Item #4

Email discussing Professor John Gibson's research, and attachment "The Price is Right"

Email chain discussing Dr John Gibson's research proposal on sugar taxes, and attached copy of his Marsden Fund application form (Ministry of Health only holds pages 1-10), sent 4 May 2015

Sent By: John Gibson <[redacted]> on 4/05/2015 11:08:24 a.m.
To: Bronwyn_Croxson@moh.govt.nz
Copy To:
Subject: email from John Gibson: Your work on the impact of taxes on sugar consumption

Hi Bronwyn

Oh sure, I am happy for you to circulate it and it can be in a form that it becomes a public domain document.

The Whale Oil blog had some (unfavorable) discussion of the proposal, based on the newspaper reports of the time. The basic criticisms were "what a lot of money to study the self-evident" or "they are spending money on research outside of NZ" that NZ taxpayers have funded. I did send in a reply to the main points, but more public information on what researchers propose to do, and the slow rate at which we manage to achieve changes in understanding of issues should all help with public debates like this.

John

On Mon, May 4, 2015 at 10:34 AM, <Bronwyn_Croxson@moh.govt.nz> wrote:
Many thanks John. The grant application sets out very clearly the issues relating to accurately measuring price elasticities. May I give the proposal to others in the Ministry and, perhaps, to the Minister? This can be done either in confidence or in a way which makes it a public document - I cant see the proposals, only summaries, on the Marsden website so assume this is not normal practice here. I would like to see this type of detail in the public domain - what do you think?

With thanks again and would certainly like to host you to give a talk in Wellington when you are ready.

Bronwyn

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From: John Gibson <[redacted]>
To: Bronwyn_Croxson@moh.govt.nz,
Date: 03/05/2015 01:56 p.m.
Subject: Re: Your work on the impact of taxes on sugar consumption

Hi Bronwyn

Thanks for the interest. Technically the project started on Friday and runs for 3 years from then.

Please note that it is methodological work, so there is nothing that will use NZ data, but it may still provide reasons for caution that analysts might point out when interpreting results for policy makers.

In addition to the proposal here is a link to a paper we did that uses the same demand framework, and addresses many of the same issues, and shows the magnitude of these effects in biasing naive estimates of price elasticities:

https://ideas.repec.org/a/eee/wdevel/v43y2013icp329-340.html

Once we are some way through the project I would be happy to give a talk at MoH when I am in WLG for other reasons.

John

On Sun, May 3, 2015 at 9:30 AM, <Bronwyn_Croxson@moh.govt.nz> wrote:
Hi John,

I was very pleased to see you had been awarded a Marsden grant to do some rigorous work on the impact of so-called "sin taxes". This is, as you know, topical.

I wondered, please, if I might have a copy of your grant proposal, both to understand the data you will be using and the likely dates when results will be available.

With best wishes

Bronwyn

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[attachment "Gibson_Olivia_Le_Andalon_proposal_Price_is_Right.pdf" deleted by Bronwyn Croxson/MOH]
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Proposal	Contact PI's Surname	Initials	Application Number	Panel
Standard	Gibson	JK	14-UOW-014	EHB

MARSDEN FUND FULL RESEARCH PROPOSAL

Standard Application Form

1A. TITLE OF RESEARCH PROPOSAL

The Price is Right?

1B. IDENTIFICATION

Contact Principal Investigator

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1D. SUMMARY

Correct estimates of how quantity demanded falls as prices rise are fundamental for evaluating public policies like sin taxes on tobacco products and proposed taxes on sugar-sweetened beverages. Existing studies in economics and public health are likely to have overstated the magnitude of quantity responses to price rises. Consequently, there is likely to be excessive optimism over the scope for sin taxes to cut consumption of items like soft drinks and tobacco as ways to improve health. Consumers adjust to higher prices by reducing quantity, and also by downgrading the quality (cost per unit) of what they consume. But the existing literature ignores quality responses. Instead, the demand estimation framework used with survey data wrongly treats any consumer response on the quality margin as a quantity response. In order to correct this error, innovation is needed in terms of the survey data and estimation frameworks used to estimate demand responses, so that consumers' choices of both quantity and quality are correctly modeled. The proposed research is the first systematic study of bias from ignoring quality responses when modelling effects of tax-induced price rises on quantity, and is also the first study of data options to mitigate this bias.

2A. BACKGROUND

Market prices are the main coordinating mechanism used to guide purchase decisions. This reflects standard economic theory; regulation by price is more efficient than command and control (Glazer et al, 1996). To stimulate a desired activity, prices facing consumers are lowered. Examples include tertiary education, with subsidized tuition and interest-free loans, and ideas for encouraging fresh fruit and vegetable consumption by removing GST. Conversely, to nudge consumers away from products such as tobacco, prices are increased through imposition of commodity-specific sin taxes. It is rare in market economies to see outright bans, with price signals relied on most of the time.

But by how much should prices move to induce meaningful changes? Some evidence suggests even small price changes may nudge consumers in desired directions. For example, a proposed 20% tax on fizzy drinks is predicted to save lives and reduce New Zealand's obesity burden (Ni Mhurchu et al, 2014a). A broad movement in favour of taxes on unhealthy foods is emerging in many countries; according to the New Zealand Medical Association "taxation on unhealthy foods is the single most cost-effective approach to tackling obesity" (2014: 20). The research literature on this topic has fixed attention on a 20% tax on sugar-sweetened beverages (SSBs). Briggs et al (2013) predict that such a tax would reduce the number obese in the United Kingdom by 180,000 while a similar tax in India is predicted to avert 11.2 million cases of obesity over the next decade (Basu et al, 2014).

At the heart of these studies is the concept of the *price elasticity of demand* – the percentage change in the quantity demanded with respect to a one percent change in the price. Blakely et al (2014) sum up evidence on this parameter as "[E]conometric research generally finds that a 1% increase in SSB price should decrease consumption by about 1%". Armed with an estimate of this elasticity, one can predict how much SSB consumption would fall by, if prices rose 20% after the imposition of a tax. The fall in liquid calorie intake then maps into less weight gain and a lower rate of obesity in the population. A few threats to this causal pathway are examined in the literature; for example, a tax on SSBs could cause consumers to switch their demand to other categories of food and drink that might also be unhealthy. The evidence suggests limited inter-food substitution (Finkelstein et al, 2013). Errors in measurement also may affect the elasticity estimates (Zhen et al, 2014).

But what has not been considered in this literature is a much bigger threat to elasticity assumptions. The textbook price elasticity considers demand for a specific item but the data used in these studies on SSB taxes do not correspond to this idealized case. These studies aim for results that are age-, income- and ethnic-group specific and it is only survey data that can be disaggregated in such ways. In particular, it is surveys of household budgets that are used. Almost 60 years ago the nature of these data was described by Prais and Houthakker (1955, p.110):

> "An item of expenditure in a family-budget schedule is to be regarded as the sum of a number of varieties of the commodity each of different quality and sold at a different price."

This variation within the expenditure items defined by the survey causes problems to unsuspecting researchers, even if the items are as finely defined as "fizzy drinks" rather than as broadly as "all non-alcoholic drinks". Consumers adjust to higher prices by reducing quantity, but also by down-grading quality (cost per unit) of what they consume. A switch to cheaper varieties allows spending on an item to fall by more than quantity. But the studies that model effects of taxes on SSBs (and on sin taxes, more broadly) ignore these quality responses. Instead, these studies wrongly treat any consumer response on the quality margin as a quantity response and thus exaggerate the elasticity.

How big is the bias from ignoring quality responses? The evidence is just from poor countries but it shows large bias. McKelvey (2011) finds a price elasticity of demand for sugar in Indonesia that seems to be -0.40 if quality substitution is ignored, but is much less elastic, at -0.14 if account is taken of quality downgrading. **Gibson** and Kim (2012) find the price elasticity of demand for rice in Vietnam seems to be -0.83 if quality effects are ignored, but is only -0.27 once they are accounted for, with similar attenuation for other foods. The bias is likely larger in rich countries, where consumers have a wider range of varieties available. For example, in the *New World* supermarket near the University of Waikato, the dearest fizzy drink is $6.06 per litre (a 4 pack of 330ml bottles

of *Coke*) and the cheapest is just $0.66 per litre (a 1.5 litre bottle of *Pams* cola). The 9:1 ratio of dearest to cheapest gives great scope if one wishes to maintain fizzy drink intake as prices rise, by sliding down the quality scale from small *Coke* bottles to large *Pams* bottles. Even staying loyal to one brand, there is a 3.6:1 ratio of dearest to cheapest variety (size) for *Pepsi* and a 4.5:1 ratio for *Coke.* The consumer who economizes by buying cheaper varieties (eg, brands, bottle sizes) of fizzy drinks when prices rise is wrongly treated in the existing literature as a consumer who has reduced the *quantity* that they consume (and hence, reduced their sugar intake). The true fall in quantity is likely much smaller than what is modeled, and the efficacy of SSB taxes in reducing obesity (or of sin taxes, more broadly) will be much lower than is hoped.

Such problems with price elasticities from survey data were raised more than 25 years ago (Deaton, 1987). But they remain almost entirely ignored, not just in the literature on SSB taxes but more broadly in the applied demand literature. Moreover, the method proposed by Deaton (1988, 1990) to untangle quantity and quality responses to price changes is rarely used and restrictions it relies on seem to fail in practice (McKelvey, 2011; **Gibson** and Kim, 2013; **Gibson** et al, 2014). As a result, it is not clear that "the price is right" in proposed sin taxes based on some research studies.

2B. OVERALL AIM OF THE RESEARCH

The first general research goal is to test for, and demonstrate the bias that occurs in the literature, if studies of consumer responses to price changes wrongly treat quality adjustments as a quantity response. Existing studies that advocate for SSB taxes ignore this potential bias, despite the large scope for within-item quality substitution. Only a few countries (and not New Zealand) have the required data for estimating within-item quality responses as consumers adjust to price changes, for policy-salient items such as SSBs and tobacco. What is needed is data on demand, in terms of expenditures or budget shares, data on prices, and data on the quality (average cost per unit or some other proxy) matched at a spatially- and commodity-wise disaggregated level. Our research team are experienced with consumption and price surveys in some of these countries, including Mexico, Indonesia and Vietnam (**Andalon**, 2011; **Olivia** and **Gibson**, 2013; **Gibson, Le,** and Kim, 2014).

The first specific objective is to test for bias in estimates of the elasticity of quantity demand for sugar-sweetened beverages with respect to prices, when responses on the quality margin are ignored. To achieve this objective, we will use survey data to study soft drink demand in Mexico, which is one of the few countries with the required data for testing the hypothesized bias. Since Mexicans are heavy consumers of soft drinks and a tax on these items was recently imposed, this is also a salient setting for the tests. In fact, diabetes is the second leading cause of life years lost in Mexico, and obesity is the top risk for disability-adjusted life years (IHME, 2013).

Our second specific objective is to test amongst ways of controlling for within-item quality change as prices change, to see what methods allow the elasticity of quantity demand to be recovered free of bias. To achieve this objective, we will use survey data on smoking in Indonesia, where it is possible to control for quality either with unit values (overall item expenditures relative to overall item quantities, which indexes costliness of the varieties smoked) or with brand level controls, since brands reflect some of the attributes that smokers pay for. This study also is of interest to the country involved, since smoking is the 3rd highest risk factor for disease burden in Indonesia.

Our second general goal is to assess data options to overcome the bias studied under the first goal. Some researchers are guilty of using an incorrect demand framework that ignores quality choice, but in many cases the required data are unavailable even if they are aware of the importance of quality choice. Most countries lack the needed integrated data; budget surveys have data on demand and on a proxy for quality (unit values) but not on prices. The obstacle to progress in modelling demand responses along quality and quantity margins is data rather than lack of good econometric tools. Under this goal we will test novel ways of obtaining prices when they are not surveyed.

The **overall aim** of the research is to improve the modelling of demand responses to tax-induced price rises. Our findings will aid fiscal policy and public health by ensuring that the price is right.

2C. PROPOSED RESEARCH

The proposed research comprises four analyses. The first three exploit unusual existing data that are yet to be analysed while the fourth is an experiment on "crowd-sourcing" prices. Overall, this is the first systematic study of bias from ignoring quality responses when modelling effects on quantity of tax-induced price changes, and is also the first study of data options to mitigate this bias.

1. Effects of quality responses in undermining taxes on sugar-sweetened beverages (SSBs)

Many public health researchers advocate raising taxes on SSBs (fizzy and other soft drinks), such as Brownell et al (2009), Briggs et al (2013), Blakely et al (2014). It is the *quantity* consumed that is of interest, since sugar intake is proportional to this. But econometric models are for *expenditures*, typically in the form of *budget shares* following the seminal paper of Deaton et al (1980). For example, Ni Mhurchu et al (2014b) use budget shares for 24 food and drink groups from the NZ Household Economic Survey, where one group is fizzy drinks. The share of the budget spent on group G by household i, w_{Gi} is regressed on the logarithm of the household's total income or expenditure, $\ln x_i$, the logarithm of a price index for foods in group H, $\ln p_H$, household attributes (eg, ethnicity, demographics) that are contained in the vector z_i, and u_{Gi} is a random error term.

$$w_{Gi} = \alpha_G^0 + \beta_G^0 \ln x_i + \sum_{H=1}^{N} \theta_{GH} \ln p_H + \gamma_G^0 \cdot z_i + u_{Gi}^0 \qquad [1]$$

There are many varieties within a group so expenditure on group G represents price, quantity, and quality. This is not a normative description; *quality* simply represents average expenditure per unit and can be measured by the unit value (v_{Gi}). Total expenditure on the group is then $v_{Gi}Q_{Gi}$, where Q_{Gi} is group quantity for household i, and the budget share is $v_{Gi}Q_{Gi}/x_i$. Consequently, any change in the budget share as prices rise involves both quantity and quality responses and a second equation is needed to model quality choice (based on the unit values for household i, v_{Gi}):

$$\ln v_{Gi} = \alpha_G^1 + \beta_G^1 \ln x_i + \sum_{H=1}^{N} \psi_{GH} \ln p_H + \gamma_G^1 \cdot z_i + u_{Gi}^1 \qquad [2]$$

The variables in [2] are as defined in [1], with superscripts 0 and 1 to tell apart parameters between the equations. The literature on SSB taxes ignores equation [2]. Log-differentiating equation [1] with respect to income and price (subscripts are dropped to reduce clutter) shows why this matters:

$$\partial \ln w_G / \partial \ln x = \beta_G^0 / w_G = \varepsilon_G + \beta_G^1 - 1 \qquad [3a]$$

$$\partial \ln w_G / \partial \ln p_H = \theta_{GH} / w_G = \varepsilon_{GH} + \psi_{GH} \qquad [3b]$$

where ε_G and ε_{GH} are elasticities of quantity demanded with respect to income and the price of H, β_G^1 is the income elasticity of quality and ψ_{GH} is the elasticity of the unit value to the price of H (the *quality substitution elasticity).* The key parameters for modeling impacts of taxes on SSB quantity and on sugar intake are the ε_{GH} which should be estimated as: $\varepsilon_{GH} = (\theta_{GH}/w_G) - \psi_{GH}$. In other words, budget share responses to price changes, θ_{GH} must have quality responses to price, ψ_{GH} subtracted before a quantity response can be recovered. But if equation [2] is not estimated, ψ_{GH} is assumed to be zero, and any response on the quality margin is treated as a quantity response. This exaggerates falls in soft drink quantities as price rises and the efficacy of sin taxes will be over-stated.

Equation [2], and the correct price elasticity formula, cannot be estimated with extant data from NZ (or most countries). But it can for Mexico since surveys there pay special attention to SSBs; Mexico is the world's largest per capita consumer of soft drinks, has the highest obesity rate for any large country, and recently imposed a one peso (NZ$0.10) per litre tax on SSBs (Case, 2014). We will use ENIGH (*Encuesta Nacional de Ingresos y Gastos de los Hogares*) budget survey data for SSBs and other goods, matched to detailed price surveys at state level (www.profeco.gob.mx) to estimate equations [1] and [2]. A preliminary inspection of the prices shows that price variation from cheap to costly soft drink brands within a locality exceeds inter-area variation, even between poor states like Oaxaca and rich areas like Mexico City. This scope for within-group quality substitution makes ψ_{GH} unlikely to be zero, so modelled falls in SSB quantities as prices rise are likely overstated. Also we will test the indirect method of getting ψ_{GH} proposed by Deaton (1990), whose assumptions fail when it has been tested elsewhere (McKelvey, 2011; **Gibson** and Kim, 2013; **Gibson** et al, 2014).

2. Alternative controls for quality, in budget share and quantity demand studies for tobacco

While taxes on SSBs are a recent focus of public health and fiscal policy research, excise taxes on tobacco are of long-standing interest (Warner, 1990). The issues outlined for the first analysis also hold; without proper control for quality responses, price elasticities from survey data will likely overstate the efficacy of sin taxes. While studies of tobacco demand take account of complications due to addictive behaviour (Chaloupka, 1991) they ignore bias from treating quality responses as if they were quantity responses. In this analysis we will test for bias in estimated cigarette demand for Indonesia. There is high scope for within-item quality substitution, with Indonesians smoking both clove cigarettes (*kreteks*) and regular (white, filtered) ones; *kreteks* have high nicotine and tar levels (CDC, 1985) and sell at a premium. Yet existing studies of the price elasticity of cigarette demand in Indonesia (eg, Ahsan et al, 2013; Hidayat et al, 2011) ignore this quality variation.

Three features of the data enable us to build on findings from the SSB analysis. Individual demand rather than household demand is recorded; in Indonesia 67% of men smoke but just 5% of women (WHO, 2012) so it makes sense to study smoking of men separately. Second, the Indonesia Family Life Survey asks respondents about the type of tobacco products they use, how many cigarettes they smoke, and the price, brand, and quantity of cigarettes purchased over the last week. So in addition to using the unit value to control for quality when recovering quantity responses to prices, we will also control for the brand smoked as an indicator of quality. Third, the budget share models can be compared with models where the logarithm of the quantity of cigarettes smoked is the dependent variable. A changed functional form should not remove bias in demand models caused by ignoring quality variation. **Gibson** and Rozelle (2011) predict that double log demand models yield price elasticities that are too elastic (further from zero) if quality variation in unit values is not controlled. This will be tested with the Indonesian data, as will the prediction of **Gibson** and Kim (2014) that the relative price of high quality and low quality items within a commodity group varies over space, due to per-unit shipping costs (high value-to-weight of cigarettes poses a hard test). If relative prices vary it invalidates use of unit values as a measure of spatial price differences (Deaton, 1988).

3. Systematic assessment of using local knowledge of prices

The first two analyses are for Indonesia and Mexico not just as salient places to study smoking and soft drink consumption but also as two of the few countries with integrated data on demand, price, and quality. In most countries, surveys used to study demand do not gather prices (**Gibson, 2013**). These surveys may get quantities and expenditures on commodity groups, so *unit values* can be calculated, but these are best thought of as proxies for quality, and price elasticity calculations from just unit values are likely to be biased measures of quantity responses (McKelvey, 2011; **Gibson** and Kim, 2013; **Gibson** et al, 2014). The obstacle to making progress in modelling demand responses along quality and quantity margins is data rather than lack of good econometric tools. The contributions of Deaton (1987, 1988, 1990, 1997) in devising a clever method to derive quality and quantity responses to price changes if one just has unit values are unlikely to be bettered. The problem is that restrictions used by Deaton's method do not appear to hold in practice, albeit with results in just three countries (Indonesia, PNG, and Vietnam) that have the right data for testing.

To overcome the data obstacle, new ways to gather spatially- and commodity-wise disaggregated prices are needed. One type of data that is ignored is expert knowledge of local residents, who see prices in their everyday market transactions. Using local knowledge of prices to model demand if a formal price survey is either absent or incomplete was proposed by **Gibson** and Rozelle (2005) but to date the idea is untested. Data for such a test are available in a unique survey from Vietnam that used focus groups with the Women's Union in each of 1600 communes in 2010 to find the lowest price the good sells for (a), the typical price (b), and the highest price (c), for 60 consumer goods (including tobacco and SSBs). To ensure that reports in all places referred to the same quality for each item, photographs of the items were shown to key informants. With the data from (a), (b), and (c), one can use a triangular distribution to estimate the mean and variance of the local prices:

$$\mu = \frac{a+b+c}{3} \qquad \sigma^2 = \frac{a^2+b^2+c^2-ab-ac-bc}{18} \qquad [3]$$

A price index can be estimated for each area, weighting the mean of the prices obtained from key informants by their precision (inverse variance) to account for uncertainty in the reports.

A benchmark for assessing these prices comes from a spatial cost of living index survey carried out in the same communes at the same time. This cost of living survey provided the prices used to see how food demand responds on the quantity and quality margins as rice prices rise (**Gibson** and Kim, 2013) and also is used for testing a 'no-price' method of spatial and temporal deflation (**Gibson**, **Le**, and Kim, 2014). In this analysis we will estimate demand models for soft drinks, tobacco, and food groups using price reports from the key informants, and budget shares and a quality index (unit values) from a household survey carried out concurrently. We will test if the results match those estimated by combining the household survey with the cost of living survey.

4. Crowd-sourced price surveys using smart phones

The greatest scope for price policy to nudge consumers into healthier choices is in poor countries. In part this reflects more price elastic demand of poor people (Timmer, 1981). Also, such countries are early enough in the transition to a rising burden of nutrition-related non-communicable diseases to potentially prevent the most costly outcomes (Popkin, 2003). It is also poor countries where prices vary the most over space, due to weak infrastructure and diverse supply chains (**Gibson**, 2013). This price variation aids estimation of the elasticity of demand. But these same features make price surveys difficult; markets may be remote so survey teams skip them or else items are missing due to low density of demand. These are especially features of rural areas in poor countries, where studies often rely on heroic assumptions about prices that were not actually measured (Glewwe, 1991). Also in parts of Africa and Asia the widespread use of non-metric local units of measure undermines verbal reports on price and quantity (Capeau and Dercon, 2006).

An innovative solution to gathering prices in such settings leverages the growing access to low cost smart phones. As of May 2014 there are over five billion mobile phone subscriptions in developing countries and the mobile penetration rate will reach 90% by the end of 2014. Over half of mobile broadband subscriptions are in developing countries, versus just one-fifth in 2008, with growth in Africa far faster than elsewhere in the world (ITU, 2014). Impacts of mobile phones on aspects of economic development in poor countries are increasingly studied (e.g. Jensen, 2007; Aker, 2010) but much less attention is paid to the opportunities that mobile phones open up for data collection. Armed with a smart phone, it is possible for one to take a photo of an item for sale in a market, add a geo-tag and upload the details, including the price that the item is offered for. This could be done by a statistics office employee, giving a modern spin to the way a Consumer Price Index (CPI) has its prices collected, but a far more effective solution may be to "crowd-source" the activity.

Rather than pay someone to go to an area to survey a price, crowd-sourcing uses *in situ* residents to supply data using modern communication technologies. To date, this idea has been trialled in urban areas of developing countries, with participants rewarded with $5 of airtime for sending in a batch of prices for 30 supermarket items (Hamadeh et al, 2014). Soft drink prices were easily crowd-sourced and had the lowest rate of readings discarded for failing quality checks amongst items in the trial. Soft drinks also had some of the most variable prices over space, with a coefficient of variation two-thirds higher than for rice, in a sample of Indian cities. So even for demand research using a source like the National Sample Survey in India, that does not survey prices and only has unit values, it may be possible to add crowd-sourced prices to allow quantity and quality responses to price changes to be modelled (using elasticity formula that rely on equation [2]).

Our experiment will extend use of this method to rural areas and traditional markets. We plan to work in Tanzania, where the PI already collaborates on survey experiments (**Gibson** et al, 2015), where there is good 3G coverage, and where traditional non-metric units are pervasive. A market price survey using trained enumerators will provide a benchmark to test if crowd-sourced prices let researchers estimate quantity and quality responses to price changes that approximate those found by combining consumption surveys with traditional market price surveys. We will test how well the approximation works for urban and rural areas, and for formal retail outlets and traditional markets.

2D. REFERENCES

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2E. TIMETABLE

Number of Years (maximum of 3): 3

Year 1

(1) We will obtain and clean data to be used in the first three analyses, prioritizing analyses #1 (soft drink taxes) and #3 (local knowledge of prices), since the data are complete while IFLS is on-going (so new data may be available during the project). As AIs Andalon and Le are experienced working with the ENIGH, VHLSS and SCOLI data, we expect this step will proceed quickly.

(2) We will begin work on our first analysis, of quality substitution bias in demand elasticities for sugar-sweetened beverages in Mexico. This will follow methods outlined in McKelvey (2011) and **Gibson** and Kim (2012). We will begin a working paper from this study before the end of year 1.

(3) We will begin work on the third analysis, using the focus group data on local knowledge of prices and comparing with the results from the cost of living survey used in **Gibson, Le** and Kim (2014). We plan to begin writing a working paper from this study before the end of year 1.

(4) The PI will also work with the unnamed Masters student in year 1 to develop a suitable dissertation topic related to either Analysis #1 or #3 within the scope of the project.

(5) The PI will take the lead in preparatory work for the pilot experiment on crowd-sourcing prices.

Year 2

(6) Our next step will be to begin work on our second analysis, using budget share and double-log quantity-price models of cigarette demand in Indonesia. Since the AI and the PI have previously worked with the IFLS data (**Olivia and Gibson,** 2013) we expect to make fast progress on this analysis. Our goal will be to have a working paper version of the paper finished towards the end of the year. A Masters student will be involved in this work.

(7) We plan to work on revisions to the soft drink demand paper and the local knowledge of prices paper after getting feedback from academic presentations and circulating the papers. By the end of year 2, we expect to have submitted both of these papers to academic journals.

(8) A partner agency to field the experiment on crowd-sourcing prices will be chosen and the required programming to implement the experiment will be completed.

Year 3

(9) After presenting the tobacco demand paper in different forums and getting suitable feedback, we will work on revisions and submit it to an academic journal by the middle of year 3.

(10) The PI will work with a Masters student on design and analysis of the crowd-sourcing experiment and a working paper version of this study will be complete by the end of year 3.

(11) Finally, we will work to put together two short project summaries describing our main findings. The first will be directed at public health advocates and fiscal policy agencies, describing the importance of accounting for quality choice when assessing the efficacy of sin taxes. The second will focus on options for novel data collection methods to assist in the modelling of consumers' joint choice of quality and quantity. This summary will be presented to statistical agencies and research institutes and funders (e.g. RAND, the World Bank) that are involved in designing and fielding surveys used for demand analysis.

2F. ROLES AND RESOURCES

Principal Investigator (PI) Gibson will contribute 0.30 FTE per annum to the project in the first two years and then 0.25. He will work with Associate Investigators (AIs) Andalon, Le, and Olivia on the empirical methodology for the first three parts of the project and to write up the results. He will work with a Masters student and programmer(s) to develop the fourth part of the project. He will also provide project leadership and be responsible for making sure the work progresses. He also has