Are tortillas a Giffen Good in Mexico?

David Mckenzie

Department of Economics, Stanford University

Abstract

Jensen and Miller (2001) have recently demonstrated rice and noodles to be Giffen Goods among the poor in South and North China respectively. We examine whether tortillas, the main staple in Mexico, are also a Giffen Good. The large income change due to the 1995 Peso Crisis and the large tortilla price increase arising from the removal of government subsidies provide an ideal environment for this test. We find tortillas to be an inferior good, but not a Giffen Good.

1   Introduction

> "I have no choice but to buy more tortillas and less meat, chicken and vegetables"
> María Teresa Muñoz as quoted in The Washington Post (p A11, Jan 12, 1999).

On the first of January 1999, the Mexican government ended 25 years of tortilla subsidies and price controls, resulting in a sharp increase in the price of this staple food. This decision was politically controversial, as Mexicans consume an average of 220 pounds of tortillas each per year. Moreover, critics contended that the removal of these controls would hurt the poor disproportionately, since tortillas account for half the daily calorie consumption of poor Mexicans.[1] The quote above suggests that poor Mexicans may have actually increased their tortilla consumption in response to the price rise, that is, that tortillas may be a Giffen good amongst the poor in Mexico.

Jensen and Miller (2001) have recently provided the first[2] documented example of a Giffen good, finding rice to be a Giffen good for the poor in the south of China, and demand for noodles to be Giffen in the north of China. Using several theoretical models, they show that Giffen behaviour is most likely to arise when consumers face a subsistence constraint and rely on a basic good for a large fraction of their food consumption. It follows that staple goods in developing countries are the best candidates for Giffen goods. We follow their methodology to examine whether tortillas, the basic staple in Mexico, also exhibit Giffen behaviour.

The Mexican peso crisis caused real GNP per capita to fall 9.2 percent in 1995[3] and resulted in large falls in household income. This large change in income enables us to first examine whether tortillas are an inferior good, before then determining whether they are Giffen in response to the later large price increase. One would expect households to respond to changes of these magnitudes, and in particular, we do not have to rely on cross-sectional price variation to identify price effects. We find that tortillas are indeed inferior for most consumers, with expenditure shares on tortillas increasing during the peso crisis. However, we find no evidence that tortillas are Giffen goods, and after controlling for income, find that consumers reduced their tortilla consumption in response to the price rises.

The remainder of the paper is organized as follows. Section 2 shows the increase in relative prices and tests whether tortillas are an inferior good. Section 3 then examines tests for Giffen behaviour, while Section 4 concludes.

2   Price and Income Changes

Figure 1 shows the prices of food, tortilla, chicken pieces, pork and beef, relative to overall consumer prices, over the period 1992-2001. After moving roughly one for one with overall prices between 1992 and 1997, tortilla prices increased dramatically from 1998 onwards, as the government began to phase out tortilla price controls and subsidies. Moreover, we see that the relative prices of different meats were falling over the 1998-2001 period.

Household surveys of income and expenditure are now taken at two-year intervals in Mexico. We use the 1994, 1996, 1998 and 2000 rounds of the Encuesta Nacional de Ingreso-Gasto de

---

[1] source: Washington Post (1999).

[2] They note that the classic textbook examples of the potato during the Irish famine and bread and wheat in Britain during Giffen's time have been discredited by subsequent research (see also Rosen, 1999).

[3] *source:* World Bank (2001).

los Hogares (ENIGH), which were carried out during the third quarter of each survey year. The survey size consisted of 12,815 households in 1994, 14,042 in 1996, 10,952 in 1998 and 10,108 households in 2000. The surveys contain extremely detailed information about the components of expenditure for each household, along with information on income after taxes and social security contributions, capital expenditure and demographic variables. Food and Beverage Expenditure is classified into 208 distinct expenditure items in the 1996 survey (see INEGI (2000) for the complete list). Among these is the corn tortilla (*tortilla de maíz*), which was purchased by 72 percent of reporting households in the reference week in 1996, and by 75 percent of reporting households in the 2000 reference week.[4] Households record their total expenditure on tortillas, and the quantity in kilograms, from which the price per kilogram is calculated.[5] Following Villagómez and Solís-Soberón (1999) we deflate the data using the September month consumer price index from the Banco de Mexico in each survey year to obtain real prices, real total expenditure, and real income.

Figure 1: Prices Relative to Overall CPI
(1994=1)

source: IPC por objeto del gasto Nacional, Banco de Mexico
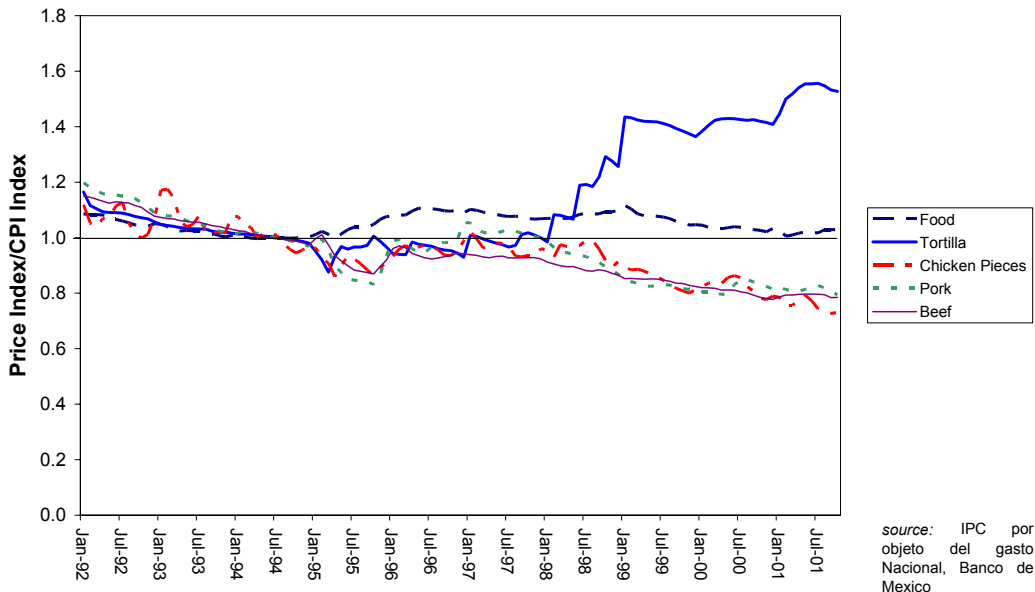
Different individuals are surveyed each period, and so analysis is based on repeated cross-sections, rather than on panel data as Jensen and Miller (2001) are able to do. In Table 1 we first examine how tortilla expenditure shares and quantities differ by income quartile, and how they have responded to income changes over time. The expenditure share of tortillas actually increases slightly from the bottom to the second income quartile, and thereafter falls. In the cross-section then, tortillas are an inferior good for those with higher incomes, but may not be so for the

---

[4]Flour tortillas (tortilla de harina) are much less popular, being purchased by only 4 percent of households in 1996. Analysis of tortillas in this paper refers to corn tortillas only.

[5]This differs from Jensen and Miller (2001), who use consumption data rather than expenditure data. We do not include own production of tortillas or free tortillas, however using the 2000 ENIGH, we calculate that households in the lowest income quartile only averaged 0.14Kg. or 5% of their tortilla consumption from sources other than direct monetary expenditure. Our results are robust to the inclusion of these additional sources.

2

poorest households. However, when incomes fall between 1994 and 1996 due to the peso crisis, the expenditure share of the lowest income quartiles increases the most, as does their quantity of tortilla purchases. This is what one would expect from an inferior good. Note that although the expenditure share falls with income, the absolute quantity of tortilla purchased increases with income up to the fourth income quartile. This was one of the reasons behind the elimination of the tortilla subsidy, namely a lot of leakage of its benefits to the middle class.

Table 1: Tortilla Expenditure Shares, Quantities and Incomes

| | Income Quartile | | | | | All |
	1 (lowest)	2	3	4	5 (highest)	Households
	Mean Expenditure Share of Tortillas					
1994	0.029	0.033	0.027	0.021	0.011	0.024
1996	0.039	0.041	0.033	0.025	0.012	0.030
1998	0.044	0.045	0.035	0.026	0.013	0.033
2000	0.043	0.045	0.036	0.026	0.013	0.033
	Mean Weekly Tortilla Purchases (in Kilograms)					
1994	2.02	4.53	5.62	6.25	5.11	4.71
1996	2.79	5.37	6.28	6.69	5.24	5.27
1998	2.79	4.96	5.70	5.89	4.90	4.84
2000	2.58	4.93	5.51	5.75	4.70	4.69
	Mean Three month household Income (1994 Pesos)					
1994	964	2153	3444	5586	16320	5671
1996	805	1691	2661	4260	12158	4309
1998	797	1766	2866	4721	13452	4717
2000	983	2054	3247	5228	14958	5298

source: author's own calculations from 1994, 1996, 1998 and 2000 ENIGH

To formally test whether tortillas are an inferior good, we estimate an Engel curve linking a household's tortilla expenditure share to their total expenditure and to the demographic composition of the household. To allow for the possibility that tortillas are a necessity at some income levels, and a luxury at others, we include a quadratic term in log expenditure, as suggested by Banks, Blundell and Lewbel (1997). For each cross-section separately, we estimate the following equation:

$$\omega_j = \lambda + \beta \ln\left(\frac{x_j}{n_j}\right) + \delta\left(\ln\left(\frac{x_j}{n_j}\right)\right)^2 + \theta \ln(n_j) + \sum_{k=1}^{K} \gamma_k \left(\frac{n_{k,j}}{n_j}\right) + \tau z_j + u_j \ . \qquad (1)$$

Here ω_j is the budget share of tortillas for household j, x is total household expenditure, n is total household size, $n_{k,j}$ is the number of people in the household j in age-sex class k, z is a dummy variable for a female head of household, and u_j is the error term. Table 2 gives the coefficients β, δ and θ for each year of this estimation. Each year we find $\beta > 0$ and $\delta < 0$, so that tortillas are in fact a necessity at very low levels of total expenditure, and then quickly become inferior.

3

Table 2: Engel Curve Estimation for Tortillas - Are Tortillas an Inferior Good?

	without demographic controls				with demographic controls			
	1994	1996	1998	2000	1994	1996	1998	2000
Log per capita expenditure	0.0333	0.0238	0.0464	0.0394	0.0337	0.0239	0.0483	0.0399
	(11.65)	(7.44)	(11.14)	(8.02)	(11.61)	(7.45)	(11.51)	(8.08)
Log per capita expenditure squared	-0.0031	-0.0028	-0.0040	-0.0034	-0.0031	-0.0028	-0.0041	-0.0034
	-(14.54)	-(11.43)	-(14.44)	-(11.11)	-(14.42)	-(11.34)	-(14.74)	-(11.12)
Log household size	-0.0004	0.0003	-0.0019	-0.0032	0.0006	0.0017	-0.0008	-0.0010
	-(0.62)	(0.38)	-(2.01)	-(3.41)	(0.69)	(1.76)	-(0.74)	-(0.89)

Notes: T-values in parentheses

Demographic controls are proportion of males and females aged 0-4, 5-9, 10-14, 15-59, 60+, and a dummy for female headship

Estimation is carried out year-by-year for households with heads aged 25-65 years.

3 Are Tortillas Giffen?

Jensen and Miller (2001) regress changes in the consumption of rice and noodles on a vector of market price changes and the change in income in order to test for Giffen behaviour. Using panel data, their specification is:

$$\Delta q_{i,j} = \alpha_0 + \Sigma_{k=1}^{K} \alpha_k \Delta p_{i,k} + \alpha_{K+1} \Delta y_i + \eta_i \, , \qquad (2)$$

where for individual i, $\Delta q_{i,j}$ is the change in quantity of food j consumed, $\Delta p_{i,k}$ is the change in price of food k, and Δy_i is the change in income. Using a panel of individuals, Jensen and Miller (2001) split the sample by whether a household is in the poorest income quartile, and estimate (2) for these two groups separately for the north and south of China, due to differences in dietary preferences. They find a positive association between price changes and quantity consumed among poor consumers for rice in the south, and for noodles in the north.

As we observe each individual household only once, we are not able to directly estimate (2) at the household level. Instead, we form birth-education cohorts based on the age and education of the household head. We use five year birth intervals and six education groups: no schooling, incomplete primary schooling, complete primary schooling, junior high, high school, and higher education. We then can compare, for example, the change in the mean quantity of tortilla consumed by households with unschooled 30-34 year old heads in 1994 to mean tortilla consumption of 32-36 year old unschooled heads in 1996. The cohort level analogue of (2) is then:

$$\Delta q_{c,j} = \alpha_0 + \Sigma_{k=1}^{K} \alpha_k \Delta p_{c,k} + \alpha_{K+1} \Delta y_c + \eta_c \, , \qquad (3)$$

where $\Delta q_{c,j}$ is the change in the mean quantity of food j consumed by households in cohort c, Δy_c is the change in mean income for households in cohort c, and $\Delta p_{c,k}$ is the change in the mean price of food k. Since the price of a food is only observed for individuals who consume that food, we take mean prices over households that consume the good in question. We first estimate (3) for all households, and then only for those with unschooled heads. Table 3 presents the results.

Table 3: Giffen Good Regression Coefficients

Dependent variable: Change in Quantity of Tortillas Purchased

	All Cohorts			Unschooled Cohorts		
	OLS	OLS	IV	OLS	OLS	IV
Change in Price of Tortillas	-0.028	0.122	-0.831	-0.252	-0.121	-1.372
	-(0.33)	(1.39)	-(5.21)	-(0.94)	-(0.37)	-(3.10)
Change in Price of Chicken		0.057	0.102		0.023	0.072
		(1.90)	(3.54)		(0.17)	(0.68)
Change in Price of Beef		0.013	0.094		0.113	0.197
		(0.49)	(3.38)		(1.04)	(2.46)
Change in Price of White Bread		0.114	0.048		0.153	0.104
		(5.46)	(2.25)		(1.93)	(1.52)
Change in Income	-3.42E-05	8.82E-06	7.90E-05	-4.37E-04	-4.09E-04	6.14E-05
	-(1.16)	(0.31)	(2.81)	-(1.03)	-(0.91)	(0.15)
Constant	0.043	0.113	0.879	0.278	0.561	1.471
	(0.49)	(0.98)	(5.70)	(0.90)	(1.39)	(3.62)

Notes: T-values in parentheses

IV instruments with Change in Relative Price of Tortillas, calculated from the National CPI by expenditure item index of the Banco de Mexico. Estimation is for household heads aged 25-65 years.

Using OLS to estimate (3), we obtain insignificant coefficients on the change in tortilla price. For the unschooled cohorts, the poorest education group, this coefficient is negative under several specifications. There are several good reasons for not using the cross-sectional variation in prices. Measured prices are unit values, rather than true prices. As Deaton (1997) points out, unlike prices, unit values are to some extent a consumer choice, to the extent that the good differs in quality. Moreover, as unit values are calculated by dividing expenditure by quantity, measurement errors in quantity will result in measurement errors in prices. Deaton suggests a method to control for quality variation, which is based on variation between villages, assuming prices don't vary within a village. This method is clearly not appropriate for large cities, and in the context of tortillas in Mexico, quality issues are perhaps less of a problem. Moreover, we have a large identifiable exogenous source of a price increase, namely the change in government price control and subsidy policy. We use changes in the national tortilla price index relative to overall consumer prices to instrument the measured changes in unit values.[6] The effect of a price change on quantity is then identified from changes in the tortilla price over time, rather than cross-sectional differences. The instrumented regressions in Table 3 find a significant negative coefficient on the change in tortilla prices, for both all cohorts, and for the unschooled group separately. That is, we find that tortillas are a normal good, not a Giffen good.

While it is the case that unschooled household heads have the lowest mean income by schooling level, there is still considerable income heterogeneity amongst unschooled heads. In each of our sample years, only 43 to 45 percent of households with unschooled heads are in the lowest income quartile, while 17-19 percent are in the top forty percent of the overall income distribution. If tortillas are only a Giffen good for the poor, the use of age-education cohorts may therefore be unable to pick this up, due to the presence of both poor and non-poor households in each cohort. To examine whether this explains our results, we fix real total expenditure, and then examine how the quantity of tortilla differs over time for households with the same total expenditure (and hence the same permanent income). If tortillas are truly a Giffen good, we would expect the large relative price increase of tortillas between 1996 and 1998, and again between 1998 and 2000, to result in

---

[6]The correlation between relative unit value prices and the relative national tortilla price is 0.604.

households with a given level of total expenditure consuming a higher quantity of tortillas.

Table 4: How did quantity respond to the Tortilla Price Increases?

Relative Price of Tortillas:		Sept. 1996	0.9553
		Sept. 1998	1.2186
		Sept. 2000	1.4286

1996 Total Expenditure decile	Mean Tortilla Purchases (kilograms/week)			Welch test of equality p-values	
	1996	1998	2000	1996 & 1998	1998 & 2000
1	1.82	1.59	1.41	0.135	0.259
	(0.11)	(0.11)	(0.11)		
2	3.73	3.41	3.14	0.133	0.235
	(0.15)	(0.15)	(0.16)		
3	5.37	4.95	4.25	0.118	0.006
	(0.19)	(0.20)	(0.16)		
4	6.33	5.70	5.49	0.020	0.443
	(0.19)	(0.19)	(0.19)		
5	6.20	5.93	5.72	0.330	0.431
	(0.18)	(0.20)	(0.18)		
6	7.13	6.38	6.12	0.007	0.365
	(0.20)	(0.19)	(0.22)		
7	7.01	6.18	6.00	0.002	0.466
	(0.19)	(0.18)	(0.17)		
8	7.13	6.50	5.91	0.026	0.177
	(0.21)	(0.19)	(0.02)		
9	6.13	5.71	5.67	0.096	0.876
	(0.18)	(0.18)	(0.18)		
10	4.59	4.42	4.34	0.461	0.702
	(0.15)	(0.16)	(0.15)		

A Closer Look at the Bottom 10% of the 1996 Total Expenditure Distribution

1996 Total Expenditure centile	Mean Tortilla Purchases (kilograms/week)			Welch test of equality p-values	
	1996	1998	2000	1996 & 1998	1998 & 2000
1	0.33	0.31	0.41	0.905	0.608
	(0.11)	(0.13)	(0.15)		
2	0.92	0.62	0.60	0.256	0.939
	(0.23)	(0.14)	(0.24)		
3	1.36	1.03	0.63	0.316	0.206
	(0.24)	(0.22)	(0.22)		
4	0.88	0.91	0.68	0.950	0.478
	(0.21)	(0.24)	(0.19)		
5	2.01	1.47	0.96	0.285	0.273
	(0.37)	(0.35)	(0.31)		
6	1.84	1.49	1.47	0.505	0.964
	(0.32)	(0.40)	(0.34)		
7	2.48	2.11	1.75	0.501	0.523
	(0.39)	(0.38)	(0.42)		
8	3.06	2.51	2.41	0.337	0.872
	(0.41)	(0.40)	(0.45)		
9	1.97	2.38	2.23	0.545	0.835
	(0.34)	(0.58)	(0.42)		
10	3.33	3.07	2.38	0.692	0.263
	(0.44)	(0.46)	(0.41)		

source: author's calculations from 1996, 1998 and 2000 ENIGH
Means are for households with heads aged 25-65 years.
Standard errors in parentheses.
Welch test tests for equality of means
Relative price of tortilla=Corn tortilla Price Index/Overall CPI

Table 4 shows mean tortilla purchases by 1996 total expenditure decile for households in 1996,

1998 and 2000. It also partitions the data further to examine the poor in greater detail, considering separately each of the bottom ten centiles of the 1996 total expenditure distribution. Welch tests are used to test the null hypothesis of equality of mean quantities in 1996 and 1998, and also in 1998 and 2000. For every expenditure decile, we find that tortilla purchases declined between 1996 and 1998, and again between 1998 and 2000, with this difference being significant for most deciles between 1996 and 1998. Smaller sample sizes make the case less cleancut when we consider the bottom ten centiles, and in no case can we reject equality of purchases. However, the signs show that mean tortilla consumption fell for eight of the bottom ten centiles over 1996-98, and nine of the bottom ten over 1998-2000. The evidence hence suggests that our finding that tortillas are not a Giffen good is not due to uncontrolled income heterogeneity.

4   Conclusions

Despite the opening quote and the controversy accompanying the removal of government subsidies, we find no evidence of tortillas being a Giffen good in Mexico. In their conclusions, Jensen and Miller (2001) speculate that if appropriate data was collected for similarly impoverished consumers (to their Chinese consumers), other examples of Giffen goods may be found. There are several plausible explanations for why Mexico is not such a case. First, in Mckenzie (2001) I find that households increased their tortilla consumption by more than Engel's law would predict during the peso crisis, and so comparisons with this crisis year may be complicated by household crisis-adjustment mechanisms. However, such an explanation holds much less weight for the 1998-2000 comparison. Secondly, the existence of a means-tested free tortilla program called Tortibono may alleviate subsistence concerns amongst the poorest in Mexico.[7] Thirdly, Mexican consumers may have a wider array of substitutes available than do Chinese consumers, so that tortillas do not play quite the same role as rice does in China. In response to the relative price increase, Mexican consumers were thus able to reduce the quantity of tortillas purchased, as the law of demand would predict. The search for other convincing examples of Giffen goods should hence focus on staples with few substitutes in less-developed countries than Mexico.

References

Banks, J., R. Blundell and A. Lewbel (1997). "Quadratic Engel Curves and Consumer Demand", *The Review of Economics and Statistics* 74(4): 527-539.

Deaton, A. (1997) *The Analysis of Household Surveys*. The Johns Hopkins University Press: Baltimore.

Instituto Nacional de Estadística, Geografía e Informática (INEGI) (2000). *Encuesta Nacional de Ingresos y Gastos de los Hogares 1998* (ENIGH). INEGI: Aguascalientes.

Jensen, R. and N. Miller (2001) "Giffen Goods", mimeo. John F. Kennedy School of Government, Harvard University.

---

[7]Although, as noted, tortilla consumption from sources other than direct monetary expenditure accounts for only a small percentage of total tortilla consumption.

Mckenzie, David J. (2001) "The Household Response to the Mexican Peso Crisis", Stanford Department of Economics Working Paper 01-017.

Rosen, S. (1999) "Potato Paradoxes", *Journal of Political Economy* 107(6): 294-313.

Villagómez, A. and F. Solís-Soberón (1999) "Ahorro y Pensiones en Mexico: Un Estudio al Nivel de las Familias", *Economia Mexicana, Nueva Epoca*, 13(2): 339-66.

The Washington Post (1999) "Tortilla Price Hike Hits Mexico's Poorest", Tuesday January 12, 1999, Page A11.

World Bank (2001). *World Development Indicators 2000*, CDROM, The World Bank: Washington DC