

Impact of religious participation, social interactions and globalisation on meat consumption and CO_2 emissions: Evidence from India

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Introduction

- ▶ India has the largest share of vegetarians in the world (almost 300 million as of 2014 (Sample Registration Survey)).
 - ▶ This can be attributed to the prevalence of religious customs and traditions: majority of Indians identify themselves as Hindus, a religion which explicitly bans the consumption of beef by its followers (and prohibits meat consumption in general).
 - ▶ However, in recent times, more Indians have begun eating meat (who did not eat meat before).
 - ▶ This may be driven by the impact of increasing incomes, better access to meat and exposure to global lifestyles.
- ▶ Our goal is to study the determinants of this shift in consumption behaviour and to quantify its effect on climate change.

Trends for Meat Consumption in Developing Countries

- ▶ A part of the increase in global meat consumption may be attributed to the increase of household incomes (Vranken et al. (2014), for instance, show that there is an inverse U-shaped relationship between meat consumption and income).
- ▶ Meat consumption has positive implications on nutritional outcomes in developing countries (Pingali and Khwaja (2004)), but it has negative implications for the climate (Revell (2015), (Springmann et al. 2016)).
- ▶ Policy-makers may need to focus efforts on the development of nutritional norms that lead to sustainable consumption pathways.

Religious Norms Regarding Meat in India

- ▶ Three religions in India impose restrictions on meat consumption.
 - ▶ Hinduism (followed by about 82% of Indians) restricts the consumption of meat: in ancient India, Hindu philosophers vigorously encouraged the idea of nonviolence (or ahimsa) towards animals, which gave rise to a largely vegetarian diet.
 - ▶ There is heterogeneity in the practice of vegetarianism among Hindus, largely driven by differences in state of residence, caste, and culture: however, the idea that vegetarianism is pivotal for achieving a positive state of health has been passed down generations even though Hinduism does not explicitly ban meat consumption (except beef).
 - ▶ Buddhism and Jainism (practiced by less than 2% of the Indian population) are other religions that prohibit meat consumption.
- ▶ Islam, Christianity and Sikhism are the other predominant religions in India, and they do not impose any binding restrictions on meat consumption by their followers (except pork for Muslims).

Hypotheses-I

Hypothesis 1: Hindus, Buddhists and Jains are less likely to consume meat than those belonging to the other religions.

- ▶ Levy and Razin (2012; 2014) develop a theoretical framework, where they propose that religion serves to instil beliefs in individuals, which determines how they behave in the social sphere.
- ▶ In this model, religious individuals are more likely to cooperate in participating in religious rituals in social settings, whereas secular individuals are less likely to do so.
- ▶ Social interactions may act as a stimulus to keep religious Hindus from eating meat, or meat-eating Hindus from switching to vegetarianism depending on what kind of groups they interact with each other in, and what cooperation implies in the context of membership in that group.

Hypotheses-II

- ▶ Applying these findings, Hindus that are members of religious groups are then likely to "cooperate" by not eating meat.
- ▶ In the context of a non-religious group, Hindus are more likely to interact with others who eat meat (possibly due to membership of non-Hindus, or other Hindus that may well eat meat), and thus they are more likely to "cooperate" in eating meat.

Hypothesis 2: Hindus that interact with others through groups or networks of a non-religious nature are more likely to eat meat than Hindus that are not members of such groups. Hindus that are members of religious groups are less likely to eat meat than other Hindus.

Hypotheses-III

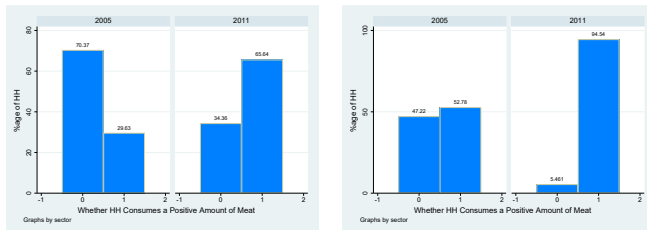
- ▶ Alluding to the framework of Levy and Razin (2012), globalisation can be defined as an exogenous positive utility "shock" affecting all households.
- ▶ In the presence of positive utility shocks, beliefs of agents increasingly become polarised.
- ▶ Levy and Razin (2012) show that with positive utility shocks, the pivotal agents are those who previously interacted with seculars; they are now more likely to abandon religious rituals (by beginning to eat meat, for instance). Thus, in the midst of forces such as globalisation, the size of the religion is expected to shrink.

Hypothesis 3: Hindus that are exposed through sources of media to global lifestyles are more likely to eat meat than other Hindus.

Data

- ▶ The data are drawn from the India Human Development Survey (IHDS), prepared by the University of Maryland, in collaboration with the National Council for Applied Economic Research (NCAER) in India (Desai et al. 2010; Desai et al. 2015).
- ▶ This is a large-scale survey on a representative sample of households (HHs) across Indian states and union territories, and spans two rounds (2005-06 and 2011-12). About 83% of HHs that are sampled in the first round of the survey are retained in the sample in the second round, constituting a panel of 40,018 HHs.
- ▶ The survey collects extensive information on socio-economic characteristics of HHs and the individual members, and on the consumption profile of households (in the previous 30 days prior to the date of survey).

Objective-I



(a) Hindus

(b) Reference Group

Figure 1: Source: IHDS, Rounds I and II

- ▶ We seek to explain the distinct shift in consumption pattern between Hindu HHs and the reference group (Muslims, Christians and Sikhs) over the time period of the study.
 - ▶ Social interactions through membership in groups and access to global lifestyles through sources of media

Objective-II

Table 1: Summary Statistics on Group Membership and Use of Media

Type of category	2005-06			2011-12		
Religion and group	Obs	Propn.	Std. Dev.	Obs	Propn.	Std. Dev.
Hindus: non-religious groups	32475	0.32	0.47	32714	0.37	0.48
Hindus: religious groups	32475	0.13	0.33	32714	0.10	0.30
Non-Hindus: non-religious groups	7543	0.30	0.46	7304	0.32	0.47
Non-Hindus: religious groups	7543	0.21	0.41	7304	0.18	0.38

Use of media	2005-06			2011-12		
Religion and use of media	Obs	Propn.	Std. Dev.	Obs	Propn.	Std. Dev.
Hindus	32475	0.81	0.39	32714	0.85	0.36
Non-Hindus	7543	0.82	0.38	7304	0.85	0.36

Notes: Non-religious groups include women's groups, youth/sports organisations or reading groups, unions or business-based groups, self-help groups, credit and savings organisations, caste associations, development groups or NGOs and agricultural groups or cooperatives. Use of media is measured as either infrequent or frequent use of newspapers, radio and television either by adult men or women of the HH.

Methodology-I

- ▶ To test hypothesis 1, we estimate the following model using the pooled probit methodology:

$$M_{i,T} = \alpha_0 + \alpha_1 H_{i,T} + \alpha_2 B_{i,T} + \alpha_3 J_{i,T} + \alpha_4 X_{i,T} + \mu_{i,T} \quad (1)$$

- ▶ where $M_{i,T}$ is a dummy indicating whether HH i purchased a positive amount of meat in the last 30 days in year T , $H_{i,T}$ is a dummy for whether HH i is Hindu, $B_{i,T}$ is a dummy for Buddhist HHs and $J_{i,T}$ is a dummy for Jain HHs. $X_{i,T}$ denotes a set of household-specific controls. The model includes district and caste dummies, along with a year dummy.

Results-I

Table 2: Estimation results to test Hypothesis 1

Marginal Effects (semi-elasticities at means) Column	Pooled Probit (1)	LPM (2)
Hindu	-0.110*** (0.016)	-0.070*** (0.012)
Buddhist	-0.063 (0.058)	-0.027 (0.042)
Jain	-3.390*** (0.448)	-3.543*** (1.568)
Socio-economic controls District, Caste, Year Dummies	Yes Yes	Yes Yes
Observations	59622	59622

Notes: Dependent variable is a dummy variable to denote whether household i purchased a positive quantity of meat in the last 30 days prior to the date of the survey. *, ** and *** respectively denote significance at 10%, 5% and 1% levels. Standard errors are clustered at the household level. The coefficient of the constant has not been reported.

Methodology- II

- ▶ In order to test hypotheses 2 and 3, we estimate three sets of models
- ▶ The first is a set of two "transition probability models" using pooled probit methodology, where we estimate the likelihood of a Hindu HH i switching meat consumption pattern between the two years:

$$\begin{aligned} S_{i,T} &= \alpha_0 + \alpha_1 R_{i,T} + \alpha_2 N_{i,T} + \alpha_3 A_{i,T} + \alpha_4 X_{i,T} + \mu_{i,T} \\ S'_{i,T} &= \alpha'_0 + \alpha'_1 R_{i,T} + \alpha'_2 N_{i,T} + \alpha'_3 A_{i,T} + \alpha'_4 X_{i,T} + \nu_{i,T} \end{aligned} \quad (2)$$

- ▶ where $S_{i,T}$ and $S'_{i,T}$ are dummies denoting whether Hindu HH i switched from vegetarianism in 2005 to positive meat consumption in 2011 (or didn't change consumption pattern), or whether it switched from positive meat consumption to vegetarianism between those two periods.
- ▶ $R_{i,T}$ is a dummy for membership in religious groups, $N_{i,T}$ is a dummy for membership in groups of a non-religious nature, and $A_{i,T}$ is a dummy for whether households have used sources of media, and $X_{i,T}$ denote socio-economic controls.

Table 3: Hypotheses 2 and 3: Transition Probability Models

Dependent variable Column	Dummy for Vegetarian in 2005 to meat in 2011 (1)	Dummy for Meat in 2005 to vegetarian in 2011 (2)
Religious group	-0.099*** (0.018)	0.228*** (0.075)
Non-religious group	0.058*** (0.012)	-0.146*** (0.061)
Use of media	-0.017 (0.016)	-0.061 (0.072)
Logarithm of annual HH income	-0.035*** (0.008)	-0.024* (0.014)
Education of adult men	0.004 (0.013)	-0.068*** (0.025)
Education of adult women	0.027** (0.013)	0.011 (0.025)
Whether HH is urban	0.221 (0.019)	-0.023 (0.035)
Whether HH owns a cellphone	-0.063*** (0.020)	0.014 (0.041)
Whether HH owns a telephone	-0.010 (0.022)	-0.047 (0.040)
Whether HH owns a fridge	0.007 (0.021)	0.073* (0.041)
Household size	-0.018*** (0.003)	0.022*** (0.004)
Price of meat (Rs./kilo)	-0.058*** (0.017)	0.036 (0.036)
Price of lentils (Rs./kilo)	0.163*** (0.025)	-0.138*** (0.041)
Price of milk (Rs./litre)	-0.348*** (0.032)	0.038 (0.057)
Meat consumption by non-Hindus	0.966*** (0.064)	-0.768*** (0.088)
Observations	48019	47974

Notes: Estimation methodology is pooled probit in both columns. Both specifications include dummies for districts, caste and year. * ** and *** respectively denote significance at 10%, 5% and 1% levels. Standard errors are clustered at the household level.

Methodology- III

The second model adjusts for unobserved heterogeneity amongst HHs and is estimated using the linear probability model (LPM) methodology:

$$M_{i,T} = \alpha_0 + \alpha_1 R_{i,T} * I_i + \alpha_2 N_{i,T} * I_i + \alpha_3 A_{i,T} * I_i + \alpha_4 X_{i,T} + \alpha_5 \delta_i + \alpha_6 \nu_{S,T} + \mu_{i,T} \quad (3)$$

- ▶ Where $M_{i,T}$ denotes whether HH i purchased a positive amount of meat in period T , I_i denotes an indicator for whether HH i was vegetarian in 2005, and δ_i and $\nu_{S,T}$ denote HH and state-year fixed effects.

Table 4: Hypotheses 2 and 3: Fixed effects estimations

Dependent variable: whether HH i purchased meat in last 30 days Column	Hindus (1)	Non-Hindus (2)
Religious group	0.216*** (0.059)	0.157** (0.072)
Non-religious group	-0.075** (0.035)	-0.057 (0.063)
Use of media	-0.090** (0.043)	-0.056 (0.039)
Religious group* Vegetarian in 2005	-0.218*** (0.073)	0.003 (0.114)
Non-religious group* Vegetarian in 2005	0.157*** (0.044)	0.141** (0.063)
Use of media* Vegetarian in 2005	0.144*** (0.053)	0.033 (0.080)
Socio-economic controls	Yes	Yes
Fixed effects	HH and state-year	HH and state-year
Observations	33806	7648

Notes: Column (2) includes results for estimation on the subsample of Muslims, Christians and Sikhs. Estimation methodology is the linear probability model in both columns. *, ** and *** respectively denote significance at 10%, 5% and 1% levels. Standard errors are clustered at the district level. The coefficient of the constant has not been reported.

Methodology-IV

The third model is an endogenous switching regression model, where Hindu HHs are assumed to belong to two separate regimes.

- ▶ The model for Regime 1 estimates the likelihood of purchasing meat for Hindu HHs that were vegetarian in 2005:

$$M_{i,T} = \alpha_0 + \alpha_1 R_{i,T} + \alpha_2 N_{i,T} + \alpha_3 A_{i,T} + \alpha_4 X_{i,T} + \mu_{i,T}, \text{ if } S_{i,T}^* > 0 \quad (4)$$

- ▶ and Regime 2 predicts the likelihood of purchasing meat for Hindu HHs that already ate meat in 2005:

$$M_{i,T} = \alpha'_0 + \alpha'_1 R_{i,T} + \alpha'_2 N_{i,T} + \alpha'_3 A_{i,T} + \alpha'_4 X_{i,T} + \epsilon_{i,T}, \text{ if } S_{i,T}^* < 0 \quad (5)$$

and the regime change equation is predicted using probit methodology as:

$$S_{i,T} = \beta Z_{i,T} + \nu_{i,T} \quad (6)$$

where we use state-level measures of infrastructure and telecommunications as excluded instruments in $Z_{i,T}$. The model is predicted using full-information maximum likelihood (FIML).

Table 5: Hypotheses 2 and 3: Endogenous switching regression model

Model	LPM (Conditional on Regime = 1)	LPM (Conditional on Regime = 0)	Probit (Regime change equation)
Dep.var.	Whether meat purchased by HH	Whether meat purchased by HH	Whether HH vegetarian in 2005
Column	(1)	(2)	(3)
Religious group	-0.0242*** (0.005)	0.0003 (0.004)	-0.145*** (0.021)
Non-religious group	0.0269*** (0.003)	0.007** (0.003)	-0.027** (0.015)
Use of media	0.008** (0.004)	0.007* (0.004)	-0.071*** (0.020)
Socio-economic controls	Yes	Yes	Yes
District, caste and year dummies	Yes	Yes	Yes
Total Length of Surfaced Roads			-0.094*** (0.022)
Telephones per 100 of the population			0.007*** (0.0004)
Total length of rail track			0.018*** (0.0008)
Total number of cold-storage facilities			-0.087*** (0.009)
Total number of air traffic passengers handled per day			-0.002*** (0.0005)
Correlation Coefficients	0.127*** (0.039)	-0.003 (0.048)	
Wald test of independence of equations			10.6
P-value			0.0011
Kleibergen-Paap rk Wald F-Statistic			241.601
P-Value			0
Observations	44436	44436	44436

Notes: Full-information maximum likelihood (FIML) is the estimation methodology. All specifications include district, caste and year dummies. **, * and *** respectively denote significance at 10%, 5% and 1% levels. Robust standard errors are reported. The coefficient of the constant has not been reported.

Conclusion and Next Steps

- ▶ Hindu HHs are less likely to consume meat than followers of other religions for whom meat consumption is not restricted.
 - ▶ Hindu HHs that are members of religious groups are less likely to have switched from vegetarianism to meat consumption than Hindu HHs that are not members of such groups.
 - ▶ Hindu HHs that members of non-religious groups are more likely to have switched from vegetarianism to eating meat than Hindu HHs that are not members of these groups.
 - ▶ Hindu HHs that have access to some form of media are more likely to have switched from vegetarianism to eating meat than Hindu HHs that do not use media at all.
- ▶ We hypothesise that this response HHs may have played an important role in increasing meat consumption, which has implications for GHG emissions in India (this is work-in-progress).

Thank you for your attention.