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Where to sell the next cappuccino? Income per capita and coffee consumption

Arturo Jose Galindo
Inter-American Development Bank

Abstract

This paper estimates the world demand for coffee using a dataset for 88 countries from 1990 to 2005, and dynamic panel data estimators. Results suggest that the income elasticity of demand is non constant and varies according to a country's income level. Higher income countries have lower income elasticities than middle and low income ones. Differences in price elasticities are not significant across income groups.

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Contact: Arturo Jose Galindo - ajgalindo@gmail.com.
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1. Introduction

According to the International Coffee Organization (ICO) during 2006 the world consumed nearly 116 million bags of coffee and produced about 122 million bags[1]. Coffee consumption has been increasing rapidly throughout the world. In 1995 world coffee consumption was just over 96.5 million bags, meaning that in a decade world coffee consumption grew over 20%.

Coffee is a medium to long term crop. A full coffee crop is usually obtained nearly 3 years after the coffee tree is planted or renovated. Because of this, there is an important technological rigidity that hinders coffee growers to respond to short term movements in demand. Coffee growers, hence, need to make their long term planting or renovating decisions based on some medium to long term estimate of demand.

Unfortunately there is a wide gap in literature regarding estimates of coffee demand. To our knowledge there are only a few recent papers that have studied coffee demand[2]. These papers have focused on very few countries, namely Germany, Mexico, Netherlands, Sweden and the United States[3]. While these countries are important coffee consumers and account for nearly 30% of world coffee consumption (the US consumes nearly 21 million bags and Germany 8.5 million) a significant portion of world demand still remains unexplored. Using a panel of 88 countries from 1990 to 2005, this paper contributes to filling this gap by estimating world demand for coffee. As noted throughout the paper there is strong evidence of heterogeneity across countries particularly determined by the country's income level, which is explicitly captured in the estimations. A non-linear relationship between coffee consumption and income is detected. This is a crucial result for coffee growers for their medium and long term production decisions.

2. Specification and Data

A standard log linear demand function is estimated. The demand for coffee in per capita terms for each country during each year is modeled as a function of the country's per capita income and a relevant measure of coffee prices. In order to capture country specific factors that affect coffee demand such as cultural factors and local market specific characteristics, among others, country fixed effects are included in the empirical specification. Additionally and in order to capture world trends or events that affect coffee consumption such as the expansion retail stores around the world or price changes of substitute goods like tea, year effects are also included in the specification. Formally the following baseline specification is estimated:

$$\log(C_{it}) = \beta_1 \log(Y_{it}) + \beta_2 \log(P_{it}) + \mu_i + \theta_t + \varepsilon_{it} \qquad (1)$$

where C_{it} is country i's per capita consumption of coffee at time t (measured in kilograms per person), Y_{it} is income per capita in US dollars in country i at time t, P_{it} is the relevant price for coffee of country i at time t in US cents per pound, μ are country fixed effects and θ are year effects. A panel of 88 countries from 1990 to 2005 is available for estimation[4].

[1] See ICO (2006). A bag of coffee is equivalent to 60 kilograms of coffee.

[2] Several studies are available, but they consider periods prior to the 1990s when the international Coffee market was regulated both in terms of prices and quantities.

[3] See Bettendorf and Verboven (1998 and 2000), Durevall (2007a and 2007b), Koerner (2002a and 2002b) and Martinez and Salinas (2004) for recent research on coffee demand in these countries.

[4] The sample includes the following countries: High Income: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Netherlands, Ireland, Israel, Italy, Japan, Korea, New Zealand, Norway,

The source of coffee consumption data is Landell Mills Commodities Studies (LMC International)[5], income per capita data as well as population data to obtain per capita coffee consumption comes from the World Bank's World Development Indicators, and prices are constructed based on ICO data as well as LMC data.

The price data is crucial for this study. Ideally retail prices in each country would be the preferred price measure to use in the estimations, but this data is not available for most countries. Instead, a relevant price is estimated for each country based on its imports or production of coffee. There are four varieties of coffees in the world: robusta, natural o unwashed arabica, Colombian milds, and other milds. For each of these varieties the ICO publishes daily international market prices. In order to construct a relevant price for each country, they are divided between net producers and net importers of coffee. For importers, the price measure used is the weighted average of the ICO price of each type of coffee imported using as weights the average share of each variety imported (with source LCM)[6]. For producers prices are also the weighted average of ICO prices weighted by the share of each type of coffee produced in the country[7].

Despite the fact that the average import and retail prices can differ due to the competitive structure of the local market among other factors, for the 22 countries for which retail price data is available there is a strong correlation between the two[8]. In any case, one can expect that part of the price markup due to local factors is time invariant, and hence is partially captured by the country fixed effect.

Table I reports summary statistics for the main variables used in the empirical study. The statistics are reported for the total sample, as well as for groups of countries according to the World Bank's income level classification. It is worth noting the relevant differences in coffee consumption across income levels. While the difference is smaller between medium and low income countries, there is a notable difference when compared to high income countries where the yearly per capita consumption reaches an average of nearly 5 kilograms per year.

3. Empirical Methodology and Results

In order to estimate equation (1) several methodological issues need to be considered. First, given that coffee consumption is highly persistent at the country bank level, its lag is included as a regressor. The inclusion of a lagged dependent variable in the context of a panel with fixed effects is well known to generate biased and inconsistent estimates. This is the case because, by construction, the lagged dependent variable will be correlated with the error

Portugal, Singapore, Slovenia, Spain, Sweden, Switzerland, United Kingdom, and United States; Middle Income: Algeria, Saudi Arabia, Argentina, Bolivia, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Ecuador, El Salvador, Slovak Republic, Russian Federation, Philippines, Gabon, Guatemala, Honduras, Hungary, Jamaica, Malaysia, Morocco, Mexico, Panama, Paraguay, Peru, Poland, Czech Republic, Dominican Republic, Romania, Sri Lanka, South Africa, Thailand, Trinidad and Tobago, Turkey, and Venezuela; and Low Income: Angola, Benin, Burundi, Cameroon, Central African Republic, Congo, Democratic Republic of Congo, Ethiopia, Ghana, Guinea, Haiti, India, Indonesia, Ivory Coast, Kenya, Madagascar, Malawi, Nicaragua, Papua New Guinea, Rwanda, Sierra Leona, Tanzania, Togo, Uganda, Vietnam, Zambia, and Zimbabwe. Income classification follows the World Bank's criteria.

[5] The source of the data is LMC International – Coffee Quarterly.

[6] The average share is used to reduce endogeneity problems that may arise given that the share in each period of time can be influenced by the relative prices of each variety. The empirical exercises that follow are also estimated using a price measure based not on the average share, but on the lag of the share. Results using this measure are similar to the ones obtained in this study, and are available upon request.

[7] In most countries only one variety is produced, so the relevant price in producer countries is almost always the ICO price of the variety produced.

[8] The pairwise correlation coefficient is 0.35 and significant at the 1% significance level.

term. Second, there is a potential of endogeneity in the estimation given that prices may be influenced by quantities consumed, and there may also be unobservable factors driving both coffee consumption and GDP per capita. To deal with these issues, and following Arellano and Bover (1995) and Blundell and Bond (1998), equation (1) is estimated using the system GMM estimator[9]. The use of the system GMM estimators controls for the bias induced by the lagged dependent variable and also provides a set of instruments to control for possible endogeneity of the rest of the regressors[10].

Table I: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
All Sample				
log(Per capital coffee consumption, kilos)	-0.187	1.851	-5.868	2.545
log(GDP per capita US$)	7.903	1.680	4.437	11.026
log(Price US$/lb)	-0.254	0.455	-1.289	0.688
Low Income				
log(Per capital coffee consumption, kilos)	-2.131	1.606	-5.868	0.905
log(GDP per capita US$)	5.885	0.640	4.437	7.789
log(Price US$/lb)	-0.347	0.505	-1.289	0.688
Middle Income				
log(Per capital coffee consumption, kilos)	-0.092	1.203	-5.017	1.822
log(GDP per capita US$)	7.811	0.682	5.791	9.442
log(Price US$/lb)	-0.231	0.446	-1.289	0.688
High Income				
log(Per capital coffee consumption, kilos)	1.564	0.560	0.153	2.545
log(GDP per capita US$)	9.990	0.435	8.744	11.026
log(Price US$/lb)	-0.196	0.400	-1.244	0.603

Results of estimating equation (1) by GMM are reported in the first column of table II. The lagged dependent variable is significant, suggesting that in fact the persistence of coffee consumption is statistically relevant. The estimated income and price elasticities are significant and have the expected signs. A one standard deviation increase in income per capita (1.68) leads to a 16% increase in per capita coffee consumption, while a one standard deviation increase in prices (0.455) leads to a reduction of nearly 7.1% in coffee consumption. Country fixed effects are differenced out in the estimation, and year specific effects are included, which, as reported in the lower half of the table, are also statistically significant. The rest of the statistical tests reported in the table suggest that the system GMM specification and the selected set of instruments are valid. The Sargan test validates the

[9] This method relies on differencing the equation to address the problem of possible omitted-variable bias induced by the presence of the country fixed effects. In addition, and to address the problem of joint endogeneity, lagged values of both the independent and dependent variables are used as instruments for contemporaneous values of the independent variables. The results reported use the system estimator that improves on the standard first differenced GMM estimator by exploiting instruments available for the equations in levels. This improves the precision and reduces the finite sample bias when these additional moment conditions are valid.

[10] In the estimations the first four lags of GDP per capita and of the price of coffee, and the second to fourth lags of the dependent variable are used as instruments. As noted in table 2, the instruments are validated by the Hansen test.

selection of instruments, and the AR(1) and AR(2) tests are in line with the specification of the model[11].

The results in column 1 assume that there are no differences in the estimated coefficients across countries. However, and as frequent in demand estimations, it is likely that differences across individuals or countries are present and hence aggregate results may be biased. A frequently used differentiation criteria across units is their income level. Studies have shown that lower income individuals (or countries) have higher income elasticities in their demand for commodities[12]. This research is followed to test if coffee demand also responds differently to income and prices at different income levels. There are several reasons that could explain such differences. On the one hand higher income is associated with higher savings rates. When income is higher, a reduction in income may be accommodated via lower savings without altering consumption. When income is lower, a reduction in income necessarily leads to a reduction in consumption since the savings buffer may not be available. In addition, and as noted in table I, high income countries have high levels of consumption. An increase in income will not necessarily lead to higher consumption, since coffee drinkers may already be at their optimal level. For lower income societies, the increase in income may allow them to converge faster to their optimal coffee consumption intake.

Table II: Empirical Results

Dependent variable: log(Per Capita Consumption of Coffee)	(1)	(2)	(3)	(4)
Lag of log(Per Capita Consumption of Coffee)	0.907***	0.913***	0.875***	0.878***
	[0.080]	[0.061]	[0.096]	[0.092]
Log (GDP Per Capita)	0.096*	0.161**	0.386**	0.390**
	[0.052]	[0.071]	[0.156]	[0.151]
Log (GDP Per Capita)*High Income		-0.026**		
		[0.011]		
Log(Price)	-0.155**	-0.190***	-0.185**	-0.180*
	[0.066]	[0.068]	[0.078]	[0.095]
Log(Price)*High Income		0.013		
		[0.019]		
Log (GDP Per Capita)^2			-0.017*	-0.017**
			[0.009]	[0.008]
Log (GDP Per Capita)*Log(Price)				0.005
				[0.010]
Observations	1264	1264	1264	1264
Number of Countries	88	88	88	88
Year effects	Yes	Yes	Yes	Yes
P-Value F test Year effects = 0	0.001	0.041	0.047	0.043
P-Value Sargan Stat	0.581	0.985	0.908	0.857
P-Value AR1	0.002	0.003	0.004	0.004
P-Value AR2	0.981	0.999	0.992	0.987

Windmeijer(2005) corrected standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

A first approach for testing this idea is by interacting the determinants of demand with dummy variables indicating the income level of each country according to some

[11] By construction and due to the inclusion of the lagged dependent variable there is serial correlation of order 1in the residuals. The appropriateness of the specification is reflected in the fact that there is no evidence of higher order serial correlation.

[12] Among others, Gately and Huntington (2002) show that there are crucial differences in income elasticities across countries for energy commodities, and Park et al (1996) show similar results for food commodities.

classification. This is done in the second column of table II using World Bank income classification. Results following this approximation show that in fact the estimated elasticities differ between high income countries and medium and low income ones. For high income countries, the income elasticity is significantly lower than for the rest. As seen from the estimated interactions, not only is the difference between the elasticities significant in statistical terms, but is also sizeable and about 20% lower for high income countries. There is no statistical difference in the price elasticity across groups.

In order to push this result further and instead of using an arbitrary classification of income levels another avenue is pursued. Columns 3 and 4 of table II report estimation results in which, instead of adding interaction with dummies, the interactions with the level of income per capita itself is included. This specification assumes that there is a non-linear relationship between per capita coffee consumption and per capita income, which is equivalent to assuming a linear relationship between income elasticity and income per capita. Two specifications are estimated following this idea. The third column of table II, only reports a non-linearity with respect to income. The fourth column reports interactions with both income and prices.

The results in column 3 of table II, confirm the finding that income elasticity decreases with income level. In fact, for high income countries, income elasticity is not significantly different from to zero[13]. In column 4, the interaction between prices and income is not significant supporting the evidence provided in column 2.

In order to provide a magnitude of the ranges in which the income elasticity fluctuates figure 1 plots the estimated elasticity of coffee per capita consumption to GDP per capita, for different levels of GDP per capita based on the estimates of column 3. The figure also plots 95% confidence intervals for the estimated elasticity[14]. For the country with the lowest GDP per capita in the sample (Burundi) the estimated income elasticity is 0.268 and significant at the 5% significance level. For the country with the highest income per capita in the sample (Switzerland) the estimated elasticity is 0.07, and is not statistically different from zero. According to these estimates, the estimated elasticity becomes non significant at an income per capita of about US$14,000[15].

4. Final remarks

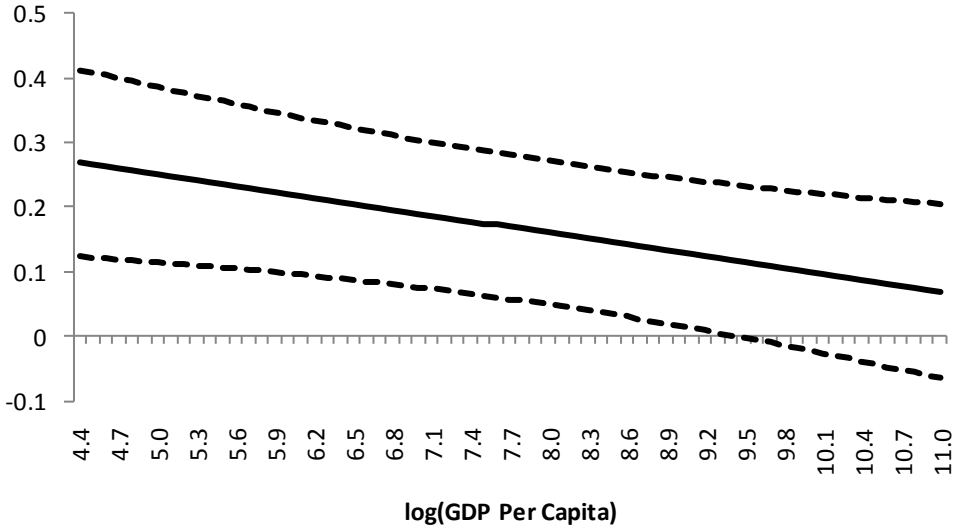
This paper provides evidence of non-linearities in the demand for coffee using a sample of 88 countries during 15 years. Particularly, it shows that high income countries, which represent over 60% of the total consumption of the countries in the sample in 2005, have a very low income elasticity of demand. Noting this difference across different types of countries is crucial for coffee growers in their attempt to forecast medium and long term coffee demand and adjust their production schedule accordingly. These results suggest that the strategy employed by large coffee producers of promoting coffee consumption in middle income countries such as some in emerging Asia and Eastern Europe, may be profitable.

[13] Income elasticity in this case is given by $\beta + \gamma*2*\ln(y)$ where β is the coefficient of log(y), γ is the coefficient of $\log(y)^2$, and y is GDP per capita.

[14] Note that the relevant income dependent standard deviation with which the confidence intervals are constructed is given by: $\widehat{\sigma_y} = \sqrt{var(\hat{\beta}) + 4y^2 \cdot var(\hat{\gamma}) + 4y \cdot cov(\hat{\beta}\hat{\gamma})}$ and the coefficients are defined as in the previous footnote.

[15] This includes the following countries in the sample: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovenia, Spain, Sweden, Switzerland, United Kingdom, and theUnited States.

Figure 1: Estimated Income Elasticity and Confidence Intervals



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