



Increasing incomes, increasing waistlines?

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Motivation

- Unprecedented income growth in China in recent decades
 Income
- ...coincides with a strong increase (small decrease) in the proportion of overweight or obese (underweight) men and women

▶ BMI

- The literature suggests a strong income gradient in health (Cutler, Deaton, Lleras-Muney 2006)
- Could fast income growth trigger fast diet change (that in turn may affect waistlines)?

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Motivation

- strong income gradient in health
- Ruhm (several years): health (mortality) decreases (increases) with income (in the short run)
- e.g. Cutler and Lleras-Muney (2016): positive (negative) long-run income gradient in health (mortality)
- Our study:
 - snapshot of 20 years (1991-2011)
 - focus on the link between income and nutrition (and bodyweight)
 - estimate Engel curves in calories and macronutrients (carbs, fat, protein)

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• carefully instrument for income

Data

- Chinese Health and Nutrition Survey 1991-2011
- ca. 7,200 households with 30,000 individuals in 15 provinces
- records daily initial and final food stocks and flows (incl. eating out) \rightarrow measures consumption
- calories and macronutrients derived by nutritionists using nutrient conversion factors (e.g. 100g rice contain 130 calories)
- individual dietary intake monitored for three consecutive days
- measures of physical activity at work (through occupational information and self-reported strenuousness of work)
- rich individual and community-level characteristics, and food prices

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sample: 18-55 year old working males and females

Calories and macronutrient composition, 1991-2011, by gender

	rural				urban			
	1991	2000	2011	% change	1991	2000	2011	% change
Calories								
female	2647	2198	1903	-28.12	2329	2070	1667	-28.44
male	3028	2547	2291	-24.35	2785	2477	2038	-26.83
Carbohydrates (in kcal)								
female	1817	1370	1039	-42.82	1428	1115	777	-45.57
male	2049	1571	1242	-39.38	1696	1317	961	-43.37
Fat (in kcal)								
female	528	576	650	+23.21	616	689	700	+13.53
male	585	652	782	+33.59	718	808	767	+ 6.89
Protein (in kcal)								
female	302	251	244	-18.99	281	262	247	-12.15
male	347	291	294	-15.30	335	312	299	-10.61
Carbohy female male Fat (in f female male Protein female male	2049 kcal) 528 585 (in kcal) 302 347	(in kcal) 1370 1571 576 652) 251 291	1039 1242 650 782 244 294	-42.82 -39.38 +23.21 +33.59 -18.99 -15.30	1428 1696 616 718 281 335	1115 1317 689 808 262 312	2030 777 961 700 767 247 299	-45.57 -43.37 +13.53 + 6.89 -12.15 -10.61

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Dietary change between 1991 and 2011

• Large change in calorie sources:

- calories fell during the sample period by 24 to 28%
- carbohydrate decline (by ca. 39-45%)
- fat increase by 6-35% (with large variation by gender and urbanity)
- small protein decrease

• And.....

Macronutrient trends, levels and shares, 1991-2011

		rural		urban			
	1991	percenta	ge change	1991	percentage change		
	share	share	level	share	share	level	
Carbohy	drates						
female	0.69	-20.32	-42.82	0.62	-22.94	-45.57	
male	0.68	-20.01	-39.38	0.61	-22.25	-43.37	
Fat							
female	0.20	+61.09	+23.21	0.26	+43.61	+13.53	
male	0.19	+60.62	+33.59	0.25	+43.06	+6.89	
Protein							
female	0.11	+15.10	-18.99	0.12	+24.09	-12.15	
male	0.12	+13.87	-15.3	0.12	+23.01	-10.61	

Diet composition, 1991 to 2011

- ...even larger changes in diet composition:
 - carbohydrate decline (by ca. 20-23%)
 - fat increase by 43-60 (!)%
 - protein increase (by 14-24%)

Are these changes driven by price changes or preference shocks, or are they income-related?



Existing studies

- Income-related increase in food eaten out (Ma et al. 2006)
- Prices
 - large price elasticities, e.g. for edible oils and rice esp. for pork (Guo, Popkin, Mroz and Zhai 1999)
 - decreases in the price of energy-dense foods lead to increased body fat, but not bodyweight (Lu and Goldman 2010)
- Income channel
 - income growth disrupts income insurance
 - tripling of permanent income shock transmission, esp. in rural areas (Santaeulalia-Llopis and Zheng 2015)
 - but: little work on income effects on nutritional intake

We use three types of instruments for income:

- mix of households in rural and urban areas, with income from agriculture, and earnings
- 1: weather shocks (deviations from long-run province trends in rainfall, sunshine and temperature) Weather



Identification

We use three types of instruments for income:

 2: tax reforms in 1993, 2005, 2007, 2010 (changing tax exemption thresholds and marginal tax brackets for IIT) taxreform

from individual to household income: construct share of household members falling into each tax bracket

 3: augment with "bracket creep" that originates from nominal tax schedules and inflation (Saez 2003) → inflation increases the marginal tax rate levied on X real Yuan earned

Income measurement for ${\sf IV}$





Notes: The solid (dashed) lines show the maximum (minimum) gross monthly earnings per observed net earnings.

Estimation

- IV estimation
- $N_{ict} = \alpha + \beta f(x_{ict}) + \sum_k \delta_k P_{kict} + \gamma p_{ct} + \theta Z_{ict} + \eta C_{ct} + \tau_t + \epsilon_{ict}$
- control for community-level food prices
- control for occupational physical activity
- distinguish between urban and agri-rural households
- control for female decision power (ratio of male to female financial control (using individual IV))

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Estimation

- estimate a flexible functional form in income
- test the Lakdawalla, Philipson and Bhattacharya (2006) hypothesis of a hump-shaped Engel curve



First stage results

	(1)	(2)	(3)	(4)	-
	Non-agri		۵	gri	i
Variable	Income	Ratio	Income	Ratio	_
Marginal tax rate:0.05	1,010***	0.141***	-483.2*	0.0536**	
	(295.2)	(0.00982)	(293.6)	(0.0220)	
Marginal tax rate:[0.1,0.15]	2,466***	0.271***	381.3	0.228***	
	(419.0)	(0.0139)	(400.5)	(0.0300)	
Marginal tax rate:[0.2,0.35]	5,503***	0.345***	1,232**	0.318***	
	(761.6)	(0.0253)	(620.9)	(0.0464)	
Lagged spring temperature shock	-280.3***	-0.00244	-159.4***	-0.000629	
	(50.77)	(0.00169)	(38.70)	(0.00289)	
Lagged spring rainfall shock	0.0211	3.92e-06**	-0.123***	9.28e-06***	
	(0.0511)	(1.70e-06)	(0.0355)	(2.66e-06)	
Lagged spring sunshine hour shock	0.0868	3.45e-06	0.109	1.42e-05**	
	(0.110)	(3.66e-06)	(0.0825)	(6.17e-06)	
Share 1	4,173***	-0.0939***	2,330***	-0.0874***	
	(259.5)	(0.00864)	(186.8)	(0.0140)	
Share 2	7,230***	-0.152***	4,388***	-0.152***	
	(386.3)	(0.0129)	(270.1)	(0.0202)	
Share 3	7,413***	-0.179***	6,977***	-0.211***	
	(717.6)	(0.0239)	(437.7)	(0.0327)	
Observations	12,698	12,698	18,654	18,654	ite for
R-squared	0.456	0.332	0.293	0.087	Studie

Results: Calories



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Results: calories



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Results: macronutrients



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Results: carbohydrates



Results: Income elasticities

	(1)	(2)	(3)		
	All	Female	Male		
Panel A: Non-agricultural individuals					
Calories	0.093	0.139	0.068		
	[0.152]	[0.178]	[0.128]		
Fat		0.134	0.151		
Protein		0.137	0.106		
Carbohydrate		0.146	0.021		
Panel B: Agricultural individuals					
Calories	0.082	0.128	0.035		
	[0.119]	[0.145]	[0.059]		
Fat		0.273	0.130		
Protein		0.120	0.042		
Carbohydrate		0.090	0.007		

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Summary of results

- hump-shaped Engel curves in calories
- with similar income elasticities between 0.08 and 0.09 at median income for urban and agri-rural individuals
- significant gender differences:
 - females are more income elastic towards calories and macronutrients
 - poor males are more income elastic towards fat
 - shift in females diet patterns away from a traditional carb-rich diet

• females with more control over financial resources increase consumption of calories and other macronutrients by more

Robustness checks

- alternative equivalence scales
- alternative functional forms (higher order polynomials)



Preliminary conclusion

- hump-shaped Engel curves in calories
- point to declining role of underprovision with calories as incomes rise
- and a self-limiting effect due to health or ideal weight concerns (as proposed in Lakdawalla et al)
- aa shift in diet towards fats
- along with rising proportions of problematic bodyweight

Outlook

- fully extend the analysis to 1991-2011
- analyse elasticities off median in more detail and characterise diet shifts by income quartiles
- extend the estimation to link income, nutrition and bodyweight changes
- use richer detail on time use to control for physical activity



Working individuals aged 18-55. Data from China Health and Nutrition Survey

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Working individuals aged 18-55. Data from China Health and Nutrition Survey

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Weather shocks

Variable		Std. Dev.
Panel A: Individual income tax rates		
Tax bracket 1: tax rate 0.05	Across individuals	0.231
	Across time	0.202
Tax bracket 2: tax rate [0.1,0.15]	Across individuals	0.162
	Across time	0.139
Tax bracket 3: tax rate [0.2,0.35]	Across individuals	0.108
	Across time	0.083
Panel B: Weather variation		
Lagged spring temperature shock	Across provinces	0.542
	Across time	1.153
Lagged spring rainfall shock	Across provinces	549
	Across time	917
Lagged spring sunshine hour shock	Across provinces	238
	Across time	519





Individual income tax schedules

