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How to sell a condom? The impact of demand creation tools on male and female condom sales in resource limited settings

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ABSTRACT

Despite condoms being cheap and effective in preventing HIV, there remains an 8 billion shortfall in condom use in risky sex-acts. Social marketing organisations apply private sector marketing approaches to sell public health products. This paper investigates the impact of marketing tools, including promotion and pricing, on demand for male and female condoms in 52 countries between 1997 and 2009. A static model differentiates drivers of demand between products, while a dynamic panel data estimator estimates their short- and long-run impacts. Products are not equally affected: female condoms are not affected by advertising, but highly affected by interpersonal communication and HIV prevalence. Price and promotion have significant short- and long-run effects, with female condoms far more sensitive to price than male condoms. The design of optimal distribution strategies for new and existing HIV prevention technologies must consider both product and target population characteristics.

1. Introduction

Since the onset of the HIV epidemic around 50 million HIV infections have been averted by the use of condoms (Stover, 2014). Condoms are cheap and highly cost-effective. However, in 2012, 2.3 million people still became infected with HIV (Joint United Nations Programme on HIV/AIDS, 2013). A recent UNAIDS meeting identified a condom gap of over 8 billion condoms, i.e. the difference between the UNAIDS target condom use in risky sex acts and actual use, with an annual use of just eight condoms per sexually active person in sub-Saharan Africa (Deperthes, 2014). Though there is new optimism that bio-medical tools exist to stem the HIV epidemic in the form of anti-retroviral (ARV)-based HIV prevention (Fauci and Folkers, 2012), these are service intensive, expensive, and not widely available. Achieving high levels of uptake of preventive interventions is particularly challenging because it requires a change in behaviour among populations who may not perceive themselves to be at risk, feel ill or face barriers, real or perceived, to accessing products and product support. For condoms and new HIV prevention products to fulfil their public health potential they must be used widely and effectively; this requires both ensuring consistent and accessible condom supplies and demand creation activities such as mass media advertising and inter-personal communication (IEC) promotion approaches.

Though public sector distribution may be free or very cheap for consumers to access public health products, it has a number of potential drawbacks such as limited opening hours, inconsistent supply, and low perceived quality of products and services (Hanson et al., 2001). Where private sector markets do exist, prices are often too high for those who need the products most. Additionally, competitive prices will be above the socially optimal price for HIV prevention because they are not capturing external benefits to society attributable to reductions in HIV. To fill this gap, social marketing organisations have been active for decades, initially distributing subsidised contraceptives including condoms, and more recently expanding to a range of public health commodities and services, such as mosquito nets, voluntary counselling and testing services, and male and female condoms for HIV prevention.

Social marketing is the application of private sector demand creation tools to stimulate positive behaviour change (Kikumbih et al., 2005). In particular, consideration is given to the four Ps: product,

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promotion, price and place (Grier and Bryant, 2005). Branded products aim to segment the market and appeal to different user groups. Promotion applies both generic advertising to increase the overall market size as well as branded advertising to appeal to different user groups, and interpersonal communication strategies. Differentially priced products allow for cross-subsidisation of high to low priced products, with the higher priced products capturing more of the consumer surplus, whilst providing a low-end product to ensure broad access. Additionally, having a sufficiently low, but positive, price aims to instil a sense of value and has been shown to have lower wastage associated with freely distributed condoms (Chapman et al., 2012). Subsidised products tend to be placed within the private sector retail distribution networks to increase outlets, while being sold by retailers for a profit, to ensure consistent supply and sustainability. In many countries, social marketing is now the dominant source of condom supply (Chapman et al., 2012). Because social marketing applies traditional demand stimulation tools to public health, while public sector distribution generally does not, it provides an opportunity for studying the effectiveness of these tools for stimulating demand for new and existing HIV prevention products, in the absence of private markets. Understanding drivers of demand for the male and female condom not only informs programmes on how to better stimulate demand for existing products, it also provides lessons that can potentially be applied to the introduction of both new single ARV based HIV prevention products and multi-purpose products that prevent both HIV and other infections or unwanted pregnancies.

No recent studies have addressed these questions. Brent (2009) estimated individual conditional demand for social marketing condoms in Tanzania and found a price elasticity around 1 with a strong influence of quality on willingness to pay, but did not allow price elasticity to vary by gender, though 86% of respondents (condom purchasers) were men. Sweat et al. (2012) reviewed the literature on the contribution of condom social marketing on condom use and their meta analysis showed that, though the evidence is weak, in particular for estimating the cumulative effect over time, exposure to a condoms social marketing programme doubled reported condom use among the general population. Differences in responsiveness between contraceptive products targeting men and women have been explored. A few studies provide some guidance as to the effect of social marketing on male condoms and oral contraceptive demand and they showed that the demand for products responded differently to the same stimulation tools. For example, Boone et al. (1985) showed that male condom demand was much more sensitive to changes in prices and advertising expenditures than oral contraceptive demand. Meekers and Rahaim (2005) looked at the impact of market environment and showed that, while male condom demand reacts consistently to variables representing country level socio-economic context, oral contraceptives were not significantly influenced by these in most of their analyses. Ciszewski and Harvey (1995) showed that condoms had much larger and quicker declines in sales than oral contraceptives following price increases in Bangladesh. More specifically for male and female condoms, a few important product and programme differences suggest potential differences in their demand responses. Firstly, male condoms have long been distributed and used as contraceptives, with the additional benefit of reducing the risk of STI and later HIV. Male condoms have generally been distributed through a wide range of distribution channels with minimal training and support for the users. Female condoms were developed as a method that women could use to protect themselves from HIV and pregnancy (Warren and Philpott, 2003). However, female condoms need significant introductory support: interpersonal communication and peer support groups have been shown to help women continue to use female condoms (Vijayakumar et al., 2006).

While these studies have shed some light on how marketing tools can stimulate demand, they have methodological weaknesses. None have tested for differences in drivers of demand between HIV prevention products, nor have any accounted for the fact that behaviour adjusts slowly to interventions and therefore analyses that fail to account for this may obtain biased estimates of the responsiveness of condom demand to changes in marketing tools and their long-run effects.

In this paper we explore the drivers of demand for HIV prevention products targeted at women and men (i.e. female and male condoms), using unique expenditure and sales data from Population Services International (PSI), a large international social marketing organisation, in an unbalanced panel of 52 countries over 11 years: 1997–2009.[1] To the best of our knowledge, this is the first study to conduct an economic/econometric analysis of the drivers of demand for female and male condoms. In addition to price, both programmatic demand creation tools (mass media advertising; 'information, education, and communication' (IEC) and programme effort), as well as the broader country context (income levels and adult HIV prevalence) are considered as potential drivers of demand. A dynamic panel data estimator is used to identify the short- and long-run impact of advertising, price and programme effort (staffing). This study can guide programmes on how best to allocate funds across their social marketing tools to maximise uptake and to inform programming of new HIV prevention products.

Broadly speaking this paper belongs to the advertising/promotion, and product/service use literature and is hence close in spirit to some papers in the health economics literature. Avery et al. (2012) study the impact of direct-to-consumer advertising on antidepressant use in the US, and similarly to this paper, they make a comparative analysis of female and male use of the product. Windmeijer et al. (2006) examine the responsiveness of general practitioners to promotional activities for ethical drugs by pharmaceutical companies in the Netherlands. Ridley (2015) investigates price and advertisement elasticities of demand in the US drug market. Dave and Saffer (2013) show that in the USA smokeless tobacco advertising both increases the market demand (primary demand) as well as shifting existing users to the advertised brand. Moreover they show taxes (i.e. higher prices) have a differential effect, reducing demand more among younger male smokers and lower educated individuals. These papers are all in high income settings and in the context of profit maximising firms. Our paper thus complements the economics of advertising literature by presenting evidence on a very different type of product, in resource limited settings and for a non-profit organisation aiming to maximise output.

There is a growing interest in the economics of HIV, with a body of papers addressing the interaction between HIV and the economy, or other structural factors such as schooling, gender based violence, risky sexual behaviour and labour force participation (Alsan and Cutler, 2013; Baranov et al., 2015; Chin, 2013; Francis, 2008; Galarraga et al., 2010; Oliva, 2010; Oster, 2012; Wilson, 2012). Many of these studies raise the challenge of establishing causality due to endogeneity issues, and address this using an instrumental variables approach. As another approach to establishing causality, economists have introduced randomised control trials in particular to test the impact of incentives on HIV prevention, such as keeping girls in school for longer (Baird et al., 2012), HIV testing (Baird et al., 2014; Thornton, 2008), staying free from sexually transmitted infections (de Walque et al., 2012; Galárraga et al., 2014) or voluntary medical male circumcision (Thirumurthy et al., 2014). While

[1] 2005 and 2006 data were not collected centrally and were therefore not available for this analysis.

in general financial incentives do induce behaviour change in the short-run, the impact is not consistent on male and female trial participants, and the long-run impacts are yet to be assessed. It is in estimating the long-run impact of marketing tools on behaviour change (condom use) that this paper contributes to the literature on the economics of HIV.

The remainder of the paper is organised as follows. Section 2 introduces the conceptual framework for analysing demand, especially the impact of demand creation tools on sales. Section 3 describes the data and Section 4 outlines the econometric approach. Section 5 presents and discusses the results and Section 6 concludes.

2. A model of male and female condom demand

The starting point for this analysis is the basic relationships underlying an aggregate demand model, where the quantity of a good demanded is a function of its price, the price of its substitutes (or complements),[2] and income. *Quantity* demanded is proxied by aggregate country level male and female condom social marketing sales by PSI. *Price* is set by country offices with the aim of high levels of distribution while aiming for sustainability and low wastage rather than being determined by market forces. *Income* is proxied by GDP per capita.

Given our interest in the effect of demand stimulation tools, the natural starting point is a generic model of the impact of advertisement on sales. The most common dynamic approach to estimating advertising impact is to specify Koyck's infinite geometric distributive lag model (Koyck, 1954), given by

$$\ln(q_t) = \alpha + \sum_j \beta^j \ln(X_t^j) + \lambda \ln(q_{t-1}) + \varepsilon_t,$$

where q_t is condom sales in period t and the X_t^j are variables impacting the quantity of condoms sold. λ is a coefficient representing the habit persistence/speed of adjustment and ε_t is a random error term. In this model λ lies between 0 and 1. If λ is 0, past experience has no impact on current purchasing decisions; if λ is 1, the process is non-stationary. A larger λ implies slower adjustment to external stimuli.

The short-run marginal effects of the explanatory variables (advertising and other external stimuli) are represented by β, and the long-run marginal effect is given by

$$\frac{\beta}{(1-\lambda)} \tag{1}$$

In the case of advertisement, the expression in (1) is commonly referred to as 'carryover' or 'goodwill'. To estimate how long it takes for 90% of the effect to have occurred, we use the 90% duration interval defined by Clarke (1976) as

$$\left(\frac{\ln(1-0.9)}{\ln(\lambda)}\right) - 1 \tag{2}$$

As we are using logarithmic transformations of the variables, the marginal effects are the short- and long-run elasticities.

In addition, the following determinants of condom demand are included. *Promotion* is explored as a composite of mass media advertising and 'information, education, and communication' (IEC) expenditures as well as in its disaggregated forms. As programmes can increase the quantities sold in various ways, including expanding distribution systems and improving the consistency of supply, *programme effort* (proxied by PSI local salary expenditures) is included. Acceptability and use of innovations (new products) increase with exposure (Bass, 1969; Rogers, 1962), we therefore include a measure of exposure called *product maturity*, i.e. the number of years each product has been sold. Although condoms can be used as a contraceptive, they are also an HIV prevention technology and their use is thus likely to be related to HIV-risk, represented by adult *HIV prevalence*. In contrast to a typical demand function, the dependent variable is not individual condom demand, but rather aggregate country level demand, making the size of the market, i.e. *population size*, important. As an issue of special interest, we will examine whether the relationship under discussion differs by product type: female versus male condoms.

3. Data

The data consist of country level PSI financial accounts used for routine programme monitoring, supplemented by the World Bank's World Development Indicators (WDI) (World Bank, 2006). Though PSI distributes a wide variety of public health products, this analysis focuses exclusively on male and female condom distribution. We have a total of 385 and 133 observations on male and female condoms, respectively. The sample includes countries in Africa, Latin America, Asia and Eastern Europe. The sample used in the static estimation contains 382 data points for male condoms and 133 for female condoms. The dynamic estimator requires at least three years of data to obtain one observation, because of the need for lags. The dynamic estimation thus had 280 male condom observations and 85 female condom observations.

Aggregate condom demand is proxied by country level sales of social marketing male and female condoms in an unbalanced panel of 63[3] countries over the period 1997–2009. The definition and descriptive statistics of each variable are presented in Table 1. Mean male condom sales are 100 times larger than mean female condom sales. Within this dataset, total country programme expenses are captured by expenditure category: local salaries; advertising and promotion; and information, education and communication (IEC), and are allocated across the range of public health products being distributed. As an illustration PSI country programmes that were distributing male condoms distributed on average four other products (range 0–19 additional products). Male condom programmes are generally far larger than female condom programmes, with mean female condom programme expenditures across these categories (IEC, advertising and local salaries) ranging from 6% to 9% of male condom programme expenditures. The WDI dataset contribute population size, HIV prevalence, and per capita income. All prices are adjusted to 2011 purchasing power parity (PPP) dollars ($).

Appendix 1 provides an overview of the data availability across countries and years and the descriptive statistics of the full data set, including the percentage of observations that were dropped in the static estimation.

Fig. 1 presents the sales quantities of male and female condoms over time. Generally, an increasing trend can be seen, with more

[2] Though we would have liked to examine the substitute market in detail, the substitute markets are not well defined in this case. Conceptually substitutes for condoms are both contraceptives and HIV prevention products. Alternatively these could be more narrowly defined as female condoms as substitutes for male condoms and vice versa. However, the full country level aggregate distribution of each was not available for this analysis. An alternative approach would be to define it more specifically as socially marketed products. Prices for social marketing male condoms were available as the substitute market for female condoms; for male condoms this approach would result in a very large loss of observations: only 25–50% of condoms distributing male condoms also distribute female condoms. An alternative definition of the substitute market for male condoms could be to define a dummy variable for the availability of female condoms in the social marketing method mix. Inclusion of this is explored in the robustness checks presented in Table A6.

[3] The number of country programmes increased over time.

Table 1
Summary statistics.

Variable	Definition, source	Data source	Male condom programme		Female condom programme	
			Mean* (Min–Max)	Fraction of zero values	Mean* (Min–Max)	Fraction of zero values
Demand	Condom quantity sold	PSI	16,729,476.84 (249–197,030,442)		163,801 (26–4,238,960)	
Price	Condom price	PSI	$0.09 ($0–$0.65)	4.5%	$0.36 ($0–$4.14)	14.3%
Programme effort	Local salary expenditure	PSI	$1,082,587 ($0–$17,580,319)	1%	$115,202 ($0–$1,159,756)	9.8%
Advertising	Advertising expenditures Advertising refers to mass media promotion strategies	PSI	$776,628 ($0–$7,897,325)	3.7%	$64,832 ($0–$690,505)	28.6%
Information & Education Campaign	IEC expenditures IEC refers to one-on-one or small group intra-personal communication promotion strategies	PSI	$491,159 ($0–$12,362,417)	22.0%	$297,789 ($0–$441,515)	33.8%
Promotion	IEC expenditures + advertising expenditures	PSI	$1,267,788 ($0–$15,761,431)	1.6%	$95,338 ($0–$690,505)	19.5%
Product maturity	Years of condom product sales	PSI	8.13 (0.2–24)		4.43 (1–13)	
HIV adult prevalence	Prevalence of HIV in the adult population	WDI	5.64% (0.10%–28.70%)		8.27% (0.10%–28.60%)	
GDP per capita	GDP per capita	WDI	$3.642 ($548–$18,032)		$3.489 ($583–$14,023)	
Population Size	Population size (in millions)	WDI	55.82 (47.73–71.49)		55.87 (48.55–69.44)	
n			382		133	

* Values are presented in natural units (not logarithms).
All prices are presented in 2011 purchasing power parity dollars.
PSI: Population Services International programme accounts, the social marketing organisation. WDI: World Development Indicators database.

widespread and larger scale male – than female – condom sales. Condoms sold by region over time can be found in Fig. A1. Africa has the highest distribution of all condoms, with a substantial number of male condoms distributed in Asia, while few female condoms are distributed outside of Africa.

4. Estimation strategy

4.1. Static analysis to compare drivers of demand between products

We start with a static model of the demand for male and female condoms to test for differences between their responsiveness to the various demand determinants. We estimate static pooled OLS and fixed effects models where we include intercept and slope dummies to distinguish between female and male condoms as follows:

$$\ln(q_{kit}) = \alpha + \theta FC + \sum_j \beta^j \ln(X^j_{kit}) + \sum_j \phi^j FC * \ln(X^j_{kit}) + \nu_i + \omega_t + \varepsilon_{kit}, \quad k = 1, 2;\ i = 1, \ldots, N;\ t = 1, \ldots, T$$

where k, i and t index respectively: product type (female or male condoms), country and time period, and FC is a dummy variable taking the value one if the product is female condom and zero otherwise. As already enumerated in Section 2, the full set of variables

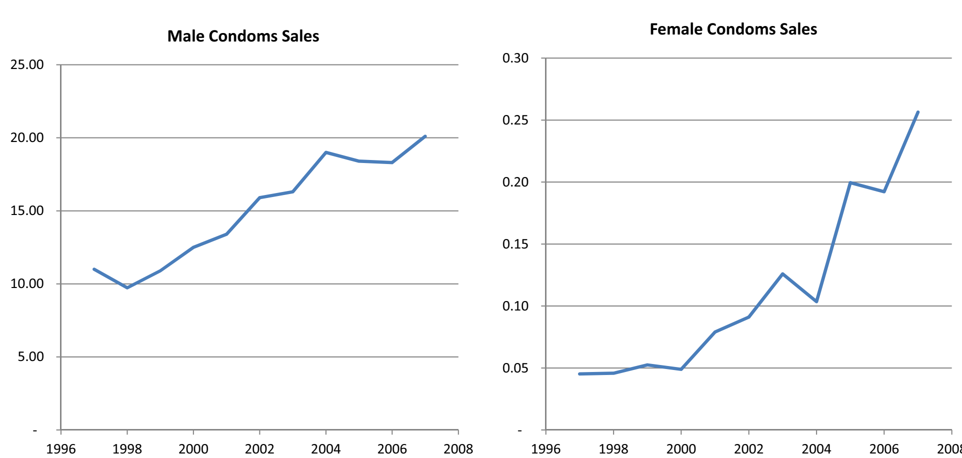

Fig. 1. Condom sales by product and year (in millions).

to be explored is: *Price of condoms, Promotion* (or *Advertising and IEC*) and *Programme effort, Income, HIV prevalence, Product maturity*, and *Population size*. The ν_i and ω_t are country and time effects, respectively. The country fixed effects absorb the effects of any unobserved country characteristics, such as geography and culture. The time fixed effects capture the impacts of factors such as yearly fluctuations in funding flows that may affect all country programmes and both product types in a certain time period. Given the strain on degrees of freedom, we will also estimate an alternative specification of the time fixed effect by including just a trend variable.

4.2. Dynamic models of demand

Following our discussion in Section 2, a dynamic model of demand for each product (female or male condom) can be specified as follows:

$$\ln(q_{i,t}) = \alpha + \sum_j \beta^j \ln(X^j_{i,t}) + \lambda \ln(q_{i,t-1}) + \nu_i + \omega_t + \varepsilon_{i,t},$$
$$i = 1\ldots N;\ t = 1\ldots T$$

where variables and coefficients are defined as above. As is well known, the OLS and fixed effects estimators for λ are expected to be biased upwards and downwards, respectively, the latter especially with a short time series dimension T as we have here. Thus the fixed effects estimator is likely to imply a higher rate of annual advertising depreciation (thus a smaller λ) compared to estimation using pooled OLS (Blundell et al., 2000).

The generalised methods of moments (GMM) estimator provides a consistent estimation framework for dynamic panel data models (Arellano and Bond, 1991). With GMM, the model is first-differenced to remove the country effects ν_i. Then $\ln(q_{i,t-2})$, $\ln(q_{i,t-3}), \ldots, \ln(q_{i1})$ can be used as valid instruments for the lagged sales difference $[\ln(q_{i,t-1}) - \ln(q_{i,t-2})]$, which is endogenous in the first-differenced model. The instruments are valid as $E[(\varepsilon_{i,t} - \varepsilon_{i,t-1})\{\ln(q_{i,t-2}), \ln(q_{i,t-3}), ..., \ln(q_{i1})\}] = 0$, under the assumption that the $\varepsilon_{i,t}$ are serially uncorrelated.

It has been shown that the Arellano and Bond estimator suffers from finite sample weak instruments bias when the series are persistent (Blundell et al., 2000). To mitigate this problem Blundell and Bond proposed the 'system' (SYS) GMM estimator, which estimates the parameters based on a combination of levels and differences. Specifically, the SYS-GMM employs the lagged differences as instruments for the equations in levels, assuming that initial conditions, like mean-stationarity, are in place such that

$$E[(\nu_i + \varepsilon_{i,t})\Delta \ln(q_{i,t-1})] = 0.$$

The main disadvantage of the GMM estimation approach is the loss of degrees of freedom. This loss of degrees of freedom is not random: the early years of a sample, which often represent new market entry, are lost. The GMM estimator quantifies advertising effects only in the more mature markets because it includes only groups with three or more years of sales history. It can thus not provide information on the relative value of advertising in early years of a product's history. Moreover the number of potential instruments becomes large when there are many time periods and variables; it is therefore recommended to limit the number of instruments included. The one-step system GMM estimator using sequential instruments dated $t-2$ to $t-3$ is used to estimate the parameters of the dynamic panel data model (4), using Stata command xtabond2 (Roodman, 2009).

As the marketing tool variables include zero values, i.e. when condoms are distributed freely or there were no expenditures for promotion or local staff, we assign a small value (0.1) to these observations before taking logs, and include binary indicator variables for those observations.[4] The GMM estimates are then used to estimate the long-run effects of the demand stimulation tools on sales, Eq. (1). The variances of these long-run effects are estimated using the delta method; in STATA this is done using the 'nlcom' post estimation command. We use these to evaluate the significance of the long-run elasticities.

As we mentioned above, prices, promotion and programme effort are determined by country offices. After controlling for country and time fixed effects, the endogeneity of these variables with respect to demand shocks is limited as normal market forces are not at work here. There may of course be some slow responses to demand shocks, but we assume that they are such that $\varepsilon_{i,t}$ and $\varepsilon_{i,t-1}$ do not affect current and one-period lagged prices, promotion and programme efforts. Under this assumption, the GMM estimator, only controlling for the endogeneity of lagged demand, will consistently estimate the short- and long-run effects.

Our dynamic panel data framework allows us to treat all variables as endogenous, but at a cost of weaker identification and an increasing number of instruments. As a robustness check, we also estimate the dynamic model parameters by GMM, treating prices, promotion and programme effort as endogenous, using lagged levels dated $t-2$ and $t-3$ as instruments for the first-differences and lagged changes dated $t-1$ as instruments for the levels.

5. Empirical results

5.1. Main results

As already discussed our aim is to understand the drivers of demand and whether they vary by product, in order to inform the appropriate approach to demand stimulation (i.e. which type of marketing tool will give the greatest increase in sales per dollar spent). Table 2 presents the results of the static pooled OLS and fixed effects models with female condom dummy variables to test for differences in the determinants of demand. The pooled OLS model is rejected in favour of the FE model allowing for estimated country fixed effects; we therefore focus on the FE estimates. The Log-likelihood Ratio (LR) test could not reject the year trend in favour of the 10 year-specific effects; as such time is captured by a trend in the presented models. The results with alternative specifications of the time effects are presented in Appendix Table A5. The results are very similar, though the IEC*female condom interaction variable loses significance in the alternative specification.

Country effects and coefficients for the 'Year' trend and 'No expenditures' dummies (No advertising, No local salaries, No IEC, free products, respectively) are not presented. Table A6 presents the same model run separately for Male and Female condoms, but including HIV prevention substitutes in the marketing mix (female condoms as substitutes for male condom, and the price of substitutes (the price of male condoms as a driver of demand for female condoms).

The signs of the marketing coefficients conform to expectations: *Advertising, IEC* and *Programme Effort* all have positive signs while *Price* has a negative sign. In the fixed effects model *Price* and *Programme Effort* are not significant at conventional levels of significance.[5] *Price* does however have a significant negative effect (elasticity −0.453, $p < 0.00$) on condom sales when estimated jointly for both products (not shown).

The static fixed effects model suggests considerable differences between male and female condom demand responses, with female

[4] The magnitude of the 'small value' does not affect the estimates in any way.

[5] To explore the possibility that price is driven by country fixed effects, we have run a regression of price on country- and year-specific fixed effects. The coefficient of determination is very low (r-squared = 0.31) suggesting otherwise.

Table 2
Estimation results: static model of the demand for condoms.

Dependent variable: Ln country condom sales	(1)		(2)	
	Pooled OLS		Fixed effects	
Variables	Year as trend		Year as trend	
Constant	21.330	(30.68)	−84.41	(62.11)
Female condom dummy (FC)	2.423	(2.215)	0.385	(1.996)
Ln advertising	0.241***	(0.085)	0.192***	(0.067)
*FC	−0.199*	(0.116)	−0.192*	(0.101)
Ln IEC	0.124***	(0.044)	0.081**	(0.032)
*FC	0.162	(0.121)	0.176*	(0.105)
Ln own price	−0.230***	(0.076)	−0.123	(0.100)
*FC	−0.246*	(0.143)	−0.179	(0.133)
Ln programme effort	0.231***	(0.075)	0.131	(0.081)
*FC	−0.148	(0.194)	−0.035	(0.178)
Ln GDP per capita	0.108	(0.096)	−0.530	(0.407)
*FC	0.002	(0.198)	0.146	(0.188)
Ln population size	0.407***	(0.050)	−0.036	(1.293)
*FC	−0.242**	(0.114)	−0.317***	(0.122)
Ln adult HIV prevalence	0.055*	(0.033)	0.445*	(0.259)
*FC	0.282**	(0.112)	0.336***	(0.097)
Ln product maturity	0.484***	(0.075)	0.383**	(0.150)
*FC	0.004	(0.193)	−0.048	(0.243)
Year	−0.011	(0.015)	0.050	(0.039)
Observations	515		515	
R-squared	0.865		0.930	
LR-test (H0: no country effects)		335***		

Robust standard errors (clustered by country) in parentheses.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

condoms being more responsive than male condoms to: *IEC*, *Population size* and *HIV prevalence* and less (to the point of not at all) responsive to mass media advertising.

This static approach is arguably satisfactory for exploring differences in the determinants of demand by product. However, as discussed in the previous section, demand is expected to be driven not only by current marketing strategies, but also by previous period investments. In such cases a dynamic model is more appropriate. A one-step system GMM estimator is used to estimate the short- and long-run effects of promotion, prices and programme effort and country contexts and the duration of their effects (Table 3). 'Promotion' is here defined as the sum of mass media advertising and IEC as estimation of separate effects led to unstable results.

The specification tests for the GMM estimator are satisfied, i.e. we find 1st order serial correlation (ar1), albeit slightly above conventional p-values, and no 2nd order serial correlation (ar2). The Hansen test does not reject the over-identifying conditions. The large Hansen p-value for the female condom estimates is caused by the small sample size. Conforming to expectations, the system GMM estimate for λ lies between the OLS and FE estimates.

Qualitatively, the three estimators provide reasonably consistent results, particularly for male condoms and for the presence of persistence and effectiveness of promotion for increasing demand. In contrast to the significantly positive coefficient on population size in the GMM model, the OLS and fixed effects models did not identify this effect.

Both the male and female condom display significant persistence, with male condom demand slower to adjust to stimuli than female condom demand, as seen in the relatively higher λ in the male condom estimates (0.570) relative to the female condom estimates (0.347). It takes 3.1 and 1.2 years for 90% of the cumulative effects to be exhausted, respectively, for male and female condoms.

Short- and long-run male condom demand is driven largely by promotion, price and population size. The GMM estimates show that the short-run impact of a 10% increase in promotion spending is 1.66%, whereas such an investment is expected to increase demand by 3.85% in the long-run. A 10% increase in price is expected to generate a 0.82% decrease in male condom demand in the short-run, increasing to 1.92% in the long-run. Programme effort has no immediate or long-run effect. It can be further seen that income, as proxied by GDP per capita, and product maturity or HIV prevalence do not significantly affect male condom demand.

In the female condom fixed effects model all coefficients lose significance except product age and promotion which is likely attributable to the small sample size. Demand for female condoms changes more rapidly than demand for the male condom ($\lambda = 0.347$). The short-run effect of a 10% increase in promotion spending is 1.78% rising to 2.72% in the long-run. Price has a very large effect on demand, with a 10% price increase leading to a 3.60% and a 5.51% decrease in demand in the short- and long-run, respectively. In contrast to male condom demand, female condom demand is affected by HIV prevalence in both the short- and long-run.

5.2. Robustness checks

As robustness checks, for the demand for male condoms we have estimated these relationships under a variety of alternative GMM specifications. One specification excludes Eastern European which and Central Asian countries from the estimation sample. Another treats prices, promotion and programme efforts as endogenous, as described above. These specifications do not qualitatively change the results (see Table A8). Estimation of the 'ordinary' first-differenced GMM did result in considerably different results (see Table A8). The model with instrumented prices, promotion and programme effort shows a higher rate of persistence ($\lambda = 0.714$), and higher short-run and long-run promotion and price elasticities (short-run 0.208 and −0.111, long-run: 0.727 and −0.387). As

Table 3
Estimation results: dynamic panel data model of the demand for condoms.

Dependent variable: Ln country condom sales	Dynamic male condom estimates			Dynamic female condom estimates		
Variables	OLS	Fixed effects	GMM	OLS	Fixed effects	GMM
Lag Ln condom sales	0.755***	0.540***	0.570***	0.451***	0.186	0.347***
	(0.0792)	(0.123)	(0.113)	(0.114)	(0.188)	(0.124)
Ln promotion	0.160***	0.139***	0.166***	0.166*	0.165*	0.178**
	(0.0514)	(0.0518)	(0.0612)	(0.0875)	(0.0889)	(0.0874)
Ln price	−0.0524	−0.172***	−0.0826*	−0.335**	−0.171	−0.360***
	(0.0538)	(0.0608)	(0.0490)	(0.120)	(0.108)	(0.110)
Ln programme effort	0.0501	0.142	0.112	−0.0605	−0.122	−0.0513
	(0.0700)	(0.115)	(0.0885)	(0.102)	(0.126)	(0.0798)
Ln GDP per capita	−0.00652	0.207	−0.00341	−0.0123	−0.818	0.00253
	(0.0712)	(0.383)	(0.0773)	(0.170)	(3.057)	(0.188)
Ln product age	−0.0456	−0.117	0.0872	0.178	2.754*	0.344
	(0.0683)	(0.199)	(0.113)	(0.303)	(1.348)	(0.333)
Ln population size	0.0569	1.554	0.148**	0.177	−12.50	0.185
	(0.0618)	(0.972)	(0.0645)	(0.124)	(17.03)	(0.116)
LN adult HIV prevalence	0.00799	0.532***	0.0189	0.173	0.188	0.215*
	(0.0237)	(0.192)	(0.0262)	(0.122)	(0.793)	(0.117)
ar1p			0.137			0.130
ar2p			0.521			0.390
hansenp			0.165			0.973
Long term effects						
Promotion		0.385** (0.161)		0.272** (0.145)		
Price		−0.192** (0.097)		−0.551*** (0.152)		
Programme effort		0.261 (0.177)		−0.079 (0.127)		
GDP per capita		−0.008 (0.180)		0.004 (0.29)		
Product age		0.203 (0.227)		0.527 (0.446)		
Population size		0.345*** (0.100)		0.283* (0.170)		
Adult HIV prevalence		0.044 (0.062)		0.329** (0.154)		
Observations		280			85	
R-squared	0.889	0.570		0.761	0.616	
Number of countries		58			26	

Robust standard errors in parentheses.
Parameters for the constant, year, country and dummy's for no promotion, free condoms and no staffing are not shown, but available upon request.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

discussed, this specification has weaker identification due to the instrumentation of all the variables, which also leads to quite a large number of instruments, relative to the sample size, may bias the estimates.

For the original specification, the results did not change when adding $q_{i,t-4}$ as a further instrument for the differences (not shown). Because Zimbabwe had far higher female condom sales than the other countries and contributed 10% of the observations, we removed its observations to check for its influence on the results; again the results remain broadly intact when excluding Zimbabwe (not shown).

5.3. Study limitations

Within the scope of HIV prevention products, the full substitute market was not observed. We only analysed data on condom sales through PSI; the free public sector was not incorporated nor was the private condom sector (in the few countries where it existed). When considering condoms as contraceptives, there exist both private and public markets for contraceptives in these countries, which were also not captured. We did however run our static models capturing the price of PSI male condoms as the price of substitute for female condoms and found no significant effect, while programmes selling female condoms had significantly higher male condom sales (Table A6). The study period covered the introduction of HIV treatment in some countries. Though the general trend is captured by the time dummies, ideally it would have been included in more detail. Other variables that theoretically should have been included were: Gini coefficient (to account for aggregation bias in country level analyses), and age and sex distribution of the population (to capture the at-risk population). Complete time series data on these variables across our sample countries were not available and changed little over the study period, however the country and time effects remove biases potentially introduced by their omission.

Though this dataset is the largest of its kind that can be used to estimate the effects of marketing tools on condom sales, it is relatively small compared to many other analyses of advertising and price elasticities of demand.

The social marketing data may contain measurement error and inconsistencies over time and countries attributable to the following factors. While PSI has provided financial data on the allocation of costs from 1997 to 2009, it should be noted that during this timeframe, PSI implemented a rolling upgrade of its financial system, which contributes to some variation in the data by country and year. Reporting requirements by PSI funders sometimes vary, leading to differences in allocations of costs between expenditure categories. Allocations of shared expenditures across products may not have been applied consistently. The data do not differentiate between generic and branded promotional expenditures. The measurement error could lead to attenuation bias, which can then be part of the reason why we find bigger effects when treating all variables as endogenous.

Despite these limitations, we find largely robust results, in particular for the male condom analysis. The female condom results should be considered indicative rather than conclusive due to the smaller sample size. These results are largely consistent with the literature of advertising impact, however given the products at hand and the country settings, direct comparison of the magnitude of demand elasticities is not productive.

6. Conclusions

This study aimed to evaluate the effectiveness of social marketing tools in stimulating demand for male and female condoms. It contributes to the literature by comparing their effects on products targeting men (male condoms) and products sold mainly to women (female condoms) and by estimating both short- and long-run effects (allowing for condom use behaviour to adjust slowly) using a dynamic model that also controls for potential endogeneity.

We have shown that marketing tools do not have a consistent impact across condom types, in line with the contraception literature on oral contraceptive versus condoms (reviewed in Section 1). Mass media advertising is an important marketing tool for male condoms. Advertising is however not found to be effective in stimulating demand for female condoms. IEC appears important for all condoms with a slightly stronger impact on female than male condoms. For both products, promotion and price have strong long-run effects, approximately doubling the short-run effects.

More research needs to be done to better understand the differences between the price elasticities of demand between the male and female condom; in particular to disentangle price and income effects: i.e. are the effects truly attributable to differences in price levels and products, or are they more related to the user groups, with female condoms targeted particularly for purchase by women, known to have lower ability to pay. Care needs to be taken when setting prices to ensure they remain consistent with social marketing aims: i.e. sufficiently low to not form a barrier to demand, while reducing wastage, instilling a sense of value associated with the products and reducing stigma (Brent, 2009, 2010).

The findings of this paper have a number of policy implications. Firstly, despite the fact that condoms remain one of the most cost-effective approaches to preventing HIV (Schwartländer et al., 2011), the global HIV prevention community is increasingly looking towards new HIV prevention products (Stover et al., 2014). This study shows that with consorted effort including promotion and low product pricing, demand for condoms can be increased, with lasting effects, and should not be forgotten as part of a combination prevention approach to the HIV epidemic.

Secondly, our results provide guidance for developing demand creation approaches for these new HIV prevention products: it is important to consider the target user as well as the product characteristics. If sold, consideration to purchasing power of the intended target users may be critical to the scale of their distribution, as well as the fact that the product price is only part of the cost of product use; many people face high costs to access health services, both in terms of direct transport costs and labour time lost. Social marketing can play a critical role in diversifying distribution outlets to bring products to more accessible locations and in increasing demand and reduce product stigma through interpersonal communication and mass media advertising, while complementing public sector free distribution to ensure access to public health products for those with less financial resources.

Finally, analyses of the impact of behaviour change interventions need to consider that many changes in human behaviours, in particular preventive ongoing behaviours, are slow to adjust. Where appropriate data exist, estimating dynamic models, as done in this analysis, should reduce the bias otherwise present and improve the interpretation of coefficients for policy applications.

Conflict of interest

None declared.

Acknowledgements

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Appendix 1.

Tables A1–A8

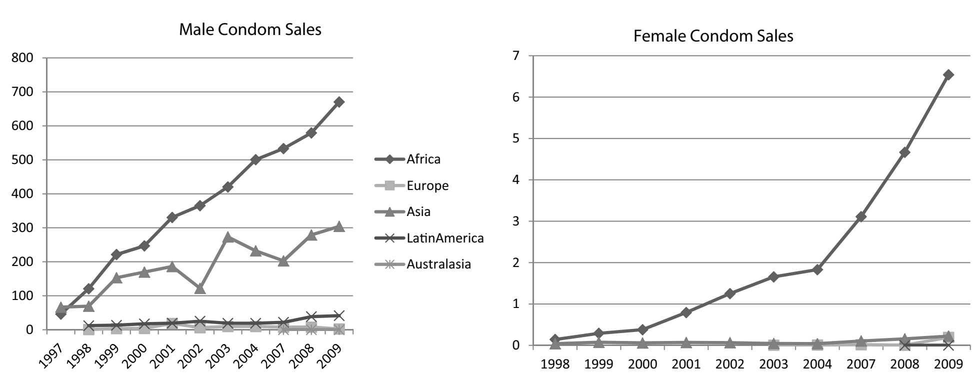

Fig. A1. Condom sales by region (in millions).

Table A1
Summary statistics of full sample.

Variable	Definition, source	Male condom programme			Female condom programme		
		N	Mean*	% of values dropped in estimation	N	Mean*	% of values dropped in estimation
		(Min–Max)			(Min–Max)		
Demand	Condom quantity sold, PSI	430	15,900,000 (249–197,000,000)	10%	155	147,802 (26–4,238,960)	14%
Price	Condom price, PSI	416	$0.10 ($0–$0.95)	7%	142	$0.37 ($0–$4.14)	6%
Programme effort	Local salary expenditures, PSI	416	$1,065,602 ($0–$17,600,000)	7%	145	$116,555 ($0–$1,159,756)	8%
Advertising	Advertising expenditures, PSI Advertising refers to mass media promotion strategies,	416	$778,457 ($0–$8,263,314)	7%	145	$64,170 ($0–$690,505)	8%
Information & Education Campaign (IEC)	IEC expenditures, PSI IEC refers to one-on-one or small group intra-personal communication promotion strategies	416	$467,164 ($0–$12,400,000)	7%	145	$28,930 ($0–$441,515)	8%
Promotion	IEC expenditures + advertising expenditures, PSI	416	$1,240,311 ($0–$15,800,000)	7%	144	$93,746 ($0–$690,505)	8%
Product maturity	Years of condom product sales, PSI	430	8.89 (0.2–24)	10%	155	4.21 (1–13)	14%
HIV adult prevalence	Prevalence of HIV in the adult population, WDI	394	5.53% (0.10–28.70%)	2%	141	8.16% (0.10–28.70%)	6%
GDP per capita	GDP per capita, WDI	406	$4.150 ($548–$22,630)	5%	139	$3.576 ($583–$14,023)	4%
Population Size	Population size (in millions), WDI	406	66,700,000 (293,544–1,330,000,000)	5%	139	80,600,000 (301,016–1,330,000,000)	4%

* Values are presented in natural units (not logarithms).
All prices are presented in 2011 purchasing power parity dollars.
PSI: Population Services International programme accounts, the social marketing organisation. WDI: World Development Indicators database.
Sample used in the static estimation contains 382 observations for male condoms and 133 for female condoms. The dynamic estimator requires at least 3 years of data to obtain 1 observation, because of the need for lags. The dynamic estimation thus had 280 male condom observations and 85 female condom observations.

Table A2
Overview of panel data structure (number of country's programmes distributing each condom type by year).

Year	Male condom	Female condom
1997	11	3
1998	21	4
1999	37	7
2000	36	9
2001	43	11
2002	43	15
2003	48	16
2004	44	19
2007	44	17
2008	51	26
2009	52	28
Total	430	155

Table A3
Male condom data availability.

Country	Year									
	1997	1998	1999	2000	2001	2002	2003	2004	2007	2008	2009
Afghanistan							1	1			
Albania			1	1	1	1	1				
Angola					1	1	1	1	1	1	1
Belize										1	1
Benin	1	1	1	1	1	1	1	1	1	1	1
Bolivia		1	1	1	1	1					
Botswana			1	1	1	1	1	1	1	1	1
Burkina Faso			1	1	1	1	1	1	1		
Burundi			1	1	1	1	1	1	1	1	1
Cambodia	1	1	1	1	1	1	1	1			
Cameroon		1	1	1	1	1	1	1	1	1	1
Caribbean											1
Central African Republic			1		1	1	1	1	1	1	1
Central America		1	1	1	1	1	1	1	1		
Chad	1	1	1								
China								1	1	1	1
Congo (Dem. Rep. & Rep.)						1	1	1			
Congo, Dem. Rep.				1	1				1		1
Congo, Rep.			1	1	1					1	
Costa Rica										1	1
Cote d'Ivoire	1	1	1	1	1	1	1	1	1	1	1
Cuba					1	1					
Dominican Republic							1	1	1	1	1
El Salvador										1	1
Eritrea			1	1	1	1	1	1			
Ethiopia										1	1
Georgia					1	1	1	1			
Guatemala										1	1
Guinea	1	1	1	1	1	1	1	1	1	1	1
Guinea-Bissau					1	1	1				
Guyana								1			
Haiti	1	1	1	1	1	1	1	1	1	1	1
Honduras										1	1
India	1	1	1	1	1	1	1	1	1	1	1
Kazakhstan						1	1		1	1	1
Kenya	1		1	1	1	1	1	1	1	1	1
Kosovo					1	1	1				
Kyrgyzstan							1	1	1	1	1
Lao PDR			1	1	1	1	1	1	1	1	1
Lesotho			1	1				1	1	1	1
Lesotho & Swaziland					1	1	1				
Liberia											1
Madagascar			1	1	1	1	1	1	1	1	1
Malawi		1	1	1	1	1	1	1	1	1	1
Mali					1	1	1	1	1	1	1
Mexico									1	1	1
Mozambique		1	1	1	1	1	1	1	1	1	1
Myanmar			1	1	1	1	1	1	1	1	1
Namibia		1	1	1	1	1	1	1	1	1	1
Nepal							1	1			
Nicaragua										1	1
Nigeria		1	1	1	1	1	1	1	1	1	1
Pakistan			1	1	1	1	1	1	1	1	1
Panama										1	
Papua New Guinea									1	1	1
Paraguay		1	1	1	1	1	1		1	1	1
Romania		1	1	1	1	1	1	1	1	1	1
Russian Federation		1	1	1	1	1	1	1	1	1	1
Rwanda		1	1	1	1	1	1	1	1	1	1
South Africa		1	1	1	1	1	1	1	1	1	1
Sudan										1	1
Swaziland								1	1	1	1
Tajikistan							1		1	1	1
Tanzania			1	1	1	1	1	1	1	1	1
Thailand							1	1	1	1	1
Togo	1	1	1	1	1	1	1	1	1	1	1
Uganda			1	1	1	1	1	1	1	1	1
Uzbekistan							1				
Vietnam									1	1	1
Zambia	1		1	1	1	1	1	1	1	1	1
Zimbabwe	1	1	1	1	1	1	1	1	1	1	1
Total	11	21	37	36	43	43	48	44	44	51	52

Table A4
Female condom data availability.

Country	Year										
	1997	1998	1999	2000	2001	2002	2003	2004	2007	2008	2009
Belize											1
Benin										1	1
Bolivia		1	1	1	1	1					
Botswana						1	1	1		1	
Burkina Faso								1			
Cambodia							1	1	1		
Cameroon						1	1	1	1	1	1
Caribbean											1
Central African Rep.										1	1
Central America				1	1	1	1	1	1		
China								1	1	1	1
Congo (Dem. Rep. & Rep.)								1			
Congo, Dem. Rep.									1		1
Congo, Rep.										1	
Costa Rica										1	
Cote d'Ivoire								1			
El Salvador										1	1
Guatemala										1	1
Guinea-Bissau						1	1				
Haiti	1	1	1	1	1	1	1	1	1	1	1
India									1	1	1
Lesotho								1	1	1	1
Lesotho & Swaziland					1	1	1				
Madagascar										1	1
Malawi										1	1
Mali						1	1	1	1	1	1
Mozambique				1	1	1	1	1	1	1	1
Myanmar							1	1	1	1	1
Namibia										1	1
Nicaragua										1	1
Nigeria											1
Papua New Guinea										1	1
Paraguay					1	1	1			0	0
South Africa		1	1	1	1	1	1	1	1	1	1
Swaziland								1			
Tanzania			1	1	1	1	1	1	1	1	1
Togo			1	1	1	1	1	1	1	1	1
Uganda											1
Vietnam									1	1	1
Zambia	1		1	1	1	1	1	1	1	1	1
Zimbabwe	1	1	1	1	1	1	1	1	1	1	1
Total	3	4	7	9	11	15	16	19	17	26	28

Table A5
Correlation matrix.

	Ln condom sales	Ln promotion	Ln advertising	Ln IEC	Ln price	Ln programme effort	Ln product age	Substitute (dummy)	Ln GDP per capita	Ln population size	Ln adult HIV prevalence
Male condom (*N* = 382)											
Ln male condom sales	1.00										
Ln promotion	0.30	1.00									
Ln advertising	0.32	0.70	1.00								
Ln IEC	0.16	0.26	0.09	1.00							
Ln price	0.13	0.09	0.24	−0.04	1.00						
Ln programme effort	0.28	0.83	0.57	0.23	0.10	1.00					
Ln product age	0.53	0.02	0.07	0.22	0.05	0.06	1.00				
Substitute (dummy)	0.21	0.08	0.06	0.22	0.01	0.05	0.16	1.00			
Ln GDP per capita	−0.19	−0.07	−0.13	−0.02	−0.06	−0.06	−0.22	−0.01	1.00		
Ln population size	0.56	0.17	0.08	0.06	−0.11	0.14	0.24	−0.00	0.00	1.00	
Ln adult HIV prevalence	0.17	0.01	0.08	−0.04	−0.05	0.01	0.32	0.29	−0.24	−0.20	1.00
Female condom (*N* = 131)											
Ln female condom sales	1.00										
Ln promotion	0.22	1.00									
Ln advertising	0.33	0.80	1.00								
Ln IEC	0.20	0.70	0.48	1.00							
Ln price	0.33	0.15	0.30	−0.02	1.00						
Ln programme effort	0.19	0.45	0.34	0.39	0.06	1.00					
Ln product age	0.50	−0.08	0.07	0.14	0.21	−0.06	1.00				
Substitute (dummy)	−0.09	−0.03	0.10	−0.11	0.52	0.04	0.03	1.00			
Ln GDP per capita	−0.18	−0.17	−0.11	−0.22	−0.36	−0.13	−0.12	−0.11	1.00		
Ln population size	0.16	0.01	0.03	−0.09	0.09	−0.10	0.05	0.02	−0.03	1.00	
Ln adult HIV prevalence	0.46	−0.06	−0.01	−0.05	0.23	−0.02	0.41	−0.17	−0.07	−0.14	1.00

Table A6
Estimation results (robustness check): static model with year-specific effects.

Variables	(1) OLS trend	(2) FE trend i.c	(3) OLS i.y	(4) FE i.y i.c
Constant	21.33	−84.41	−0.816	18.03
	(30.68)	(62.11)	(1.354)	(19.35)
Female condom dummy	2.423	0.385	2.543	0.349
	(2.215)	(1.996)	(2.205)	(1.975)
Ln Advertising	0.241***	0.192***	0.245***	0.192***
	(0.0846)	(0.0665)	(0.0858)	(0.0665)
*FC	−0.199*	−0.192*	−0.211*	−0.196*
	(0.116)	(0.101)	(0.116)	(0.1000)
Ln IEC	0.124***	0.0812**	0.136***	0.0893***
	(0.0444)	(0.0315)	(0.0451)	(0.0334)
*FC	0.162	0.176*	0.136	0.148
	(0.121)	(0.105)	(0.125)	(0.107)
Ln Own Price	−0.230***	−0.123	−0.242***	−0.129
	(0.0763)	(0.100)	(0.0789)	(0.0987)
*FC	−0.246*	−0.179	−0.274*	−0.201
	(0.143)	(0.133)	(0.146)	(0.134)
Ln Programme Effort	0.231***	0.131	0.211***	0.120
	(0.0752)	(0.0813)	(0.0765)	(0.0826)
*FC	−0.148	−0.0349	−0.144	−0.0424
	(0.194)	(0.178)	(0.190)	(0.176)
Ln GDP per capita	0.108	−0.530	0.126	−0.555
	(0.0963)	(0.407)	(0.0991)	(0.416)
*FC	0.00248	0.146	−0.00630	0.149
	(0.198)	(0.188)	(0.199)	(0.186)
Ln Population Size	0.407***	−0.0364	0.409***	−0.207
	(0.0501)	(1.293)	(0.0499)	(1.332)
*FC	−0.242**	−0.317***	−0.230**	−0.298**
	(0.114)	(0.122)	(0.113)	(0.121)
Ln Adult HIV prevalence	0.0547*	0.445*	0.0525	0.503*
	(0.0327)	(0.259)	(0.0331)	(0.284)
*FC	0.282**	0.336***	0.281**	0.333***
	(0.112)	(0.0972)	(0.114)	(0.0980)
Ln product maturity	0.484***	0.383**	0.493***	0.372**
	(0.0752)	(0.150)	(0.0739)	(0.149)
*FC	0.00396	−0.0477	0.0131	−0.0269
	(0.193)	(0.243)	(0.193)	(0.246)
Year	−0.0112	0.0496		
	(0.0153)	(0.0390)		
Observations	515	515	515	515
R-squared	0.865	0.930	0.868	0.931
LR-test		2 versus 1	3 versus 1	4 versus 2
		335***	12.2	12.8

Robust standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

Table A7
Estimation results: static model including substitutes/substitute price.

Dependent variable Ln quantity	Male condom, FE		Female condom, FE	
Ln advertising	0.194***	(−0.069)	−0.0486	(−0.121)
Ln IEC	0.087***	(−0.029)	0.299**	(−0.127)
Ln own price	−0.143	(−0.099)	0.0959	(−0.165)
Substitute dummy; Ln Psubstitute for FC model	0.328***	(−0.103)	−1.733	(−2.698)
Ln programme effort	0.096	(−0.081)	0.0832	(−0.123)
Ln GDP per capita	−0.119	(−0.357)	−4.247*	(−2.151)
Ln population size	−0.788	(−1.134)	12.81	(−8.678)
Ln adult HIV prevalence	0.665***	(−0.229)	1.513*	(−0.843)
Ln product maturity	0.523***	(−0.121)	0.541	(−0.489)
Year	0.0129	(0.036)	−0.090	(0.136)
Constant	−2.494	(−56.52)	12.41	(−204.4)
Observations	381		132	
R-squared	0.9		0.854	

Robust standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

Table A8
Robustness checks of the dynamic male condom model under alternative specifications.

Variables	Base: systems GMM	1st-differenced GMM	Lags 2–4	Excl. EurAsia	Endogenous price, promotion and programme effort
Lag Ln condom sales	0.503***	−0.125	0.503***	0.844***	0.714***
	(0.135)	(0.208)	(0.135)	(0.0957)	(−0.0892)
Ln promotion	0.165**	0.0602	0.162**	0.135*	0.208***
	(0.0664)	(0.0516)	(0.0664)	(0.0726)	(−0.0764)
Ln price	−0.0845	−0.0383	−0.0857	−0.0510	−0.111*
	(0.0525)	(0.0934)	(0.0522)	(0.0475)	(−0.0651)
Ln programme effort	0.128	−0.0187	0.128	−0.00286	0.0185
	(0.0881)	(0.226)	(0.0876)	(0.0599)	(−0.0989)
Ln GDP per capita	−0.00420	1.114	−0.00406	0.0217	0.0295
	(0.0798)	(0.957)	(0.0798)	(0.0626)	(−0.076)
Ln product age	0.102	0.0650	0.103	−0.0984	−0.0168
	(0.131)	(0.453)	(0.131)	(0.101)	(−0.0879)
Ln population size	0.191**	1.838	0.192***	0.0400	0.0665
	(0.0746)	(2.547)	(0.0747)	(0.0471)	(−0.074)
Ln adult HIV prevalence	0.0205	0.372	0.0206	0.0217	0.00765
	(0.0292)	(0.268)	(0.0294)	(0.0211)	(−0.0248)
_Iyear_1998	0.0326		0.0317		−0.00573
	(0.137)		(0.136)		(−0.119)
_Iyear_1999		0.250		0.0805	
		(0.183)		(0.111)	
_Iyear_2000	−0.237**	0.255	−0.237**	−0.177*	−0.275***
	(0.106)	(0.274)	(0.106)	(0.0974)	(−0.0999)
_Iyear_2001	−0.0177	0.489	−0.0169	−0.0180	−0.0116
	(0.115)	(0.341)	(0.115)	(0.0793)	(−0.105)
_Iyear_2002	−0.0805	0.510	−0.0800	0.0309	−0.0856
	(0.113)	(0.454)	(0.113)	(0.104)	(−0.108)
_Iyear_2003	−0.113	0.596	−0.113	−0.0558	−0.12
	(0.0967)	(0.551)	(0.0965)	(0.0842)	(−0.0885)
_Iyear_2004	0.0335	0.660	0.0328	0.0412	0.044
	(0.116)	(0.650)	(0.116)	(0.0883)	(−0.112)
_Iyear_2008	−0.0391	0.257**	−0.0402	0.109	0.0452
	(0.165)	(0.127)	(0.167)	(0.146)	(−0.116)
_Iyear_2009	−0.375**		−0.375**	−0.279**	−0.333**
	(0.164)		(0.164)	(0.110)	(−0.135)
Constant	0.534		0.537	0.0831	0.0652
	(1.108)		(1.113)	(0.803)	(−1.053)
ar1 *p*-value	0.128	0.786	0.126	0.0175	0.159
ar2 *p*-value	0.514	0.428	0.517	0.514	0.435
Sargan *p*-value		0.0937			
Hansen *p*-value	0.201		0.319	0.289	1.00
Observations	280	190	280	267	280
Number of countries	58	46	58	53	58
Long-run effects					
Ln Promotion	0.332**	0.054	0.327**	0.332**	0.727*
	(0.155)	(0.045)	(0.154)	(0.155)	(0.392)
Ln rice	−0.170*	−0.034	−0.172*	0.170*	−.387
	(0.090)	(0.086)	(0.090)	(0.09)	(0.231)
Ln programme effort	0.257*	−0.017	0.258*	0.257	0.065
	(0.149)	(0.199)	(0.149)	(0.085)	(0.334)
Ln GDP per capita	−0.008	0.990	−0.008	−0.008	0.103
	(0.161)	(0.898)	(0.161)	(0.161)	(0.264)
Ln product age	0.206	0.058	0.206	0.206	−0.058
	(0.220)	(0.398)	(0.220)	(0.22)	(0.318)
Ln population size	0.385***	1.633	0.387***	0.385***	0.232
	(0.385)	(2.355)	(0.089)	(0.089)	(0.213)
Ln adult HIV prevalence	0.041	0.330	0.041	0.041	0.027
	(0.058)	(0.196)	(0.058)	(0.058)	(0.088)

Robust standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.
Coefficients for the dummy variables indicating variable imputation for 0 values of price, promotion and staffing are not shown.

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