms through which trade rules influence NCD prevention, to under-state number of cases of influence, and to provide a limited insight into the characteristics of these cases. Engaging in a formal trade dispute can incur significant economic costs. For example, it was reported that Australia spent at least US$50 million on defending its plain packaging legislation (Knaus 2017).[10] Curran and Eckhardt also noted that formal trade disputes can carry significant political costs as they risk jeopardizing relations with other states and may undermine their support in future trade negotiations (Curran and Eckhardt 2017).

Consequently, governments face strong incentives to acquiesce any challenge to a food, beverage or tobacco regulation's consistency with trade rules. This may lead to so-called 'policy or regulatory chill' effects which restrict policy space as governments delay, alter, or abandon a policy in order to avoid the costs associated with a formal dispute (Koivusalo et al. 2009). This can occur regardless of whether or not WTO rules do actually provide sufficient flexibility for introducing regulations as governments may make claims which are

[10] Philip Morris was subsequently ordered to pay the Australian government's legal fees but this was an unknown outcome when the dispute began and when the Australian government incurred its defensive costs (McGhee 2017).

invalid – or have uncertain validity – but are not fully verified in the absence of a formally adjudicated trade dispute (Hawkes 2015).

Like the impact of sanction threats, failing to consider this pathway to impact may under-specify the mechanisms through which FTAs influence policy, and failing to enumerate these cases may under-state the number of cases in which trade rules influence policy. Like enforced sanctions, formal disputes about food, beverage and tobacco regulations are also likely to arise from a non-random selection process. Formal disputes may be more likely to occur when stakes in the outcome are particularly high, or when one or both parties are especially confident of a victory (Curran and Eckhardt 2017). For example, Curran & Eckhardt (2007) argued that one reason why the disagreement over Australia's plain packaging legislation had escalated to the formal dispute stage was because its outcome would be a landmark ruling that affected whether similar legislation would be introduced in other countries. Those who sought a change in legislation feared its global consequences, making the dispute a high-stakes issue, whilst countries who wanted to implement similar policies encouraged Australia to leave the policy unchanged and move forward with a dispute in order to avoid incurring the costs of a dispute themselves (ibid).

The economic and political costs associated with disputes are likely to be an especially significant deterrent for developing countries, and so developed countries may target poorer countries disproportionately in informal challenges due to greater chances of successful influence in this setting. Thus, even if judicial procedures redress power asymmetries by providing poorer states with a platform for airing their grievances (Chorev 2005), these

countries may still lack sufficient economic resources to devote to the administrative and legal costs of a dispute and have a weaker capacity to suffer the consequences of a loss. This may deter poorer countries from moving forward with a dispute and so lead them to change their policy to avoid further escalation.[11] Curran and Eckhardt also noted that poorer countries may be especially unwilling to jeopardize their relations with wealthier states as they are more dependent on securing economic relations through trade agreements and diplomatic support (Curran and Eckhardt 2017). This is consistent with an earlier study by Lindeque and McGuire, who argued that few low-income countries formally disputed the US's protectionist agricultural policies between 1995 and 2004 as they were "worried about angering trade lobbies in the US Congress and about losing access to the American market" (Lindeque and McGuire 2007:742).

5.3 Literature review

The majority of empirical studies of the impact of trade rules and disputes on food, beverage and tobacco regulations are in legal scholarship. As noted above, Mitchell and Voon (2011) observed that few disputes have arisen and concluded that WTO rules are not necessarily

[11] This possibility became evident when the global tobacco firm Philip Morris, with gross revenues of US$64 billion in 2010, threatened to sue Uruguay, with a GDP of US$32 billion that year, for introducing graphic health warnings on cigarette packages. Philip Morris argued that Uruguay was breaching its commitments under an investment treaty with Switzerland. International media reported that Uruguay had considered weakening its proposed health warnings in order to avoid a long and expensive battle with Philip Morris, but Uruguay ultimately retained the warnings and persisted with its legal defence after receiving financial support to cover legal fees from Michael Bloomberg, a businessman and philanthropist (Wilson 2010).

inconsistent with food, beverage and tobacco regulations targeting NCD prevention. But, as I have argued, focussing only on the number, content and outcomes of formal disputes may overlook informal pathways to influence.

My systematic review of the influence of FTAs on health outcomes and policy in Chapter 2 showed that no empirical studies have systematically investigated informal pathways to influence. Most scholarship on these informal pathways was theoretical frameworks, commentaries and single country case studies (McNeill et al. 2017; Thow, Snowdon, et al. 2015). One particular incident was extensively cited as evidence of the informal, deterrent effect of WTO rules on regulations: Thailand's proposed introduction of a traffic-light labelling system on food packages in 2006. The proposed labels would include red, orange and green circles that indicated how far the fat, sugar, salt or calorie content of the product exceeded a specified proportion of an individual's recommended daily intake. Under pressure from the US, which argued that the policy contravened WTO rules, the Thai government abandoned its preferred approach and implemented monochrome daily guideline labels, which are less-effective (Borgmeier and Westenhoefer 2009), thereby preventing escalation to a formal dispute (Friel et al. 2014).

Similarly, Thow et al. (2017) identified four additional challenges to food labelling regulations proposed by Indonesia, Peru, Ecuador and Chile during informal meetings at the WTO. They found that queries were often raised about whether the labels were necessary and were consistent with pre-agreed international standards, as required by WTO rules. Lencucha et al. (2016) similarly analysed arguments against plain tobacco legislation during formal trade

disputes and pre-dispute trade challenges at the WTO (Lencucha, Drope, and Labonte 2016). The authors identified similarities between the patterns of argumentation put forth by WTO officials and well-documented industry arguments against the legislation. This included the argument that there is no scientific evidence showing that the measure would achieve its intended objectives, and that the measure would also lead to an increase in illicit trade and consumption of tobacco (Lencucha et al. 2016).

However, many important questions pertaining to the possible influence of invoking trade rules to challenge food, beverage and tobacco regulations remain unanswered from these case studies. How often are trade rules invoked to informally challenge to food, beverage or tobacco regulations? What proportion of informal challenges escalated to formal disputes, and so to what extent do informal challenges represent a possible 'hidden hand' of influence that is under-specified and under-estimated in analysis of formal disputes? What are these challenges about: what products and policies were under scrutiny; what trade rules are being cited? Finally, to what extent do informal challenges reflect the well-known asymmetry of economic and political power and capacity between high-and low-income countries? And how exactly might informal challenges – especially those raised by high-income countries – lead a country to alter, delay, or abandon a policy?

What is missing from this literature in order to answer these questions is a comprehensive description of the frequency, scope, and power asymmetries which characterise countries' attempts to invoke trade rules – such as the WTO's TBT Agreement – in order to influence food, beverage and tobacco regulations via informal pathways. This limitation has partially

arisen due to a dearth of systematically coded data about informal challenges. In this chapter I address these gaps. I analyse a newly constructed dataset of informal challenges to food, beverage and tobacco regulations at the World Trade Organization (WTO) Technical Barriers to Trade Committee (where these challenges are raised), 1995-2016. I thematically analyse the frequency and content of informal trade challenges, the proportion that escalated to disputes, and identified patterns in the economic resources and associated political power of the countries raising and defending them. I further summarized four case-studies that illustrate how informal challenges might be used by high-income countries to influence regulations aimed at reducing processed food, soft-drink, and alcohol consumption in poorer countries.

5.4 Methods

5.4.1 Data sources and coding procedures

I studied the potential influence of trade rules on food, beverage and tobacco regulations via informal challenges during meetings at the World Trade Organization's (WTO) Technical Barriers to Trade (TBT) Committee. The WTO's rules and procedures for notifying and informally challenging members' regulations provide a unique opportunity to analyse the potential influence of trade rules on food, beverage and tobacco regulations via informal channels for three reasons. First, unlike most FTAs, informal challenges are systematically recorded by the WTO in meeting minutes and a corresponding database. Second, these records are freely available online. And third, WTO debates provide some insight into the

challenges that may be raised elsewhere, as the clauses in many subsequent FTAs incorporated and expanded upon the WTO's rules (Allee and Elsig 2015; Dür et al. 2014).

To monitor compliance with the rules in the WTO's TBT Agreement, WTO members are obliged to notify other members of any regulation they are considering or have proposed that may have an impact on trade. This requirement is designed to ensure that trading partners can evaluate the regulation's consistency with WTO rules. Notifications are then discussed at the WTO's TBT Committee meetings in Geneva, which take place 2-3 times each year. Notification must take place at an early stage so that comments and suggested amendments can be considered before the measure is in force. If other members want to challenge whether a notified measure is consistent with WTO rules they do so at these meetings. This constitutes an informal trade challenge. The meetings are designed to prevent escalation to a formal dispute and, as stated in a 2015 WTO report, they have "effectively facilitated the resolution of – or diffused at an early stage – issues arising between members" (WTO 2015:28).

I constructed a dataset of informal trade challenges at the TBT Committee by combining information from two sources: the WTO's TBT Information Management System ('TBT-IMS') and written minutes of TBT Committee meetings (WTO 2017b, 2017c). Figure 5.1 summarizes how I constructed my dataset by extracting, coding and combining information from these two sources, as described in further detail below.

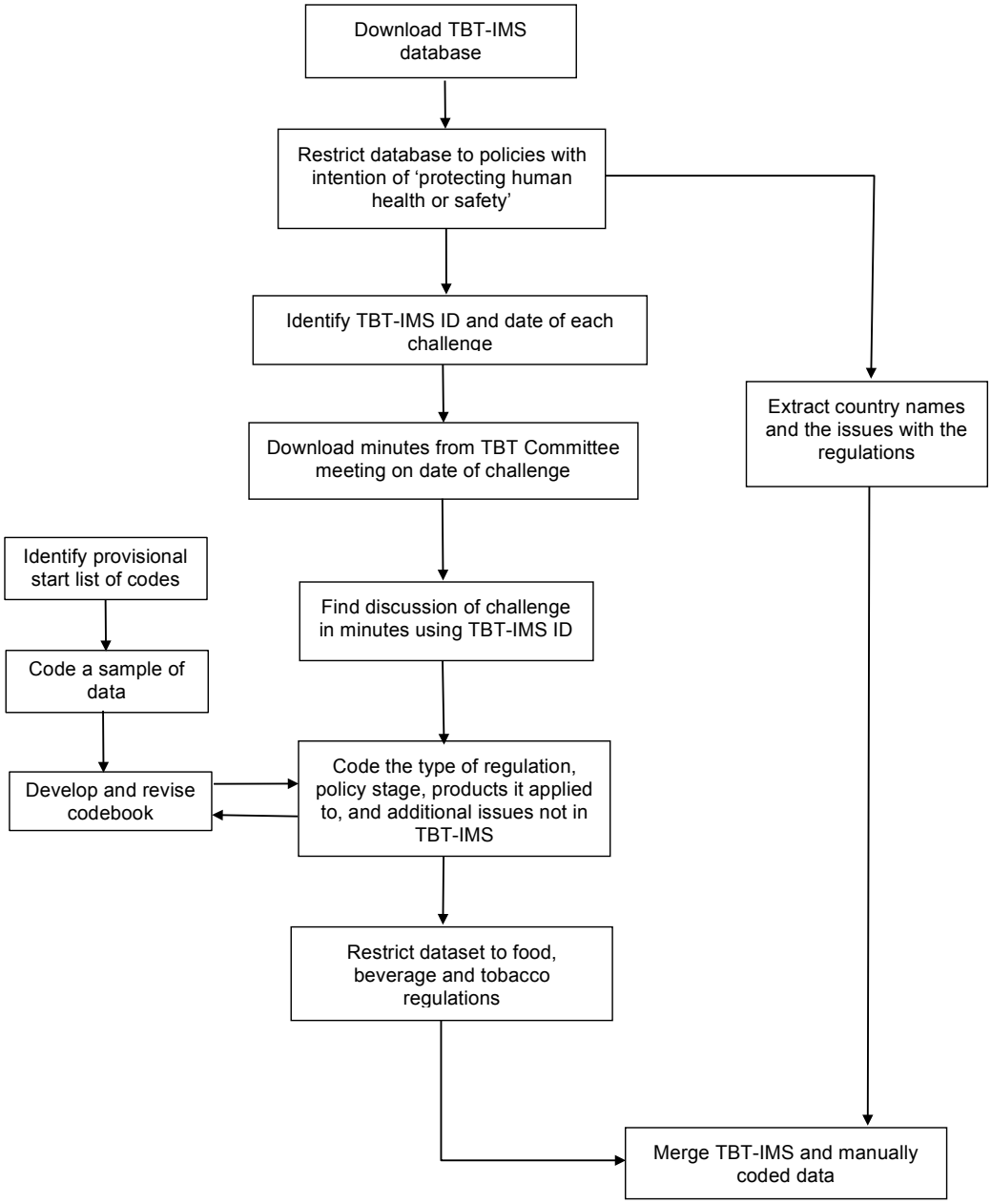


Figure 5.1 Database construction procedures
Notes: See text for full description of data identification and coding procedures.

The TBT-IMS is a freely available online database of all regulations that were notified to the WTO since the WTO's foundation in 1995. The database includes information about the regulation's original objective(s). These are coded by the officials who registered the details of the regulation onto the TBT-IMS. The officials can select these objectives from the WTO's

pre-defined categories of 'legitimate' policy goals, which are policy goals that may be achieved by introducing policies that have a detrimental and costly impact on trade. These legitimate goals include 'the protection of human health or safety'.

The TBT-IMS contains information about all challenges that were raised at the TBT Committee since 1995. The database contains a unique ID for each regulation, the member that registered it, its objective, the names of the other WTO members that challenged the regulation, the trade rules they argued were being contravened, and dates of the TBT Committee meetings where these challenges were raised. I extracted TBT-IMS data about all challenges that were raised, 1995-2016, and then restricted the dataset to challenges that were raised against policies with the registered objective of 'protecting human health or safety'.

Since the TBT-IMS did not provide full details of the specific issues discussed in each challenge, the type of regulation being introduced, whether it had been implemented or not, and the products it applied to, I manually extracted and coded this information from 1,496 pages of minutes from the 71 TBT meetings where challenges were raised. I obtained these minutes from the WTO's freely accessible 'Documents Online' repository (WTO 2017e). To identify discussions about each regulation and associated challenges I first identified and downloaded the minutes corresponding to the meetings in which the challenges were raised, as listed in the TBT-IMS database. I then identified challenges to a regulation using the sub-headings of the minutes, which were labelled according to the TBT-IMS ID of the regulation under discussion.

After identifying the challenge, I manually coded the description of the discussion in the minutes to identify the specific problems or issues with the regulation according to the country raising the challenge, the type of regulation being introduced, the products it applied to, and whether it had been proposed (but not ratified), ratified (but not implemented), or implemented. When coding these textual data I applied a list of codes I developed following procedures recommended by Miles, Huberman and Saldana (Miles, Huberman, and Saldana 2013). These widely applied procedures involve 1) identifying a 'start list' of provisional codes based on relevant literature, 2) coding a sample of the data whilst adding or modifying the codebook where appropriate, 3) coding the remaining data, again modifying the codebook where necessary, and 4) checking for coding accuracy and reliability.

I identified my provisional 'start list' of codes for describing the policies and the policy's stage of development from the WTO Agreement Series: Technical Barriers to Trade, 2015 edition (WTO 2015b), and I identified a start list of product categories from the UN's Harmonized Commodity Description and Coding System Combined Nomenclature, 2007 edition (UN 2007). I then randomly selected 10 challenges and identified references to the policy, its stage in development, and the product it applied to, as described in the associated meeting minutes, and assigned them categories using the provisional start list of codes. As recommended by Miles, Huberman and Saldana (2013) I modified and disaggregated existing codes and created new codes where the start list of codes was inaccurate, ambiguous, or combined a large number of diverse policies, policy stages, or products into a single category.

Next, I used the codes developed from the first two stages to code the remainder of the data. Again, I modified existing codes, developed new codes and revised the codebook, and re-coded earlier sections of the data where necessary. After coding 65 (28.1% of 231) challenges I made no further revisions to the codebook. Finally, to check the reliability of my coding procedure I randomly selected 10% (n = 23) of the challenges and asked another DPhil student to code them using the codebook I developed. An ambiguity in coding arose in 1 case and was resolved by clarifying the definitions in my codebook.

To give a specific example, in May 2011 the United States challenged Thailand's new requirements for including health-warning labels on alcoholic beverage packages. The minutes from the TBT Committee meeting at which the challenge was raised stated:

> "The representative of the United States raised previously-aired concerns about the proposed legislation, including the scientific basis for the text of the alcohol warning requirements and the size of the warning label in proportion to the bottle." (WTO 2011b)

Here I coded the product as 'beverages' with the sub-category 'alcohol'. I coded the policy as a 'labelling regulation', and I coded the policy stage as 'proposed (but not ratified)'. Additional examples are provided in Appendix 5.2.

After coding the products and other additional information I restricted my analytical sample to challenges that were raised about measures only affecting food, beverage and tobacco products. Finally, to study possible economic asymmetries in informal challenges I imported country income level data from in the World Bank World Development Indicators, 2017 edition, and grouped members into income quartiles according to their income in the year each challenge was raised (World Bank 2017). The final dataset included 93 challenges raised

in the period from 1995, when the first challenge to a food, beverage or tobacco regulation was raised, to 2016, when data for a full year were most recently available.

5.4.2 Thematic analysis

I conducted a 'thematic analysis' of the frequency and scope of informal trade challenges. This approach incorporates multiple analytic methods to record, examine and summarise key patterns within textual data (Miles et al. 2013). I first analysed trends in the number of informal challenges to food, beverage and tobacco regulations raised each year and compare these figures with trends in all trade challenges and all challenges focussing on regulations aimed at 'protecting public health or safety'. As a rising number of challenges could simply reflect the growing number of WTO members over time, I also divide this figure by the number of WTO members in each year.

I then assessed the degree to which informal challenges constitute a possible 'hidden hand' of influence by tracking the proportion of challenges that escalated to overt formal disputes. I identified escalation from the WTO's index of disputes citing the TBT Agreement (WTO 2017a). I identified all disputes relating to food, beverage and tobacco products, noted the description of the regulation and members involved, the specific issue(s) in the dispute with the regulation, and the year of the dispute. I then searched my database for an earlier challenge involving the same members, regulation and issue(s).

Next, I analysed the content and scope of informal trade challenges by summarizing the type of regulations subject to challenges, the products the regulations applied to, and the arguments that were made against them. It was not possible to systematically identify the outcomes of all challenges as this was not systematically reported in the TBT-IMS or TBT Committee meeting minutes. However, I could observe whether or not it escalated to a formal dispute, the number of meetings in which challenges were made towards a policy, and the stage of a policy's development at the time of the first challenge: proposed (but not ratified), ratified (but not implemented), and in force.

To study potential economic and political power asymmetries I first calculated the proportion of challenges raised and defended by and to members in each income quartile. Next, to study asymmetries in challenge country pairs or 'dyads', I reformatted the data into a matrix showing the frequency and direction of challenges between each dyad, where cell x_{ij} counts the number of challenges raised by a country or 'node' i (in the rows) to node j (in the columns). I then imported income quartile data for each node and calculated the total proportion of challenges raised against members in each income quartile by members in each quartile. To visualize these patterns, I plot the network of challenges raised against members in each income group separately.

Finally, I review four cases where regulations were changed following an informal trade challenge from the wealthiest WTO members. The goal of this specific aspect of the analysis was to elucidate in more detail the precise ways in which this highly-debated source of influence might occur. I examined how members responded to the challenge; whether the

policy change entailed the delay, alteration, or repeal of policy; and, if possible, whether any specific comments in each challenge were subsequently incorporated into the policy.

I identified examples based on three criteria. First, like previous sociological studies of policy-making in international organizations I selected examples with "heightened importance in scholarly debates" (King & Sznajder 2006:767). These can advance a debate by providing insights into its "central battlegrounds" (King & Sznajder 2006:767; Kentikelenis & Seabrooke 2017). Here, the debate centres on whether and how powerful, wealthy, Western countries use trade rules to undermine NCD prevention by delaying or altering regulations on processed foods, sugar-sweetened soft-drinks, alcoholic beverages, and tobacco in less- wealthy, non-Western countries (Beaglehole and Yach 2003; Friel, Gleeson, et al. 2013; Friel, Hattersley, et al. 2013; Kelsey 2012; Mitchell and Voon 2011; Thow et al. 2017; Weiss et al. 2015; WHO 2013). I therefore sought examples with these country and policy characteristics.

Second, my ability to select examples was restricted by whether data were available to track policy changes. This occurred only when a challenge was raised about a policy that had already been changed in response to an earlier challenge, and when the officials representing the country defending the policy or raising the challenge mentioned that the policy had already been changed during this subsequent TBT meeting. This occurred very rarely. Finally, I excluded the Thai traffic-light labelling case and plain tobacco packaging debates which have already been described in extensive detail elsewhere (Curran and Eckhardt 2017; Friel et al. 2014; Lencucha et al. 2016). This yielded four examples in Indonesia (processed foods), Chile (processed foods), Colombia (alcohol), and Saudi Arabia (soft-drinks).

5.5 Results

5.5.1 Trends in informal WTO challenges

Here I describe the results from my analysis of trends in informal trade challenges and the characteristics of members raising and defending them. The left panel in Figure 5.2 shows that the number of challenges to food, beverage and tobacco regulations per year has grown markedly over time, rising from zero in 1995 to a high of 13 in 2014. The right-hand panel in Figure 5.2 shows that the ratio of challenges to WTO members in each year exhibited a similar pattern. This means that the trend in the left-hand panel is not due to growing WTO membership.

Overall, a total of 93 informal challenges were raised concerning regulations aimed at protecting individuals from the risks associated food, beverage and tobacco products during the study period. These challenges constituted 17.9% of all challenges raised at the TBT committee during this period and 38.0% of measures registered with the objective of 'protecting human health or safety'. Few challenges were followed by a formal dispute, suggesting that they were resolved without resorting to formal WTO channels. A formal trade dispute occurred following only one informal challenge (1.1% of cases): the Australian plain packaging case.

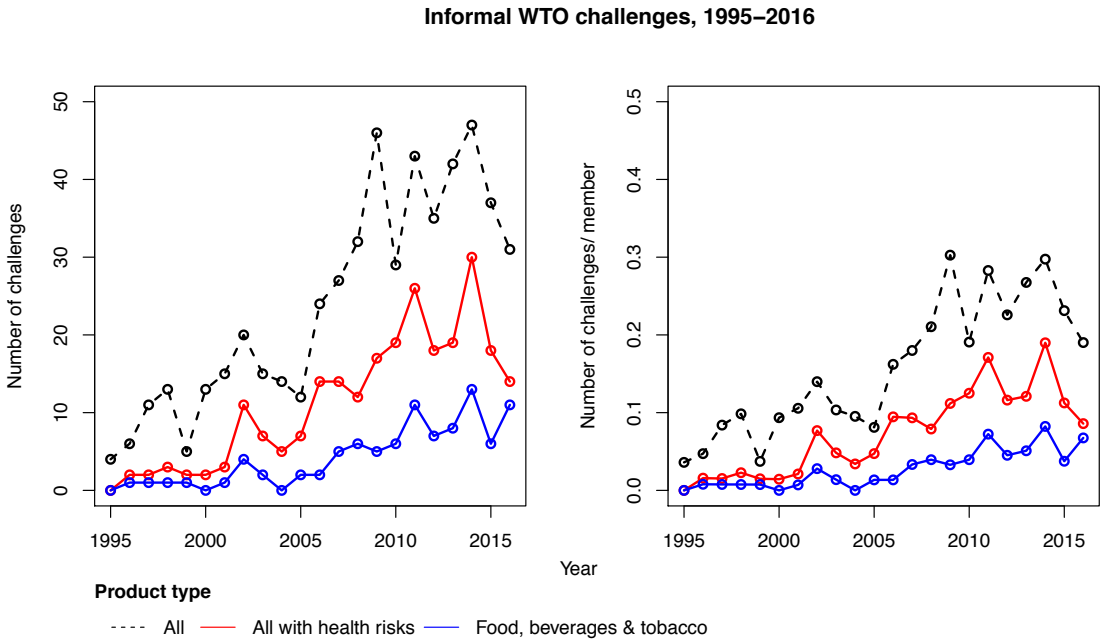


Figure 5.2 Trends in WTO trade challenges, 1995-2016

A majority of challenges were raised before the policy had been finalized or implemented: 61.3% of food, beverage and tobacco regulations had been proposed but not yet ratified, 12.9% had been ratified but not implemented, whilst 25.8% were implemented when the informal challenges were raised. In addition, a majority of challenges were raised at least once: they were raised during one meeting in 31.2% of cases, during two meetings in 21.5% of cases, and during at least three meetings in 47.3% of cases.

Members in the highest income quartile raised just under half of all challenges (43.2%), followed by upper-middle income members (20.7%), lower-middle-income members (20.4%) and lowest-income members (15.6%). In addition, over one third of all challenges were raised against the highest-income members (38.1%), followed by upper-middle (20.7%), lower-middle-income (27.4%), and low-income members (13.7%).

Although high-income members most frequently raised and defended challenges overall, this aggregate pattern obscures substantial differences in members' incomes within each challenge dyad. For example, the five most common challenge dyads were raised by high- to lower-middle or upper-middle income members: the EU to Brazil (n = 8 challenges), Canada to Ecuador (n=5), the EU to Ecuador (n=5), the US to Brazil (n=5), and the US to Ecuador (n=5).

Figures 5.3-5.4 visualize the challenges raised by and against each individual country on a world map, separated according to the income quartiles of the members being challenged. Arrows from and to each country's capital city show that at least one challenge was raised by and to those members. The colour and thickness of each line corresponds to the number of challenges raised from and to those specific members. Thinner, light green lines show fewer challenges, whilst thicker, dark blue lines show more challenges. Countries in the EU are represented as a group rather than as individual countries at the WTO, and so challenges to and from countries within the EU or the EU as a whole are all directed to/from Brussels in Figures 5.3-5.4.

In the top panel of Figure 5.3 the lines from high-income members to members in the lowest-income quartile show how challenges against members in the lowest-income quartile were primarily raised by members in the highest income quartile. Furthermore, a number of high-income members, such as the US, Australia and the EU, raised multiple challenges to select members in the lowest-income quartile, such as India and Vietnam, as indicated by the dark shading of the lines to and from these members. Overall, 82.1% of challenges made to

members in the lowest income quartile were raised by members in the highest income quartile, followed by upper-middle income members in the second highest quartile (17.9%), whilst members in the lowest two income quartiles raised no challenges in this category.

The bottom panel of Figure 5.3 shows challenges against members in the second lowest-income quartile. A similar pattern emerges: challenges were primarily raised by members in the highest income quartile, and a number of high-income members, such as Canada, the US and the EU, raised challenges to lower-middle income members, such as Ecuador and China, on multiple occasions. However, unlike the top panel of Figure 5.3, a slightly higher proportion of challenges was raised by upper-middle members (second highest quartile). Overall, 59.6% of challenges made to lower-middle income members were raised by members in the highest income quartile, followed by upper-middle income members in the second highest quartile (28.1%), other lower-middle income members (9.0%) and lowest-income members (3.4%).

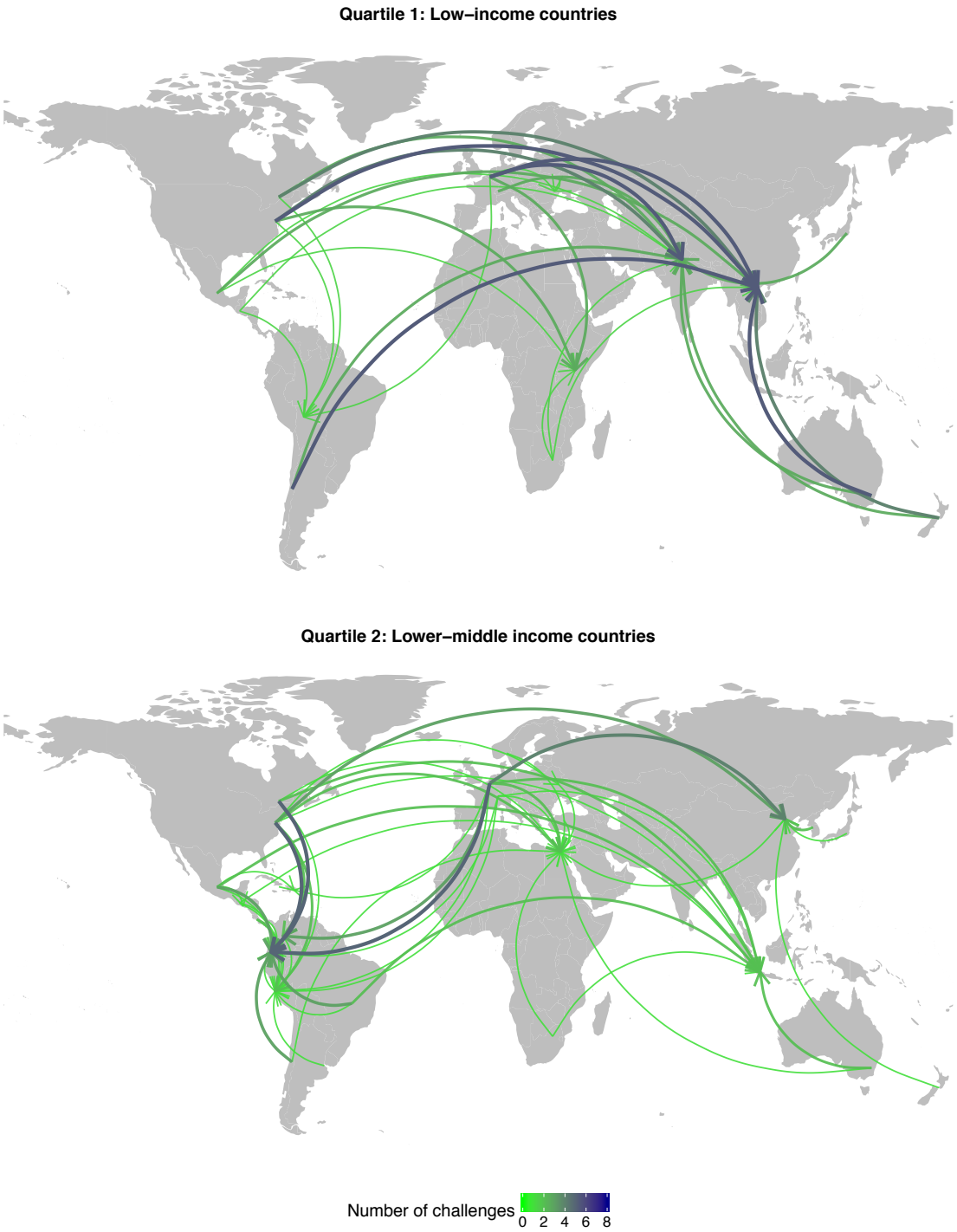


Figure 5.3 Challenges to low- and lower-middle income WTO members

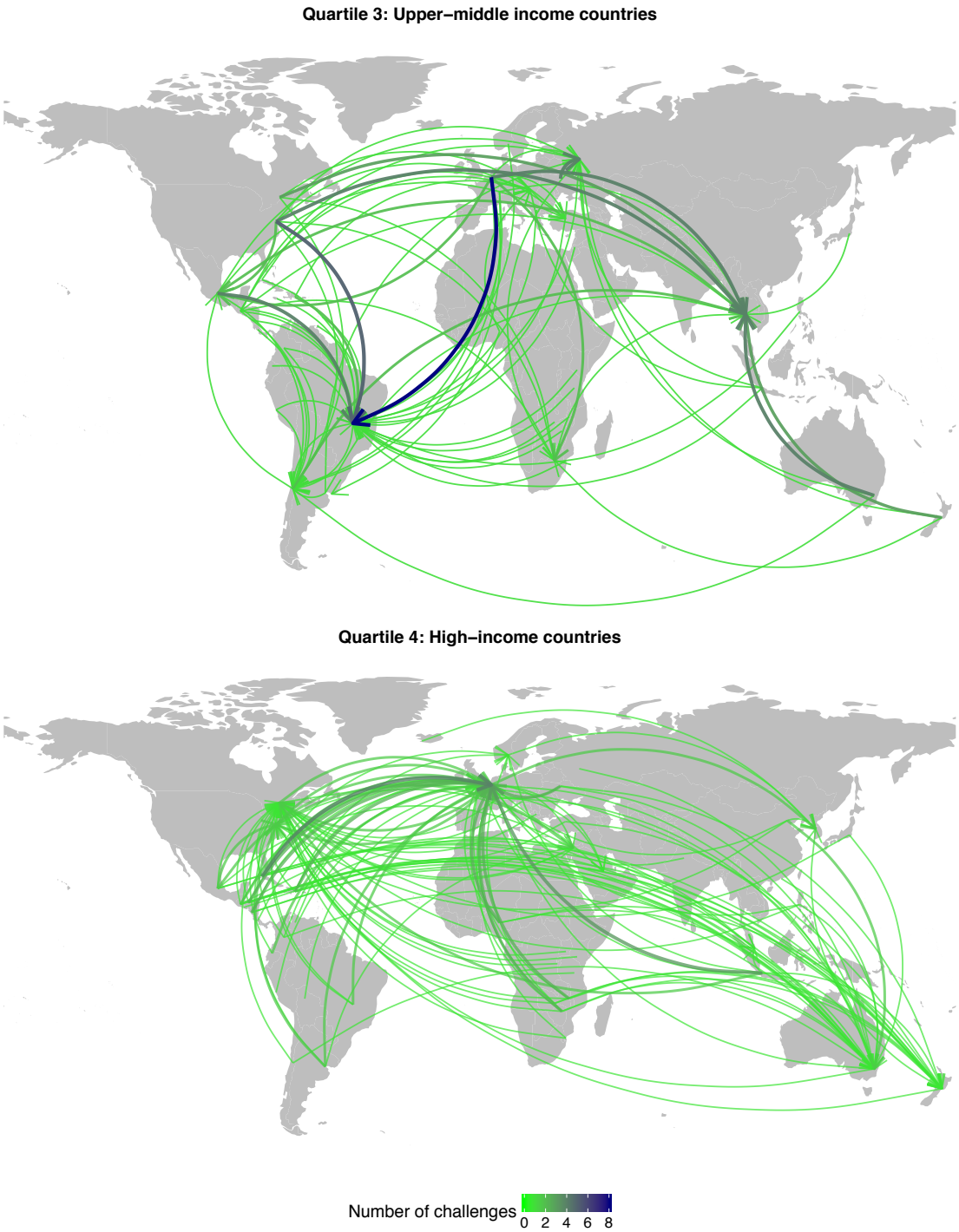


Figure 5.4 Challenges to upper-middle and high-income WTO members

Turning to countries in the top two income quartiles, the top panel of Figure 5.4 shows that members in the highest income quartile, especially the EU and US, repeatedly raised challenges against members in the second-highest income quartile, such as Brazil and Thailand. However, the figure also shows a larger number of green arrows compared with Figure 5.3. Several of these arrows are directed from members in the lowest two income quartiles towards upper-middle income members. Thus, almost a third of challenges in this category arose from members in the top three income quartiles: 28.4% from high-income members, 27.2% from other upper-middle income members, 29.5% from lower-middle income members, with a slightly smaller proportion, 14.7%, from low income members.

The bottom panel of Figure 5.4 paints a different picture yet again. The figure shows a large number of green arrows directed away from diverse members. In addition, no single country raised a large number of challenges against any high-income members: there are no dark blue lines. Overall, high-income members received challenges from upper-middle income members (30.6%), lower-middle income members (29.6%), and low- income members (23.1%) in similar proportions, with a smaller proportion from other high-income members (16.7%).

5.5.2 Thematic analysis

Here I describe the characteristics of policies subject to trade challenges, the products they applied to, and the trade rules that other members argued had been violated. As shown in Table 5.1, informal challenges were raised against measures affecting diverse food, beverage and tobacco products. These included infant milk formulae, alcoholic beverages, soft-drinks,

manufactured food products and their ingredients, cigarettes, tobacco, and tobacco flavourings.

Table 5.1 Food, tobacco and beverage products that were regulated by measures later subject to informal challenges

Product	Description	No. challenges
Food	Food products, including processed foods, and their ingredients	46
Beverages	Alcoholic beverages, soft-drinks, fruit juices and other non-alcoholic beverages, infant milk formulae	36
Tobacco	Tobacco, tobacco flavourings, cigarettes	15

Notes: Number of informal challenges about each product category exceeds the number of informal challenges (n=93) as some challenges were raised about regulations that affected more than one product.

Figure 5.5 summarises the measures subject to challenges, separated by the product they applied to. Categories on both axes are sorted according to the total number of challenges raised (sorting first by product, then by regulation), so that the product/measure in the top right-hand corner was subject to the most challenges, and the product/ measure in the bottom left hand corner was subject to the least challenges. The figure shows that members most frequently challenged labelling requirements (42.2% challenges), followed by product quality standards and restrictions on using of certain ingredients (19.3% challenges), 'conformity assessment procedures' used for determining whether an import conformed with these regulations (12.6% challenges), and marketing regulations (10.3% challenges). Members primarily raised challenges about labelling regulations where they affected food and beverage products.

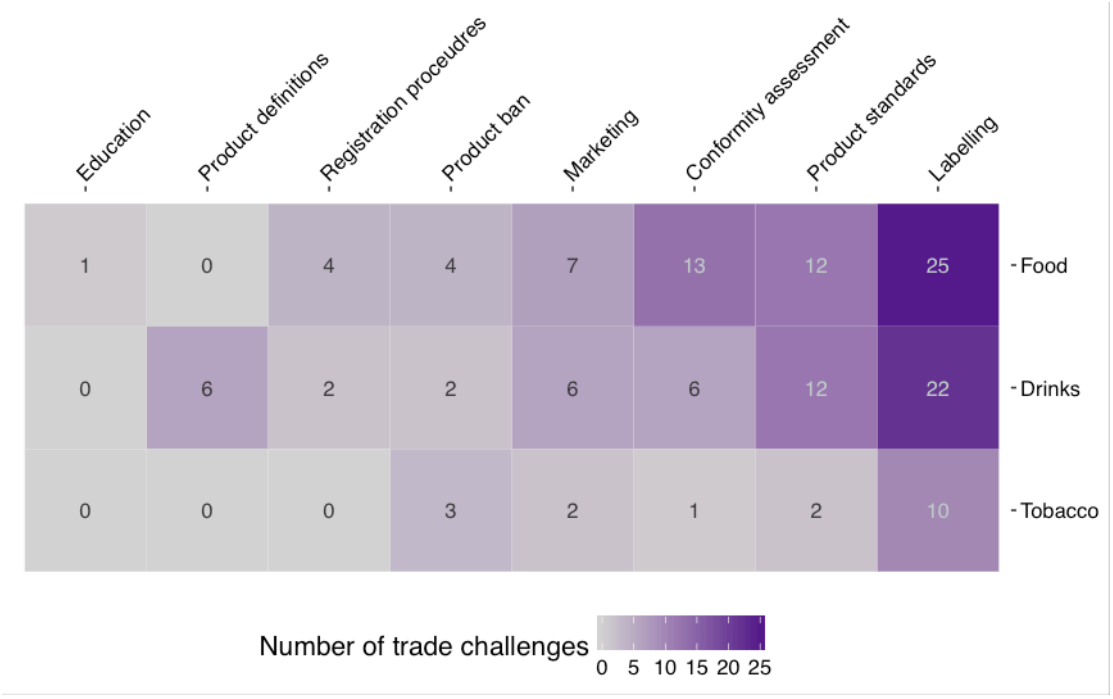


Figure 5.5 Food, beverage and tobacco measures subject to informal challenges.
Notes: 'Conformity assessment' refers to the methods used to evaluate, test and certify whether a product meets the country's standards. 'Standards' set quality requirements and limits to the use of certain materials in production. 'Labelling' refers to packaging and labelling requirements and restrictions. 'Product ban refers to a ban on a product, both via importation and via domestic production. 'Registration procedures' refer to the regulations for registering a product for sale or production in a country. 'Marketing' refers to the rules and restrictions on advertising and promotion of a product. 'Definitions' refer to standardized country definitions for what characteristics of a product qualify it as meeting a certain definition. 'Education' refers to a health promoting education campaign.

Members invoked diverse trade rule infringements when challenging the regulations, and complaints rarely focused on a single infringement alone. Members most frequently argued that the regulation posed an 'unnecessary barrier to trade' (16.4% challenges), meaning that they thought the goal of the regulation could be achieved through an alternative policy or regulation that would have lower costs and a smaller impact on trade. For example, in 2013 Mexico challenged Peruvian legislation which mandated health warnings on a range of food and beverage products high in salt, sugar and fat, and prohibited their sale in schools. Mexico

argued that the legislation created "unnecessary" trade costs and suggested that "daily meal guides" could be developed instead (WTO 2013a:5). And, in 2014, the EU and the US challenged a Thai proposal to introduce health warning labels on alcoholic beverage packages by asking Thailand to "take into consideration less trade restrictive measures or, failing this, clarify on which basis and evidence Thailand concluded that different, less costly and burdensome alternatives than the indication of a graphic health warning would be insufficient to address the objective pursued" (WTO 2014b:41).

WTO members also frequently sought clarification about an aspect of the regulation, such as the scope of products affected or the timeline to implementation (15.4% challenges). Intriguingly, the third most common category of issues actually did not cite a specific violation of WTO rules (12.9% challenges), unlike the other challenges. Instead, it focused on how the measure posed a barrier or cost to trade, without stating that this violated WTO rules or that the trade costs associated with the measure were 'unnecessary' (5.3% challenges). Another common argument was the claim that the measure would have other harmful consequences, such as causing consumer confusion, impeding economic development, and increasing unemployment (3.8% challenges). Elsewhere, members claimed that the costs of the measures were disproportionate to the risks associated with the products they affected (3.5% challenges).

Fourth, WTO members often sought greater transparency in other members' reporting procedures (11.6% challenges), meaning that they complained that other members had provided no, little or unclear information about a measure, or had left inadequate time for

other members to adapt to the new regulations. In addition, members frequently questioned the regulation's 'rationale or legitimacy', that is, whether the measure was really necessary (11.6% challenges). Fifth, WTO members regularly challenged regulations by arguing that they were inconsistent with existing international standards, as required by WTO rules (11.1% challenges). For example, in 2016 the US challenged Thailand's proposal to introduce mandatory restrictions on the content and marketing of a powdered milk formula to substitute breastfeeding. A Thai official noted that the measure was based on the WHO's International Code of Marketing of Breast-milk Substitutes and a 2016 World Health Assembly resolution on ending the inappropriate promotion of foods for infants and young children. The US raised its objections about the costs of the measure by arguing that the WHO guidance "was not an international standard in accordance with the criteria established by the TBT Committee" and that "the application of the 1981 WHO's International Code of Marketing of Breast-milk Substitutes was voluntary" (WTO 2016a:64).

5.5.3 Examples of policy change

Here I summarize examples of policy change following TBT challenges. I identified four examples of challenges to food and beverage regulations which met my criteria. First, in 2013 the Indonesian government ratified legislation that mandated the display of health warnings on processed food packages from April 2016 onwards (WTO 2013d). The warnings would describe the product's salt, sugar and fat content. Canada, Australia, and the EU, among others, challenged the measure at a WTO TBT Committee. They questioned the scientific justification for the measure and requested that Indonesia considered alternative measures

that would have a smaller impact on trade and be less costly to implement (WTO 2013a). An Indonesian official responded to the challenge by re-iterating the goals of the measure: "to protect consumers from certain non-communicable diseases such as hypertension, stroke, and diabetes and heart attack (cardiovascular)" (WTO 2013c:35). They also noted that the Ministry of Health was currently considering feedback from various stakeholders, and that WTO members would be informed about any subsequent revisions.

In 2015, an Indonesian official reported to the TBT Committee that the regulation's scheduled implementation had been delayed by four years from 2016 to 2019 (WTO 2015a). The official also said that it would re-evaluate the regulation and consider alternative approaches to NCD prevention during the extended transition period. This included considering a public education campaign to increase awareness about the risks associated with excess sugar, salt and fat consumption, instead of imposing mandatory labels. This was precisely what an EU official had suggested at an earlier WTO meeting (WTO 2013a).

Second, in 2013 Chile proposed legislation mandating the display of a red or black 'STOP' sign on the packages of food and beverage products with a salt, sugar or fat content that exceeded a specified threshold. The US, Australia, Switzerland, Canada, Argentina and the EU objected to the measure at the TBT committee on 8 occasions between 2013 and 2016. They challenged the scientific basis for the size of the label, which was to occupy at least 20% of the main face of the packaging. They also questioned the rationale for proposing the red label rather than a wider range of colours that would blend in with the product's existing colours, and asked the Chilean representative why they had imposed a mandatory labelling

requirement rather than introducing voluntary labelling guidelines (WTO 2013b). A US official also argued that 'STOP' sign on the label could "mislead consumers or create fear about consuming food, even in moderation, as part of a healthy diet" (WTO 2013b:28). A representative of the Chilean government responded by welcoming the comments, and noted that Chile was working to integrate feedback from WTO members into subsequent versions of the draft legislation. The representative also noted that "it was precisely due to the large number of comments and developments being taken into account that the implementation process would take longer than expected and the deadlines for implementation would be modified accordingly" (WTO 2013b:8).

Later, in 2014, a Chilean official reported to the committee that it had made several changes to the proposed labelling requirements. The government had reduced the required size of the warning label, and Chile was considering a wider range of label colours, including green (WTO 2014a), a colour indicative of a healthy food choice (UNICEF 2016). In addition, the measure's scheduled implementation was to be delayed by three years from 2013 to 2016. The final measure was implemented in 2016. It used the black-only hexagon, shaped like a an "internationally recognised stop sign" (WTO 2014:32). However, the final measure no longer included the 'STOP' wording, and was reduced in size to 4-7% of the package surface (Carreno et al. 2015), two aspects of the design which members had complained about at the TBT Committee.

Third, in 2009 Colombia drafted a regulation that would require the display of health warnings about the risks associated with excess alcohol consumption, especially among

pregnant women, on the front label of alcohol bottles. In June 2011 the EU and the US complained that the introduction of warning labels would have a burdensome and costly impact on its exports to Colombia (WTO 2011b). The two members raised this challenge again at four subsequent TBT meetings. In response, a Colombian official explained that "in light of the comments received, the competent authority considered it necessary to revise the draft regulation" (WTO 2011b:13). They added that comments received by Members would be considered, and that information about subsequent changes would be provided. In November 2011, a Colombian official notified the WTO that the measure had been amended (WTO 2011a). The final regulation significantly reduced the scope of alcohols it affected, and it no longer imposed any health warning labelling requirements.

Finally, in 2014 the Saudi Arabian government ratified a regulation that mandated the display of health warnings on energy drink cans. Several WTO members, including the EU, US, and Switzerland, questioned whether the health warnings were necessary and scientifically accurate (WTO 2014b). The Saudi Arabian official responded to the challenge by stating that WTO members' comments would be discussed and considered at the next meeting of the governmental committee overseeing the design and implementation of the new measure. In 2017 the Saudi Arabian government implemented the labelling law, which required a warning stating that "Energy drinks are harmful to health" (Shalhoub 2017). However, as an official representing Saudi Arabia noted at a TBT Committee meeting in 2015, the law was introduced only after it had been "delayed more than once in response to the concerns of WTO Members" (WTO 2015a).

5.6 Discussion

5.6.1 Main findings

My systematic analysis of informal trade challenges at the WTO has shown that a growing number of food, beverage, and tobacco regulations were challenged on the basis of their purported violations of trade rules between 1995 and 2016. These challenges had five main characteristics. First, 93 challenges were raised, but only one escalated to a formal dispute. Second, diverse regulations were subject to challenges. They included regulations dealing with alcoholic beverages, soft-drinks, cigarettes, and manufactured food products and their ingredients, and members most frequently challenged labelling regulations. Third, high-income members, especially the EU and the US, most frequently raised and defended informal challenges overall, but a large majority (82.1%) of challenges raised against members in the lowest income quartile were raised by members with the highest incomes. Finally, informal challenges were often raised on multiple occasions and before the regulation was ratified or implemented, and in Indonesia, Chile, Colombia and Saudi Arabia, regulations were altered or delayed following an informal WTO challenge.

To my knowledge, my study is the first to systematically describe the scope, power dynamics, and frequency of this potential 'hidden hand' of trade-related influence on food, beverage and tobacco regulations. I have shown that this potential influence on policy is an increasingly frequent occurrence, that it occurs more regularly than formal disputes, that it applies to a wide range of products including soft-drinks, food, and alcohol labelling requirements, and that lower-income members were targeted by wealthier nations.

These findings show that trade rules in FTAs are regularly invoked to challenge and possibly influence governments' attempts to implement policies that prevent the consumption of harmful food, beverage and tobacco products. Thus, my findings also show more broadly how the persistence of unhealthy behaviours may be partially attributable to the influence of governments invoking rules in FTAs to constrain attempts at preventing them. In addition, unhealthy behaviours are more common in lower SES individuals, and so attempts at preventing them may play an important role in alleviating SES gradients in unhealthy behaviours and related NCDs (Bloom, Chisholm, et al. 2011). My findings therefore illustrate how FTAs can help us to better understand the persistence of unhealthy behaviours and, quite possibly, their concentration in lower SES groups, as they are regularly invoked to challenge policies that could alleviate them. This demonstrates the importance of FTAs for sociologists' understanding of unhealthy behaviours. It also shows how FTAs can have a detrimental impact on an important determinant of a society's well-being – its ability to prevent NCDs – because they contain rules that are invoked in attempts to constrain the ability of governments to prevent the consumption of harmful food, beverage and tobacco products.

My study also builds on previous scholarship about the impact of trade disputes on food, beverage and tobacco regulations. Previous theoretical commentaries and reviews have argued that trade rules could be informally invoked to prevent governments from implementing food, beverage and tobacco regulations that reduce NCDs. This argument was frequently substantiated with reference to the Thai food labelling case (Schram et al. 2017; Thow, Snowdon, et al. 2015). My study expands on this theoretical and empirical scholarship

by showing how often, in what domains, and among and by whom this possible pathway to influence on policy can occur.

First, my results show that governments regularly challenge one another's food, beverage and tobacco regulations at the WTO, that compliance with complaints was monitored, as complaints were raised on several occasions, and that challenges were followed by a delay, change, or abandonment of the proposed food, beverage and tobacco regulations in four cases. This shows that an informal pathway to influence on these regulations, TBT Committee challenges, is a frequent possibility, and that these challenges may have been influential in changing the regulations. Second, my study has shown that an overwhelming majority of informal challenges do not escalate to a formal dispute: only one (1.1%) of the 93 challenges to a food, beverage and tobacco regulations at the WTO escalated further, the Australian plain packaging case. Third, informal challenges were raised against regulations that affected diverse products, including those dealing with infant milk formulae, soft-drinks, and manufactured food products and their ingredients. In addition, members regularly challenged labelling regulations and product quality standards or restrictions on using certain ingredients (such as processed meats). My analysis therefore shows that the products and regulations subject to challenges are wider in scope than previously identified in analyses of formal disputes, which documented only one dispute concerning alcohol taxes and tobacco, and none concerning soft-drink, food and alcohol labelling regulations had arisen at the WTO (Mitchell and Voon 2011).

These three findings highlight how the influence of invoking trade rules in an attempt to change a food, beverage or tobacco is much more common and diverse than is indicated by the number and outcomes of formal disputes. Failing to take this pathway to influence into account therefore under-specifies the scope and mechanisms through which trade rules can potentially influence food, beverage and tobacco regulations and under-estimates the total number of cases of potential influence.

My analysis of challenge dyads also revealed differences in the income levels of members who raised and defended informal challenges. High-income members most frequently raised and defended challenges overall, whilst a large proportion of challenges raised against low (82.1%) and lower-middle (59.6%) income members were raised by the wealthiest members, especially the US and the EU. Informal challenges were therefore patterned by the "well-known asymmetry of economic and political power and capacity between wealthier and poorer members" (Ottersen et al. 2014). Food, beverage and tobacco regulations in lower-income countries therefore appear to be susceptible to informal challenges and subordination under the economic and political interests of high-income nations. In addition, analyses of formal disputes – which primarily occurred between high-income countries – may under-state the power asymmetries that characterise the influence of invoking trade rules on policy.

One important caveat to this point is that approximately one third of challenges raised against members in the highest income quartile were raised by members in the two lowest income quartiles. Like formal disputes, the TBT committee appeared to provide lower-income members with an opportunity to raise challenges against wealthier members that might have

otherwise been unavailable (Chorev 2005; Lindeque and McGuire 2007). This may have partially redressed potential asymmetries. But it does not appear to have protected lower-income members entirely, as they were still targeted disproportionately by high-income members. In addition, it remains possible that differences in power and capacity rendered the challenges raised by lower income countries less effective than those raised by more wealthy members.

5.6.2 Determinants of challenge dyads

What explains the observed patterns in challenge dyads? Poorer members may have had a weaker capacity to design policies that met the WTO's technical standards, and so wealthy members with greater expertise were simply responding to poorly designed regulations by enforcing pre-defined obligations, standards and norms. However, this may not apply in all cases, as many challenges were not always concerned only with technical issues: many also centred on 'unnecessary' trade costs or other issues that were not directly related to WTO rules. Furthermore, if states were motivated to enforce the TBT Agreement and associated obligations, this raises a further question: what, in turn, motivates high-income members to do so?

One possibility is that challenge dyads reflect states' desires to sustain their trade flows and, in the case of high-income countries, their trade-related economic dominance and associated political power over poorer members. This explanation takes a 'state interests' approach to government decision making, whereupon states take actions that help achieve their goals such

as trade growth, economic development, and the maintenance of hegemony vis-à-vis other actors (Grindle and Thomas 1989; Oatley 2016). This has been identified as a motivation for government pressure in other inter-governmental organizations, such as the International Monetary Fund (Dobbin et al. 2007; Dreher, Sturm, and Vreeland 2009; Vreeland 2006), and so may apply at the WTO.

Challenge dyads could also reflect businesses interests in keeping food, beverage and tobacco production costs to a minimum. This explanation takes a 'class-analytic' approach to state decision making, whereupon a government's trade negotiations represent the interests of particular classes or groups, such as food and beverage corporations, which have advantageous resources, organizational capacity, and access to trade policy makers vis-à-vis other groups (Brownell and Warner 2009; Fairbrother 2014; Stuckler et al. 2012). Many food, beverage and tobacco products are produced and sold by international corporations registered in high-income countries (Hawkes et al. 2010; Stuckler and Nestle 2012). Their predominance in raising challenges could therefore reflect the interests of businesses seeking to maintain profits. In addition, lower-income members may be disproportionately targeted by wealthier members as growing middle classes in poorer nations represent an especially fruitful opportunity for food, beverage and tobacco businesses in high-income countries to maintain profits whilst compensating for the stagnating domestic market growth (Stuckler and Nestle 2012).

Indeed, WTO officials occasionally stated that their challenges represented concerns raised by the food, beverage and tobacco corporations (Hawkes et al. 2010). For example, in 2013

a US official commented on Peru's attempts at introducing health warnings on select food and beverage products by stating that "the U.S. pre-packaged food industry has expressed concern over the economic impact of the inclusion of warning statements on a mandatory basis" (WTO 2013a:5). And, in 2006, a Canadian representative commented on Thailand's proposed snack food labelling regulations by noting that "the Canadian industry had questioned the scientific merit of the proposed regulation and argued that it discriminated against snack foods" in a letter to the Canadian government (WTO 2007:17).

Both 'state interests' and 'class-analytic' accounts suggest that challenge dyads may correspond with product specific trade flows between countries. However, whether or not this is the case is an open question as challenges could alternatively represent an effort to ensure that trade costs on all products are kept to a minimum, and so prevent the introduction of costs on the specific products that a country trades in. Furthermore, observed patterns of challenge-dyads may be partially attributable to disregard for the rules or a weak capacity to fulfil them. In addition, they may also be explained by exceptional levels of political commitment and policy implementation to address NCDs by introducing large numbers of food, beverage and tobacco regulations. Ecuador, for example, featured 6 times in TBT Committee challenges despite its small size, potentially owing to its high levels of activity in implementing food, beverage and tobacco regulations to prevent NCDs (NCD Alliance 2016). Future research should evaluate these possibilities in more detail.

5.6.3 Limitations

My study has several limitations which I have attempted to address. It was not possible to identify whether and how all 93 informal challenges ultimately impacted on policy as this information is not systematically reported in the TBT-IMS or the TBT Committee minutes. My analysis nevertheless suggests that at least some informal challenges were influential, for three reasons. First, many regulations had not yet been ratified or implemented when challenges were raised, so a change in policy was actually possible. Second, a majority of informal challenges were raised repeatedly. This suggests that those raising informal challenges subsequently monitored adherence to their complaints and expected they would be addressed. In addition, repeated challenges may have increased the incentives for complying with complaints if they were interpreted as a signal that a politically and economically costly formal dispute was increasingly likely. Third, I identified four cases where informal challenges were followed by a reported delay or change in policy. I cannot definitively confirm whether informal WTO challenges led to these policy changes. However, the sequencing of these events, the feasibility of policy change, and the incorporation of comments made at the WTO into final policies provide indications of their likely influence.

In addition, I did not investigate the validity of informal challenges citing trade rules, as this was not a goal of my analysis. As I noted earlier in this chapter, challenges may yield an influence regardless of their validity because challenges are not formally scrutinised or because their validity can be uncertain in the absence of a formally adjudicated trade dispute (Hawkes 2015). However, my analysis does raise the question as to whether or not the challenges were valid. There are several possibilities. The challenges may constitute a legitimate complaint

about a policy according the TBT Agreement because, for example, the regulations were unclear or created additional costs without being effective. In addition, the applicability of trade rules and associated validity of trade challenges may be debatable due, for example, to how scientific ambiguity regarding the effectiveness of regulations and their optimal design is understood in relation to the TBT Agreement (Voon 2015), or due to the absence of clear international standards, norms and guidelines. The challenges may also be invalid because they cite TBT rules where they did not apply. This could include, for example, making false scientific claims that a proposed policy is ineffective and/or claiming that an alternative is more effective.

Furthermore, my analysis highlights that informal challenges are a potential pathway to influence on policy, but it is also still possible that other informal pathways to influence occur that prevent an informal challenge from arising. For example, governments or businesses may invoke trade rules in direct communications outside the TBT committee. A related possibility is that national governments do not even propose policies because they fear a trade-related challenge or disputes (Friel et al. 2014).

Finally, my study may have limited external validity beyond the WTO. Challenges raised at the WTO may not represent the full scope and content of challenges raised under alternative FTAs and trade institutions. For example, challenges may differ within the EU, where the European Court of Justice has consistently applied a requirement in European treaties to ensure a high level of health in all policies. This could disincentivise challenges or render

them less effective by sending a signal that a formal dispute would be more likely to conclude that a food, beverage or tobacco regulation is consistent with EU rules (Greer et al. 2013).

Challenges may also differ in other FTAs which have incorporated and expanded upon the TBT Agreement by extending protections to investments and multi-national corporations (Allee and Elsig 2015; Dür et al. 2014). However, government officials stated that informal challenges at the WTO represented concerns raised by the food, beverage and tobacco corporations, many of whom make substantial foreign investments which are protected in alternative FTAs and investment treaties (Hawkes et al. 2010). The scope and arguments raised in WTO challenges may therefore give a degree of insight into those raised under alternative FTAs and investment treaties, and by multi-national food, beverage and tobacco corporations.

Future research should address the limitations of this study by investigating whether challenges are invoked citing other trade agreements and outside trade committees, the validity of trade challenges, whether they influence and undermine effective public health policies, and whether challenges raised by low- and lower-middle income members were as effective as those raised by upper-middle and high-income members. More research is also necessary to investigate the determinants of challenge dyads and associated asymmetries, including their correlations with trade flows, and precisely why specific members are frequently subject to trade challenges.

5.7 Conclusions

These limitations notwithstanding, this chapter has shown that a growing number of food, beverage, and tobacco regulations were challenged and potentially altered due to their purported violations of WTO rules, 1995-2016. Much of this possible influence of invoking WTO rules to delay or alter policies was previously overlooked, as only one challenge escalated to a formal dispute. These findings show that trade rules in FTAs are regularly invoked to challenge and possibly influence governments' attempts to implement policies that prevent the consumption of harmful food, beverage and tobacco products. Thus, my findings also show more broadly how the persistence of unhealthy behaviours may be partially attributable to the influence of governments invoking rules in FTAs to constrain attempts at preventing them. This illustrates the importance of FTAs for scholars' understanding of unhealthy behaviours. It also shows how FTAs can have a detrimental impact on an important determinant of a society's well-being – its ability to prevent NCDs – because they can constrain the ability of governments to prevent the consumption of harmful food, beverage and tobacco products.

5.8 Appendix

Appendix 5.1 Formal WTO disputes about food, beverage and tobacco regulations

The table below summarizes the WTO disputes identified in Mitchell and Voon (2011) and expands their list to include the Australian plain packaging case, which was resolved after Mitchell and Voon concluded their analysis.

Complainants	Defendant	Product	Policy	Treaty	Year	Policy outcome
USA	Thailand	Cigarettes	Import ban	GATT[a]	1990	Overturned[b]
Canada, USA, and the EU[c]	Japan	Alcohol	Excise tax	GATT[a]	1995	Overturned[b]
EU[c], Canada, and Mexico	South Korea	Alcohol	Excise tax	GATT[a]	1997	Overturned[b]
Indonesia	USA	Cigarettes	Ban on flavourings	GATT[a]	2009	Dispute ongoing
Ukraine	Armenia	Alcohol and cigarettes	Excise taxes	GATT[a]	2010	Dispute ongoing
Ukraine, Honduras, Cuba, Indonesia, and the Dominican Republic	Australia	Cigarettes	Plain packaging	TBT[d]	2012	Upheld

Notes: Adapted from Mitschell and Voon (2011). a: The General Agreement on Tariffs and Trade (GATT), the WTO's precursor. b: The panels required the excise taxes to be reduced because they discriminated between domestically produced and imported spirits. c: countries in the EU are represented as a group rather than as individual countries at the WTO. d: Technical Barriers to Trade Agreement. See 'Data and coding' for further details of this specific agreement.

Appendix 5.2 Codebook and examples

Variable	Code	Description	Example(s)
Policy	Labelling	Regulations for product packaging and labelling	"The representative of the United States raised previously-aired concerns, including the scientific basis for the text of the alcohol warning requirements, the size of the warning label in proportion to the bottle..." (G/TBT/M/53) "The representative of Argentina reiterated his delegation's concerns with respect to the EC regulation on production and labelling of organic products..." (G/TBT/M/45)
	Product standards and restrictions	Product standards, including production and quality requirements and maximum limits to the use of certain materials in their production	"The representative of the European Union raised concern regarding Colombia's draft decree laying out requirements for the manufacture, processing, packaging, marketing, sale, export and import of alcoholic beverages...she noted that some quality parameters, such as the restriction on the use of colouring, flavouring and sweeteners in liqueurs were not in line with international practice..." (G/TBT/M/53)
	Conformity assessment procedures	Regulations for certifying that products conform to a country's regulations	"The representative of the United States raised concerns with respect to Israeli Ministry of Health regulations governing the sale of infant formula... He pointed out that the US TBT Enquiry Point had sent two separate requests on 10 April and 15 May 2007 for copies of all relevant Israeli Ministry of Health regulations ... on infant formula laboratory testing, renewal of infant formula product licences and administrative fees..." (G/TBT/M/42)
	Product ban	Full prohibition of a product applying both	"The representative of Argentina raised a concern regarding Canada's

		to importation and domestic production	legislation "Cracking Down on Tobacco Marketing Aimed at Youth Act"... The representative of Argentina noted that the measure prohibited the use of various additives in certain tobacco products, including cigarettes, cigarillos and blunt wraps" (G/TBT/M/49) "The representative of Australia said that in December 2014, the Indonesian Government had issued a regulation limiting imports of beef to prime cuts and some offal and manufactured meat." (G/TBT/M/65)
	Product definitions	Regulations about the definitions and/ or classification of a specific product	"The representative of the European Union stated that in January 2016 the EU had provided detailed comments on India's draft alcoholic beverages regulation (notified in December 2015) establishing the requirements and definitions applicable to different types of alcoholic beverages (such as spirits, wines and beers)..." (G/TBT/M/68) "The representative of Barbados drew attention to a Brazilian notification circulated on 27 October 2003 concerning a decree setting out amendments to definitions for certain beverages and spirits, specifically aguardiente, cachaça and rum..." (G/TBT/M/31)
	Registration	Regulations for registering a product for production, sale and/or marketing in a country	"The representative of Mexico stated that the Congress of the United States had approved the Food Safety Modernization Public Law in January 2011, and that the promulgation provided for major changes in the areas of production, transportation, distribution and

			import of food products into the United States...This covered the gathering of records of all involved establishments, and the registration of these establishments with the FDA when they were part of the food production chain." (G/TBT/M/53) "The representative of Mexico noted her delegation's concern with Brazil's draft technical regulation on the list of foods that needs to be registered before marketing." (G/TBT/M/50)
	Education	Policies to promote education through an education campaign	"The representative of Peru stated that the measure's objective was to reduce obesity and other risks to non-communicable diseases through: organizing educative campaigns in schools to promote healthy eating...." (G/TBT/M/60)
Policy stage	Proposed (but not ratified)	The measure had been proposed and/or a first draft of the measure had been written but was not yet finalised, approved, and/or passed into law	"The representative of Zimbabwe said that her delegation shared the concerns raised by the previous delegations regarding Ireland's proposal to introduce standardized plain packaging of tobacco products..." (G/TBT/M/60) "China - Formula Registration Regulation for Infant and Follow-up Formula, G/TBT/N/CHN/1165 (IMS ID 493) .... The representative of the European Union continued to have serious concerns about some aspects of the draft measure." (G/TBT/M/69)
	Ratified (but not implemented)	The measure had been finalised, approved by government authorities, and/ or passed into law, but had not yet come into effect	"Ecuador - Resolution No. SENAE-DGN-2013-0300-RE relating to post entry control of imported alcoholic beverages... the EU expressed its concern with the entry into force of the measure, as it allowed just 30 days before beverages shipped to

			Ecuador would be required to comply with the labelling obligation..." (G/TBT/M/62) "The representative of Mexico stated that the Congress of the United States had approved the Food Safety Modernization Public Law in January 2011, and that the promulgation provided for major changes in the areas of production, transportation, distribution and import of food products into the United States...." (G/TBT/M/53
	Implemented	The measure had already come into effect when the dispute was raised	"The representative of Mexico expressed concern about the Alcoholic Controls Act 2010, published by Kenya on 7 December 2010, and notified 1 March 2011... she said Kenya did not appear to uphold the obligation stemming from Article 2.9 of the TBT Agreement, since the legislation entered into force before it had been notified to the WTO: the measure was notified in March 2011 but had been enforced in December 2010." (G/TBT/M/54) "China - Specification for Import and Export of Food Additives Inspection, Quarantine and Supervision (2011 No. 52) – Disclosure of formulas for imported food additives... The representative of the United States recalled that this measure was enacted by China's General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) on 18 April 2011 and it entered into force on 1 July 2011." (G/TBT/M/55)
Product	Food	Regulations that affect processed and un-processed foods, and	"The representative of the United States raised concerns regarding Korea's Ministerial Enforcement

		their ingredients, including sugar, fat, salt and genetically modified foods and ingredients	Regulation for Food Industry Promotion Act... The new measure, which included guidelines, regulations and certification procedures for organic processed foods..." (G/TBT/M/48) "Indonesia – Labelling Regulations (Ministry of Trade Regulation 62/2009 and 22/2010...The representative of the United States said that the supplementary labelling for processed food products should be allowed to be applied at the importers' select warehouse and other approved locations" (G/TBT/M/55)
	Beverages	Alcoholic beverages, soft-drinks, juices and infant milk formulae	"The representative of the European Communities was concerned about a measure adopted by Moldova on 15 August 2007 (Government Decision 934) which introduced new quality and control requirements for bottled, non-alcoholic beverages including mineral, natural water and soft drinks." (G/TBT/M/43) "The representative of the United States expressed his delegation's concerns on the proposed warning label requirements for alcoholic beverages." (G/TBT/M/55)
	Tobacco	Tobacco, tobacco additives and flavourings, and cigarettes	"The representative of the European Union reiterated concerns about Canada's Bill C-32 amending the Tobacco Act, and requested Canada to provide replies to several questions... In particular, the European Union urged Canada to provide some background with regards to its approach to ban a comprehensive list of additives, including certain flavours...." (G/TBT/M/51)

			"The proposed measure would imply discontinuation of European exports of traditionally blended tobacco products to Brazil, and would also affect European exports of additives that were currently used in tobacco products." (G/TBT/M/55)
'Other' issues	Trade costs	Trade delays, costs or problems for businesses from implementing measure and/or its overall impact on trade	"The representative of the European Union stressed that adaptation to the new requirements would require significant investment for manufacturers..." (G/TBT/M/59) "The representative of Canada was concerned that this regulatory proposal would have a negative impact on Canada's significant food exports to Chile..." (G/TBT/M/59)
	Scientific basis	Query or concern about whether there is sufficient scientific evidence to support the introduction of the measure and achieve the stated objective of protecting human health	"The EU recognised that for certain nutrients there was evidence of a positive association between its intake and the risk of developing a disease or disorder, but there was no scientific evidence suggesting an identifiable threshold above which the risk existed..." (G/TBT/M/60) "The representative of the European Union reiterated concerns about Canada's Bill C-32 amending the Tobacco Act... the European Union urged Canada to provide some background with regards to its approach to ban a comprehensive list of additives, including certain flavours which might be perceived as appealing to youngsters. Further, the representative of the European Union asked whether Canada could make available scientific studies or other relevant information that established a link between the prohibited additives and attractiveness to youngsters." (G/TBT/M/51)

	Other harmful consequences	The measure may have adverse non-trade consequences that may have not been adequately assessed or considering, including misleading consumers, a rise in illicit trade, exacerbating the problem, and having a negative impact on small businesses, incomes, employment, and the wider economy	"...the EU was concerned with the introduction by this draft regulation of two different types of warnings on alcoholic consumption...could mislead consumers, who could conclude that some alcoholic beverages were more harmful than others" (G/TBT/M/58) "The representative of the European Union expressed her delegation's concerns regarding the procedure of notification of alcoholic products... she stated that the labelling requirements were excessive and, in some cases, could mislead the consumer..." (G/TBT/M/59)
	Policy principle	Members question the principles behind the policy, such as whether it was proportionate with the risks associated with the product(s)	"The representative of Zambia echoed concerns regarding Australia's measure... Mandatory plain packaging was a disproportionate response to the stated health objectives of the legislation." (G/TBT/M/55)
	Intellectual property	The policy is inconsistent with TRIPS and/or would potentially require businesses to share confidential information and their intellectual property	"Honduras argued that the measure in question not only lacked basis in scientific proof, but was also more trade restrictive than necessary and damaged intellectual property rights..." (G/TBT/M/62)
	International practice	The policy was inconsistent with existing regulations and practices (but not a formally agreed international standard) in place in other countries	"The representative of the European Union stated that in January 2016 the EU had provided detailed comments on India's draft alcoholic beverages regulation... He outlined several concerns on the notified draft. It was considered that, if adopted in its current form, the draft regulation would create a number of unnecessary barriers to trade, particularly in consideration of its inconsistencies with current international practice.

Chapter 6. Conclusions

6.1 Overview

This thesis sought to gain new insights into the relationships between FTAs and unhealthy behaviours. To this end, I investigated whether and how FTAs encourage unhealthy diets and affect governments' abilities to introduce new regulations targeting the overconsumption of harmful food, beverage and tobacco products. I aimed to advance existing research investigating these links by collecting new data and using advanced quantitative methods to generate more robust evidence about the causal impact of FTAs and associated mechanisms. These goals were based on a series of methodological and substantive limitations in current research that I identified through a systematic review in Chapter 2. I showed that unhealthy behaviours, especially diets, were the main focus of previous scholarship on the health impact of FTAs. However, most previous studies precluded definitive conclusions of causality, analysed a narrow range of outcomes, and did not investigate the specific clauses within FTAs that correlated with dietary changes. In addition, there were no systematic quantitative studies investigating whether and how trade rules are invoked to challenge and potentially influence food, beverage and tobacco regulations, largely due to a dearth of suitable data. Finally, there was relatively weak co-citation between studies in economics and public health.

In this chapter I review the main findings, conclusions and contributions of the empirical sections of this thesis. I then discuss the broader implications of my thesis for sociological debates about the determinants of unhealthy behaviours, the political economy of health, and

the social consequences of globalization. Finally, I discuss the policy implications of my findings, review the limitations and unanswered questions that arose from my analyses, and provide recommendations for future research.

6.2 Principal findings and contributions

In Chapter 3 I investigated whether a US FTA, the 1989 Canada-US Free Trade Agreement (CUSFTA), led to a rise in calorie availability and intake in Canada. Drawing on economic scholarship (Abadie and Gardeazabal 2003; Breinlich 2015; Trefler 2004), I analysed this unique 'natural experiment' using fixed-effects regression models and the synthetic control method. The results from my analysis showed that calorie availability was approximately 170 kilocalories per capita per day (kcal/ capita/ day) higher and grew, on average, by an additional 35 kcal/capita/day per year in Canada following CUSFTA, compared with comparison countries. CUSFTA was also associated with a $1.82 billion rise in US investment and $5.26 billion rise in US exports in the food and beverage sector. In addition, I estimated that the post-CUSFTA rise in calorie availability could have contributed to an average weight gain of 1.8-9.3kg for men and 2.0-12.2kg for women who were 40 years old in Canada, depending on their physical activity levels and assumed pass-through from calorie availability to intake.

My analysis in Chapter 3 built on previous studies of the relationship between US FTAs and unhealthy diets in three important ways. First, I drew on economic scholarship to utilise more robust, quasi-experimental methods to infer a causal impact of the FTA. Moving beyond

previous studies, my fixed-effects regression models, synthetic control analysis, and the unique 'natural experiment' created by CUSFTA's implementation enabled me to sharply demarcate the pre- and post-intervention periods and to isolate CUSFTA from potential confounders.

Second, my analysis suggested that CUSFTA impacted the number of calories that were available and likely consumed in Canada. This moves beyond previous statistical analyses which showed that FTAs and related trade policies can lead to higher sugar-sweetened beverage sales (Baker et al. 2016; Mendez Lopez et al. 2017; Schram et al. 2015). My study advances this scholarship by showing how FTAs can influence a previously overlooked but substantively important outcome – caloric availability and likely intake – which plays a critical role in causing obesity.

Third, existing studies of FTAs and related liberalisation policies analysed the role of trade in mediating their consequences. However, I found that US investment in the Canadian food and beverage sector also increased following CUSFTA. Furthermore, changes to calorie availability followed changes in US FDI at a consistent 5-year interval throughout the post-CUSFTA period, suggesting that higher US FDI at least partially mediated the impact of CUSFTA on caloric availability and likely intake. This builds on previous studies by showing how the impact of FTAs can be mediated by increases in investment as well as trade.

The results from my analysis in Chapter 3 suggest that CUSFTA substantially increased calorie availability and likely intake in Canada. Thus, excess caloric intake in the post-CUSFTA period in Canada appears to be partially rooted in the country's 1989 trade deal

with the US as it fostered the overconsumption of calories in Canada. Insofar as my findings extend elsewhere, my analysis also shows more broadly how US FTAs can have a detrimental impact on an aspect of a society's well-being because they lead to a cross-country diffusion of the unhealthy, high-calorie diets that are common in the US.

The results from Chapter 3 raise a further question: which specific clauses within US FTAs lead to dietary changes? As I noted in my systematic review in Chapter 2, previous studies have yet to adequately address this question, as most rigorous statistical analyses of FTAs (including Chapter 3) used dichotomous FTA indicators. In addition, prior studies investigated the impact of FTAs on the total number of calories (Chapter 3) or specific food and beverage products that people consume (Baker and Friel 2015; Mendez Lopez et al. 2017; Schram et al. 2015). Yet it is also plausible that they affect dietary composition via changes to the use of ingredients in food and beverage production.

In Chapter 4 I addressed these limitations by analysing the impact of removing a 5% tariff on imports of HFCS from the US on the supply and likely consumption of this syrup in Canada. Using the synthetic control method I found that tariff reductions in NAFTA coincided with an increase in the availability and likely consumption of caloric sweeteners including HFCS of approximately 45.1 kilocalories per capita per day. However, the rise in the supply of caloric sweeteners including HFCS was offset by a decline in cane and beet sugar availability. Consequently, HFCS accounted for an increasing proportion of total sugar and sweetener supply, but sugar availability did not increase overall. In addition, net

Canadian imports of beverage syrups containing HFCS from the US doubled in the period after NAFTA, and constituted an increasing proportion of total sugar and sweetener imports.

Chapter 4 builds on Chapter 3 and other previous studies of the relationship between FTAs and unhealthy diets in three important ways. First, I isolated the impact of a specific clause within FTAs on diets: changes to import tariffs, within an existing system of liberalized trade in goods (following CUSFTA). I showed that the modest and potentially inconspicuous removal of tariffs on imports of hazardous ingredient in an FTA, like HFCS, can precipitate a change in a society's diets by increasing consumption of the hazardous commodity.

Second, my analysis provides a strong basis for inferring a causal impact of these tariff changes. Again, I drew on economic scholarship to develop a more robust, quasi-experimental study design by using the synthetic control method (Abadie and Gardeazabal 2003). This moves beyond prior studies of product specific trade policy changes as they were predominantly post-reform case studies that precluded causal conclusions.

Third, I found that the rise in HFCS supply following NAFTA did not lead to a subsequent rise in total sugar supply, as the rise in caloric sweeteners including HFCS was offset by a coinciding decline in cane and beet sugar supply. These findings suggest that tariff changes in NAFTA increased the proportion of HFCS in Canadian sugar consumption, but did not increase the overall quantity of sugar consumed. My analysis therefore identified a previously unrecognized pathway through which tariff reductions can lead to a rise in unhealthy diets:

a 'hazardous substitution effect', in which producers replace less hazardous ingredients for potentially more hazardous ingredients – like HFCS – that are subject to lower tariffs.

Thus, the findings from my analysis in Chapter 4 suggest that lower tariffs on HFCS following NAFTA increased the supply of caloric sweeteners including HFCS in Canada via a 'hazardous substitution effect'. This suggests that the unhealthy composition of Canadian sugar composition in Canada in the post-NAFTA period was partially rooted in the structure of tariff reductions in the country's 1994 trade deal with the US. Insofar as these findings extend elsewhere, my study also shows how inharmonious tariff reductions in US FTAs can have a detrimental impact on well-being by leading producers to use more hazardous commodities that originate in the US, like HFCS, in place of less hazardous ingredients.

Whilst Chapters 3-4 focussed on the relationship between FTAs and unhealthy diets, my framework in Chapter 2 highlighted how FTAs can potentially impact on unhealthy behaviours through another pathway: influencing governments' abilities to introduce regulations designed to prevent the overconsumption of harmful alcohol, food and tobacco products. FTAs may do so as they contain rules which governments and businesses invoke to dispute food, beverage and tobacco regulations that increase trade costs. Whilst few such disputes have arisen and overturned such a regulation, a relatively informal trade 'challenge' to a regulation's consistency with trade rules may lead countries to delay, alter or repeal a regulation in order to avoid the costs of a formal dispute (Koivusalo et al. 2009). This can occur regardless of whether or not the rules are genuinely restrictive. Furthermore, poorer countries – who are in a disadvantageous position with respect to economic and political

resources and dependency – could be especially susceptible to such challenges from wealthier states.

To evaluate this I constructed and analysed a new dataset of informal trade challenges to food, beverage and tobacco regulations among WTO members, 1995-2016. Drawing on 1,496 pages of the minutes from 71 WTO meetings of the TBT Committee, I thematically analysed the scope, frequency and country characteristics of informal trade challenges. I also summarized four examples of challenges followed by policy changes in order to elucidate how challenges from high-income countries might yield an influence in poorer countries.

The results from my analysis showed that a growing number of food, beverage and tobacco regulations were challenged on the basis of their purported violations of trade rules between 1995 and 2016. Whilst 93 challenges were raised, only 1 escalated to a formal dispute. The regulations targeted in these challenges included those dealing with alcoholic beverages, soft-drinks, cigarettes, and manufactured food products and their ingredients, and members most frequently challenged labelling regulations. In addition, high-income members, especially the EU and the US, most frequently raised and defended challenges overall, but a large majority (82.1%) of challenges raised against the poorest members were raised by the wealthiest members. Finally, informal challenges were often raised on multiple occasions, before the regulation was ratified or implemented, and food and beverage regulations were altered or delayed following challenges to Indonesia, Chile, Colombia and Saudi Arabia.

To my knowledge, my analysis in Chapter 5 is the first to systematically investigate the frequency, scope, and power dynamics that characterise the possible influence of informally invoking trade rules in FTAs to delay, alter, or repeal food, beverage and tobacco regulations. My study therefore builds on prior case studies by elucidating precisely how often, in what domains, and among and by whom this influence could occur. In addition, my analysis showed that trade rules are invoked to challenge food, beverage or tobacco regulations more frequently in the relatively informal setting of the TBT Committee compared with formal disputes. This shows that the potential influence of invoking trade rules on policy is much more common than is indicated by the number and outcomes of formal proceedings. Furthermore, the regulations targeted in these challenges were more diverse, and differences in the income levels of members who raised and defended informal challenges were much more acute, compared with formal disputes. My analysis therefore advances prior scholarship by showing how failing to take this pathway into account under-specifies the mechanisms, under-estimates the total number of cases, and under-states the scope and economic power asymmetries that characterise how rules in FTAs are invoked to delay or alter food, beverage and tobacco regulations.

Taken together, the findings from Chapters 3-5 show that FTAs can impact on unhealthy behaviours by encouraging higher caloric intake, increasing the proportion of hazardous ingredients like HFCS in a society's diets, and leading to challenges that could delay or alter policies that are designed to prevent the overconsumption of harmful food, beverages and tobacco products. My thesis advances existing scholarship that investigated these

relationships by providing more robust evidence to infer a causal effect of FTAs and by elucidating their pathways to impact.

6.3 Implications

What, then, do my findings contribute to social scientific scholarship more broadly? I argue that my thesis makes two inter-related contributions. First, my thesis demonstrates that FTAs are important for sociologists' understanding of unhealthy behaviours as they can help us to better understand their root causes and their persistence. Second, my thesis shows that FTAs can have detrimental consequences for a society's well-being in ways that are often overlooked in economic FTA evaluations. Below I discuss these contributions and their relation to debates about the causes of SES disparities in unhealthy behaviours, the political economy of health, trade policy and NCD prevention.

6.3.1 The sociology of unhealthy behaviours

The first contribution of my thesis is to demonstrate the importance of FTAs for sociologists' understanding of unhealthy behaviours, as they can help us to better understand what causes them, and why they persist. As I noted in the Introduction of this thesis, sociologists commonly invoke micro- and meso-social factors to explain unhealthy behaviours, such as an individual's SES or local environmental characteristics. This has proved fruitful for understanding why unhealthy behaviours and related health outcomes are concentrated in disadvantaged SES groups (Beckfield et al. 2015; Olafsdottir and Beckfield 2011). Yet, some

important aspects of unhealthy behaviours cannot be fully understood with reference to these factors alone. First, there is societal and historical variation in exposure to the determinants of unhealthy behaviours, such as the 'obesogenic' environment that encourages unhealthy diets and obesity. Second, unhealthy behaviours have persisted, despite political commitments and the availability of cost-effective interventions that can prevent them. Micro- and meso-sociological accounts are of more limited utility in explaining these phenomena because they do not problematize the 'root causes' of unhealthy behaviours which contribute to contextual variation in exposure to the determinants of unhealthy behaviours, or the factors that contribute to their persistence through, for example, their influence on the policy process.

The findings from my thesis have shown how examining the influence of FTAs can help us to better understand the 'root causes' of unhealthy behaviours that cause contextual variation in exposure to their determinants. Specifically, Chapters 3-4 of this thesis showed how US FTAs can alter the timing and extent of a society's exposure to the determinants of unhealthy, high-calorie diets and hazardous ingredients. It is likely that the dietary changes I identified in Chapters 3-4 were mediated by diverse changes to the socio-economic and environmental determinants of unhealthy diets which, in turn, encouraged higher calorie intake and consumption of HFCS in Canada. These include (but are not limited to) lower manufacturing costs and prices, increased marketing, and more widespread availability of calorie dense foods. Data limitations precluded an exhaustive examination of these potential pathways to impact. Yet, regardless of the specific mechanism, my findings in Chapters 3-4 suggest that exposure to the diverse socio-economic and environmental determinants of

unhealthy diets in Canada was altered by the country's FTAs with the US (Chapter 3) and the tariff changes they mandated (Chapter 4) in ways that encouraged higher calorie and HFCS consumption.

Chapters 3-4 therefore help us to better understand why caloric intake and HFCS consumption increased to a larger extent in Canada, in the post-CUSFTA and post-NAFTA periods, compared with comparison units and earlier time points. Thus, unlike micro- and meso-sociological accounts of unhealthy diets, FTAs can help us to better understand the causes of societal and historical variation in exposure to the determinants of the quantity and composition of individuals' food and beverage consumption. By doing so, Chapters 3-4 show how FTAs can improve our understanding of what causes unhealthy diets by identifying a cause of exposure to their determinants, that is, what Marmot called the 'root causes' or 'causes of the causes' of disease and its determinants (Marmot 2007).

The findings from my thesis have also shown how examining the influence of FTAs can help us to better understand the persistence of unhealthy behaviours, despite political commitments to implement cost-effective policies that can prevent them. In Chapter 5 I found that governments regularly invoked WTO rules to challenge and potentially influence other governments' proposals to introduce regulations targeting harmful food, beverage and tobacco products. I could not definitively confirm or deny whether and how all WTO challenges ultimately influenced policy design and implementation. Yet, I identified indications of their possible influence, as challenges were followed by policy changes, policy changes were feasible, and comments made at the WTO were incorporated into the final

policies. This shows how FTAs can help us to better understand the persistence of unhealthy behaviours as they contain rules that are invoked to informally challenge and possibly alter or the implementation of policies that can prevent them.

In each chapter, I also noted that my findings about the impact of FTAs could help us to better understand the causes of SES disparities in unhealthy behaviours and related diseases. First, in Chapter 3, I suggested that changes to calorie intake may have been concentrated in – and potentially driven by – lower SES individuals, especially women (Sommer et al. 2015). Next, in Chapter 4, I suggested that less educated individuals may have been relatively more exposed to the substitution of cane and beet sugars for more hazardous HFCS following NAFTA. And, in Chapter 5, I noted that unhealthy behaviours are more common in lower SES individuals, and that attempts at preventing them may play an important role in alleviating SES gradients in unhealthy behaviours and related NCDs (Bloom, Chisholm, et al. 2011). It is therefore possible that FTAs can also help us to better understand the root causes and persistence of SES disparities in unhealthy behaviours and related diseases.

These findings about the impact of FTAs also show, more broadly, how unhealthy behaviours are fundamentally rooted in a society's political economy. The implementation and design of FTAs, including Canada's trade deals with the US, are influenced by a wide array of factors, including political forces, interests, and inequities. This includes geo-political interests, such as a desire to secure long-term political alliances; the interests of well-endowed political organizations, such as business lobbies; and the interests of elites, such as 'technocrats' (Dür et al. 2014; Mansfield and Milner 1997). For example, in an analysis of NAFTA negotiations,

Fairbrother noted that trade officials' academic training as economists bestowed them with "formal authority over policy making such that their preferences exercised significant direct influence over key outcomes" (Fairbrother 2014:1331). In addition, Dreiling and Darves' (2011) analysis of CUSFTA and NAFTA showed that large US businesses could influence the content of these deals by organizing into unified networks that enabled them to participate in governmental trade advisory committees and congressional trade policy hearings (Dreiling and Darves 2011).

My analyses of the impact of FTAs therefore show, indirectly, how the causes and persistence of unhealthy behaviours are influenced both by the implementation of FTAs and by the political forces, interests and inequities which shape them. This demonstrates how FTAs constitute one way in which unhealthy behaviours are rooted in a society's political economy as they are "produced, literally and metaphorically, by the structures, values and priorities of political and economic systems" (Krieger 2011:167).

Thus, my findings also have implications for scholars in another field of medical sociology: the political economy of health. This growing scholarship has identified how diverse policies, regimes and institutions influence the determinants of health and related health outcomes (Beckfield and Krieger 2009; Muntaner et al. 2011; Pega et al. 2013; Schrecker and Bambra 2015). These include analyses of the impact of rapid privatization in post-communist countries (Stuckler, King, et al. 2009), European welfare-regimes (Bambra and Eikemo 2009) and labour market policies (Stuckler, Basu, et al. 2009), housing reforms (Reeves et al. 2016), and immigration policies (Bakhtiari et al. 2018). By showing how FTAs can influence

unhealthy behaviours, my thesis complements and expands on this body of work by providing more robust and detailed empirical evidence to support the inclusion of FTAs on this list of influential institutions.

6.3.2 The social consequences of globalization

A second-order contribution of my thesis concerns social scientific debates about the social consequences of globalization, that is, "a process that erodes national boundaries, integrates national economies, cultures, technologies and governance, and produces complex relations of mutual interdependence" (Norris 2000:155). This broad definition encompasses rising economic integration – through international trade and investment – as well as increasing participation in international organizations that aim to achieve political co-operation, promote market liberalising reforms, and sanction the conformity of domestic public policies to international norms and treaties (Dobbin et al. 2007; Dreher 2006).

Sociologists have identified myriad social consequences of these processes (Brady, Beckfield, and Zhao 2007). They have found, for example, that increasing globalization contributed to rising income inequality in Western Europe, 1973–1997 (Beckfield 2006), although it did not precipitate a 'race to the bottom' in which governments' competed by undercutting one another's social spending levels (Brady, Beckfield, and Seeleib-Kaiser 2005). Elsewhere, sociologists have shown that the market liberalising policies mandated by the International Monetary Fund (IMF) and World Bank have restricted development policy space

(Kentikelenis, Stubbs, and King 2016), per capita health care spending (Stubbs et al. 2017), and human rights attainment in certain developing countries (Stubbs and Kentikelenis 2017).

Studies of the health impact of FTAs had previously been missing from this social scientific scholarship. My findings therefore contribute to scholarly debates about the social consequences of globalization by showing how one of its primary driving forces, FTAs, can encourage unhealthy diets and constrain governments' abilities to prevent unhealthy behaviours. These findings complement the aforementioned sociological studies showing how the institutions which encourage and facilitate globalization can, in some ways, have a detrimental impact on societies. They also make two additions to this scholarship: first, they show how FTAs constitute one such institution, and second, they show that encouraging unhealthy behaviours constitutes one of these institutions' detrimental consequences.

Thus, my findings also serve as a counterpoise to the view, based on economic FTA evaluations, that FTAs and other trade liberalising policies yield improvements in a society's welfare (Bhagwati 2004; Dollar 2001; UN 2015a). For example, in a widely cited analysis of the potential welfare consequences of trade barrier reductions in FTAs, Anderson and Wincoop (2001) concluded that a "bigger drop in average trade barriers ... leads to a bigger rise in welfare. A world union has the largest possible effect on welfare" (Anderson and Wincoop 2001:12). This analysis invoked a material definition of 'welfare', treating it as synonymous with economic gains (in this case, trade flows and prices), as is common in economic FTA evaluations (Anderson and Neary 2005; Grossman and Helpman 1991;

Krugman et al. 2011; Norman 1990), and the discipline of economics more broadly (Atkinson 2009).

However, 'welfare' is a multi-faceted concept that can also encompass non-material factors, including human health, which affects individuals' overall sense of well-being and their capacity and freedom to engage in social, political, and economic activities (Atkinson 2009; Fleurbaey 2009; Sen 2005). And, as I have shown, FTAs can encourage unhealthy diets and constrain regulations which target unhealthy behaviours, both of which can contribute to the growth and persistence of diseases that undermine human health and, consequently, material and emotional well-being (Jan et al. 2018; Jaspers et al. 2015; Scarborough, Bhatnagar, et al. 2011).

This does not imply that countries would be better off in every respect without FTAs. Indeed, economic welfare is still an important dimension of overall welfare, and FTAs can yield several other consequences that promote non-material welfare. These include greater consumer choice owing to increased product diversity, and stronger political alliances that prevent military conflicts (Billmeier and Nannicini 2013; Dür et al. 2014; Hegre, Oneal, and Russett 2010). And, as I have shown elsewhere, FTAs and other trade liberalization policies can have a positive impact on other aspects of a society's health, beyond unhealthy behaviours, by reducing child mortality rates in developing countries that have pro-growth, pro-poor institutions (Barlow 2018).

What the findings from my thesis do show, however, is that FTAs can have detrimental consequences for important dimensions of a society's welfare that are often overlooked in economic impact assessments: its tendency to engage in unhealthy behaviours, risk of developing NCDs and ability to prevent them. Indeed, it is possible that the substantial economic costs that are associated with unhealthy behaviours and related NCDs partially offset the economic gains identified in economic analyses of FTAs. None of the aforementioned economic FTA evaluations took this into account. Thus, my findings serve as a cautionary note to temper the view, based on economic assessments, that the trade and investment liberalising policies which increase globalization necessarily translate into improvements in a society's welfare.

6.3.3 Trade policy

My findings therefore have important implications for trade policy. Several governments have recently committed to negotiating and implementing new FTAs. These include the Comprehensive Economic and Trade between Canada and the EU, signed in October 2016; the Transatlantic Trade and Investment Partnership (TTIP), a potential agreement between the US and the EU; and possible new deals between United Kingdom and multiple countries, including the US, following the UK's 'Brexit' referendum (HM Government 2018; WEF 2014). The results from this thesis suggest that new FTAs, especially with the US, could carry certain social costs, as noted above: they could contribute to a rise in certain unhealthy dietary behaviours and NCDs (Chapters 3 and 4) and hamper efforts to prevent unhealthy behaviours and NCDs by implementing food, beverages and tobacco regulations (Chapter 5).

Governments may therefore wish to ensure that cost-benefit evaluations of trade deals take their possible impacts on unhealthy behaviours into account. Failing to do so could reduce the overall welfare gains of these new FTAs. It could also lead governments to unwittingly compromise their commitments to prevent unhealthy behaviours and related diseases, in two ways. First, as I showed in Chapter 5, trade rules are regularly used to challenge new food, beverage and tobacco regulations. Partners in other trade agreements and investment treaties may therefore invoke the rules in new FTAs in an attempt to challenge one another's policies targeting the overconsumption of food, beverages, and tobacco, or attempt to alter these regulations when drafting regulatory harmonization clauses in new trade agreements. Second, my findings from Chapters 3 and 4 showed that FTAs – especially with the US – can contribute to increases in unhealthy dietary behaviours. The negotiation and implementation of new FTAs, especially with the US, could therefore compromise NCD prevention commitments by encouraging higher consumption of calories and hazardous ingredients, whilst simultaneously being invoked to hinder governments' attempts at introducing new legislation aimed at reducing the consumption of harmful food, beverage, and tobacco products.

One caveat to this suggestion, noted by Schram and Labonte, is that the recent resurgence of nationalist, anti-trade politics in the US could alleviate or prevent any detrimental impact of FTAs on unhealthy behaviours in other countries (Schram and Labonte 2017). Following his election in November 2016, US President Donald Trump has withdrawn from the Trans-Pacific Partnership (TPP), a deal between the US and 11 Pacific Rim countries; has sought to renegotiate NAFTA; may abandon TTIP negotiations; and has imposed tariffs on steel,

vehicle and car part imports from other WTO members, including China, Canada and Mexico (Lynch, Dawsey, and Paletta 2018; USTR 2018). Such events could be interpreted as a signal that the detrimental impact of the US's participation in FTAs and the WTO on unhealthy behaviours will greatly diminish in future due to the US's withdrawal from the global, rules-based trading system (Schram and Labonte 2017).

However, US participation in FTAs may not necessarily decline, as the US is now pursuing new treaties bilaterally (USTR 2018). In addition, Trump's 'America First' policy of promoting US business interests could lead US trade negotiators to seek greater reductions on barriers to trade in the food, beverage and tobacco products. This could occur, for example, via increased challenges to regulations on these products at the WTO and via greater attempts to negotiate reductions to US export and investment barriers when negotiating FTAs – or when re-negotiating existing ones, such as NAFTA. Trump's challenges to the global, rules-based trading system could therefore exacerbate – rather than mitigate – the potential for US FTAs to lead to a rise in unhealthy diets whilst creating stronger barriers to preventing the overconsumption harmful food, beverage and tobacco products. Fortunately, however, the design and implementation of trade deals is not beyond human control. Trade deal negotiations may therefore be a critical window in which governments could ensure that any detrimental effects of FTAs on unhealthy behaviours are kept to a minimum.

6.3.4 Obesity prevention

My findings also have implications for how governments approach obesity prevention. Whilst my analyses in Chapters 3-4 did not specifically analyse the effectiveness of policies designed to alleviate obesity, they did help us to better understand its causes – and, consequently, what policies might be effective in preventing it (Hawkes et al. 2015). One implication is that, by showing how US FTAs can contribute to unhealthy diets, my findings from Chapters 3 and 4 suggest that US FTAs could be a promising tool for intervention to prevent obesity if they are designed and implemented in ways that maintain tariffs on calorie dense and hazardous products. A second, broader implication is that by showing how one of the causes of obesity is located at a macro-structural level, my findings suggest that other aspects of this macro-level environment could be an important domain of intervention. Whether and how other aspects of the macro-level environment impact on unhealthy behaviours are therefore important questions for future research. Below I discuss this point in further detail, together with the additional outstanding questions that arise from this thesis.

6.4 Outstanding questions and extensions

Whilst this thesis has generated important new insights into the relationships between FTAs and unhealthy behaviours, some important questions arising from the limitations and implications of my findings remain unanswered. Briefly, these relate to my use of aggregate availability measures, the generalizability of my findings, mediating mechanisms, the determinants of WTO challenge dyads, the impact of FTAs on additional outcomes, and the potentially broader relationships between macro-economic and political institutions and

unhealthy behaviours. Below I discuss these outstanding questions in further detail and provide recommendations for future work in this area.

6.4.1 Aggregate availability measures

The first set of unanswered questions pertains to my use of aggregate, country-level food supply indicators in Chapters 3 and 4. Data limitations precluded a direct analysis of social disparities in dietary changes following CUSFTA and NAFTA. As I noted in Chapters 3 and 4, it is possible that effects of these trade agreements were greater among lower SES individuals who were more sensitive to price changes, lacked awareness of the harms to health from consuming more calories and hazardous ingredients, and consumed sugar-containing products – such as soft-drinks – in larger quantities (Green et al. 2013; Pampel et al. 2010). Lower SES individuals were potentially more responsive to changing food availability and prices following CUSFTA, and more exposed to the substitution of cane and beet sugars for HFCS following NAFTA. Thus, a critical question for future research is to empirically investigate this hypothesis by examining whether FTAs with the US contribute to a rise in socio-economic disparities in unhealthy behaviours and related diseases.

A further question pertaining to the limited availability of individual-level data is whether and how changes to the availability of calories and sweeteners including HFCS translated into changes to consumption. It is possible that there was limited pass-through from availability to intake due to wastage. However, I have argued that availability is a helpful, widely-used proxy for consumption in the absence of other long-term, cross-national measures

(Bleich et al. 2008), and may even have several strengths compared with self-reported measures which are subject to recall and social desirability biases (Harper and Hallsworth 2016; Miller et al. 2008). Furthermore, rising availability translating into wastage would only impact my interpretation of the impact of CUSFTA and NAFTA on diets if a rise in wastage precisely coincided these FTAs and if the rise in wastage in Canada following the FTAs exceeded the rise in other countries. Such a scenario may be unlikely as many countries without US FTAs, such as the UK, have experienced high growth in food wastage since the early 1990s (WRAP 2015). However, future research should address this by incorporating individual, self-reported measures of food and beverage consumption in FTA evaluations.

6.4.2 Generalizability of study findings

The second set of open questions arising from my thesis concerns the generalizability of my study findings. Given that Chapters 3-4 focussed on the impact of US FTAs in Canada, there is first of all the common issue of generalizability to other social, political and economic contexts. In principle, several outcomes and mechanisms underlying the impact of US FTAs are not entirely bound to the Canadian context and are thus likely to apply to other countries to at least some degree. This is especially plausible given that CUSFTA and NAFTA were used as a blueprint for many subsequent FTAs (Allee and Elsig 2015).

Certain contextual factors may nevertheless modify the scale and nature of the dietary impacts of US FTAs elsewhere. For example, the impact of US FTAs on calorie availability and intake could be smaller in the presence of regulations that prevent the overconsumption

of calorie dense food and beverages or the use of hazardous ingredients in their production. The effects of US FTAs could also depend on the presence of factors that affect the profitability and flows of US exports and investments, such geographic distance, diplomatic relations, a country's main language, and domestic food and beverage market maturity (Baier and Bergstrand 2009). For example, the effect of US FTAs on diets may be strongest in countries which, like Canada: are geographically close to the US, such as Latin America; have strong diplomatic ties to the US, such as the UK; and where English is widely spoken, such as New Zealand, Australia, and former British colonies in Asia and the Pacific. US FTAs may also lead to a greater rise in US food and beverage exports, investment, and associated dietary changes in low- and middle-income countries where US companies face weaker competition and where projected market growth rates are high (Stuckler et al. 2012).

Another consideration relating to generalizability is whether my analyses of CUSFTA and NAFTA apply to non-US FTAs. I argued that FTAs with the US are especially likely to lead to a rise in unhealthy diets, including high caloric intake and HFCS consumption, as US food and beverage businesses have competitive advantages elsewhere, and produce large quantities of calorie dense food and beverages which use hazardous ingredients (Guthman 2011). It is nevertheless possible that FTAs with other countries that have internationally competitive food and beverage corporations could also lead to a rise in unhealthy dietary behaviours. For example, Germany and the UK are also home to large producers of sugar, calorie-dense snacks, confectionery, and prepared meals (Grant Thornton 2017). Whilst these countries are less-specialised in the production of calorie-dense products compared with the US, it is

plausible that reducing trade barriers with these countries could contribute to a rise in unhealthy behaviours in partner countries, albeit to a lesser degree.

Conversely, some countries, such as the Netherlands and Spain, are competitive exporters of nutritious foods, including fruits and vegetables (Eurostat 2016). FTAs with these countries could therefore lead to a substitution of unhealthy diets for more healthy, nutritious diets and ingredients, potentially improving dietary composition and preventing excess caloric intake. In addition, because lower SES-individuals are more responsive to price changes, such FTAs may also yield greater improvements in dietary quality in this social group, potentially reducing disparities in dietary quality, caloric intake, and related diseases.

It also remains an open question whether the findings from my analysis of challenges at the WTO pertain to other trade and investment treaties which grant legal protections to investments as well as trade, and which extend those rights to multi-national corporations as well as to governments. Yet, as I noted in Chapter 5, trade rules in many other FTAs incorporated and expanded upon WTO provisions like those in the TBT Agreement (Dür et al. 2014). In addition, government officials occasionally stated that informal challenges at the WTO represented concerns raised by the food, beverage and tobacco corporations. Furthermore, an important feature of my analysis of the WTO was the unique ability to systematically identify challenges through meeting minutes that are not provided under alternative treaties. This suggests that the scope of arguments raised in WTO challenges provide a rare insight into those raised under alternative treaties.

Addressing the above questions regarding the generalizability of my findings was beyond the scope of my analyses. However, they represent an important logical follow-up to this thesis. To the extent possible, future studies should investigate whether my findings apply to other FTAs and in different social, political, and economic contexts.

6.4.3 Mechanisms and motivations

A further set of outstanding questions concerns the exact mechanisms underlying the relationships presented in this thesis, since I was unable to evaluate all of these pathways. Due to the limited availability of data in Canada and comparison countries I was unable to fully investigate whether changes to trade and/or investment mediated observed changes to the availability of calories and HFCS in Chapters 3 and 4. Furthermore, I was not able to investigate how FTAs impacted on the determinants of food and beverage and consumption, including availability, price, marketing, and changing incomes and demand. It is possible that several mechanisms operated in concert and even reinforced one another. Following CUSFTA, for example, US food and beverage corporations may have entered the Canadian market and set competitively low prices for their products, leading Canadian firms to respond to a rise in competition by lowering their prices further and by initiating advertising campaigns. I recommend future research to test these potential mechanisms in detail.

In addition, it would be helpful to better understand the precise motivations for WTO challenges and associated patterns of challenge dyads. Challenges may arise between countries due to high-levels of bilateral trade, which increase a government's and businesses' motivation

to raise challenges in an attempt to minimise the number and scope of regulations – and associated costs – affecting the products they export. Challenges between high- and low-income countries may therefore reflect high volumes of food, beverage and tobacco exports between these countries (Bailey and Wellesley 2017).

Yet, as I noted in Chapter 5, challenges could also be unrelated to trade in the specific commodities affected by the regulations under discussions. This is because they may represent an attempt to discourage the introduction of any costly policy and so prevent the introduction of future regulations affecting the products that a country does export. For example, countries which do not export alcoholic beverages might still question alcohol control measures to discourage governments from introducing regulations that affect their trade interests in other products. Future research could address this by testing the correlation between product-specific trade flows and product- specific challenge dyads. In addition, interviews with trade officials could identify additional motivations and establish in more detail exactly why and how countries raise challenges.

The above discussion concerning the need to investigate the possible determinants of challenge dyads relates to a further outstanding question: whose interests do the challenges ultimately represent? As I noted in Chapter 5, the officials who raised challenges occasionally noted that their challenges reflected comments made in industry correspondence to the government. It is therefore plausible that WTO challenges to food, beverage and tobacco regulations also represent businesses' interests in the introduction of new regulations. Thus, trade challenges to food, beverage and tobacco could represent a way in which businesses

leverage their advantageous financial resources and access to officials in order to ensure that policies which compromise their profits are kept to a minimum. This could be evaluated by comparing the arguments made about regulations at the WTO with pre-identified arguments raised by industry in other fora, such as open public policy consultations.

6.4.4 Unexamined outcomes

Whilst my thesis has improved our understanding of the links between FTAs, unhealthy diets, and regulations targeting food, beverage and tobacco products, I left some potential consequences of FTAs unexamined. One set of outcomes pertains to the health implications of my finding that CUSFTA and NAFTA were respectively associated with increased availability and likely consumption of calories and HFCS in Canada. Due to data limitations I was unable to analyse the extent to which these changes ultimately impacted on health-outcomes that are related to these dietary behaviours, such as increased body weight, obesity, type 2 diabetes, and cardiovascular disease. Indeed, internationally comparable, long-term longitudinal data for assessing these changes are sparse, despite their necessity for rigorous, country-level comparative analyses of population policies. In future, researchers could address this by redoubling their efforts to collect and code such data, and by analysing more recent or future US FTAs, for which appropriate data could become available.

A second set of under-examined outcomes pertains to the influence of WTO challenges on policy. My analysis in Chapter 5 provided evidence to suggest that at least some challenges were influential, but I was unable to systematically identify the extent, frequency and precise

nature of policy impact. It may never be possible or financially feasible to monitor the influence – or a lack thereof – of every single challenge. However, future studies could improve on existing knowledge by conducting detailed case-studies of randomly selected challenges. This would involve tracking pre- and post-challenge changes in domestic government committee minutes and reports, public consultation documents, and legislative drafts. It would be particularly fruitful to investigate whether the wording of WTO challenges subsequently featured in these documents, and to identify the specific type of delay or change – including whether any alterations rendered the policy less effective compared with the original proposed measure.

Several outcomes also remain under-explored in the broader literature on the health impacts of FTAs. These include the possible beneficial and harmful impacts of FTAs on exposure to diverse health determinants and associated outcomes, including alcohol consumption, job security, working conditions, and access to pharmaceuticals. It is also plausible that WTO challenges are raised against a wider range of health policies. Indeed, whilst collecting my data for Chapter 5 I observed that members frequently raised challenges about regulations that were designed to protect individuals from the risks associated with the use of hazardous chemicals in cosmetics and unsafe children's' toys.

FTAs could also have other consequences for individual and societal well-being that remain unexamined. This includes, for example, possible impacts on poverty rates, crime, civic participation, and pollution levels due to changes in the structure of economic activity,

employment, wages, and working conditions (Autor, Dorn, and Hanson 2013; Labonte and Schrecker 2007).

Future empirical research should therefore consider a wider range of potential impacts of FTAs in order to gain a more complete understanding of their positive and negative consequences, and the socio-economic stratification of these outcomes. This will be important for helping scholars and policymakers to arrive at a balanced, empirically informed understanding of the net impact of FTAs on a society's health and overall well-being, and in whom these effects are concentrated.

6.4.5 The political economy of unhealthy behaviours

Finally, I have argued that the findings in my thesis show how unhealthy behaviours are rooted in a society's political economy. By doing so, my thesis advances our understanding of these behaviours by identifying the causes of exposure to their determinants and their persistence. This illustrates the potential value of investigating the political economy of unhealthy behaviours more broadly. Future studies could therefore expand on the insights from this thesis by redoubling their efforts to consider and empirically evaluate how a wider range of policies and institutions shape a society's exposure to the determinants unhealthy diets. Under-studied institutions that could be influential in this respect include welfare regimes, which could increase individuals' ability to afford healthy diets, and agricultural subsidies, which impact the relative prices of healthy and unhealthy food prices and ingredients (Hawkes et al. 2015).

In addition, my findings in Chapter 5 suggest that it may also be fruitful to investigate additional possible determinants of policy implementation to prevent unhealthy behaviours by incorporating frameworks of the policy-process grounded in other sub-disciplines in sociology and political science (Sabatier and Mazmanian 1980; Sabatier and Weible 2007). For example, these frameworks have helped identify how the media can influence policy implementation by shaping how the public understands a specific issue (Boykoff and Boykoff 2007), and how macro-economic conditions can shape individuals' political orientation and support for government intervention (Margalit 2013). Future studies could therefore incorporate such insights to investigate these additional possible determinants of policy implementation to prevent unhealthy behaviours and, by doing so, help us to better understand their persistence.

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