Department of
Economics

University of Pittsburgh
Kenneth P. Dietrich School of Arts and Sciences

WORKING PAPER SERIES

17/010

Weight gains from trade in foods: Evidence from Mexico

Osea Giuntella, Matthias Rieger and Lorenzo Rotunno

November, 2017

Weight gains from trade in foods: Evidence from Mexico*

Osea Giuntella[†]

Matthias Rieger[‡]

Lorenzo Rotunno[§]

This draft: November 3, 2017

Abstract

This paper investigates the effects of international trade in food on obesity in Mexico. We classify Mexican food imports from the U.S. into healthy and unhealthy and match these with anthropometric and food expenditure survey data. We find that exposure to imports of unhealthy foods significantly contributes to the rise of obesity in Mexico. The empirical evidence also suggests that unhealthy food imports may widen health disparities between education groups. By linking trade flows to food expenditure and obesity, the paper sheds light on an important channel through which globalisation may affect health.

Keywords: Trade, obesity, nutrition transition, Mexico

JEL codes: F60, F16, I10

*Previously circulated under the title "Trade in unhealthy foods and obesity: Evidence from Mexico". We are grateful to Nicolas Berman, Amitabh Chandra, Eleonora Fichera, Sergi Jimenez, Fabrizio Mazzonna, Brandon Restrepo and participants at the 2017 HCHE Workshop on Risky Healthy Behaviors, 2017 ETSG conference, 2017 FREIT Sardinia Conference, 2017 American-European Health Study Group Workshop, 2017 DIAL Conference, 2017 IRDES Workshop, 2017 Policy Evaluation in Health Workshop, and seminars at PSE, Aix-Marseille School of Economics, Toulouse School of Economics, and International Institute of Social Studies (ISS), Erasmus University, for their comments and suggestions. We thank Sarah Elven and Alessia Mortara for able research assistance. Part of the research was funded through the project "Trade liberalisation, nutrition transition, and health" (LED0938) by the John Fell Fund (Oxford University Press).

[†]University of Pittsburgh. Department of Economics, Posvar Hall, 230 S Bouquet St, Pittsburgh, PA 15213.

[‡]International Institute of Social Studies (ISS), Erasmus University, Kortenaerkade 12, 2518 AX The Hague, The Netherlands.

[§]Aix-Marseille University (Aix-Marseille School of Economics), CNRS & EHESS. Chemin du Château Lafarge, 13290 Les Milles, France. Office B987/988; Tel.: +33 (0)442935987. Email: lorenzo.rotunno@univ-amu.fr

1 Introduction

The prevalence of obesity, overweight and other diet-related chronic diseases has increased rapidly in the developing world. Today an estimated 62 percent of obese individuals live in developing countries (Ng and et al., 2014). The number of overweight or obese people living in the developing world has tripled between 1980 and 2008 (Keats and Wiggins, 2014). Over the same period many emerging economies have opened up their food markets to international competition. In response, policy makers have paid more attention to the implications of globalisation and international trade for population health and diets. The World Health Organization (WHO, 2015), for instance, has adopted a clear mandate to help and support member states to better align trade and health policies. Despite the perceived association between trade liberalisation and diet-related health outcomes, the causal effects of trade in foods on obesity and their quantitative importance are not well established.[1]

The rise of obesity in emerging economies has been associated with a "nutrition transition" whereby diets become richer in animal fats and sugars, and rely more on processed foods as average income increases (Popkin and Gordon-Larsen, 2004). These nutritional changes are intertwined with an epidemiological transition in which populations increasingly suffer from obesity, diabetes and cardiovascular diseases rather than infectious diseases and undernutrition (Omran, 1971).

Greater openness to trade in foods can affect the nutrition transition and hence obesity through changes in income, food prices, tastes and norms. By increasing average income, trade liberalisation can fuel the nutrition transition and contribute to the rise in obesity. Its effects through prices are however ambiguous as they depend on the induced price changes and availability of unhealthy and healthy foods. Furthermore, globalisation and trade openness can affect norms and preferences by, for instance, heightening exposure to food advertising on television and the internet (Dragone and Ziebarth, 2017).

In this paper, we empirically examine the effects of U.S. exports of foods and beverages (F&B or 'food' for short) on obesity in Mexico. Over the last decades, Mexico has recorded spectacular increases in diabetes and obesity rates, and has become a prime example of a country in the nutrition transition (Popkin et al., 2012). According to the latest WHO data from 2014, it ranks among the twenty most obese countries in the world, with an estimated 28 percent of the adult population being obese. Trade flows between the U.S. and Mexico have also grown substantially since the 1980s and following the North America Free Trade

[1] A recent literature in public health has studied the link between trade liberalisation and supply and sales of products containing high-fructose corn syrup (Barlow et al., 2017), and sugar-sweetened beverages (Lopez et al., 2017; Schram et al., 2015).

Agreement (NAFTA) in 1994 (Caliendo and Parro, 2015).[2] This is particularly true for the F&B industry, where U.S. products represent around 80 percent of total Mexican imports (see section 4.1 for details). In our empirical analysis, we dissect these aggregate patterns and investigate the influence of U.S. "unhealthy" foods on Mexican diets and hence on obesity prevalence in Mexico.[3] By so doing, we assess to what extent the U.S. has "exported" its high obesity prevalence (the highest among OECD countries (OECD, 2017)) to Mexico through trade in foods.

To identify the effect of U.S. food exports within Mexico, we allocate trade flows to Mexican states (i.e., the lowest spatial unit at which data are representative) according to their 'exposure' to each type of food as measured by each state's historical expenditure by food product. The underlying idea is that national trade shocks affect regions and individuals differentially and depending on, for instance, their access to trade routes (Atkin and Donaldson, 2015) and their sectors employment (Dix-Carneiro and Kovak, 2017; Autor et al., 2013). In our paper, we use the share of total national expenditure of a given food product that goes to each state since it measures exposure to trade shocks as predicted by baseline food consumption (and hence nutrition) patterns.[4] Specifically, this empirical approach implies that a Mexican state where expenditure in, say, processed foods has been historically higher will receive a larger share of a given increase in U.S. exports of processed foods.

To delve into the nutrition channel, we differentiate between "healthy" and "unhealthy" foods using the USDA Dietary Guidelines for Americans (DGA, 2010). This categorisation allows us to impute the share of unhealthy food imports coming from the U.S. at the state level. We then estimate the effect of exposure to the share of unhealthy food imports across Mexican states on the measured obesity status of individuals living in these states.[5]

We document a positive and robust effect of unhealthy food imports on obesity across Mexican states. Our main results are based on a repeated cross-section of adult women, as male anthropometric data was only collected in later surveys (2006 and 2012). The estimates

[2]A large literature has examined the implications of Mexican economic liberalisation for economic growth (Hanson, 2010), labour markets and wage inequality (e.g, Hanson, 2007; Verhoogen, 2008), and retail prices and household welfare (Atkin et al., 2017).

[3]Anecdotal evidence points to a positive correlation between trade liberalisation and the observed rise in obesity in Mexico (e.g., Clark et al. (2012)). As the UN Special Rapporteur on the Right to Food stated in 2012, the widespread belief is that at least part of the obesity emergency could have been avoided if "the health concerns linked to shifting diets had been integrated into the design of the country's trade policies" (Guardian, 2015).

[4]Fajgelbaum and Khandelwal (2016) highlight the importance of expenditure shares at the individual level in determining the distribution of the gains from trade.

[5]Obesity status is derived from the Body-Mass Index (BMI, equal to weight (in kg) over height squared (in meters)), commonly used as a measure of body fat and weight.

from our baseline specification imply that a one standard deviation increase in the unhealthy share of imports (equivalent to a 14 percentage point increase) leads to an increase in the risk of being obese of 4.6 percentage points among adult women. This effect is statistically significant and equivalent to 18 percent of the average obesity prevalence in our sample. The results are robust to controlling for Mexican exports of unhealthy foods and to the use of food imports statistics for final demand only. Lower estimates from specifications that control for missing values on observables and that include male adults still suggest an obesity effect of around 3 percentage points (or 10% of the average obesity prevalence in the estimation samples).

To bolster a causal interpretation of the estimates, we follow Autor et al. (2013) and use U.S. food exports to other upper middle-income countries (UMIC for short) as an instrument for U.S. food exports to Mexico in a specification with long-differenced (between 1988 and 2012) obesity prevalence and trade variables at the state level. The IV estimates are in line with the positive OLS effect of exposure to relative changes in unhealthy imports on changes in obesity prevalence. We obtain similar results using gravity residuals that net out demand-side influences, indicating that supply-side factors (i.e., U.S. food production becoming increasingly specialised in unhealthy foods) help identifying the effect of unhealthy imports from the U.S. on obesity in Mexico.

The estimated effects are driven by the rising importance of U.S. exports of unhealthy foods, rather than by a general increase in food exports or exports of other products like apparel. While U.S. food exports to Mexico increased more than seven-fold between 1989 and 2012, exports of unhealthy foods had the highest increases (e.g., exports of "prepared foods" are 23 times higher in 2012 than in 1989), determining the detrimental effect on obesity. Results from a placebo test using imports of apparel as an alternative measure of states' exposure to trade indicate that the baseline effect is specific to imports of unhealthy foods rather than to overall trends in exposure to imports from the U.S.. Food exports from other countries to Mexico have insignificant effects, suggesting that U.S. exports to Mexico are particularly specialised in obesity-prone food varieties within the unhealthy category. Reassuringly, we also find that the share of unhealthy imports is uncorrelated with an index of lagged predictors of obesity.

The strong effect of unhealthy food imports is robust to controlling for other state-level determinants of obesity, such as relative prices of unhealthy foods and average income. To investigate more directly the mediating role of these variables, we also estimate a household demand equation over healthy and unhealthy foods. Results suggest that households shift more expenditure towards unhealthy foods in states that are more exposed to food imports from the U.S.. The correlation between household relative demand for unhealthy foods and exposure to U.S. foods does not change when we control for local prices and real household expenditure, suggesting a 'taste' channel of influence (see also Atkin (2013)) – in states that are increasingly exposed to U.S. food exports, individuals develop stronger preferences for unhealthy foods and hence face a higher risk of being obese.

We further extend the empirical analysis to investigate how the obesity effect of exposure to unhealthy U.S. foods varies along individual characteristics. Our findings point towards an important heterogeneity by levels of education. Results indicate that imports of unhealthy foods increase obesity significantly more among less educated women (i.e. those who have attained at most primary education). Furthermore, our estimates suggest that unhealthy imports magnify existing disparities in obesity risk. The average difference in the likelihood of being obese between women who have at least completed high school and less educated women experiences a significant 3 percentage-point increase (from 5 to 8 percentage points) as states' exposure to U.S. unhealthy foods rises by 14 percentage points (one standard deviation).

This paper provides novel empirical evidence on the role of trade in unhealthy foods in driving obesity rates. It expands recent conceptual studies (WHO, 2015; Thow, 2009) underlying the contributions of trade liberalisation to the nutrition transition and to the related rise in obesity, diabetes and other cardiovascular diseases in developing countries. Existing cross country studies provide mixed evidence – Miljkovic et al. (2015) and Vogli et al. (2014) report a positive and significant effect of trade openness on obesity and BMI, whereas the findings in Oberlander et al. (2017) and Costa-Font and Mas (2016) suggest that social (rather than economic) globalisation matters. We use detailed data from a single country, Mexico, and contribute to this nascent line of empirical work by identifying the effects of trade in unhealthy foods (rather than total trade flows), and by assessing the role of interactions between exposure to trade and socioeconomic drivers of obesity at the micro level.

Our study also complements recent work documenting negative effects of trade liberalisation on health through income and labour market channels (Colantone et al., 2017; Hummels et al., 2016; Pierce and Schott, 2016; Lang et al., 2016; McManus and Schaur, 2016). These papers analyse supply-related mechanisms – increasing trade integration affects workers' physical and mental activities – through which trade affects health outcomes. Our paper applies a comparable empirical methodology to allocate trade shocks across regions within a single country, but it is the first one to focus on obesity and on the demand side channel operating through the nutrition transition (Popkin and Gordon-Larsen, 2004; Rivera et al., 2004).

By studying the effects of trade on obesity, the paper adds to a large body of work on the economic determinants of obesity and dietary habits (Cawley, 2015). Courtemanche et al. (2016) find that the local economic environment (e.g., proximity to supercenters -such as Walmart- and restaurants) explains a significant portion of the observed rise in obesity in the U.S..[6] Handbury et al. (2015), however, find that spatial differences in access to healthy foods explain only a small fraction of the differences in nutritional intake across people from different socioeconomic groups (e.g., across people with different levels of education). Our paper adds to this strand of the literature by highlighting the role of international trade in foods as a quantitatively important economic driver of obesity.

The rest of the paper is organised as follows. Sections 2 and 3 describe the empirical strategy and the data used in the analysis. Section 4 discusses the results, focusing on a descriptive analysis first (subsection 4.1), and then delving into the econometric results (subsections 4.2 to 4.4). Section 5 concludes.

2 Empirical strategy

The empirical analysis aims to identify the effects of U.S. food exports to Mexico on obesity. It proceeds in three steps. First, we present some descriptive patterns in obesity and U.S. food exports to Mexico. Second, we estimate the effect of greater exposure to unhealthy food imports from the U.S. on the probability of being obese at the individual level, and investigate possible demand-based mechanisms. Finally, we examine the heterogeneity of documented effects as a function of skill (or education) levels and other socioeconomic characteristics.

Our baseline specification relates obesity status for each individual in the sample to exposure to U.S. exports of unhealthy food allocated to the 32 Mexican states – the lowest level of aggregation at which the health surveys are representative. In practice, we estimate the following regression:

$$(1) \quad Obesity_{i,s,t} = \beta_1 UnhealthyImp_{s,t} + \beta_2 C_{i,s,t} + \beta_3 X_{s,t} + \gamma_s + \gamma_s t + \theta_t + \epsilon_{i,s,t}$$

The *Obesity* variable equals one if the individual i living in state s has a BMI greater or equal than 30 in t, the year of the health survey (1988, 1999, 2006, and 2012). The estimation sample is a repeated cross-section of adult women – the same individual is not followed over time. The main covariate of interest is $UnhealthyImp$ and equals the share of total imputed

[6]See also Currie et al. (2010) on the effects of fast food restaurants on obesity.

food imports coming from the U.S. at the state level that is classified as "unhealthy" – i.e., $UnhealthyImp = \frac{M_{s,t}^{unh}}{M_{s,t}}$, where $M_{s,t}^{unh}$ and $M_{s,t}$ represent the imputed imports of unhealthy food products and the total imputed imports of food products of state s at time t from the U.S., respectively.[7]

The coefficient β_1 identifies the effect of unhealthy food imports on obesity in 'reduced-form'. The variable $UnhealthyImp$, measuring states' exposure to unhealthy imports, can be thought of as an instrument for the (unobserved) actual consumption of unhealthy foods from the U.S. by individual i. Individual consumption of unhealthy imports is likely to be endogenous – e.g., if being obese shifts preferences for unhealthy (relative to unhealthy) foods. Our identification strategy relies on variation in local exposure to (rather than actual consumption of) U.S. food exports to Mexico in order to estimate the effect on obesity.

Imports from the U.S. for each Mexican state at the product level are imputed from national trade statistics – imports at the state level are not available for the period under study. We use the state's expenditure share for a given product (i.e., the state expenditure for a product relative to total national expenditure for the same product) to allocate imports across states. Specifically, total imputed food imports M per capita of state s at time t are defined as follows:

$$(2) \quad M_{s,t} = \frac{1}{Pop_{s,1988}} \sum_{g} \frac{E_{g,s,1984}}{E_{g,1984}} M_{g,t}$$

where the subscript g identifies a product within the food & beverages (F&B) macro-category. The expenditure shares are computed using data from 1984 (the first year where such data are available), and hence before the beginning of our sample in 1988, and held fixed throughout the sample period. Imputed unhealthy food imports, $M_{s,t}^{unh}$ – i.e., the numerator of the unhealthy share of imports, $Unhealthyimp$ –, is computed by restricting the summation in (2) only to food categories g that are classified as unhealthy.

Variation in expenditures shares across states and products and changes in trade flows over time identify our coefficient of interest, β_1, in the regression equation (1). If the relative expenditure on unhealthy foods is equally distributed across states, the $Unhealthyimp$ share also does not vary across states and β_1 cannot be identified separately from the time dummies

[7] In our baseline specifications, we do not use import penetration ratios (imports from the U.S. over household expenditure) at the state level because expenditure and imports flows are not directly comparable – we nonetheless show the country-level trend of this variable in Figure 2. Trade data may include also purchases by firms (i.e. not for final consumption), and our constructed measure of imports for final demand has its own limitations, as discussed in Section 4. However, results tend in the same direction when using a metric of unhealthy import penetration rather than the unhealthy share of imports.

θ_t. Moreover, the time dummies absorb the influence of the unhealthy share of total food imports from the U.S. as well as of other national, time-varying shocks. If there were no significant changes in relative imports of unhealthy foods over time, the effect of the $Unhealthyimp$ variable would be subsumed by the state fixed effects γ_s. We further add state-specific time trends ($\gamma_s t$) to our specification in order to control for the generalised upward trends in obesity and in trade between Mexico and the U.S.. Thus, deviations from within-state time trends in the share of imputed unhealthy food imports provide the source of identifying variation in the linear probability model of equation (1). In addition, we include various socioeconomic determinants of obesity at the individual or household level – age, education, employment status, role in the household, and wealth indicators – and collect them in matrix C. The term X denotes a set of other state variables that characterise the economic environment and can channel or confound the effect of unhealthy food imports. Standard errors are clustered at the state level.[8]

The methodology that we use to impute state food imports is borrowed from the literature on the local labour market impact of import competition (see, e.g., Autor et al., 2013), which has recently been applied also to investigate the effects of imports on workers' health (Colantone et al., 2017). In that line of work, the objective is to investigate trade effects in the labour market and hence imports are allocated within countries according to the employment share of each spatial unit in national employment by sector. In our analysis, we focus on a nutrition channel – expenditure shares are thus the relevant measure of trade exposure at the local level. By differentiating healthy and unhealthy foods on the basis of their nutritional composition, we further attenuate the possible influence of labour market channels (e.g. greater import competition altering the patterns of physical activity) on our estimates of interest.[9]

The causal interpretation of the effect of exposure to unhealthy imports on obesity relies on the assumption that variation in U.S. exports to Mexico across food categories and over time ($M_{g,t}$ in equation (2)) comes from changes in supply-side determinants of U.S. food production that are not affected by Mexican demand. To verify this presumption and to adopt a more long-run view at the Mexican obesity epidemic, we adopt the empirical strategy of Autor et al. (2013) and instrument changes in U.S. food exports to Mexico with changes in U.S. food exports to other upper middle-income countries (UMIC), within a specification

[8] The state share of total population in the initial period (1990) is used as weight in the regressions to correct for sampling error in computing the state-level variables.

[9] More specifically, the coefficient β_1 in equation (1) could capture the influence of changing physical activity due to import competition if the healthiness categorisation is correlated with the physical effort level required in production and if the pre-determined expenditure shares correlate with initial employment shares.

in long differences (between 1988 and 2012) at the state level:

$$(3) \quad \Delta Obesity_s = \alpha + \beta_1 \Delta UnhealthyImp_s + \beta_2 X_{s,1988} + \epsilon_s$$

with "Δ" denoting 2012-1988 differences, and the *Obesity* variable being equal to the share of women in state s who are obese. In this specification, the variable $\Delta UnhealthyImp$ measures exposure to changes in U.S. exports of unhealthy foods to Mexico, relative to changes in total U.S. food exports to Mexico – the trade flows $M_{g,t}$ in (2) are in differences between their 2012 and 1988 values.

Validity of the IV strategy requires that food consumption patterns in UMIC do not affect demand patterns in Mexico (see Autor et al. (2013)). This cross-country correlation could be problematic for identification if, for instance, the dietary shifts of the nutrition transition that are common to UMIC are significantly shaping U.S. food exports. To rule out this possibility, we also compute $\Delta UnhealthyImp$ by using the residuals of a gravity regression of the difference (in logs) between U.S. exports and Mexican exports to UMIC on product and destination fixed effects (Autor et al., 2013). The variation in the residuals should thus come only from changes in the patterns of U.S. comparative advantage relative to Mexico in the food sector, and from any differential changes in trade costs.[10]

A positive and statistically significant coefficient β_1 in equations (1) and (3) would support the presumption – so far based largely on anecdotal and descriptive evidence – that U.S. exports of unhealthy foods to Mexico have contributed to the rise in obesity in Mexico. To corroborate the causal interpretation of our findings and explore the role of possible mechanisms, the term X in equations (1) and (3) collects a set of state variables that characterise the economic environment and can confound the effect associated with unhealthy food imports.

We focus on the demand channels through which greater availability of unhealthy food imports can influence nutrition and obesity. The influence of changes in the relative exposure to unhealthy imports can mask the effect of changes in states' relative expenditure on unhealthy foods. We control for this confounding factor by including the unhealthy share of total food expenditure. Finding a positive and significant β_1 (and quantitatively more important than the coefficient on the unhealthy share of food expenditure) suggests also that for the same unhealthy categorisation, U.S. foods are more obesity-prone (e.g., because of different micro-nutrients used that are not captured by the coarse healthy-unhealthy

[10] Variation in bilateral exchange rates can provide another source of exogenous variation in trade flows (e.g., Colantone et al. (2017)), but cannot be applied to our empirical setting. The same bilateral exchange rate would be in both the numerator and denominator of $UnhealthyImp$, and hence cancel out.

comparison) than other foods bought by Mexican households.

The demand channel of influence can operate through changes in prices and income. Greater imports of unhealthy foods can be associated with a price effect, whereby new and relatively cheaper U.S. varieties of unhealthy foods displace the Mexican varieties in the food consumption basket. This channel can reinforce the nutrition transition by encouraging shifts towards a less healthy diet. Faber (2014) finds strong evidence for an effect of NAFTA liberalisation on relative prices in Mexico, and Cravino and Levchenko (2017) find that the price of tradables rose after the Peso crisis. These recent studies work with a very disaggregated level of food brand or variety and, like the rest of the literature, do not focus on the healthiness of food varieties. In the empirical specifications (1) and (3), we control for the weighted average price of unhealthy foods relative to the weighted average price of healthy foods at the state level, where the weights equal the share of each food product in total spending on healthy or unhealthy foods.

Trade liberalisation can increase average productivity and income, accelerating the nutrition transition and, more generally, the abandoning of traditional life styles and behaviors. This demand channel is likely to affect the estimates of interest (β_1) if income-enhancing trade integration is biased towards consumption (and imports) of unhealthy foods. In the empirical analysis, we proxy for this mechanism by adding the state GDP per capita (in logs) to our set of covariates.

Being more exposed to imports from the U.S. can be associated with other measures of economic and cultural proximity. To control for these influences, the term X in our baseline regression includes also the state's stock of inward Foreign Direct Investments (FDI) (relative to the state's GDP) and the share of the state's population that migrated to the U.S. The confounding role of other time-invariant determinants of trade with the U.S. (e.g., distance to the border) is captured by the state dummies (γ_s) in (1).

To better gauge the possible role of price and income channels in mediating the influence of unhealthy imports, we adapt the approach of Atkin (2013) and estimate the association between exposure to foods from the U.S. and household demand. Using data from expenditure surveys between 1989 and 2012, we regress household expenditure shares on states' import shares controlling for local prices, household real expenditure and other household characteristics. After controlling for these factors, Atkin (2013) attributes any residual variation in household budget shares to differences in tastes across geographical areas. We follow his lead and investigate whether any correlation between import shares and household expenditure shares is absorbed by the effects of prices, real household expenditure, other socioeconomic characteristics, or residual variation interpreted as changes in tastes.

The demand specification stems from the linear approximation of the Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980) and takes the following form[11]:

$$(4)\quad bshare_{c,h,t} = \beta_{1,c} Impsh_{c,s,t} + \sum_{c'} \beta_{c,c'} \ln p_{c',m,t} + \beta_{2,c} \ln \frac{food_{h,t}}{P^*_{m,t}} + \Pi_c Z_{h,t} + \gamma_{c,s} + \gamma_s t + \theta_t + \epsilon_{c,h,t}$$

The variable $bshare$ equals the share of household h food expenditure on food group c.[12] We identify three groups, healthy (h), unhealthy (unh) and 'other' foods.[13,14] Unit values from the expenditure surveys are used to compute local prices as median prices at the *municipio* level (subscript m in (4), the smallest geographical unit recorded in the expenditure surveys) in order to attenuate endogeneity concerns (see also Atkin (2013)). Assuming weak separability between food consumption and consumption of other goods, we can use household food expenditure (the $food$ variable) instead of total household expenditure. A Stone price index, $\ln P^*_{m,t} = \sum_c \overline{bshare}_{c,s,t} \ln p_{c,m,t}$, makes the AIDS linear. We also control for the age (and its square term), sex, occupation, education and sector of employment of the household head, as well as for household size (and its square term) and composition, and collect these variables in Z. Their effect is further allowed to vary across food groups c. We follow as close as possible the empirical specification of the obesity regression (1) and include state-food group fixed effects ($\gamma_{c,s}$), year dummies (θ_t) and state-specific linear trends ($\gamma_s t$). We use survey weights and cluster standard errors by state.

The sign and significance of the β_1 coefficients in regression (4) provide an indication of how expenditure patterns between healthy and unhealthy foods relate to imports from the U.S. (relative to the excluded category). More precisely, a positive $\beta_{1,unh} - \beta_{1,h}$ difference would suggest a higher correlation between state import shares and household expenditure shares for unhealthy than for healthy foods. This pattern would be consistent with any

[11] Huffman and Rizov (2010) apply a similar demand specification to assess the relationship between lifestyle, nutrition and obesity in Russia, while Dharmasena and Capps (2012) adopt a quadratic AIDS to study the obesity-reducing effect of a proposed tax on sugar-sweetened beverages in the U.S..

[12] The expenditure data for each survey are available at the individual level and, starting from the 1994 wave, they report the place of purchase (e.g., market, stores). Individual identifiers are however often missing. We thus perform the analysis at the household level and compute prices as weighted averages across individuals and places of purchase. We further aggregate prices across food categories (and within each of the three food groups) using household expenditure shares as weights.

[13] 'Other' foods include 12 F&B categories in the Mexican expenditure surveys for which matching with the trade or health (USDA) classifications was problematic because of imprecise definitions (e.g. "loose seeds", "packaged seeds", "packed chillis") or because there was no clear international counterpart (e.g., "pulque", "Pueblan chillis for stuffing"). They represent, on average, 4 percent of household expenditure and 3.6 percent of imputed imports of F&B.

[14] We pool the household budget share data for the three food groups and estimate (4) by interacting each explanatory variable with food groups indicators. The level effect of these indicators is absorbed by the state-group dummies $\gamma_{c,s}$.

pro-obesity effect of unhealthy import share (a positive β_1 in equations (1) and (3)) being at least partly channelled through dietary shifts towards more unhealthy foods. Furthermore, we assess whether any difference between $\beta_{1,unh}$ and $\beta_{1,h}$ is robust to the inclusion of local prices, real expenditure and household characteristics, and hence whether the demand effects of exposure to imports from the U.S. can be attributed to changes in tastes.

3 Data description and sources

To implement our empirical analysis, we use data on health, expenditure and trade. Information on BMI comes from the Encuesta Nacional de Nutricion (ENN, 1988 and 1999) which then became the Encuesta Nacional de Salud y Nutricion (ENSA, 2006 and 2012). The survey changed structure and expanded its content over time. However and importantly for the purposes of our study, all waves are representative at the state level[15], which is the level of aggregation that is therefore used to allocate trade flows. The ENN only surveyed women between 20 and 49 years of age. For this reason, we restrict our main analysis to this sample and present robustness checks using men and other age groups surveyed in the ENSA.

These data contain also information on individual socioeconomic characteristics (education, employment status, household type) that control for individual heterogeneity in the risk of being obese. The individual controls are harmonized across waves and included in the matrix C in equation (1). In absence of data on income, we proxy for the position of each household in the sample wealth distribution. We perform a principal component analysis of different household asset variables for each year (e.g., whether the house has walls made of concrete, a TV, a fridge) and use the first component as an index of household wealth – see Filmer and Pritchett (2001) for details on the methodology and Rutstein and Johnson (2004) for a commonly used application. We then allocate households to quintiles of the index in order to mitigate sampling error and add dummies for each quintile to the term C in equation (1).

Data on expenditure shares and prices (unit values) are drawn from different waves (from 1984 until 2012) of the Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH), the Mexican household-level survey on expenditure by detailed product categories. State expenditures in 1984 and hence before the beginning of the sample period are used to allocate food imports across states and construct the unhealthy share of imports as shown in equation (2). Thirteen waves of the ENIGH between 1989 and 2012 form the data backbone of the

[15]However, the 1999 wave of the ENN survey does not include four states.

demand equation in (4).

Mexican imports from the U.S. and other trade variables (in current US$) starting from 1989 (the values matched with the 1988 anthropometric survey) are obtained from UN COMTRADE. After harmonizing the product classification of the trade (SITC, revision 3) and expenditure data, we obtain a sample of 168 food products with a full time series of expenditures and imports.

To identify healthy and unhealthy products, we follow Handbury et al. (2015) and Volpe et al. (2013) and aggregate food products in the 52 groups used by the Quarterly Food-at-Home Price Database (QFAHDP). We classify these 52 products in healthful/unhealthful following USDA Dietary Guidelines for Americans (DGA, 2010; also in Volpe et al., 2013). Healthy foods are those recommended for increased consumption (e.g., "dark green vegetables"), whereas unhealthy foods are those recommended for limited consumption (e.g., "refined flour and mixes"). We assign the food items from the trade and expenditure data to the 52 USDA food categories on the basis of their text description, allowing us to estimate the share of unhealthy imports (and expenditure) at the state level using the USDA guidelines.

4 Results

Before discussing the results of the econometric analysis, we provide some descriptive evidence on the evolution of obesity and U.S. food exports to Mexico in our sample, which goes from 1988 to 2012, with data on obesity available in four periods. The objective is to better appreciate the key trends and inform the empirical strategy outlined in Section 2.

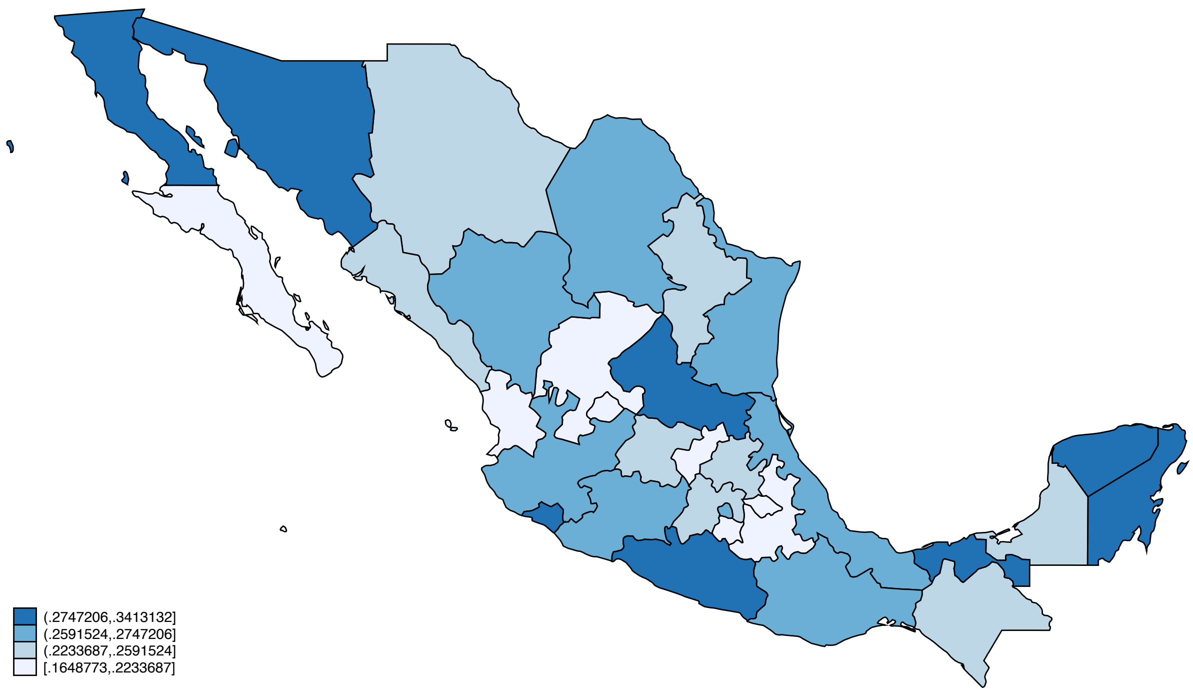
4.1 Descriptive evidence

Descriptive analysis of the anthropometric data strongly confirms the spectacular rise in obesity that has been documented in other work on Mexico (see e.g. Rtveladze et al., 2014). Average BMI in our baseline sample of women aged between 20 and 49 is 18 percent higher in 2012 than in 1988, and the rate of obesity prevalence dramatically increased during the same period, going from 10 to 35 percent.[16] The share of women who are overweight or obese (i.e. with a BMI of at least 25) doubled going from 36 to 73 percent.

[16] Using an alternative measure of obesity based on the waist-to-height (WTH) ratio (women with a WTH over 0.58 are normally classified as obese), we find that obesity prevalence almost doubles between 1999 and 2012, reaching 60 percent of the sample - we do not have have data on waist in 1988.

Obesity among adult women increased everywhere in Mexico, although the rate of change varies across Mexican states, as shown in Figure 1. The state of Nayarit experienced the smallest increase (16 percentage points), while the biggest increase (34 percentage points) is recorded in Tabasco. The empirical strategy exploits state variation in exposure to unhealthy foods coming from the U.S. to explain the observed changes in obesity.

Figure 1: Changes in obesity prevalence across Mexican states between 1988 and 2012

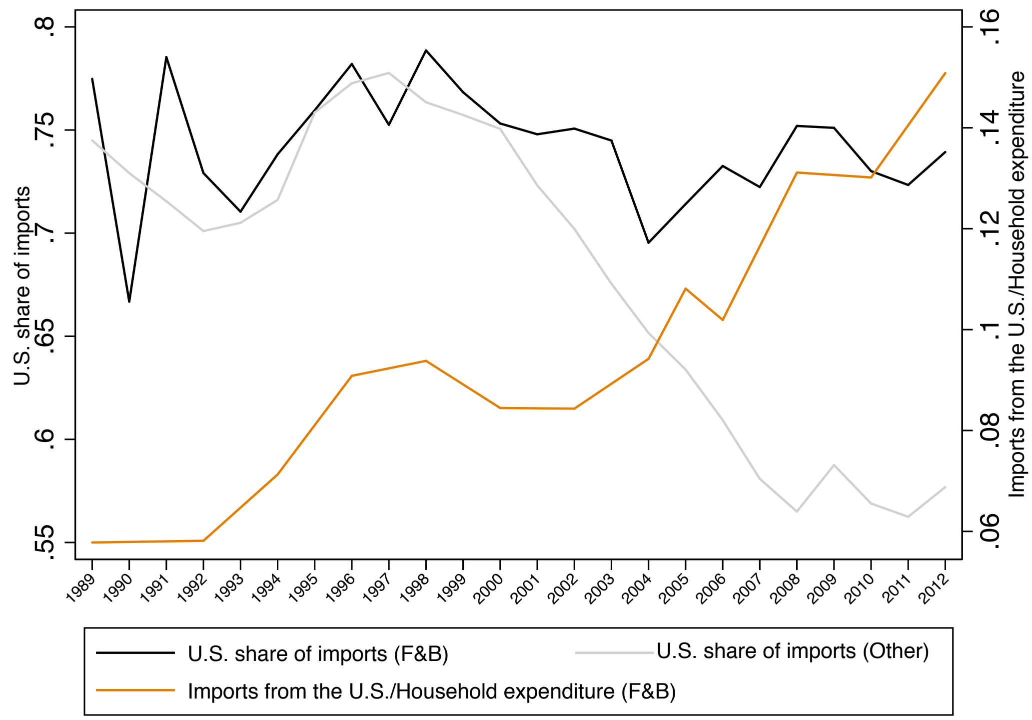


Notes: Differences in obesity rates by state between 2012 and 1988. Individual survey weights are used in calculating obesity rates by state.

Trade flows between Mexico and the U.S. have also been rising steadily since the late 1980's, following economic liberalisation policies adopted by the Mexican government and the formation of NAFTA in 1994. This trade relationship is particularly strong in the food and beverage (F&B) sector. As shown in Figure 2, the U.S. are by far the largest source of Mexican imports of F&B, while their importance in Mexican imports of other manufacturing goods has declined in 2000s mainly because of heightened competition from emerging economies such as China (Mendez, 2015). Figure 2 also shows that the share of imports from the U.S in total Mexican household expenditure in F&B ('import penetration') more than doubled between 1989 and 2012, going from 6 to 15 percent.[17]

[17]These shares are almost halved if we consider only imports classified for final consumption (see section 4). Under this alternative definition, import penetration in household food expenditure went from 2.8 to 8 percent between 1989 and 2012.

Figure 2: U.S. share of Mexican imports and U.S. import penetration in Mexican food expenditure

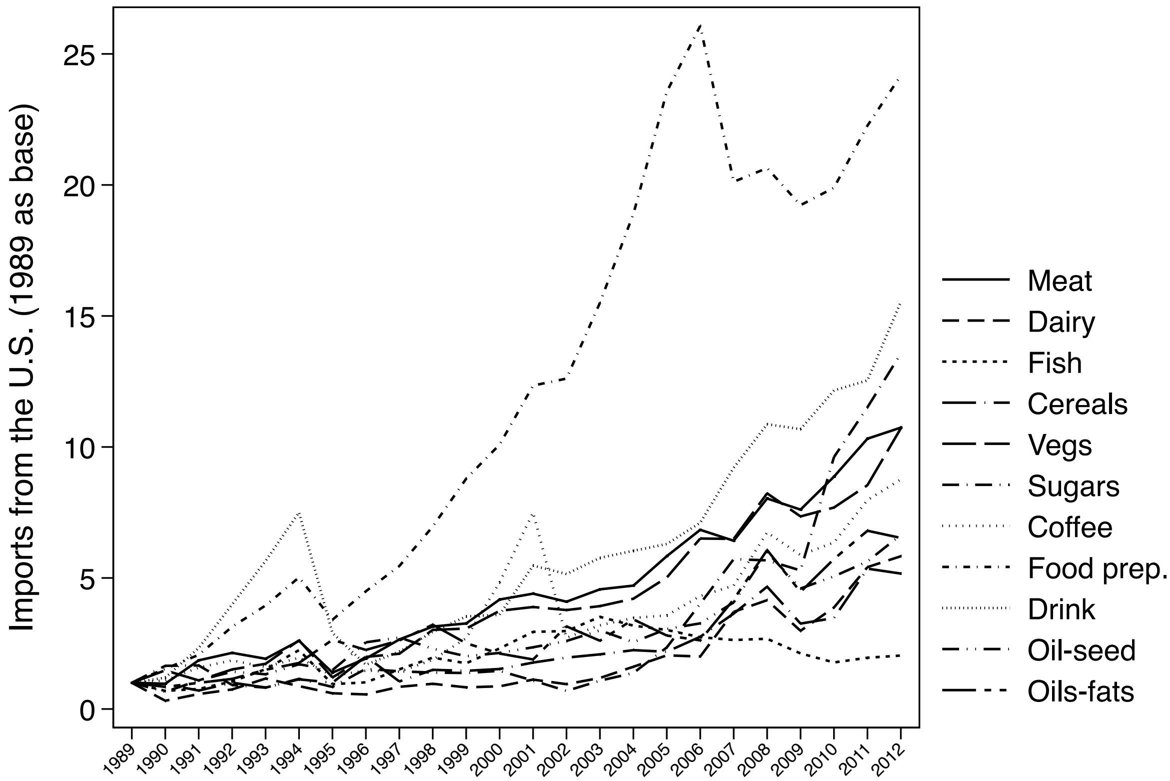


Notes: Mexican food imports are those under the one-digit categories 0 and 4, and the two-digit categories 11 and 22 of the SITC Revision 3 classification. Imports values in current US$ are converted in Mexican pesos using annual exchange rates. Mexican household food expenditures are imputed from the ENIGH surveys using the households' sampling weights.

To explore the composition of U.S. food exports, Figure 3 plots U.S. exports to Mexico in the main F&B categories over time, relative to their values in 1989. Products that are generally associated with an unhealthy and obese-prone diet – and also typical in countries undergoing a nutrition transition – have been driving the overall increase of Mexican imports from the U.S.. Imports of "Food preparations" (including preparations of fats, sauces, soups, and homogenised foods) had the highest relative increase among all food categories, going from 35.5 to 859 US$ millions.[18] "Drinks" and "sugars" are the second and third categories when it comes to rate of change in imports from the U.S., recording a fifteen-fold and a fourteen-fold increase, respectively. While purely illustrative, these patterns suggest that the increase of Mexican imports from the U.S., being concentrated in generally 'bad' foods, might have contributed to the obesity epidemic.

[18]Within the chapter "09 – Miscellaneous edible products and preparations", the product category "09893 – Food preparations for infant use" recorded the largest increase in imports relative to the base level in 1989 (a ninety-three-fold increase). "09899 – Miscellaneous food preparations" experienced the second largest relative increase (and the largest absolute one), followed by "09843 – Mustard preparations".

Figure 3: Mexican imports of F&B from the U.S. over time



Notes: Food categories are defined following the SITC Rev. 3 product classification: 'Meat' is category "01 – Meat and meat preparations"; 'Dairy' is category "02 – Dairy products and birds' eggs"; 'Fish' is category "03 – Fish (not marine mammals), crustaceans, molluscs and aquatic invertebrates, and preparations thereof"; 'Cereals' is category "04 – Cereals and cereal preparations"; 'Vegs' is category "05 – Vegetables and fruit"; 'Sugars' is category "06 – Sugars, sugar preparations and honey"; 'Coffee' is category "07 – Coffee, tea, cocoa, spices, and manufactures thereof"; 'Food prep.' is category "09 – Miscellaneous edible products and preparations"; 'Drink' is category "11 – Beverages"; 'Oil-seed' is category "22 – Oil-seeds and oleaginous fruits"; and 'Oils-fats' is category "4 – Animal and vegetable oils, fats and waxes".

The bias of U.S. exports to Mexico towards unhealthy foods is confirmed after we classify the SITC products according to the 'healthy' and 'unhealthy' categories of the USDA. As shown in Figure 4, imports of unhealthy foods from the U.S. increased faster than imports of healthy ones, especially starting from the mid-1990's.

Figure 4: Unhealthy and healthy Mexican F&B imports from the U.S.

To measure the healthfulness of food imports from the U.S., we thus take the unhealthy share of total food imports. In the rest of the analysis, this unhealthy share is estimated at the state level (see equation (2)) and used as the key explanatory variable to assess the impact of unhealthy food imports on obesity.

4.2 Effects of unhealthy food imports on obesity

(a) Baseline results

Our benchmark specification estimates the effect of the unhealthy share of food imports from the U.S. – computed using pre-determined expenditure shares at the product level – on the probability of being obese among a sample of adult women. The regressions span four periods (1988, 1999, 2006, 2012), each corresponding to a wave of the Mexican survey with anthropometric information.

The results reported in Table 1 point to a strong and positive relationship between exposure to unhealthy foods coming from the U.S. and obesity. In columns (1) and (2) we include the unhealthy share of food imports as the only state-level determinant of obesity, after controlling for state dummies, year dummies and state-specific linear time trends. The estimates in column (1) with the full sample suggest that a one standard deviation increase in the share of unhealthy food imports (equal to 14 percentage points) is associated with a 3.5 percentage point increase in the likelihood of being obese. Adding the set of individual and household controls from the health surveys makes the sample 40 percent smaller in column (2). The estimated effect of the unhealthy share of imports increases slightly – the same 14 percentage point increase in the unhealthy share of imports (equal to one standard deviation also in the smaller sample – see Table A1) would lead to a 4.6 percentage point higher risk of being obese (or 18 percent of the average sample probability of being obese).[19]

The signs and significance of the estimated coefficients on the controls at the individual level are in line with the existing evidence on the socioeconomic determinants of obesity (Baum and Ruhm, 2009). Having completed secondary or *a fortiori* college education (only 1.3 percent of the women in the sample) is associated with a significantly lower probability of being obese. Obesity is less prevalent among women who are employed in agriculture than among unemployed women, most likely because of the more intense physical activities involved (see Griffith et al. (2016) for evidence on a similar mechanism).[20] Students and women employed in sectors other than agriculture tend to be as obese as unemployed ones. Being disabled or retired as well as being affected by chronic diseases (e.g. diabetes, cardiovascular disease) are strong predictors of obesity, while speaking indigenous languages and having a leading role in the household are significantly correlated with lower obesity risk. The estimated coefficients on the four top quintile indicators of the distribution of household wealth suggest that, as expected, obesity increases with income (Dinsa et al., 2012; Prentice, 2006). They also reveal some (rather weak) non-linearity along the wealth distribution, with the obesity risk being highest in the second and third quintiles, and decreasing (but still significantly higher than for women living the poorest households) in the top quintile.

The effect of exposure to unhealthy imports remain unchanged after controlling for state-level time-varying characteristics in columns (3) to (6) of Table 1. Controlling for the unhealthy share of total food expenditure in column (3) does not affect the coefficient

[19]The difference in the coefficient of *Unhealthyimp* between columns (1) and the other columns in Table 1 is due to sample selection rather than the addition of control variables at the individual level. In Table A3 reported in the Appendix, we include observations with missing values and add dummies for missing values of each variable in of the control set C. The coefficient on the unhealthy share of imports is positive and similar in size to the one in the specification without controls (column (1)).

[20] We also estimate a specification adding a dummy for weekly moderate physical activity, which is however available only in 2006 and 2012 (we add an indicator for missing values in 1988 and 1999). The coefficient associated with the dummy is negative (indicating that being physically active lowers the risk of obesity) but insignificant, and the effect of the unhealthy share of imports is unchanged.

on the import variable, suggesting that trade exposure is not simply capturing the effect of broader shifts in expenditure patterns (correlation between the two unhealthy share variables is 0.48 – see Table A2). Including instead the relative price of unhealthy foods (in logs) also has no effect on the estimated impact of unhealthy food imports on the risk of being obese. The relative price variable has an expected negative but insignificant coefficient, suggesting that price effects might well be present at a much finer product level than what is available in the household expenditure surveys. Furthermore, the unit values that are reported in the expenditure surveys can incorporate quality effects (see also Faber, 2014), which have ambiguous implications for nutrition and obesity. In column (4), we include the states' GDP per capita to control for average income effects, and the estimated coefficient on the unhealthy share of imports is again unaltered.[21] Controlling for other state-level and time-varying confounders in column (6) gives the baseline specification of equation (1). The results point again to a positive and sizeable effect of unhealthy food imports on the risk of being obese.[22]

[21]State GDP per capita partly controls for the possibility that our measure of 'estimated' import exposure at the state level correlates with the structure of local food production. By allocating imports of food products across states according to their share in national expenditures in 1984, we might be giving more imports of, say, unhealthy foods to states that both consume and produce locally more of these foods – both in 1984 and in all subsequent years of our sample. If higher concentration of production in unhealthy foods is associated with greater income per capita, the effect of our imputed unhealthy share of imports might be mediated by GDP per capita.

[22]Results (available upon request) tend in the same direction when we replace the unhealthy shares of imports and expenditure with the ratio (in logs) of import penetration ratios in unhealthy to healthy foods (see also footnote n.7). Obesity risk increases significantly with the importance of unhealthy U.S. imports (relative to healthy ones) in household expenditure (coef., 0.067; std. err., 0.0272).

Table 1: Unhealthy share of imports and obesity

	(1)	(2)	(3)	(4)	(5)	(6)
State-level variables						
Unhealthy share of imports	0.252**	0.330**	0.328**	0.329**	0.324**	0.331**
	(0.107)	(0.146)	(0.147)	(0.137)	(0.136)	(0.132)
Unhealthy share of expenditure			0.215			0.182
			(0.342)			(0.387)
Ln(relative price of unhealthy foods)				0.00195		-0.00325
				(0.0512)		(0.0542)
Ln(GDP per capita)					0.0172	0.0193
					(0.0804)	(0.0860)
Ln(FDI/GDP)						0.000633
						(0.00583)
Migrant share						-0.669
						(1.579)
Individual controls						
Age		0.0132***	0.0131***	0.0132***	0.0132***	0.0131***
		(0.00260)	(0.00260)	(0.00259)	(0.00260)	(0.00259)
Age^2		-6.83e-05*	-6.82e-05*	-6.83e-05*	-6.83e-05*	-6.79e-05*
		(3.45e-05)	(3.45e-05)	(3.44e-05)	(3.46e-05)	(3.44e-05)
Prim. educ.		0.00924	0.00922	0.00925	0.00924	0.00922
		(0.00997)	(0.00997)	(0.00994)	(0.00997)	(0.00994)
Sec. educ.		-0.0408***	-0.0408***	-0.0408***	-0.0408***	-0.0408***
		(0.0122)	(0.0122)	(0.0122)	(0.0122)	(0.0122)
Ter. educ.		-0.170***	-0.170***	-0.170***	-0.170***	-0.170***
		(0.0185)	(0.0185)	(0.0185)	(0.0185)	(0.0183)
Retail		0.00736	0.00732	0.00736	0.00737	0.00735
		(0.00625)	(0.00624)	(0.00625)	(0.00626)	(0.00631)
Agri.		-0.0515***	-0.0518***	-0.0515***	-0.0515***	-0.0517***
		(0.0177)	(0.0179)	(0.0177)	(0.0177)	(0.0179)
Oth. sectors		-0.00706	-0.00722	-0.00706	-0.00701	-0.00710
		(0.0129)	(0.0128)	(0.0129)	(0.0131)	(0.0129)
Student		0.00730	0.00707	0.00730	0.00733	0.00715
		(0.0154)	(0.0155)	(0.0154)	(0.0154)	(0.0155)
Disabled/retired		0.0479**	0.0482**	0.0479**	0.0480**	0.0482**
		(0.0229)	(0.0228)	(0.0226)	(0.0229)	(0.0226)
Speak indigenous		-0.0384***	-0.0384***	-0.0384***	-0.0385***	-0.0384***
		(0.0133)	(0.0134)	(0.0133)	(0.0133)	(0.0133)
Chronic		0.0287***	0.0286***	0.0287***	0.0286***	0.0287***
		(0.00766)	(0.00762)	(0.00765)	(0.00763)	(0.00761)
HH head		-0.0221**	-0.0221**	-0.0221**	-0.0221**	-0.0221**
		(0.00863)	(0.00862)	(0.00859)	(0.00865)	(0.00859)
Household wealth						
2nd quintile		0.0537***	0.0535***	0.0537***	0.0537***	0.0535***
		(0.00730)	(0.00733)	(0.00736)	(0.00729)	(0.00731)
3rd quintile		0.0555***	0.0553***	0.0555***	0.0555***	0.0552***
		(0.0117)	(0.0116)	(0.0117)	(0.0117)	(0.0117)
4th quintile		0.0485***	0.0483***	0.0485***	0.0485***	0.0481***
		(0.00946)	(0.00951)	(0.00954)	(0.00947)	(0.00951)
5th quintile		0.0280**	0.0278**	0.0280**	0.0280**	0.0276**
		(0.0134)	(0.0134)	(0.0134)	(0.0133)	(0.0133)
Obs	56,714	35,971	35,971	35,971	35,971	35,971
R^2	0.068	0.121	0.121	0.121	0.121	0.121

Notes: All regressions include state dummies, state-specific linear trends, and year dummies. The state share of national population in 1990 is used as weight. Standard errors clustered at the state level are in parenthesis. Significant at: *10%, **5%, ***1% level.

(b) Robustness checks and extensions

The baseline results shown in Table 1 suggest a robust and quantitatively important effect of exposure to unhealthy food imports on obesity rates in Mexico. In the following, we further investigate the relationship between U.S. food exports to Mexico and obesity by assessing the robustness of our results to alternative definitions of trade exposure, to the inclusion of adult men in the sample, and to other BMI cutoffs.

Table 2 presents the results of different checks on the definition of the trade exposure variable. We test whether the estimated effect is specific to unhealthy foods as classified by USDA (see section 2). Total food imports from the U.S. allocated to states (i.e., the denominator of the *Unhealthyimp* variable in equation (1) and the M variable in equation 2, in logs) have no significant impact on obesity, as shown by columns (1) and (2) of Table 2. This is turn suggests that imports classified as healthy would offset the pro-obesity effect of unhealthy imports.[23]

In columns (3) and (4), we investigate whether the documented effect of unhealthy food imports is purely capturing the influence of exposure to imports from the U.S.. We thus add imputed apparel imports (per capita – see the formula in equation 2) as a tradable product that has no direct influence on diet and nutrition. The positive and significant coefficient in columns (3) suggests that greater exposure to imports from the U.S. is associated with obesity, even if the imported products are not expected to shape directly diets. This effect is however spurious as it is not robust to the inclusion of other state-level characteristics in column (4) – coefficients not shown. Importantly, the positive coefficient on the *Unhealthyimp* variable remains unchanged when controlling for imports of apparel from the U.S..

In columns (5) and (6), we amend the set of SITC trade food products in order to consider only food imports for final demand – and exclude imports for further industrial use that should not affect directly nutrition and hence obesity. We use the Broad Economic Categories (BEC) classification for trade flows (matched with the more detailed SITC classification) to identify SITC food products that are "mainly for household consumption" (BEC categories 112 and 122) and "other consumer goods" (BEC category 6). The matching between these

[23] We also estimate our baseline specification using exposure to imports (per capita) of soft drinks, which can be easily identified in the trade data (product category "11102 Waters (including mineral waters and aerated waters) containing added sugar or other sweetening matter or flavoured, and other non-alcoholic beverages, n.e.s.") and in the expenditure data (expenditure on "soft drinks"). In results available upon request, we find a positive and significant association between imputed state imports of soft drinks from the U.S. and obesity risk, which however is not robust when soft drink imports is taken as a share of total (including other unhealthy) imports.

BEC final demand categories and the SITC products is however not unique – some SITC products have multiple BEC categories –, and we thus take this exercise as a robustness test of the baseline results obtained using all SITC food products that are matched with the Mexican expenditure surveys.[24] The revised unhealthy share of imports correlates strongly with the baseline measure (correlation coefficient being equal to 0.95) and using it in columns (5) and (6) does not alter substantially the baseline empirical findings.

The trade exposure variables used so far focuses on U.S. exports because of the rising importance of U.S. (unhealthy) foods in Mexican diets (see Figures 2 and 3). In columns (7) and (8) of Table 2 we assess the influence of exposure to unhealthy imports coming from other countries than the U.S. (Rest of the World or RoW). Results corroborate the descriptive evidence suggesting a strong specialization of U.S. food exports towards varieties of unhealthy foods, also relative to food exports of other countries. Exposure to unhealthy food imports from other countries has a positive but insignificant effect on obesity risk, while the coefficient on the unhealthy share of imports (from the U.S.) remains positive and significant.

As a further check on the relevant definition of trade exposure, in columns (9) and (10) of Table 2 we assess the influence of exposure to Mexican exports of unhealthy foods to the U.S., as dictated by pre-determined expenditure specialization – we replace the import flow variable M in equation 2 with export values to the U.S.. Mexican exports to the U.S. can correlate with Mexican imports from the U.S. in the presence of intra-product trade related, for instance, to the importance of the export processing (*maquiladora*) food sector (Utar and Ruiz, 2013). Results however show that the risk of obesity among Mexican women is lower in states that are more exposed to Mexican exports to the U.S., and exposure to unhealthy imports is consistently associated with a higher obesity prevalence.[25] If anything, food trade between Mexico and the U.S. over the healthy and unhealthy macro categories seems to follow comparative advantage – Mexican exports are relatively specialized in healthy foods as suggested by the lower average unhealthy share of exports than average unhealthy share of imports (see Table A1).

[24]SITC products are classified for final demand if more than half of the entries fall into the BEC categories for final use.

[25]Similar results are obtained if we use exposure to Mexican food exports to all countries rather than exports to the U.S. only.

Table 2: Unhealthy share of imports and obesity - Alternative trade exposures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Total US food imports		Apparel imports		Final use imports		Imports from RoW		Mex. exports	
Unhealthy share of imports		0.319**		0.331**	0.273*	0.270**		0.281*		0.258*
		(0.134)		(0.132)	(0.143)	(0.129)		(0.161)		(0.132)
Ln(food imports)	0.0599	0.0309								
	(0.0473)	(0.0713)								
Ln(apparel imports)			0.0734***	0.0286						
			(0.00614)	(0.103)						
Unhealthy share of imp. from RoW							0.185	0.0712		
							(0.121)	(0.117)		
Unhealthy share of Mex. exp. to U.S.									-0.494*	-0.274
									(0.254)	(0.218)
Obs	35,971	35,971	35,971	35,971	35,971	35,971	35,971	35,971	35,971	35,971
R^2	0.121	0.121	0.120	0.121	0.121	0.121	0.121	0.121	0.121	0.121

Notes: If not explicitly stated, imports are from the U.S.. All regressions include individual and household level controls in columns (2) to (6) of Table 1, state dummies, state-specific linear trends, and year dummies. Even-numbered columns include state-level controls in columns (6) of Table 1. The state share of national population in 1990 is used as weight. Columns (5) and (6) use trade data only on food products classified for final consumption according to the BEC classification. Standard errors clustered at the state level are in parenthesis. Significant at: *10%, **5%, ***1% level.

Table A4 in the Appendix shows the results of estimating the baseline empirical specification including adult men in the sample (columns (1) to (3)), and using an indicator for being overweight (i.e., having a BMI above 25; columns (4) to (6)). The expansion of the sample to men and women between 20 and 60 years old is relevant only to the 2006 and 2012 surveys. The estimated effects of the unhealthy share of food imports are slightly lower than those in the baseline sample reported in Table 1. A one standard deviation increase in exposure to unhealthy imports is now associated with a rise in obesity risk equivalent to 10 percent of the average obesity prevalence in the sample. This evidence suggests that exposure to unhealthy imports in Mexico has had particularly strong effects on obesity for the female population and before 2006.

Results in columns (4) to (6) indicate that exposure to unhealthy imports increases significantly the risk of being overweight (which encompasses obesity), with the effect being quantitatively less important than the one on obesity and less affected by the reduction in the sample size when individual controls are included in columns (5) and (6). The estimates suggest that a one standard deviation increase in the share of unhealthy imports is associated with a rise in the likelihood of being overweight by 5 percentage points or 9 percent of the average (while the effect on obesity amounts to 18 percent of the average obesity risk).

To further assess whether the BMI thresholds for obesity and overweight are meaningful in identifying the effect of unhealthy imports, we also estimate the baseline specification (column (6) of Table 1) with BMI as dependent variable and at different quantiles of the BMI distribution. Figure A1 in the Appendix plots the estimated coefficients of these quantile regressions together with the OLS coefficient from the BMI regression. The positive and significant OLS coefficient suggests that higher imports of unhealthy foods from the U.S.

increase significantly average BMI. The coefficient rises with BMI and becomes higher than the OLS estimate for BMI levels above the sample median, which is just above the overweight threshold of 25, and it is highest for levels that are just above the obesity threshold of 30 (corresponding to BMI levels above the third quartile of the sample distribution). This piece of evidence supports the idea that the effect of unhealthy food imports is particularly strong for overweight and obesity levels of BMI, validating the linear probability specification.

Finally, we check the robustness of our results to the exclusion of individual Mexican states. In Figure A2, we plot the coefficient on the *Unhealthyimp* variable from our baseline specification (see column (6) of Table 1 and equation (1)) but dropping one of the 32 states state at a time. The estimated coefficient remains stable around the one obtained with the full sample and decreases to 0.19 and 0.17 when excluding the states of Jalisco or Mexico, whereas it increases to 0.45 when dropping the state of Sinaloa. The coefficient is nonetheless statistically indistinguishable from the baseline one, indicating that the main findings are not entirely driven by the influence of single states.

(c) Identification issues and IV estimates

A causal interpretation of the pro-obesity effect of unhealthy foods coming from the U.S. requires that changes in U.S. food exports are not endogenous to Mexican food demand over healthy and unhealthy foods. The objective is thus to isolate variation in U.S. food exports that is due to supply-side factors and not to food demand and other unobservable patterns that relate to obesity prevalence in Mexico. To this end, we adopt the identification strategy proposed by Autor et al. (2013) to study the local labour market effects in the U.S. of import competition from China.[26] As explained in section 2, we estimate a specification in differences between 1988 and 2012 (see equation (3)) relating long-term changes in obesity prevalence among adult women with changes in imports of unhealthy foods from the U.S. (relative to changes in total food imports from the U.S.). The 32 Mexican states are the most disaggregated spatial units that are representative in the health and expenditure surveys and thus are the units of analysis. The small sample size makes statistical inference problematic and hence leads us to interpret with caution the evidence from these regressions.

[26] An alternative strategy is to exploit variation in trade policy across products and over time (see, e.g., Topalova (2010); and Pierce and Schott (2016) for an application to health outcomes). In our setting, import tariffs under NAFTA went down to zero for most food products by 2012. Average tariff protection before NAFTA was not significantly different across healthy and unhealthy foods (15% for healthy foods, and 14.25% for unhealthy foods), suggesting that NAFTA tariff liberalisation cannot explain the relative increase in U.S. exports of unhealthy foods to Mexico shown in Figure 4. The similar tariff reductions do not allow us to econometrically disentangle the effect of tariff-induced liberalisation on obesity.

Table 3 reports the results of the cross-state regressions in long differences. The OLS estimates in columns (1) – which can be interpreted as a 'reduced-form' specification (see section 2) – show a positive association between changes in obesity prevalence and relative changes in unhealthy imports from the U.S.. The coefficient is lower and less precisely estimated when we control for initial state-level conditions (including distance between the Mexican state and the border with the U.S.) in column (2). Column (3) and (4) report the IV estimates, using as excluded instrument relative changes in the U.S. exports of unhealthy foods to other upper middle-income countries (UMIC). The first-stage results show that the instrument correlates strongly with the endogenous regressor, and the IV coefficient on the unhealthy import variable in the second stage is virtually identical to the OLS one. The estimates suggest that a 13 percentage-point higher relative increase in unhealthy imports from the U.S. (one standard deviation in the cross-state sample) would add 1.3 percentage points to the increase in obesity prevalence (25% in our sample) recorded between 1988 and 2012. The effect, although imprecisely estimated, is quantitatively non-negligible and equal to one fourth of the standard deviation in changes in obesity rates across states.

Cross-country correlation between changes in relative demand for unhealthy foods in Mexico and in UMIC can threaten causal identification if variation in U.S. food exports to other countries are also driven by import demand. To control for this confounding factor, we use residuals from a gravity regression of the difference (in logs) between U.S. exports and Mexican exports to UMIC on product and destination dummies. The residual variation should thus come from the evolving patterns of U.S. comparative advantage relative to Mexico across food products and over time. As in Autor et al. (2013), we thus replace changes in Mexican food imports from the U.S. with the product of import values in the base year (1989) and the changes in the gravity residuals between 1989 and 2012 to construct changes in relative exposure to U.S. unhealthy foods. Using this derived measure in columns (5) and (6) of Table 3 we obtain a positive – albeit lower and less precisely estimated than the IV one in column (4) – effect of exposure to relative changes in U.S. comparative advantage in unhealthy foods on obesity prevalence.[27]

Overall, the estimates from a specification in long differences using two different identification strategies corroborate a causal interpretation of the pro-obesity effect of greater exposure to unhealthy imports in Mexico. While the small sample size constrains inference, the results from empirical strategies that exploit plausibly exogenous variation in U.S. food

[27] Autor et al. (2013) also find that the effect of the exposure variable based on gravity residuals is quantitatively lower than the one of the exposure to import variable. As they argue, the two measures are not directly comparable – the measure based on gravity residuals is closer to net U.S. food exports to Mexico.

exports to Mexico confirm the OLS-based evidence.[28]

Table 3: Changes in unhealthy imports and the rise of obesity (2012-1988 differences)

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS		IV		Gravity residuals (OLS)	
Δ Unhealthy share of imports	0.131***	0.0919	0.129***	0.0964	0.0727*	0.0480
	(0.0357)	(0.0686)	(0.0352)	(0.0705)	(0.0381)	(0.0447)
Unhealthy share of expenditure		0.241*		0.236		0.315***
		(0.139)		(0.141)		(0.104)
Ln(relative price of unhealthy foods)		0.00917		0.00863		0.0183
		(0.0370)		(0.0365)		(0.0384)
Ln(GDP per capita)		-0.0152		-0.0153		-0.0144
		(0.0130)		(0.0130)		(0.0126)
Ln(FDI/GDP)		0.00220		0.00217		0.00181
		(0.00573)		(0.00579)		(0.00574)
Migrant share		-0.318		-0.323		-0.316
		(0.274)		(0.281)		(0.275)
Ln(dist)		-0.00380		-0.00377		-0.00519
		(0.00647)		(0.00647)		(0.00675)
First-stage results (dep. variable= Δ Unhealthy share of imports)						
Δ Unhealthy share of U.S. exports to UMIC			0.782***	0.756***		
			(0.0411)	(0.0601)		
F-stat excluded instr.			362.07	158.29		
Obs	32	32	32	32	32	32
R^2	0.235	0.320	0.235	0.320	0.108	0.296

Notes: "Δ Unhealthy share of imports" denotes the changes in unhealthy food imports from the U.S. relative to changes in food imports from the U.S. (both imputed using 1984 state expenditures). The excluded instrument has an equivalent definition. The state share of national population in 1990 is used as weight. Robust standard errors are in parenthesis. Significant at: *10%, **5%, ***1% level.

4.3 Unhealthy food imports and household demand for unhealthy foods

The evidence presented so far shows that the coefficient on the unhealthy food imports variable does not change when controlling for relative prices at the state level and GDP per capita, suggesting that price and income changes do not channel the pro-obesity effect of exposure to unhealthy imports. While these aggregate measures might not be ideal in capturing demand adjustments, other mechanisms may explain our main findings. As mentioned above, exposure to trade in foods may significantly alter tastes for products of

[28]To control more directly for reverse causality going from obesity prevalence to changes in imports of unhealthy foods, we conducted an unconfoundedness test constructing an index of obesity predictors using the data from the first health survey in 1988. We regressed our obesity indicator on our main set of covariates at the individual and household levels and used the fitted values of this regression as an index of obesity determinants. We then regressed the share of unhealthy imports at the state level on this index of obesity determinants in 1988 and find no evidence of a significant relationship. The point-estimate is negative (coef., -0.0087; std.err., 0.0150), but non-precisely estimated. If anything the share of unhealthy imports is negatively correlated with obesity predictors suggesting that our estimate might provide a lower bound of the effect of exposure to unhealthy imports on obesity.

varying healthiness. To further disentangle these demand-based mechanisms, we estimate the household demand equation over healthy and unhealthy foods as specified in equation (4) and based on the empirical strategy of Atkin (2013).

Table 4 reports the estimates of the coefficient on the import share variable. The association between state exposure to food imports from the U.S. and household food expenditure is allowed to vary between healthy and unhealthy foods (relative to other, not classified foods). Going from column (1) to column (4) of Table 4, we add local prices, total food expenditure and other household characteristics to the regression equation.

The results are consistent with food consumption shifting towards less healthy foods, thus increasing obesity rates, in states with greater exposure to food imports from the U.S. The positive and significant difference between $\beta_{1,unh}$ and $\beta_{1,h}$ suggests that households spend a higher share of their food expenditure on unhealthy foods (relative to healthy ones) as their state's exposure to food imports from the U.S. increases. Importantly, price and real income adjustments do not drive the positive association between relative demand and exposure to imports of unhealthy foods. Controlling for within-state variation in local prices and real expenditure does not substantially alter the size of the difference between the β_1 coefficients. The estimated difference is unchanged also when we control for the influence of other state-level variables (GDP per capita, FDI to GDP ratio, and the migrant share of the state's population) in column (5) of Table 4.

Taken together, these results support the evidence from the baseline obesity regressions suggesting that price and income adjustments do not explain the pro-obesity effect of exposure to unhealthy imports. While including state-level imputed imports in a household demand equation weakens the causal interpretation of the estimates, the results indicate that the positive association between relative demand and exposure to imports of unhealthy foods comes from residual variation at the state-level rather than local adjustments in prices or real income. As in Atkin (2013), differences in tastes constitute a plausible source of residual variation in expenditure shares across states (and over time). Our findings thus bolster the idea that households living in states that became more exposed to unhealthy food imports developed also stronger preferences for these unhealthy foods (for given changes in prices and income). This shift in preferences towards unhealthy foods might well be behind the documented pro-obesity effect of unhealthy imports from the U.S..[29]

[29]Preferences for different types of foods might be correlated with preferences for physical activities – both affect obesity (see Bleich et al. (2008) for evidence on their relative importance). To explore this additional interpretation of our main findings, we regress an indicator for weekly physical activity, available only in 2006 and 2012 (see footnote n.20), on the unhealthy share of imports, controlling for individual and other state-level characteristics, state and year dummies. We find no significant effect of exposure to unhealthy imports on the likelihood of being physically active, suggesting that the taste channel is acting mainly

Table 4: Demand for healthy and unhealthy foods and imports

	(1)	(2)	(3)	(4)	(5)
$\beta_{1,unh} - \beta_{1,h}$	0.0544**	0.0580**	0.0516**	0.0513**	0.0608***
	(0.0238)	(0.0241)	(0.0233)	(0.0245)	(0.0219)
$\beta_{1,unh}$	0.0353	0.0297	0.0119	0.00910	0.0708*
	(0.0326)	(0.0333)	(0.0332)	(0.0354)	(0.0396)
$\beta_{1,h}$	-0.0192	-0.0283	-0.0397	-0.0422	0.00997
	(0.0274)	(0.0263)	(0.0270)	(0.0280)	(0.0334)
Prices	N	Y	Y	Y	Y
Real expenditure	N	N	Y	Y	Y
Socioeconomic vars.	N	N	N	Y	Y
State-level controls	N	N	N	N	Y
Obs	489,981	489,981	489,981	489,625	482,955
R^2	0.607	0.608	0.612	0.624	0.625

Notes: All regressions include state dummies, state-specific linear trends, and year dummies. Socioeconomic controls for the household head include age, age squared, and dummies for education and occupation (i.e. whether employed, employed with a salary, or entrepreneur). Controls for household composition include household size, household size squared, the number of kids, the number of females, and the number of adults older than 65. State-level controls include the variables ln(GDP per capita), ln(FDI/GDP), and Migrant share. Survey weights are used. Standard errors clustered at the state level are in parenthesis. Significant at: *10%, **5%, ***1% level.

4.4 Effects of unhealthy food imports on inequalities in obesity prevalence

The evidence found so far indicates that Mexican women are more likely to be obese if they live in a state with a high exposure to unhealthy food imports from the U.S. This effect of the local food environment can be mediated by individual characteristics that affect dietary behavior and can generate disparities in the risk of being obese. In this part of our empirical analysis, we thus investigate how the average effect of exposure to unhealthy food imports from the U.S. on obesity varies along socioeconomic characteristics such as education and income.

The baseline specification in (1) is augmented by adding interactions of the unhealthy imports variable with the relevant mediating variables. Table 5 reports the results of specifications including all state-level variables alone, where the effect of unhealthy food imports is allowed to vary along individual characteristics, and of other specifications with state-year dummies absorbing the 'level' effects of state-level variables.

We first examine the mediating role of education, which is found to have a strong effect on obesity in our sample (Table 1). We interact our unhealthy share variable with an indicator equal to one if the woman has 'high education' – i.e., she has completed secondary or tertiary

through the consumption of unhealthy (relative to healthy) foods.

education, where the two education levels are merged because only 1.3 percent of the women in our sample have obtained a college degree or higher. The estimated coefficient on the interaction term in column (1) is negative and significant, suggesting that the pro-obesity effect of unhealthy food imports is concentrated in the less educated segment of the sample.

Replacing the state-level variables with state-year dummies in column (2) permits us to assess the role of unhealthy imports in shaping disparities in obesity prevalence, controlling for the level effect of all aggregate determinants of obesity (e.g., changes in economic conditions, industry structure). The coefficient on the education interaction term is still negative and significant, denoting a strong impact of unhealthy food imports on inequalities in obesity between education groups. More educated women are less likely to be obese than less educated ones, and the difference in probabilities increases with exposure to unhealthy foods. To appreciate the importance of this effect, in Figure 5 we use the estimated coefficients from column (2) to plot the difference in the probability of being obese between a woman with low or no education (i.e., with at most completed primary education) and a woman with high education, against the unhealthy share of imports. The results imply that a highly educated woman is 5 percentage points less likely to be obese than a low educated one if they both live in a state with average exposure to unhealthy foods from the U.S. (an unhealthy share of imports equal to 0.53). If the unhealthy share of imports becomes one standard deviation higher, the gap in the risk of obesity between the two education groups would become 3 percentage points larger – or 60 percent higher. In states with exposure to unhealthy imports below the first quintile, the difference in obesity risk between women from different education groups becomes insignificant.

In columns (3) to (6), we explore how the effect of unhealthy imports on obesity varies across household wealth, another important source of health inequalities (Deaton, 2003). The baseline results in Table 1 show that the risk of being obese is significantly lower for women living in households in the poorest quintile of the wealth distribution (the excluded category in the regressions). Furthermore, the differences in obesity risk along the income distribution are smallest between the poorest and the richest quintiles. We thus interact the unhealthy imports variable with an indicator for women in the poorest quintile (columns (3) and (4)) and then with an indicator for women in the richest quintile (columns (5) and (6)). The estimates on the interaction coefficients do not show any robust heterogeneity in the effect of unhealthy imports along the wealth distribution. The coefficient on the interaction with the poor household indicator is not significantly different from zero, and the negative coefficient on the interaction with the rich household indicator becomes lower and loses significance when controlling for the more robust interaction with the education variable (column (7)).

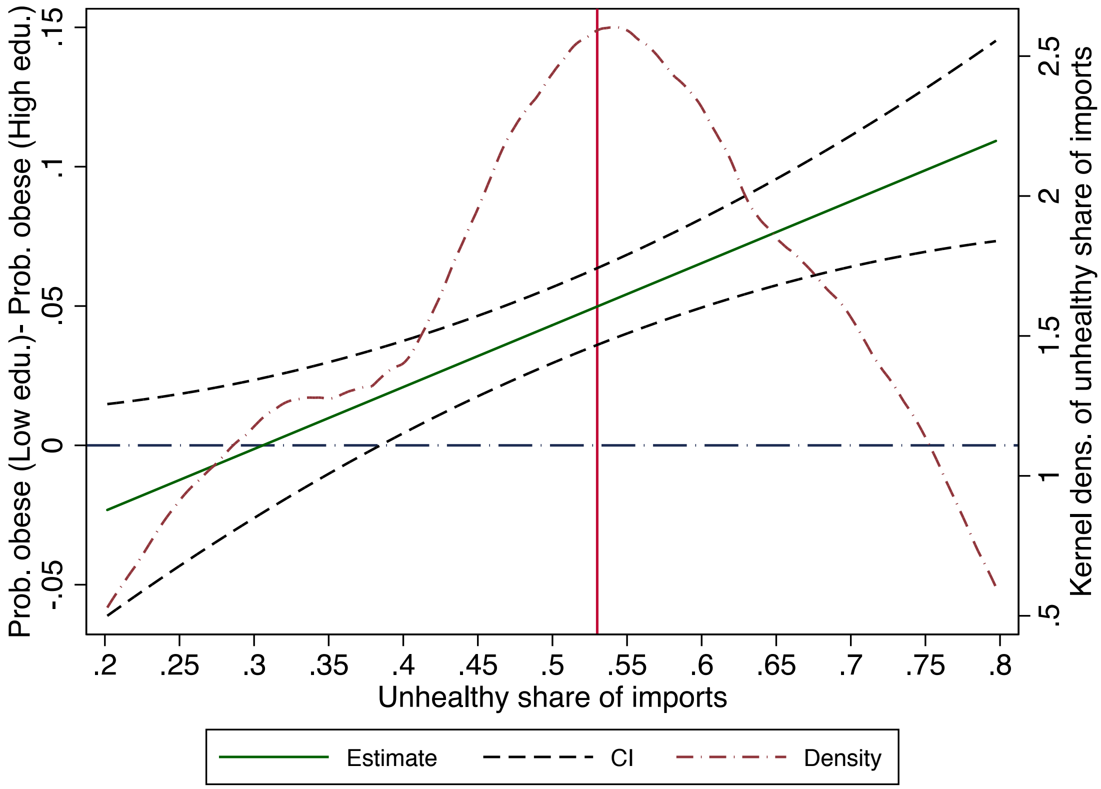
The empirical patterns point to a strong and important interaction between exposure to unhealthy food imports and education in determining the risk of being obese. The results are consistent with the well-known hypothesis that higher educated individuals are more efficient producers of health investment than less educated ones (e.g., because of peer pressure and of better information on the nutritional content of foods). Higher education leads to higher health investment because more educated individuals obtain a higher marginal return from any investment in health capital ("productive efficiency", Grossman, 1972; Michael and Becker, 1973) and because they are more efficient at selecting inputs into health investment ("allocative efficiency", Rosenzweig and Schultz, 1983). This educational gradient may be exacerbated in food environments where individuals are faced with more unhealthy food choices (Mani et al., 2013; Mullainathan, 2011; Dupas, 2011). The findings also suggest that women at different points of the wealth distribution are affected equally by greater availability of unhealthy food imports, once we control for their level of education. Nevertheless, these results should be interpreted with caution because of the various approximations and shortcomings of the procedure used to estimate household wealth in the absence of income data (Vyas and Kumaranayake, 2006).

Table 5: Unhealthy share of imports and health disparities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Unhealthy share of imports	0.418***		0.330**		0.368**		
	(0.140)		(0.138)		(0.135)		
High educ.	0.0611**	0.0680**	-0.0573***	-0.0563***	-0.0436***	-0.0425***	0.0785**
	(0.0278)	(0.0273)	(0.00769)	(0.00764)	(0.00732)	(0.00729)	(0.0291)
Unhealthy share of imports × High educ.	-0.211***	-0.222***					-0.228***
	(0.0534)	(0.0524)					(0.0573)
Poor HH			-0.0740***	-0.0905***			
			(0.0254)	(0.0249)			
Unhealthy share of imports × Poor HH			0.0461	0.0765			
			(0.0458)	(0.0459)			
Rich HH					0.0564	0.0665	0.0201
					(0.0393)	(0.0401)	(0.0433)
Unhealthy share of imports × Rich HH					-0.146**	-0.165**	-0.0788
					(0.0628)	(0.0645)	(0.0712)
Obs	35,971	35,971	35,971	35,971	35,971	35,971	35,971
R^2	0.121	0.123	0.119	0.122	0.118	0.120	0.121

Notes: All regressions include individual and household level controls in columns (2) to (6) of Table 1, but with $Higheduc.$ replacing the education dummies and $RichHH$ or $PoorHH$ replacing the household wealth dummies. Columns (1), (3), and (5) include state dummies, state-specific linear trends and year dummies. The state share of national population in 1990 is used as weight. Standard errors clustered at the state level are in parenthesis. Significant at: *10%, **5%, ***1% level.

Figure 5: Inequality between education groups in obesity risk and unhealthy food imports



Vertical line indicates the sample average of the unhealthy share of imports. Estimates from column (2) of Table 5 are used to generate the graph.

5 Concluding remarks

In this paper, we provide novel evidence on the effects of trade on obesity in Mexico. Combining household survey and trade data, we scrutinise the impact of greater exposure to food imports from the U.S. on the risk of being obese across Mexican states. We find that the risk of being obese among Mexican adult women increases significantly with the exposure to the unhealthy share of U.S. food exports to Mexico. The estimates from different identification strategies imply a robust and sizeable effect of unhealthy food imports on obesity. Our findings also suggest that exposure to imports of unhealthy foods from the U.S. is associated with demand patterns through shifts in preferences, rather than through price and income effects. Furthermore, the empirical evidence points to an important magnification effect of exposure to unhealthy food imports on existing inequalities in obesity rates across education groups. Overall, these results support the idea that health concerns should matter for the determination of trade policies, especially when it comes to unhealthy food products.

Our findings suggest the existence of possibly important negative health externalities associated with trade integration – especially when trading partners have a comparative advantage in relatively unhealthy foods. It remains unclear however how large these externalities are and their importance relative to the much heralded consumers' welfare gains from trade due to access to new and cheaper varieties. More quantitative work in this area is needed to fully assess the health and welfare implications of trade liberalisation.

References

Atkin, D., 2013. Trade, tastes, and nutrition in India. American Economic Review 103(5), 1629–1663.

Atkin, D., Donaldson, D., 2015. Who's Getting Globalized? The Size and Implications of Intra-national Trade Costs. Technical Report 21439. National Bureau of Economic Research.

Atkin, D., Faber, B., Gonzalez-Navarro, M., 2017. Retail Globalization and Household Welfare: Evidence from Mexico. Journal of Political Economy Forthcoming.

Autor, D.H., Dorn, D., Hanson, G.H., 2013. The China Syndrome: Local Labor Market Effects of Import Competition in the United States. American Economic Review 103(6), 2121–68.

Barlow, P., McKee, M., Basu, S., Stuckler, D., 2017. Impact of the North American Free Trade Agreement on high-fructose corn syrup supply in Canada: a natural experiment using synthetic control methods. Canadian Medical Association Journal 189(26), 881–887.

Baum, C.L., Ruhm, C.J., 2009. Age, socioeconomic status and obesity growth. Journal of Health Economics 28(3), 635–648.

Bleich, S.N., Cutler, D., Murray, C., Adams, A., 2008. Why Is the Developed World Obese? Annual Review of Public Health 29(1), 273–295.

Caliendo, L., Parro, F., 2015. Estimates of the Trade and Welfare Effects of NAFTA. The Review of Economic Studies 82(1), 1–44.

Cawley, J., 2015. An economy of scales: A selective review of obesity's economic causes, consequences, and solutions. Journal of Health Economics 43, 244–268.

Clark, S.E., Hawkes, C., Murphy, S.M., Hansen-Kuhn, K.A., Wallinga, D., 2012. Exporting obesity: US farm and trade policy and the transformation of the Mexican consumer food environment. International Journal of Occupational and Environmental Health 18(1), 53–64.

Colantone, I., Crinò, R., Ogliari, L., 2017. Import competition and mental distress: The hidden cost of globalization. Technical Report. mimeo.

Costa-Font, J., Mas, N., 2016. 'Globesity'? The effects of globalization on obesity and caloric intake. Food Policy 64, 121 – 132.

Courtemanche, C.J., Pinkston, J.C., Ruhm, C.J., Wehby, G.L., 2016. Can Changing Economic Factors Explain the Rise in Obesity? Southern Economic Journal .

Cravino, J., Levchenko, A.A., 2017. The Distributional Consequences of Large Devaluations. American Economic Review (648), 3477 – 3509.

Currie, J., DellaVigna, S., Moretti, E., Pathania, V., 2010. The effect of fast food restaurants on obesity and weight gain. American Economic Journal: Economic Policy 2(3), 32–63.

Deaton, A., 2003. Health, Inequality, and Economic Development. Journal of Economic Literature 41(1), 113–158.

Deaton, A., Muellbauer, J., 1980. An almost ideal demand system. American Economic Review 70(3), 312–326.

DGA, 2010. USDA Dietary Guidelines for Americans. Technical Report. Available at: https://health.gov/dietaryguidelines/dga2010/DietaryGuidelines2010.pdf.

Dharmasena, S., Capps, O., 2012. Intended and unintended consequences of a proposed national tax on sugar-sweetened beverages to combat the U.S. obesity problem. Health Economics 21(6), 669–694.

Dinsa, G., Goryakin, Y., Fumagalli, E., Suhrcke, M., 2012. Obesity and socioeconomic status in developing countries: A systematic review. Obesity Reviews 13(11), 1067–1079.

Dix-Carneiro, R., Kovak, B.K., 2017. Trade Liberalization and Regional Dynamics. American Economic Review 107(10), 2908–46.

Dragone, D., Ziebarth, N.R., 2017. Economic Development, Novelty Consumption, and Body Weight: Evidence from the East German Transition to Capitalism. Journal of Health Economics (51), 41–65.

Dupas, P., 2011. Health behavior in developing countries. Annu. Rev. Econ. 3(1), 425–449.

Faber, B., 2014. Trade Liberalization, the Price of Quality, and Inequality: Evidence from Mexican Store Prices. Technical Report. UC Berkeley.

Fajgelbaum, P.D., Khandelwal, A.K., 2016. Measuring the Unequal Gains from Trade. The Quarterly Journal of Economics .

Filmer, D., Pritchett, L.H., 2001. Estimating Wealth Effects without Expenditure Data-or Tears: An Application to Educational Enrollments in States of India. Demography 38(1), 115–132.

Griffith, R., Lluberas, R., Luhrmann, M., 2016. Gluttony and Sloth? Calories, Labor Market Activity and the Rise of Obesity. Journal of the European Economic Association 14(6), 1253–1286.

Grossman, M., 1972. On the concept of health capital and the demand for health. Journal of Political Economy 80(2), 223–255.

Guardian, 2015. The Global South has free trade to thank for its obesity and diabetes epidemic. Technical Report. Article by Ramon Vera Herrera, Monday 6th April 2015.

Handbury, J., Rahkovsky, I., Schnell, M., 2015. What drives nutritional disparities? Retail access and food purchases across the socioeconomic spectrum. Technical Report. National Bureau of Economic Research.

Hanson, G.H., 2007. Globalization, Labor Income, and Poverty in Mexico, in: Globalization and Poverty. National Bureau of Economic Research, Inc. NBER Chapters, pp. 417–456.

Hanson, G.H., 2010. Why Isn't Mexico Rich? Journal of Economic Literature 48(4), 987–1004.

Huffman, S.K., Rizov, M., 2010. The Rise of Obesity in Transition: Theory and Empirical Evidence from Russia. The Journal of Development Studies 46(3), 574–594.

Hummels, D., Munch, J., Xiang, C., 2016. No Pain, No Gain: The Effects of Exports on Effort, Injury, and Illness. Technical Report 22365. National Bureau of Economic Research.

Keats, S., Wiggins, S., 2014. Future diets: Implications for agriculture and food prices. Technical Report. Overseas Development Institute (ODI).

Lang, M., McManus, C., Schaur, G., 2016. The Effects of Import Competition on Health in the Local Economy. Technical Report. Mimeo.

Lopez, A.M., Loopstra, R., McKee, M., Stuckler, D., 2017. Is trade liberalisation a vector for the spread of sugar-sweetened beverages? A cross-national longitudinal analysis of 44 low- and middle-income countries. Social Science and Medicine 172, 21 – 27.

Mani, A., Mullainathan, S., Shafir, E., Zhao, J., 2013. Poverty impedes cognitive function. Science 341(6149), 976–980.

McManus, T.C., Schaur, G., 2016. The effects of import competition on worker health. Journal of International Economics 102, 160 – 172.

Mendez, O., 2015. The effect of chinese import competition on mexican local labor markets. The North American Journal of Economics and Finance 34(Suppl. C), 364 – 380.

Michael, R.T., Becker, G.S., 1973. On the new theory of consumer behavior. The Swedish Journal of Economics pp. 378–396.

Miljkovic, D., Shaik, S., Miranda, S., Barabanov, N., Liogier, A., 2015. Globalisation and Obesity. The World Economy 38(8), 1278–1294.

Mullainathan, S., 2011. The psychology of poverty. Focus 28(1), 19–22.

Ng, M., et al., 2014. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the global burden of disease study 2013. The Lancet 384(9945), 766 – 781.

Oberlander, L., Disdier, A.C., Etilé, F., 2017. Globalisation and national trends in nutrition and health: A grouped fixed-effects approach to intercountry heterogeneity. Health Economics 0, 1–16.

OECD, 2017. Obesity Update 2017. Technical Report. Organisation for Economic Cooperation and Development (OECD).

Omran, A.R., 1971. The epidemiologic transition: a theory of the epidemiology of population change. The Milbank Memorial Fund Quarterly 49(4), 509–538.

Pierce, J.R., Schott, P.K., 2016. Trade Liberalization and Mortality: Evidence from U.S. Counties. Technical Report 22849. National Bureau of Economic Research.

Popkin, B.M., Adair, L.S., Ng, S.W., 2012. Global nutrition transition and the pandemic of obesity in developing countries. Nutrition Reviews 70(1), 3–21.

Popkin, B.M., Gordon-Larsen, P., 2004. The nutrition transition: worldwide obesity dynamics and their determinants. International Journal of Obesity 28, S2–S9.

Prentice, A.M., 2006. The emerging epidemic of obesity in developing countries. International Journal of Epidemiology 35(1), 93–99.

Rivera, J.A., Barquera, S., Gonzalez-Cossio, T., Olaiz, G., Sepulveda, J., 2004. Nutrition transition in Mexico and in other Latin American countries. Nutrition Reviews 62(suppl 2), S149–S157.

Rosenzweig, M.R., Schultz, T.P., 1983. Estimating a household production function: Heterogeneity, the demand for health inputs, and their effects on birth weight. Journal of Political Economy 91(5), 723–746.

Rtveladze, K., Marsh, T., Barquera, S., Romero, L.M.S., Levy, D., Melendez, G., Webber, L., Kilpi, F., McPherson, K., Brown, M., 2014. Obesity prevalence in mexico: impact on health and economic burden. Public Health Nutrition 17(1), 233–239.

Rutstein, O.S., Johnson, K., 2004. The DHS Wealth Index. Technical Report DHS Comparative Reports n. 6. ORC Macro.

Schram, A., Labonte, R., Baker, P., Friel, S., Reeves, A., Stuckler, D., 2015. The role of trade and investment liberalization in the sugar-sweetened carbonated beverages market: a natural experiment contrasting Vietnam and the Philippines. Globalization and Health 11(1), 41.

Thow, A.M., 2009. Trade liberalisation and the nutrition transition: mapping the pathways for public health nutritionists. Public Health Nutrition 12(11), 2150–2158.

Topalova, P., 2010. Factor Immobility and Regional Impacts of Trade Liberalization: Evidence on Poverty from India. American Economic Journal: Applied Economics 2(4), 1–41.

Utar, H., Ruiz, L.B.T., 2013. International competition and industrial evolution: Evidence from the impact of chinese competition on mexican maquiladoras. Journal of Development Economics 105(Supplement C), 267 – 287.

Verhoogen, E.A., 2008. Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector. The Quarterly Journal of Economics 123(2), 489–530.

Vogli, R.D., Kouvonen, A., Elovainio, M., Marmot, M., 2014. Economic globalization, inequality and body mass index: a cross-national analysis of 127 countries. Critical Public Health 24(1), 7–21.

Volpe, R., Okrent, A., Leibtag, E., 2013. The Effect of Supercenter-format Stores on the Healthfulness of Consumers' Grocery Purchases. American Journal of Agricultural Economics 95(3), 568–589.

Vyas, S., Kumaranayake, L., 2006. Constructing socio-economic status indices: how to use principal components analysis. Health Policy and Planning 21(6), 459–468.

WHO, 2015. Trade and Health: Towards building a national strategy. Technical Report eds. R. Smith, C. Blouin, Z. Mirza, P. Beyer and N. Drager.. World Health Organization.

Appendix

Figure A1: Quantile BMI regressions

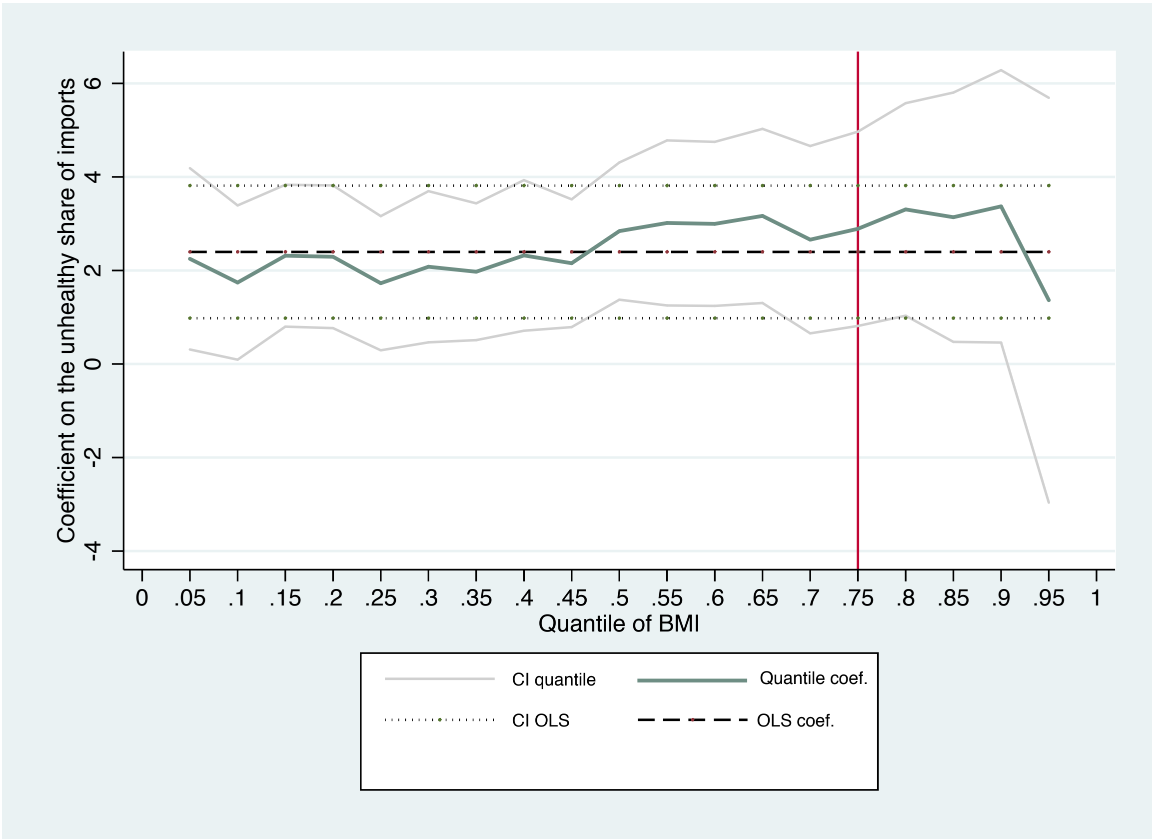


Figure A2: Unhealthy share of imports and obesity – Excluding one state at a time

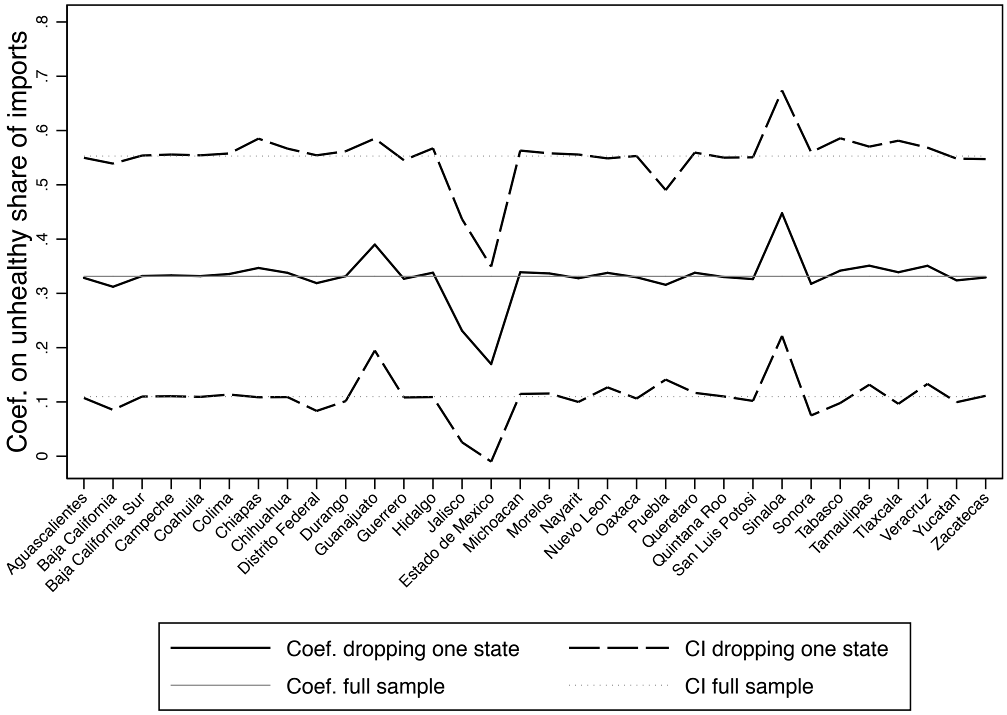


Table A1: Summary statistics for main variables (baseline sample with controls)

	(1)	(2)	(3)	(4)	(5)
	Obs	Mean	Std. Dev.	Min	Max
Obesity	35971	0.25	n.a.	0.00	1.00
Unhealthy share of imports	35971	0.53	0.14	0.20	0.80
Unhealthy share of expenditure	35971	0.41	0.05	0.30	0.56
Ln(relative price of unhealthy foods)	35971	0.67	0.14	0.29	1.23
Ln(GDP per capita)	35971	10.26	1.36	7.60	13.75
Ln(FDI/GDP)	35971	-4.21	1.23	-8.99	-1.44
Migrant share	35971	0.01	0.01	0.00	0.06
Ln(food imports from U.S.)	35971	3.02	0.98	0.48	6.03
Unhealthy share of imports (fin. demand)	35971	0.56	0.15	0.15	0.86
Ln(apparel imports from U.S.)	35971	9.92	1.40	6.44	13.21
Unhealthy share of imports from RoW	35971	0.36	0.14	0.04	0.67
Unhealthy share of exports to U.S.	35971	0.39	0.17	0.09	0.81

Table A2: Pairwise correlation table for the main variables

	(1) Obesity	(2) Unhealthy sh. of imp.	(3) Unhealthy sh. of expen.	(4) Ln(rel. price unhealthy)	(5) Ln(GDP per capita)	(6) Ln(FDI/GDP)	(7) Migrant share	(8) Ln(food imp.)	(9) Unhealthy sh. of imp. (fin. dem.)	(10) Ln(apparel imp.)	(11) Unhealthy sh. of exp. to U.S.	(12) Unhealthy sh. of imp. from RoW
Obesity	1											
Unhealthy sh. of imp.	0.14	1										
Unhealthy sh. of expen.	0.03	0.48	1									
Ln(rel. price unhealthy)	-0.04	-0.16	0	1								
Ln(GDP per capita)	0.26	0.4	-0.04	-0.13	1							
Ln(FDi/GDP)	0	0.22	-0.01	0	0.1	1						
Migrant share	0	0.16	0.19	0.06	-0.1	-0.1	1					
Ln(food imp.)	0.19	0.3	0.03	0	0.72	0.26	-0.12	1				
Unhealthy sh. of imp. (fin. dem.)	0.12	0.95	0.46	-0.15	0.37	0.17	0.15	0.25	1			
Ln(apparel imp.)	-0.04	0.14	-0.18	0.03	-0.01	0.35	-0.05	0.21	0.23	1		
Unhealthy sh. of exp. to U.S.	0.1	0.4	0.37	0.03	0.28	0.19	0.26	0.44	0.32	-0.05	1	
Unhealthy sh. of imp. from RoW	0.16	0.75	0.15	-0.08	0.55	0.32	-0.01	0.45	0.66	0.16	0.41	1

Table A3: Unhealthy share of imports and obesity - Filling in missing values

	(1)	(2)	(3)	(4)	(5)	(6)
Unhealthy share of imports	0.252**	0.195**	0.186*	0.190**	0.195**	0.192**
	(0.107)	(0.0947)	(0.0948)	(0.0908)	(0.0946)	(0.0882)
Unhealthy share of expenditure			0.146			0.118
			(0.213)			(0.239)
Ln(rel. price of unhealthy foods)				0.0138		0.00995
				(0.0421)		(0.0453)
Ln(GDP per cap.)					-0.000504	-0.000753
					(0.0348)	(0.0370)
Ln(FDI/GDP)						0.00122
						(0.00451)
Migrant share						-0.427
						(1.023)
Obs	56,714	56,714	56,714	56,714	56,714	56,714
R^2	0.068	0.109	0.109	0.109	0.109	0.109

Notes: All regressions include state dummies, state-specific linear trends, and year dummies. The state share of national population in 1990 is used as weight. Column (1) reproduces column (1) of Table 1. Columns (2) to (6) include individual controls (see the list in Table 1) and dummies for missing values of each control variable. Standard errors clustered at the state level are in parenthesis. Significant at: *10%, **5%, ***1% level.

Table A4: Effects of unhealthy imports in the full adult sample and on overweight status

	(1)	(2)	(3)	(4)	(5)	(6)
	Adult men and women			Dep. variable: Overweight		
Unhealthy share of imports	0.157*	0.253**	0.253**	0.250*	0.284**	0.351**
	(0.0893)	(0.121)	(0.120)	(0.128)	(0.126)	(0.129)
Unhealthy share of expenditure			0.200			-0.0782
			(0.300)			(0.410)
Ln(rel. price of unhealthy foods)			-0.0307			-0.0962
			(0.0466)			(0.0755)
Ln(GDP per cap.)			-0.00167			-0.0706
			(0.0678)			(0.0900)
Ln(FDI/GDP)			0.00295			0.00319
			(0.00571)			(0.00815)
Migrant share			0.126			-0.480
			(1.209)			(1.013)
Obs	87,588	41,341	41,341	56,714	35,971	35,971
R^2	0.050	0.124	0.124	0.102	0.182	0.182

Notes: All regressions include state dummies, state-specific linear trends, and year dummies. All columns except (1) and (4) include individual and household controls. The state share of national population in 1990 is used as weight. The sample in columns (4) to (6) include only adult women between 20 and 49 years old at the time of the survey. Standard errors clustered at the state level are in parenthesis. Significant at: *10%, **5%, ***1% level.