INDIA'S FOOD GRAIN POLICIES AND THE PUBLIC DISTRIBUTION SYSTEM : THE CASE OF RICE. WHO WINS, WHO LOSES, AND BY HOW MUCH?[#]

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ABSTRACT

Indian governments follow highly interventionist policies on food grains, especially rice and wheat. These policies include import and export controls which insulate the domestic market from world markets, a minimum support price (MSP) program which supports and controls domestic wholesale prices, large farm input subsidies, and consumer subsidy programs which provide rice and wheat through about half a million "fair price shops" to low income (below the poverty line-BPL) consumers at very low controlled prices. The consumer subsidy scheme was implemented under the provisions of the Targeted Public Distribution System (TPDS) until September 2013, when it was replaced by the National Food Security Act (NFSA). The NFSA aims to more than double the distribution of highly subsidised food grains (mainly rice and wheat) to cover approximately two thirds of the Indian population. Using a simple, comparative static linear model of the rice market roughly calibrated to the situation in rice marketing year 2011/12, this paper simulates the effects of various combinations of the following: abolition of the MSP regime, abolition of the TPDS, and opening of the market to exports by the private sector. The simulations identify the winners and losers and quantify the consequences of these policies for the fiscal positions of the central government and state governments, and for the welfare of rice farmers, rice consumers in general, poor (BPL) rice consumers, not-poor rice consumers, and "diverters" who illegally resell subsidised rice at market prices. The policy simulations indicate that (1) The biggest increase in aggregate welfare is in the simulation which abolishes both the MSP and the TPDS and allows rice exports without restriction subject to an export tax (2) The improvement in aggregate welfare is much larger when the policy simulations include the abolition of the TPDS (3) When the TPDS is abolished, the net aggregate welfare improvement of the winners is more than sufficient to compensate the net welfare losses of BPL rice consumers. Unfortunately the NFSA replicates and in some respects worsens the deficiencies of the TPDS, so the prospect that it will be more effective and less costly in supplying low price food grains to very poor and poor individuals does not look good

JEL classification: D61; H42; Q17; Q18

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ACRONYMS AND ABBREVIATIONS	
AAY	Antyodaya Anna Yojana (“Poorest of the Poor”)
APL	Above the Poverty Line
BPL	Below the Poverty Line
CIP	Central Issue Price
CS	Consumer surplus
FCI	Food Corporation of India
FPSs	Fair Price Shops
MSP	Minimum Support Price
MT	Metric Ton
MY	Marketing Year
NFSA	National Food Security Act
NSS	National Sample Survey
PDS	Public Distribution System
PS	Producer Surplus
SEB	State Electricity Board
TPDS	Targeted Public Distribution System

INDIA'S FOOD GRAIN POLICIES AND THE PUBLIC DISTRIBUTION SYSTEM : THE CASE OF RICE.

WHO WINS, WHO LOSES, AND BY HOW MUCH?

1.INTRODUCTION

For many years Indian governments have followed policies which aim to provide low income consumers with consumer staples at subsidised prices. The main focus of these policies has been on rice and wheat. Until 1997 the policies were implemented by the Public Distribution System (PDS), from 1997 to September 2013 by the Targeted Public Distribution System (TPDS), and since September 2013 under the more ambitious provisions of the National Food Security Act (NFSA). An essential feature of the NFSA is a major expansion of the TPDS, under which the distribution of highly subsidised food grains will be increased to cover two thirds of the Indian population. At the time of writing, most of the key provisions of the NFSA had not yet been implemented, but the extensive literature on the TPDS is highly relevant for understanding how it is likely to function in the future. Focussing on rice policies, this paper discusses how the "food security" and poverty alleviation objectives of the TPDS have involved substantial fiscal and transaction costs and have interacted with other policy objectives affecting rice and wheat, in particular farmer welfare and the perceived need for national self sufficiency.

Both domestic and trade policies for rice and wheat are managed by the Food Corporation of India (FCI). *As regards domestic policies*, "minimum support prices" (MSPs) are announced in advance of the sowing seasons at levels such that the estimated resulting production will be sufficient to cover total domestic consumption plus or minus whatever changes are desired in the "central pool" of government held stocks. Stocks are supposed to be at least sufficient to meet "buffer norms" i.e to be sufficient to cover shortfalls in production due to unexpected events such as droughts or floods, without resorting to imports. In principle ,if stock levels at the beginning of a marketing season exceed these norms, MSPs for the season should be lowered (or at least not increased as much as they otherwise would) so that part of the expected total consumption will be met from the excess stocks[1]. In practice successive governments have been extremely reluctant to make downward adjustments in MSPs in this way, with the result that large stocks well in excess of the "buffer norms" have accumulated[2]. For recent "marketing years"[3] this means that supply has

[1] See Basu,K. 2011 for a discussion of this point.

[2] Since the mid-1900s, except for a few years, actual government stocks of rice and wheat have been two to three times "buffer norms" (Gulati et al, 2012, p.24). In January 2013 stocks were 66.6 million MT compared with a buffer norm of 25 million MT (Department of Food and Public Distribution, Government of India: *Annual Report 2012-13,* p.30.)

[3] Marketing years are from October 1 to September 30 (rice) and April 1 to March 30 (wheat).

exceeded consumption, and the MSP for the year is higher than it would have been if there had been a net decline in government stocks.

In addition to the MSP regime which effectively supports and controls output prices, rice and wheat farmers are major beneficiaries of the policies under which two of their principal inputs-fertilisers and electric power-are supplied at controlled, heavily subsidised prices[4]. In real terms, fertiliser prices paid by farmers steadily declined during the 1980s up to the mid-1990s, stabilised for about five years, but then resumed their decline from 2000 and afterwards. Between 2000 and 2013 the inflation adjusted farm price of the most important fertiliser (urea) came down by about half. In 2012/13 urea was selling for approximately one quarter of the average farm-gate import price (i.e. the cif price plus port, handling and transport costs to a typical farm), with the difference being covered as part of the central government's complex set of controls and subsidies affecting the fertiliser sector. Electricity subsidies for farmers have an even longer history than fertiliser subsidies, and if anything are even more deeply entrenched in the political economy of the agricultural sector. Electric power is supplied to farmers by State Electricity Boards (SEBs) at prices which are far below production and delivery costs and in some states are zero. The resulting financial losses of the SEBs are covered by a combination of cross subsidies under which KWH prices are much higher for industrial and commercial customers, deferral of maintenance and replacement investment in generation and distribution equipment, and financial transfers to the SEBs by state governments. By the late 1990s KWH charges to farmers had reached such low levels that there was limited scope for further reductions, so that since then estimates of the total farmer electricity subsidy have been declining as a share of agricultural GDP. Even so, in 2011/12 the subsidy was about 3.4% of agricultural GDP, and probably at least double this –perhaps 6.8% to 7% (see later discussion) -of value added in rice production. All told, in 2011/12 the fertiliser and irrigation subsidies were together equivalent to about 12% of rice production valued at domestic wholesale prices[5].

As regards international trade, the overriding concerns with self sufficiency and price stability have meant that trade policies affecting rice and wheat have been managed almost entirely independently of the situation in world markets. As a result, imports have been sporadic and only occasionally allowed to meet temporary short term shortfalls in official stocks and/or expected production. When imports have occurred-mostly of wheat- they have been very small both in relation to Indian production and to world trade, and have been at prices which have sometimes exceeded and sometimes have been below domestic wholesale prices. Likewise exports have been managed with domestic objectives in mind. For a while in the mid-2000s, in order

[4] For a detailed description and analysis of India's agricultural subsidies see Gulati and Narayanan (2003).

[5] This is somewhat lower than the estimated share (18.3%) of these subsidies in the gross value of rice production valued at domestic prices in 2004 (Pursell, Gulati , and Gupta (2009) , Table 10.4). The reasons for the decline are that in real terms the domestic price of rice increased modestly over the period while the value of the subsidies went down.

to reduce excess stocks, wheat exports were subsidised. Later on common rice[6] and wheat exports were effectively banned for almost four years-from late in calendar 2007 until early calendar 2012-in order to keep domestic prices below the much higher levels of prices prevailing in world markets during this period[7]. India's export controls , together with export controls imposed by a number of other countries (notably China and Vietnam) contributed to the very large and sharp spike in the world prices of rice and wheat during early 2008 which continued into 2009. The extent of India's lost opportunity for highly profitable rice exports is apparent from Fig 1. The export ban was partially lifted in 2012 in order to reduce the very substantial holding costs of official stocks which greatly exceeded "buffer norms". This episode clearly shows that like import policies, export policies have supported domestic objectives and have had practically no relation to India's changing comparative advantage in grain production.

As well as providing an assured price to farmers, FCI's procurement of rice and wheat (currently about a third of total production) at the preannounced minimum support prices is intended to set a floor to free market wholesale prices. This objective may require FCI to accumulate stocks to prevent wholesale market prices falling below the MSP. FCI also periodically sells grain if it thinks wholesale prices are too high or are increasing too rapidly. The term "MSP regime" is used at various places in this study to include these buying and selling activities as well as FCI's procurement activities during the harvest season[8].

Much of the rice and wheat procured by FCI is for distribution under a number of welfare programs[9]. The largest of these is the "Targeted" Public Distribution System (TPDS), which in 2012/13 accounted for around 92% of the total quantity of wheat and rice allocated to these programs. Some key features of the TPDS are summarised in the next section.

[6] India regularly exports without restriction high quality "basmati" rice at prices which are double or more than double the world prices of the standard rice varieties that are traded in world markets. Indian statistics of the exports of basmati rice have only been available since FY 2004. There is no official data on domestic production of basmati, but the quantities are considered to be small, probably about 8 million MT (8% of total rice production).

[7] A detailed summary of India's export restrictions during this period is in Acharya et al (2012), pp 9-12.

[8] This policy differs from procurement policies during the 1980s into the early 1990s when rice and wheat (especially wheat) was frequently procured by FCI at below-market prices by physical and other restrictions during the harvest season which prevented grain movements out of the principal surplus states. This created a two tier system of wholesale prices which affected grain producers and (together with the PDS) grain consumers. The impact of this system at a general theoretical level on the economic welfare of different groups (specifically farmers, low income urban consumers, and high income urban consumers) was analysed by Schiff (1994). Schiff's approach resembles the present paper in distinguishing "winners" and "losers" but differs in not quantifying these effects. His paper also does not consider administrative (transaction) costs and the role of government subsidies and their fiscal impact.

[9] In 2012-13 there were 7 welfare schemes in addition to the TPDS. The largest (and most rapidly growing) of these was the Mid Day Meal (MDM) scheme for children in government schools. During 2012/13 approximately 2.4 million MT (mostly rice) was allocated to this scheme . The total foodgrain "offtake" for the seven schemes was about 7.8% of the total offtake for all Central government food welfare schemes including the TPDS. More detail on these schemes is in the 2012-13 annual report of the Department of Food and Public Distribution.

2.THE TPDS: DESCRIPTION AND SOME KEY FEATURES

Under the TPDS, every year FCI procures rice and wheat which is supplied to the states at very low "Central Issue" (CIP) prices. This grain is in turn supplied by the states to registered "Fair Price Shops" (FPSs) for resale to three categories of consuming households: (1) "Poorest of the poor" households under the AAY program (2) "Below Poverty Line" (BPL) households (3) "Above Poverty Line" (APL) households . In principle in most states AAY and BPL households are entitled to buy 35 kg of subsidized food grains per month[10], but for APL households the quantities allocated are constrained below the levels that would make this possible. The provisions of the NFSA are basically the same, except that the beneficiaries have been divided into just two groups, AAY households and members of "priority households", Central Issue prices have been reduced, and the number of individuals covered has been expanded.[11]

For many years all Indian families have been eligible to receive ration cards which entitle them to subsidized food grains. Beginning in December 1997 the system was "targeted" to provide larger subsidies to BPL families, and from August 2000 another category of "poorest of the poor" families and individuals was added under the AAY program which provided still more generous subsidies. It was originally intended that all other consumers (classified as "above the poverty line" or APL) would be weaned off the PDS system by setting APL prices at the fair price shops which were not far below or even above free market prices. For a short while, between February 1999 and June 2000 there was sharp increase-about 60%-in nominal prices, but the increase in the APL price was reversed in August 2000, and since then there has been insufficient political will to increase any of these prices-AAY, BPL, or APL-to keep up with inflation, so that they have remained the same in nominal terms[12], but have steadily declined in real terms. The downward trajectory of inflation adjusted Central Issue prices for rice is illustrated in Fig 2. Moreover, from about 2005/06 onwards, increasing numbers of state governments began setting maximum resale prices of rice and wheat in the fair price shops which were well below the Central Issue prices at which these grains are supplied by FCI. According to one study, by 2009/10 13 states (out of a total of 35 states and UTs) had reduced FPS prices to Rs 3/kg or less[13].

In the states which have not so far established their own low price structures, in selling to the different categories of customer described above, in principle the FPSs are not allowed to add more than specified

[10] Some states (about 5) set lower per household limits than 35kg/month but offset this with lower retail prices at the FPSs.
[11] As before, there is a 35 kg/month entitlement of subsidised food grains for each AAY household. Persons belonging to " priority" households are entitled to 5 kg /month per person.
[12] Except for the APL price for rice which was temporarily cut by about 12% for three months during 2002.
[13] Himanshu (2013), p.18.

retail margins. These maximum margins vary from state to state, but for the most part are much too low–say 10-15% of Central Issue prices –for the FPSs to be profitable if they were to operate as normal retail outlets (see later discussion). During 2012 Central Issue prices for rice as a percentage of prevailing wholesale prices were approximately 17% (AAY), 38% (BPL), and 47% (APL), and the corresponding Central Issue prices for wheat as a percentage of wholesale wheat prices were approximately 16% (AAY), 34% (BPL), and 49% (APL). Weighted by "offtake" (i.e. the quantities of each of these categories requested by state governments and supplied by FCI) the average Central Issue price for both rice and wheat was about one-third of wholesale market prices during 2012.

In the states which have established their own separate low price structures for the resale of rice and wheat, the FPSs require substantial state government subsidies to cover the difference between their average purchase price and their average selling price. In addition in some states (e.g. in Tamil Nadu where each resident family is entitled to 20 kg of rice per month free of charge) the demand generated by the low resale prices exceeds the supply of subsidised grains provided by FCI, and the state governments cover the difference by buying the required quantities at open market prices.

The rapid increase in the TPDS consumption subsidies for rice and wheat since the early 2000s, has been accompanied by a similar fast expansion in the "offtake" volumes supplied by FCI to the fair price shops. For rice (see Fig 3), the real per Quintal value of the TPDS subsidy about doubled between 2002 and April 2013, while during the same period the share of total rice production delivered by FCI at subsidised TPDS prices to the fair price shops increased even faster, from about 8% to almost 30%.

There is an extensive literature (including government and government-contracted reports, academic studies, newspaper articles, and Web pages) going back many years[14] which discusses and analyses various aspects of the TPDS and its predecessor the PDS. Important recent contributions and also summaries of recent research by others, are in Parmod Kumar (2010 and 2011), Shikha Jha and Ramaswami (2011), Reetika Khera (2011), Raghbendra Jha and others (2011), Peter Svedberg (2012), Ashok Gulati and others (2012), Himanshu (2013), Jean Dreze and Reetika Khera(2013), and Himanshu and Abhijit Sen (2013). Based mainly on 2004/05 NSS data, the earlier of these studies identified major deficiencies in the TPDS system. Using 2009/10 NSS data and a partial update to 2011/12, the most recent (2013) studies have pointed to substantial improvements in the performance of the TPDS, especially in some of the southern predominantly rice consuming states[15]. Nevertheless serious problems remain. In particular:

[14] Pioneering early studies include Ahluwalia (1993) and Radhakrishna et al (1997).

[15] On the basis of their analysis of implicit income transfers using 2009/10 NSS data, Dreze and Khera (2013) argue that " for the first time, the PDS is having a substantial impact on rural poverty". However they arrive at this "good news" without allowing for

- Very large shares of the offtake of subsidised rice and wheat that is supposedly supplied to low income (AAY and BPL) consumers never reaches them. A study[16] which uses the latest available NSS data estimates that the percent shares of rice and wheat that were "siphoned off" or "diverted" have changed as follows:

	1993/94	2004/05	2009/10	2011/12
Rice	19	39	25	22
Wheat	52	72	59	52
Rice +wheat	32	54	40	35

The decline in diversion rates since 2004/05 is a major improvement in the functioning of the TPDS which researchers with a specialised interest in the TPDS (for example Himanshu[17]) attribute to policies in a number of major states, in particular: (1) Expanded TPDS coverage –"near universal" in some states such as Tamil Nadu (2) Reductions to well below Central Issue price levels in the prices charged by the Fair Price shops (3) "De-privatisation" of many of the Fair Price shops (4) Administrative and technical changes which have improved the distribution system, for example the use of IT technologies to track grain movements and the use of digital ration cards that are difficult to forge. Despite these improvements TPDS leakages at the All-India level and in many states remain unacceptably high. Also, because of the rapidly expanding quantities of rice and wheat being channelled through FCI to the fair price shops (Fig 3) the decline in diversion *rates* does not necessarily imply that there has been a decline in the *quantities* diverted. For example, Himanshu estimates that the All India diversion rate for wheat came down from 72% to 52% between 2004/05 and 2011/12, but over the same period the quantity diverted increased. [18] In Svedberg's words[19] this

grain quality problems, transaction costs, and general equilibrium effects, all of which they mention and recognise as potentially important.

[16] Himanshu and Abhijit Sen (2013,II) p.68, Table 6. Other studies confirm these estimates. For example Gulati and others (2012) puts leakage rates during 2009/10 as follows: rice 25.1%, wheat 59.1% , rice plus wheat 40.4%. Khera (2011, March), Table 2, p.17 estimated rice diversion during 2004/05 at 41.3% and wheat diversion at 70.3%, and Shikha Jha and Ramaswami (2011) estimated 2004/05 rice diversion at 40% and wheat diversion at 73%. Svedberg (2012) estimated that the combined diversion of rice and wheat in 2007/08 was 43%.

[17] Himanshu (2013,September), pp 15-17.

[18] Inferred from Table 6, Himanshu and Abhijit Sen (2013,II) which estimates monthly per capita TPDS wheat diversion at 0.71 kg both in 2004/05 and 2011/12. Since the population increased over this period , the absolute quantity of the wheat diverted must have increased.

[19] Svedberg (2012), p.55.

situation reflects "inefficiency, corruption and theft on a gigantic scale": it should be more than just a "matter of concern"[20].

- Worse still, using 2004/05 NSS data, Jha and Ramaswami (2011) found that the diversion of rice intended for the "poorest of the poor" (AAY) consumers was much higher (72%) than the diversion of rice intended for BPL consumers (44%) , and was relatively low (5%) for better off (APL) consumers. This is not at all surprising, since the subsidy rate and therefore the payoff from illegal diversion is higher the lower the Central Issue price relative to the open market price. During 2004/05 the subsidy rates for rice were approximately 69% (AAY), 42% (BPL) and 15% (APL). The average diversion rate for rice came down substantially between 2004/05 and 2011/12, but so far how diversion rates during this period have changed according to income category has not been reported.
- Despite similar differences in subsidy rates, Jha and Ramaswami found that diversion rates for wheat during 2004/05 were roughly the same : 78% (AAY), 70% (BPL) and 77% (APL). This is not much of a consolation, given that only 20-30% of TPDS wheat was not being diverted (and about half in 2011/12).One possible explanation is that the informal illegal networks and practices used to siphon off wheat are on average more developed in the three major wheat supplying states (Punjab, Haryana, and MP) which between them normally account for 80% or more of FCI wheat procurement, than in the larger number and more diverse group of states which supply the TPDS system with rice[21]. In that case even relatively low subsidy rates e.g. approximately 17.5% for APL wheat during 2004/05, might create a high volume of illegal diversion activity.
- The "targeting" of rice and wheat subsidies to benefit poor households is imperfect in the extreme. For example in 2004/05, only 30% to 40% of poor households possessed an AAY or BPL ration card, so that 60% to 70% were excluded from the system[22]. On the other hand, between 60% and 70% of AAY and BPL ration cards were held by "non-poor" households, who were wrongly included in the system[23]. These very large exclusion and inclusion errors are due to the inherent difficulty of identifying poor households, compounded by the large scale production and distribution of illegal "ghost" ration cards, and by varying but in many cases major administrative weaknesses at state and local level. Since

[20] Himanshu (2013, September), p.15

[21] For rice and wheat procurement by state see Gulati et al (2012) p.23, Fig 5.

[22] Using 2004/05 NSS data, exclusion error was estimated at 63% by Svedberg (2012) and at 70% by Shikha Jha and Ramaswamy (2011). Using a 2006/07 survey of 12 states Kumar (2010, Table 5) reports similar very high exclusion error rates in a number of major states e.g. Kerala (70.2%), MP (76.3%), Maharashtra (60.1%).

[23] The Svedberg (2012) and Jha and Ramaswami (2011) estimates of inclusion error were respectively 62% and 73%. Based on a 2007/08 household survey, Jha and others (2011) report inclusion errors of 55% (Rajasthan), 72% (Maharashtra) and 73% (AP). Very high inclusion error rates among AAY and BPL cardholders are also reported by Kumar (2010, Table 5).

2004/05 a number of states have by-passed these deficiencies by introducing near-universal coverage, thereby reducing the exclusion of poor households while increasing the number of non-poor households covered. However fundamental problems (for example the *de facto* exclusion of large numbers of migrant workers[24]) remain. The state-level reforms have also come at a substantial cost for state budgets, not least to cover the losses of FPSs when their controlled low resale prices are well below the Central Issue prices at which rice and wheat are supplied by FCI.

- Despite the large and growing gap between the subsidised prices of rice and wheat and market prices, on average poor households with AAY or BPL cards buy much less than their food grain allowance (generally 35 kg per month) at the FPSs. According to Svedberg (2012) in 2004/05 they used just 43% of their TPDS allowance and purchased approximately 70% of their total grain purchases at market prices which were about double the subsidised prices. Shikha Jha and Ramaswami (2011) estimate that in 2004/05 an average family of five with a BPL card was buying 20kg per month at the subsidised prices, or 57% of their allowance. According to a 2007/08 survey conducted by Raghbendra Jha and others (2011) TPDS participating households purchased only 36% (Rajasthan), 20% (AP) and 59% (Maharashtra) of their rice purchases from FPSs. Himanshu (2013) notes that between 2004/05 and 2009/10 there was a sharp increase in the share of households buying at least some rice or wheat from the FPSs. This increase was especially marked in the case of poor households: for example, 59% of households in the bottom income quintile were using the TPDS in 2009/10 compared to just 34% in 2004/05, and along with this the share of their purchases from the fair price shops in their total rice or wheat purchases doubled. However, despite this marked increase over the period in the PDS share of their total purchases (from 15% to 30%), in 2009/10 this group was still buying 70% of its total annual consumption at open market prices which according to Himanshu were about four and a half times (rice) and about three times (wheat) average prices in the fair price shops[25].
- The failure of ration card holders to fully use their allowances is attributable to well known and well documented deficiencies in the structure and operations of the fair price shops, and related to that variable but sometimes high transaction costs for the cardholding customers and potential customers of the shops.

3.TRANSACTION COSTS, THE FAIR PRICE SHOPS, AND OPEN MARKET PRICES

[24] Svedberg (2012)p.56 notes that migrant workers are not allowed to use their cards outside their place of residence. This would deter many or most from applying for a card in the first place, and if they do possess one, from using it except when they return to their home village or town.

[25] Himanshu (2013) Table 8. According to him (p.20, Table 9) non-PDS consumption of rice and wheat in 2004/05 accounted for 90% of total consumption, and about 82% in 2009/10.

There are just over half a million "Fair Price Shops" (FPSs). Except in Tamil Nadu[26], each FPS has a fixed list of AAY and BPL customers whom it is supposed to supply with wheat and rice at prices equal to the CIP prices plus a controlled commission or margin. In addition to wheat and rice, the SPSs are allowed to sell kerosene, sugar and gunny bags at fixed discounted prices, but until 2001 they were not allowed to trade in other products. In 2001 states were "advised" to allow FPSs to sell non-PDS items for daily use. As of October 2012 it was reported that FPSs in 14 states were selling products such as edible oils, pulses, spices , iodised salt, soaps etc[27]

Most FPSs are privately owned but some (about 23%) are operated by state or local governments , various self help groups, and government controlled cooperatives. Many studies have shown that the majority of FPSs would be financially unviable if they were to operate legally and follow the rules to which they are in theory subject by the TPDS system. For example, according to a Planning Commission survey of 229 FPSs, leaving out unreported illegal activities, only 28.9% would have had a positive net income, only 22.7% would have had a profit greater than 12% of their working capital, and in only 4% of the sample would the FPS owners have had an income exceeding the poverty line. Consequently, as noted by the Planning Commission report "...most survive on leakages and diversion of subsidized grain".[28] On the basis of a detailed village level study of the operations of FPSs in Rajasthan, Kehra (2011) concluded that "the costs of running ration shops end up exceeding revenues generated. Thus, corruption has become a requirement of economic survival for the PDS dealers"[29].

In addition to illegal sales of subsidized grain on the open market, the following characteristics and practices of FPSs are reported to be very common:

- Inconvenient and distant location in relation to some members of their official customer base
- Poor service and long waiting times
- Underweighing, quality adulteration, inclusion of "foreign particles" and other practices that increase effective grain selling prices
- Irregular and infrequent opening times e.g. opening only 2-3 days a month, and closing the shop at unpredictable times when grains are not available

[26] Tamil Nadu has a "universal" system under which all Tamil Nadu residents are issued with "family" cards regardless of their income or wealth. Since June 2011 these cards entitle them to 20 kg of rice per month free of charge.
[27] Department of Food and Public Distribution, Annual Report 2012-13, p.55.
[28] PEO report p. XVI.
[29] Kehra (2011) p.21.

- Requiring AAY and BPL customers to buy their entire monthly grain quota (in most states 35kg for wheat and rice) in one or two transactions. Lack of cash and transport difficulties are reported to preclude many low income families from purchasing subsidized grain at all under these conditions

Illegal diversion and similar service and other deficiencies also affect the operations of the wholesale organisations which supply the FPSs , including FCI itself, State government Civil Supplies corporations, and private wholesalers. Some of the illegal activities at this level are large scale and blatant e.g. truck loads (and even train loads!) of subsidized grain intended for delivery to FPSs are delivered to and sold on private wholesale markets[30]. The consequent unreliability of the quantities, delivery times and quality of the grains supplied to the FPSs in turn worsens the already poor services they provide to many of their retail customers[31].

For many years, successive central governments and also state governments[32] have been well aware of the opportunities for corruption in the TPDS system and there is a long history of administrative initiatives aimed at limiting the pay-offs and bribes which are pervasive at all levels, starting at the bottom with the FPSs and extending upwards through the state level wholesale organisations to the manifold operations of FCI itself. Important parts of this effort include FCI's internal "Vigilance" organisation[33] and a "Nine Point Action Plan" initiated by the Department of Food and Civil Supplies. But despite these efforts, continuing illegal diversion and other performance deficiencies were openly recognised to be widespread in 2013[34]. The steady widening of the gap between open market and subsidized grain prices during the past 14 years together with the inherent financial unviability of the FPS retail distribution system, suggest that these efforts have had very limited success. An argument can be made that the expenditure on them within FCI and the Department of Food is financing "directly unproductive" activities i.e. activities which involve the use of labour and other resources which have real opportunity costs, but which have zero or low real outputs, and the main effect of which is on how the inherent economic rents in the TPDS system are divided.

[30] According to the Planning Commission PEO report (p.85),in 2003/04 of 14.07 million MT of food grains issued to 16 states by FCI, 5.12 million MT "leaked out from the supply chain (FCI godown to retail outlet) because of corruption in the delivery system" .

[31] A devastating description of the difficulties created for the FPSs by major deficiencies in the wholesale delivery system is in Kehra (2011). See especially p.20.

[32] The extent to which these efforts have succeeded in keeping down diversion rates varies very considerably as between states (Khera (2011, March, Table 2) and Himanshu (2013, Table 6). Some states –for example Tamil Nadu-have consistently had very low diversion rates of 5% or less, whereas others-for example West Bengal -have had diversion rates of 60% to 80% . The substantial and costly administrative effort needed to effectively limit illegal diversion can be seen on the Tamil Nadu Civil Supplies Corporation website.

[33] Food Corporation of India , *Annual Report,2011-2012,* pp 23-24.

[34] Department of Food and Civil Supplies, *Annual Report, 2012-2013,*p.50. A wide range of anti-corruption initiatives including the "Nine Point Action Plan" are summarised in pp 50-56 of this report.

Given the variable and sometimes high transaction costs involved in buying from the FPSs, it is not at all surprising that in the aggregate cardholders purchase much less than their allowances[35]. Transaction costs are also important in thinking about the economic welfare outcomes of the TPDS system. Despite this, without exception the extensive literature on this topic measures the implicit income transfer to AAY, BPL, and APL households as the difference between the subsidised price and the open market price multiplied by the quantity purchased, *without taking account of transaction costs*. The most recent example of this is a paper by Dreze and Khera (2013). On the basis of their analysis of implicit income transfers using 2009/10 NSS data, they conclude that there is now "clear evidence" that "for the first time, the PDS is having a substantial impact on rural poverty". However they arrive at this "good news" despite recognising that (p.10): "A convincing cost-benefit analysis would need to separate the transaction costs from the transfer component of the food subsidy".

Transaction costs may be substantial in the aggregate and may vary enormously as between different households. For example, distance and travel time may be negligible for households located nearby the FPS they are authorised to use, moderate to high for households that are further away, and prohibitive for households inconveniently located due to distance or poor bus and other transport links. Other transaction costs-such as minimum purchase quantities, unpredictable/infrequent opening times, long waiting times, quality adulteration-may also affect different households in very different ways. Empirical evidence on the distribution of distance and waiting times in Rajasthan, AP and Maharashtra during 2007/08 is in Raghbendra Jha et al (2011).

As well as being affected by the transaction costs involved in buying from the FPSs, the economic welfare of rice and wheat consumers also depends on the level of open market prices. This is especially important because in the aggregate more food grains are purchased from the open market than from the FPSs, as is also the case for poor (BPL) households with incomes below the poverty line. Hence policies which for example benefit TPDS consumers by reducing the subsidised prices, may reduce or even worsen net consumer economic welfare if a consequence of the same policy package is to increase open market rice and wheat prices. Something like this may have occurred in the rice market between mid-2006 and mid-2013 (Fig 2) when Central Issue prices for rice declined in real terms by just over a third, while real inflation-adjusted open market prices for rice increased by about a third. Increases in open market prices also increase the incentive to divert or "siphon off" subsidised grains, thereby reducing the supply available for legitimate FPS sales. Likewise, the fiscal cost of the TPDS depends on both the level of the TPDS subsidised prices, and also the level of free market prices. For these reasons it is important to recognise that food grain policies have

[35] The economic logic of transaction costs as one of the determinants of PDS "under-purchase" is discussed in Kehra (2011).

three not easily reconcilable components, one (the TPDS and now the NFSA) which aims to provide low prices for low income food grain consumers, a second (exemplified by MSP policies) which aims to assure farmers that they will receive "fair and remunerative" prices for their crops, and a third legitimate concern with the already very large fiscal cost not only for the central government but increasingly for state governments.

The rest of this paper analyses and provides some rough quantitative estimates of the fiscal consequences and impact of these policies on the economic welfare of participants in the rice market. It is assumed that the policies the effects of which are simulated for rice (e.g. removal of the TPDS, removal of the export ban) would also be applied at the same time to wheat, but no attempt is made to quantify the fiscal and other consequences for wheat. It would be straightforward in principle (but time consuming in practice) to apply the same methods in a separate study of the wheat market. However a considerably more complex framework would be required to treat both rice and wheat in the same model. This is one of the more important areas for further research.

The next section describes at a general level a baseline scenario which approximates the situation in the rice market during the 2011/2012 rice marketing year. This section includes a discussion of plausible guesstimates of supply, demand and subsidy parameters which are needed for subsequent policy experiments.

From this starting point the paper discusses the economic welfare and fiscal consequences of five counterfactuals:

(1) Removal of the MSP, removal of the TPDS, retention of the export ban

(2) Removal of the MSP, retention of the TPDS, retention of the export ban

(3) Retention of the MSP, removal of the TPDS, retention of the export ban

(4) Removal of the MSP, removal of the TPDS, exports allowed

(5) Removal of the MSP, retention of the TPDS, exports allowed

The first three of these experiments assume that the base scenario ban on exports remains in place. For the first and second, there are three different sub-experiments corresponding to three alternative assumptions about the rice supply elasticity. Exports are allowed in the fourth and fifth experiments, but it is assumed that Indian exports lower the world price. For each of these two experiments, there are three sub-experiments, one with no export tax, one with an "optimum" export tax, and another with an arbitrary "high" export tax. The "optimum" export tax is derived from a guessed function which relates the Indian export supply to the world price. The pros and cons of an export tax for rice in the Indian context are discussed in section 8 below.

The consequences of each of these counterfactual scenarios are worked through at a general level, in each case comparing the counterfactual with the baseline scenario, and distinguishing the likely economic welfare outcomes for rice farmers, people involved in the illegal diversion of subsidised rice ("diverters"), TPDS cardholders who buy subsidised rice from the fair price shops, all other (non-subsidised) rice consumers, and the net revenue impact for the central and state governments. At various places in the discussion the term "participants" rather than "consumers" involved with the TPDS system is used deliberately to recognise the well established fact that large shares of the "offtake" of subsidised grain is illegally diverted to the open market and never reaches the intended low income beneficiaries.

The analysis starts by constructing a highly simplified base scenario to very approximately represent the actual ex-post situation in the rice market during MY 2011/12. A simple comparative static model is then used to estimate the economic welfare and government fiscal consequences when this base scenario is disturbed by the five policy experiments.

The outcomes of the policy experiments are calculated assuming linear demand and supply curves using an Excel spreadsheet. Tables 1,2 , 3, 4.1, 4.2, 5.1 and 5.2 report the results when transaction costs are assumed to use up 20% of the economic rent generated by the TPDS for diverters, and 20% of the consumer surplus generated for TPDS cardholders who buy rice at the subsidised price. The outcomes of the first and second policy experiments are calculated and reported for three different specifications of the rice supply response . In the third policy experiment there is no change in the controlled market price, so only one set of outcomes is reported. For the fourth and fifth experiments the Tables report the results of only the first (low elasticity supply response) case , but the results of three alternative assumptions about the export demand function are reported. Alternative values for these and a number of other parameters can easily be inserted into the spread sheet calculations, but as is apparent from the discussion below, changing some of the other modelling assumptions would be more difficult to manage.

Section 4 below describes some of the principal features of India's rice market during MY 2011/12 and how they have been treated (or in some cases ignored) in these modelling experiments. Sections 5,6 and 7 summarise the principal quantitative outcomes of the first three policy simulations. Section 8 is a general discussion of the pros and cons of a rice export tax in the Indian context. Sections 9 and 10 summarise the quantitative outcomes of the fourth and fifth policy simulations. Section 11 summarises and compares some of the outcomes of the policy simulations. Section 12 concludes with a summary of the principal findings, comments on the assumptions and parameters used, and discusses the relevance of the work for evaluating the NFSA. For readers interested in the analysis underlying these results, Annex 1 provides a general description of the model and of the first three policy experiments. The other two policy experiments are

different applications of the same basic model and separate descriptions should not be needed. Annex 2 provides a list of assumptions and parameters used in the policy experiments.

4. FEATURES OF THE RICE MARKET DURING MY 2011/12, AND MODELLING ASSUMPTIONS

As discussed previously, India's domestic policies affecting the rice market are managed quite independently from the situation in world markets. Export and import controls are used to insulate the domestic market from world prices. Consistent with this, in the first three modelling experiments neither rice exports nor rice imports or trade policies are included. Decisions on these matters are assumed to be taken by the government through FCI as part of FCI's management of its large buffer stocks.

This assumption is dropped in the fourth and fifth modelling experiments, in which the rice market is opened to exports by the private sector. In the beginning, exports are assumed to take place at an "export parity" price of Rs 24/kg, which becomes the initial open market domestic wholesale price for the purposes of these two experiments. Since about early 2004 Indian domestic wholesale prices of common rice have been much lower than world prices (see Fig 4). Rs 24/kg approximates world prices as indicated by Thai export prices during MY 2011/12, after adjusting for quality differences, transport, storage and port costs to get Indian rice to the fob stage in Indian ports. Preliminary calculations indicated that it would be unrealistic to treat India as a price taker in the world rice market, as exports at that price would be far too large to take place without affecting the world price. Accordingly these simulations use a downward sloping linear demand curve for Indian rice exports such that the world price declines by approximately 1 Rupee per kg (approximately $US 19.2 /MT) for each 5 million MT increase in Indian exports. As mentioned above, these two experiments are run on three different assumptions about an export tax: first that there is no export tax, second that an "optimum" export is imposed, and third that an arbitrary "high" export tax is imposed. The "optimum" export tax is the tax which equilibrates supply and demand such that the marginal revenue from exporting equals the domestic wholesale price which in turn equals the supply price. When there is an export tax, the simulations include estimates of the central and state government revenue collected from the export tax.

In the pre-reform base scenario the government sets the open market wholesale price of rice at Rs 17/kg (Rs 17000/MT). It is assumed that this price doesn't change during the rice marketing year (October 1 2011-September 30 2012). The price is for "common" rice varieties of the kinds that are supplied to the FPSs under the TPDS. This price is slightly above the rice equivalent of the minimum support price for paddy (Rs 10.80/kg) at which FCI purchased paddy during MY 2011/12. It includes procurement and milling charges and

approximates rice "levy" prices during this period. It is also assumed that Rs17/kg is a maximum price and that increases above this level would be prevented by FCI open market sales.

Basmati rice is exported from India at prices which are about double the export prices of Indian common rice varieties, and is reported to sell domestically at much higher prices than the prices of the common rice varieties of the kinds supplied under the TPDS. Therefore basmati rice has been treated as a separate product and is removed from the statistics of rice production and demand used in the baseline scenario and in the policy experiments. This has been done by deducting 8 million MT from the official statistics of rice production during MY 2011/12, and 5 million MT from the statistics of the rice consumption of non-TPDS consumers. The balance of approximately 3 million MT of basmati rice was exported and is excluded from both the baseline scenario and the policy experiments which assume zero common rice exports during MY 2011/12. The baseline quantities used in the policy experiments are given in column 4 of Tables1-5.

For computational convenience it is assumed that all the rice supplied under the TPDS to the FPSs is sold to them at Rs 5/kg. Rs 5/kg is a rough approximation of the weighted average of the "Central Issue" (CIP) prices at which rice was supplied by the central government to the states during MY 2011-12. For rice intended for AAY, BPL and APL consumers these prices were respectively Rs 3, Rs 5.65 and Rs 8.3 per kg. It is assumed that Rs 5/kg is a delivered price which includes warehouse- to- FPS transport charges, even though in practice many FPSs are required to arrange and pay for at least part of these delivery charges.

In one set of calculations it was assumed that the rice that is not illegally diverted (see below) is resold by the FPSs to TPDS cardholders at the same price (Rs 5/kg)[36] at which it is supplied to the fair price shops. However, according to a recent study[37], in 2009-10 13 states (out of 35 states and UTs) had reduced FPS maximum selling prices for rice and wheat to Rs 3/kg or less[38], and the all-India average controlled resale price for TPDS rice was Rs 3.9/kg (rural) and Rs 3.4/kg (urban). To take account of the increasing gap in recent years between the central issue prices and the state government mandated prices at which the FPSs are allowed to resell, the set of calculations summarised in the Tables and discussed in sections 5-12 below, assumes that the average TPDS resale price is Rs 3.5/kg.

Inter-state differences in the welfare outcomes of the TPDS are not considered. The spreadsheet model can be used to provide some indication of the welfare and fiscal consequences at the all-India level of

[36] Plus retail margins: see below.
[37] Himanshu (2013), p.18
[38] To take just three examples, since June 2011 all residents of Tamil Nadu have been entitled to 20kg of rice per month free of charge. Currently the price for BPL customers in Kerala is Rs 2/kg. In Andhra Pradesh the BPL price is Rs1/kg and AAY rice is free.

different central issue and FPS reselling prices, but apart from this quantifying interstate differences and related other complexities would be a major task that is well beyond the scope of this paper[39].

All the welfare and other calculations work with wholesale prices. This is legitimate as long as wholesale and retail margins are fixed in Rs/kg and don't change with wholesale and retail prices[40]. It also assumes that normal wholesale and retail stocking and distribution services for rice are in approximately infinitely elastic supply and don't earn economic rents.

However large economic rents are associated with the rice supplied through the TPDS system, including especially the FPSs. A large share of the rice that is or should be supplied to the fair price shops is illegally "siphoned off " or "diverted" , and this has been treated as a separate activity under which the diverters appropriate the difference between the central issue price and the open market price. The siphoned off rice is sold to diverter customers at the market price, who are treated separately in tracing through the welfare consequences of policy changes that affect the free market price.

The other part of the total economic rent generated by the TPDS goes to TPDS cardholder-users who buy rice from the FPSs. The term "cardholder-users" is employed to distinguish them from households who have TPDS cards but which are not actually used to buy subsidised rice. Since cardholder-users buy and consume rice, their share of the total TPDS- generated rent is referred to as "'consumer surplus" (CS). In the literature this is usually called the "implicit income transfer" or "implicit subsidy".

It is assumed that there is just one all-India market for rice and a single free market price[41]. Transport costs and local marketing charges (including state and local taxes) are included in the "Economic Cost" of FCI's operations which are used to estimate the fiscal effects of the TPDS, but apart from that regional price and production differences are not considered.

In the base scenario, the total demand for rice (D_T) is the sum of the demand from TPDS diverters (D_d), TPDS cardholder-users (D_s) who obtain rice at the subsidised price, rice purchased at free market prices (D_m) by TPDS participating cardholders who buy both subsidised and free market rice , and the demand from all other households (D_n) which do not participate in the TPDS and buy or are supplied with rice at the prevailing open market prices. This last group includes own consumption by rice farmers and rice supplied as wages-in-kind.

[39] Interstate and regional differences are dealt with in a 2006 study of India's farm support policies by Shikha Jha and P.V. Srinivasan. As is apparent from their paper, analysing and quantifying the system at this level of disaggregation is a massive empirical task.

[40] For example, suppose that the wholesale margin for rice is Rs1/kg . Then if the wholesale price falls from Rs17/kg to Rs 15/kg, it doesn't matter whether the per kg change in producer surplus (say of farmers) is calculated as Rs (17-15)=Rs 2/kg, or as Rs (16-14)=Rs2/kg. This would not be the case if wholesale margins are some function (e.g. a fixed percentage) of producer prices. Note also that this approach is compatible with large differences in retail margins according to location and other factors.

[41] According to statistical tests reported by Acharya et al (2012) rice and wheat markets in major centres are quite well integrated despite being far apart geographically.

TPDS participants are all those individuals who purchase subsidised rice from the FPSs, whether or not they are legally entitled to do so. They include legitimate AAY and BPL cardholders, APL cardholders who buy from the FPSs, illegitimate holders of the various ration cards (including illegally produced "ghost" ration cards), and individuals at all levels of the TPDS system who are involved in the illegal diversion of subsidised rice.

TPDS demand is met by "offtake" from FCI stocks. "Offtake" during MY 2011/12 was 30 million MT. It is the sum of diverter demand (D_d) and cardholder-user demand (D_s)

Diverter demand (D_d) is the very large share (22 percent [42]) of the total rice "offtake" that is recorded as being supplied to the FPSs which is illegally diverted to the open market. It is an increasing function of the excess of the free market price over the subsidised "central issue" price. Organising, managing and enforcing these illegal arrangements involves transaction costs which increase with the quantity of rice that is diverted, up to the point at which the central issue price plus the marginal transaction cost is equal to the free market price. In the base scenario for MY 2011/12 this point is at 6.6 million MT.

According to the literature a substantial amount of the diverted rice is sold by the FPSs after delivery to them, but some never reaches the FPSs and leaks out into the private market at earlier stages in the distribution chain. The supply of rice that is diverted in this way would put downward pressure on free market prices, but in the base scenario this price is fixed by the government at Rs 17/kg, so the incremental supply is mopped up by FCI price support purchases. In some cases FCI may finish up buying back the same physical grains (the "revolving door" case discussed in the literature) but the economic story is the same whether or not this is the case[43].

The economic rents from these entrenched illegal activities are substantial, but how they are divided is not known. A large share probably goes to the FPSs, which either do not keep or falsify records of these activities. To the extent that these arrangements involve time spent negotiating bribes, delivery schedules, enforcement procedures etc, they absorb real resources which should be included in the "dead weight losses" generated by the TPDS system. In the policy experiments this has been treated by alternative assumptions on the share of transaction costs (denoted by α') in total diversion economic rents. The bribes

[42]This is the actual share during 2011/12 estimated by Humanshu and Sen (2013,II) Table 6. According to them the share of wheat diverted during 2011/12 was much higher (52%).

[43] Instead of supplying some designated FPSs, suppose a truck load of subsidised rice goes (illegally) directly from a FCI godown to a nearby private wholesale market where it sells its load. The extra supply puts downward pressure on prices in that market and also in other linked markets, so to prevent open market prices falling below the support level FCI would have to increase its rice purchases by exactly the amount of the illegal truck load. In that case it is not impossible that FCI finishes up buying back the identical truck load of rice that was diverted from the fair price shops. The transaction costs of this "revolving door" procedure could be reduced, and the payoffs for those involved could be increased, by a variety of efficiency enhancing improvements: for example, by selling and then buying the rice without removing it from the delivering truck, or better still by creating the necessary fraudulent paper work without the rice physically moving from the FCI godown at all!

associated with these arrangements just affect the allocation of the economic rents and do not absorb real resources, so they are not included in α'.

Cardholder-user demand (D_s) is an increasing function of the excess of the free market price over the subsidised price plus the excess transaction costs incurred from buying from the FPSs rather than in the private market. In the model applications, since the subsidised TPDS resale price is fixed at Rs 3.5/kg, the demand for TPDS rice increases with higher free market prices i.e. the TPDS rice demand curve is upward sloping[44].

As noted above, cardholders who purchase from the FPSs incur transaction costs (distance, inconvenient opening times, poor quality-see separate discussion below) which they would not incur if they were to buy from local retailers at free market prices. *The greater the gap between free market prices and subsidised TPDS prices, the higher are the transaction costs it is worth while incurring in order to obtain rice at the subsidized price.* There are no studies which attempt to quantify these transaction costs at the all-India level, but there is general agreement that they are substantial and that they should be allowed for in any discussion of the costs and benefits of the TPDS. In this modelling exercise, this has been recognised by adjusting the welfare changes of TPDS cardholders which result from the various policy experiments, by alternative assumptions on the share of transaction costs (denoted by the coefficient α) in the total consumer surplus created by the TPDS system for cardholder-users.

Both the transaction costs of diverters (α') and the transaction costs of cardholder-users (α) use real resources and have been treated as "dead weight losses" generated by the TPDS system.

D_m is the demand for rice purchased at market prices by cardholder-users. Empirical studies have consistently shown that BPL and other cardholder households which buy subsidised rice on average buy less than their quotas, and also buy rice (more than half of total purchases) on the open market at much higher prices than the central issue prices. The obvious explanation for this behaviour is that at some point transaction costs no longer justify buying more from the FPSs. D_m has been separated out from total non-TPDS demand in order to investigate the combined welfare consequences of policy experiments which affect both

[44] In her study of TPDS wheat in Rajasthan, Khera (2011) found that household purchases of TPDS wheat initially increased as the ratio of the free market retail price to the TPDS price increased, but after a certain stationary point TPDS household wheat purchases declined with further increases in the free market/TPDS price ratio. She attributes this to the worsening bargaining power of BPL households when the incentive of FPS owners to cheat and divert their wheat to the free market increases with higher free market/TPDS price ratios. While this may explain apparently declining household TPDS demand, it is compatible with increasing *total* TPDS demand, including the demand for wheat that is diverted. Care is also needed in interpreting Kehra's results in an economic welfare context, since at the time of her survey (2002/03) TPDS prices were fixed in nominal terms, and so all of the variance in the free market/TPDS price ratio is attributable to differences in retail prices. There are many reasons for differences in retail village level prices of commodities such as wheat, including quality, seasonal , transport cost and other factors which one would expect efficient markets to reflect.

D_s and D_m, for example the policy change which abolishes the TPDS but at the same time reduces open market prices.

Non-TPDS demand (D_n) is from consumers who buy rice on the open market at prevailing retail prices, the rice component of wages-in-kind, and the own-consumption of rice farmers. This group includes medium and higher income individuals, but also a substantial number of low income and "poorest of the poor" families and individuals who do not possess AAY or BPL cards, or who have the cards but are not able or not willing to use them. It does not include the demand(D_m) of individuals and families who buy both subsidised rice from the FPSs and also open market rice.

The supply of rice (S) during the year is from farm production and is an increasing function of the wholesale price. No allowance is made for changes in supply from private stocks. Private stocks are reported to be very small, owing to the extreme uncertainity and risks for private traders resulting from the operations of FCI and some of the state government grain marketing corporations. Private trading in rice is also discouraged by the application of the Essential Commodities Act to rice and paddy, which authorises State governments to fix stock limits as part of "de-hoarding" operations[45].

In the base scenario (see Col 4 of Tables 1-5) with the open market wholesale price fixed at Rs 17/kg and the subsidised FPS resale price fixed at Rs 3.5/kg, there is excess supply of 6 million MT which is purchased by FCI and added to its rice stocks. FCI's purchase and storage costs are covered by the central government.

Linear demand and supply curves are used to calculate the changes in supply, demand, prices and in the economic welfare of suppliers and consumers resulting from a number of policy experiments. The slopes of the demand and supply curves are based on elasticity estimates in various econometric studies[46].

Changes in the economic welfare of producers (rice farmers) are measured by changes in producer surplus (PS) i.e. changes in the area above the rice supply curve[47], and changes in the economic welfare of the various rice consuming groups are measured by changes in consumer surplus (CS) i.e. by changes in the area under rice demand curves.

Rice farmers are both producers and in most cases also consumers of rice, so when in the policy experiments open market prices of rice decline, they lose out as producers and gain as consumers, and vice versa in the policy experiments which simulate the effects of an increase in the wholesale price. Since their

[45] The Rice and Paddy Central Order authorising these licensing controls by the states was extended for another year in December 2013.

[46] On the demand side I have used Praduman Kumar et al (2011), Table 8. On the supply side I have used Gulati and Kelley (1999), Annexure Table 7.2.

[47] This assumes that rural wages and the prices of non-traded inputs used by paddy farmers are not affected by the price and output changes considered. If this is not the case, some part of the change in PS will be shared with rural workers and the suppliers of the non-traded inputs.

production normally exceeds their consumption, in the former case there is a net decline in their economic welfare, and a net welfare increase when wholesale prices go up. No attempt has been made to quantify these net welfare effects by separating out the consumption effects of the policy changes on rice farmers from the consumption effects on other rice consumers. Hence rice farmer consumption effects (changes in consumer surplus) are included in the general consumer effects reported in the policy experiments. These also include the welfare effects on "poor" consumers many of whom may well be smallholder rice farmers eligible to buy subsidised rice under the TPDS.

The policy experiments affecting rice don't allow for substitution between rice and wheat on the demand or the supply side. This is obviously unrealistic since the TPDS subsidies are for both rice and wheat, and FPS customers can choose which of these they buy. Also changes in the food subsidy system (such as changes in Central Issue prices and the introduction of the NFSA in September 2013) have and will continue to apply to both rice and wheat[48]. In the policy simulations for rice it is assumed that major changes-in particular the abolition of the TPDS-are also applied to wheat. Provided this is done, the resulting estimation errors in the rice-only model are likely to be minor[49]. This is because substitution elasticities are generally considered to be very low e.g. wheat/rice cross price demand elasticities of around 0.1 have been reported[50], while at the farm level there is limited scope for substitution of wheat for rice production and vice versa, owing to very different sowing seasons and climatic requirements.

The TPDS and also other policies affecting rice, involve expenditure by the central government and state governments. Changes in government expenditure are considered under five different headings.

Firstly, to implement the TPDS the rice has to be purchased, stored, transported and delivered to the fair price shops. For the central government, during MY 2011/12 FCI's estimate of the "economic cost" of rice exceeded the average purchase price by about 20% or Rs 3.40/kg, indicating that on average it was costing the central government this much more than the private sector to deliver rice to the places served by the FPSs. In the base scenario the total cost to the central government (i.e. the share of TPDS rice in the annual food subsidy) is estimated at the purchase price (Rs 17/kg) plus 20% of this, minus the selling price to the fair price shops (Rs 5/kg) over the 30 million MT rice "offtake" from the TPDS system. In the policy experiments which simulate the abolition of the TPDS system, this cost is no longer incurred, so the central government is a "winner" because its fiscal position improves by this amount[51].

[48] The NFSA subsidies also include coarse grains

[49] If the TPDS were abolished for rice but not for wheat, the resulting seven-fold increase in the price of rice relative to the still subsidised price of wheat would lead to a substantial increase in wheat demand at the fair price shops.

[50] See for example Jha and Srinivasan (2006), Appendix 1, Table 1.7

[51] Several studies e.g. Gulati et al (2012) and Acharya et al (2012) point out that state governments impose a variety of different taxes on rice and wheat transactions, including purchases by FCI. Some part of FCI's expenditure is therefore a tax transfer from the

Secondly, the TPDS also involves expenditure by state governments. A recent study[52] estimates that during 2011/12 state government expenditure on "civil supplies and food warehousing and storage" was approximately 19% of the total central government TPDS-related food subsidy, but no further breakdown of the state government expenditure as between rice and wheat or other foods is available. In the absence of better information the base scenario and the policy experiments assume that total TPDS rice-related expenditure at the state level is 19% of the corresponding central government subsidy for TPDS rice. This is possibly an understatement, since predominantly rice consuming states in the south (such as Tamil Nadu) and south-east have been the most active in expanding the depth and scale of food subsidies.

Thirdly, the simulated abolition of the support price in four of the five policy experiments, means that the central government's expenditure in the base scenario to finance FCI's purchase and stocking costs of MY 2011/12 excess production, is no longer incurred. The per kg savings for the government are assumed to be the purchase price (Rs 17/kg) plus 20% of this (Rs 3.4/kg) for one year's storage. Over 6 million MT purchased, this comes to a total annual savings of Rs 122.4 billion[53].

Fourth, as already noted, rice production is subsidised by the provision of fertilisers and electricity (mainly used for operating irrigation pump sets) at prices which are far below farm gate import prices in the case of fertilisers, and far below production and delivery costs in the case of electric power. According to some very rough procedures explained in Annex 2, the average fertiliser subsidy per kg of rice produced in MY 2011/12 was Rs 0.98/kg (fertilisers) and Rs 1.04 (electricity), a total of Rs 2.02. In the base scenario, the total subsidy for these two inputs was therefore Rs 191.9 billion (fertiliser Rs 93.1 billion and electricity Rs 98.8 billion). In the first two policy simulations rice production declines, so fertiliser and electricity consumption by rice farmers also decline, and so there are corresponding fiscal benefits to the central government which spends less on fertiliser subsidies, and to state governments because of the reduction in the operating losses of the State Electricity Boards. In the third policy experiment, there is no change in rice production, so there is no change in these two subsidies. In the fourth and fifth policy experiments, rice production increases, so fertiliser and electricity consumption and the associated subsidies also increase. In the Tables which

central government to state governments. To allow for this, in the spread sheet model an arbitrary downward adjustment has been made to FCI's estimate of its "economic cost". Some applied research would be needed to refine this further.

[52] Himanshu and Sen (2013,II) Table 5.

[53] The 20% annual storage charge is the sum of FCI's short term borrowing costs during MY 2011/12 (10.9% to 11.5%) plus warehousing costs and storage losses guessed to be about 9%. Grain losses due to inadequate storage are a long term and continuing problem for FCI. For example, according to USDA (2013) between 6 and 7 million tons of wheat was stored in the open without even canvas or plastic sheet (Cover and Plinth) covering during the June/July 2012 monsoon period. Under these conditions and similar storage conditions for rice, there are large losses due to rain, temperature fluctuations, rodents and other pests, and pilferage. Storage losses would presumably be lower in periods during which FCI's storage capacity is better adapted to demand. However even a fairly major improvement in storage losses reducing the total annual interest and storage cost from 20% to say 15%, would produce a relatively small reduction (about Rs 5.1 billion) in the total cost of supporting the open market price.

summarise the results of the policy simulations, the fiscal effects of the fertiliser and electricity subsidies which affect both the central government and state governments are combined into one item, but can easily be disaggregated if desired.

Finally, in the fourth and fifth policy simulations, central and state government revenue includes receipts from the export taxes.

The policy experiments which estimate the effects of the removal of the support price and the other FCI interventions affecting the open market price of rice, assume that the private wholesale rice markets which would replace FCI's operations would be competitive. It is in theory possible but in my view very unlikely that private rice millers and traders would be able to exert much market power in buying from farmers and in selling to retailers.[54] A more important qualification to the simple competitive solutions used in the simulations is likely to be the price and other effects of private storage and arbitrage, which are an inevitable (and highly desirable) consequence of the privatisation of the wholesale markets

Tables 1,2,3,4.1,4.2,5.1 and 5.2 report some of the numerical results of the policy simulations outlined above. Before summarising the principal findings some general comments are in order.

In the first two experiments which include the abolition of the support price regime, the results are shown separately for three specifications of the supply function: a low (short run) elasticity case (ε=0.27 approximately), a high (long run) elasticity case (ε=0.7 approximately), and a case (S_noG) in which the supply curve (low elasticity version) shifts back by 5 million MT (approximately by 5.3%) due to risk aversion by farmers who no longer benefit from a guaranteed price. The results reported for the fourth and fifth simulations are for the low supply elasticity case only.

The estimates reported in the tables assume that both diverter transaction costs (α') and TPDS cardholder-user transaction costs (α) each use up 20% of the gross benefit these two groups would otherwise receive from obtaining or buying rice at the subsidised price. Alternative values for these and also for other parameters are built into or if not can easily be incorporated in the spreadsheet.

The effects of the various policy simulations on the welfare of low income households are calculated on two assumptions about their share of subsidised TPDS rice sales (p_t) and their share of non-subsidised (open market) rice sales (p_c). The first assumption is that the poor households share of the CS generated by

[54] In this regard the concerns of some commentators (e.g. Basu (2011) and McCorriston and MacLaren (2011)) that the removal of FCI from its present role in the grain markets might confer excessive market power on private processors and traders seems misplaced. For example, there are many thousands of competing rice millers and traders who buy and sell paddy and rice. According to a government report on the rice milling industry at Karnal (Government of India, Cluster Development Programme (2003)) in 2003/04 there were 855 rice milling units in just one state (Haryana) and 221 in one district (Karnal). For the report's authors, concerns about excessive market power were not an issue: on the contrary the report emphasises that more concentrated market structures are needed to realise the very considerable potential for major productivity improvements in rice milling through economies of scale and updated technologies.

TPDS subsidised sales is 34% (p_t=0.34) and the poor household share of total open market CS is 23.6% (p_c=0.236). The second assumption is that these shares are respectively 50% (p_t=0.5) and 40% (p_c=0.4).

In Table 1,2, 3, 4.1 and 5.1 reductions in government expenditure are preceded by a negative sign and increases by a positive sign. The signs are reversed in Tables 4.2, 5.2, 6, 7 and 8, to indicate that the central and state governments are "winners" when their fiscal position has improved, and "losers" when it has worsened as result of the increased rice input subsidies.

The parameter values used to calculate the results are listed in Annex 2. All of them are guesstimates with varying degrees of empirical support, but some are especially problematic, notably the assumption that demand from TPDS participant cardholders would decline by approximately 14.5% (from 23.4 million MT to 20 million MT) following the abolition of theTPDS. This adjustment has been made to recognise the likely non-negligible initial downward demand shift of these buyers, who would move from a situation in which they are purchasing rice at Rs 3.5/kg plus transaction costs, to a situation in which they are initially purchasing rice at Rs 17/kg plus retail margins, albeit without the abnormal excess transaction costs associated with TPDS purchases.

All except one of the simulations assume that the support price has been abolished, so the numerical estimates of the various demand categories in the tables are the calculated values after the reforms have worked their way through the system. For example, in the first experiment, TPDS diversion demand in the pre-reform base scenario with both the support price and the TPDS operating, is 6.6 million MT. After both the support price and the TPDS have been abolished, using the low supply elasticity option, the rice consumers who previously purchased 6.6 million MT from diverters at the controlled support price of Rs 17/kg, now buy 7.0 million MT at the new lower equilibrium price of Rs 13.8/kg.

The post reform demand of the other groups listed in the tables have been calculated in a similar manner, starting with pre-reform demand and using linear demand functions the slopes of which approximate rice demand elasticities of between -0.2 and -0.4. In the first, third, and fourth simulations which assume the abolition of the TPDS, it has been guessed that demand would initially drop by about 14.5% at the starting price of Rs17/kg, before increasing (first simulation) or declining (fourth simulation) from this level as a result of the new equilibrium price. This adjustment also affects the post reform demand of the two aggregates (D_t and D_T) shown in the tables.

The following sections describe and comment on the outcomes of each of the five policy experiments. The first of these provides a detailed and fairly extensive line-by-line explanation of the welfare and fiscal effects of the first policy experiment. Much of this is relevant for understanding the outcomes of the other policy experiments, so the discussion of these is less extensive.

5. FIRST POLICY SIMULATION: SUPPORT PRICE REGIME AND TPDS BOTH ABOLISHED, EXPORTS NOT ALLOWED

Some of the outcomes of this policy experiment are given in Table 1 and are illustrated in Figs 5 and 6. The experiment assumes that-as in the base scenario- international trade in common rice (in particular exports) is not allowed. Consequently with the abolition of the support price regime and the TPDS, the market clearing equilibrium price and supply are lower than in the base scenario. The economic welfare and fiscal consequences for each of the actors listed in Table 1 are discussed below. Unless otherwise indicated, the discussion refers to the outcomes given in Col (5) of the Table, which use the low supply elasticity variant and assume that both diverter and cardholder-user transaction cost coefficients are 20%.

Producer surplus, **rice farmers**. In the low supply elasticity experiment (col 5 of Table 1), the open market price falls by Rs 3.2/kg (18.8% below the support price) and the equilibrium quantity falls by 4.8 million MT to 90.2 million MT. The resulting loss of rice farmer producer surplus is Rs 294.3 billion, equivalent to about $US 5.7 billion at average MY 2011/12 exchange rates[55].The price impact is considerably less when the supply is more price-responsive (col 6), but the farmer producer surplus loss is still substantial at Rs 185.9 billion ($US 3.6 billion). In the third variant of this simulation (col 7) the removal of the price guarantee is assumed to shift the supply curve to the left by 5 million MT, so supply at price Rs 17/kg falls from 95 to 90 million MT. The equilibrium free market price after the removal of the price guarantee is higher than in the first and second simulations because farmers react to the removal of the guarantee by supplying less rice than they would have supplied if they had been indifferent to the existence of the guarantee. The net change in rice farmer welfare is the PS in the pre-reform situation which is lost, plus the PS at the new price and quantity equilibrium following the removal of the support price and the TPDS. The PS prior to the reform is the area above the pre-reform supply curve which cuts the support price line at quantity supplied 95 million MT. The PS following the reform is the area above the new supply curve at the new free market equilibrium price Rs 15.5/kg and quantity supplied 87.9 million MT. The difference between these two PS estimates is the net change in PS (Rs 167.9 billion or $US 3.2 billion). Farmers receive a lower price and evaluate these receipts with respect to higher opportunity costs of rice production, as represented by the inward shift of the supply

[55] This assumes that rice milling and wholesale trading services are in infinitely elastic supply. If they are not millers and traders would share some of the PS decline

curve. Put another way, rice production has become less attractive relative to the production of other crops and/or activities[56].

Diverter rent. In the base scenario, illegal diverters obtained 6.6 million MT of rice for Rs 5/kg which they resold for Rs 17/kg. If there were no transaction costs, they would have been rewarded for this activity by a total economic rent of Rs 79.2 billion ($US 1.52 billion) which would have been divided up between the FPS owners, the various wholesale organisations which supply the FPSs, FCI employees , and state and central government officials. With the abolition of the TPDS this economic rent disappears. However negotiating and enforcing these arrangements involves transaction costs the size and distribution of which are for obvious reasons unknown. Transaction costs of say 10% to 20% of the economic rent (between about 7% and 14% of the base scenario market price of rice) are perhaps plausible. Table 2 assumes a 20% transaction cost ratio (α'=0.2) and so the net benefit to illegal diverters which disappears with the abolition of the TPDS is Rs 63.4 billion ($US 1.22 billion). Of course the transaction costs (Rs 15.8 billion) also disappear: this removes one of the two major non-productive dead weight economic losses generated by the TPDS (see later discussion).

Consumer surplus, diverter customers. The diverters are intermediaries who in the base scenario supply 6.6 million MT of rice to final consumers[57]. In that scenario these customers of the diverters pay the fixed open market price (Rs 17/kg), but after the reforms and the abolition of the TPDS they can buy rice at the new reduced price. In the low supply elasticity policy simulation (Table 1, col 5) the new reduced price is Rs 13.8/kg and this group of consumers increase their purchases from 6.6 million MT to 7 million MT, with a consumer surplus welfare benefit of Rs 21.6 billion (approximately $US 415 million). In the second and third variants (Table 1 cols 6 and 7) of this policy experiment the open market price falls by less and this is reflected in lower CS welfare benefits (Rs 13.6 billion and Rs 10 billion).

Consumer surplus, TPDS cardholder- users (first stage). In the base scenario, leaving aside transaction costs, TPDS cardholders who used their cards to buy rice from the fair price shops, benefited from buying 23.4 million MT at the subsidized price of Rs 3.5/kg. At the market price of Rs 17/kg, this subsidy was worth Rs 315.9 billion, so in the first stage of the policy reform involving the abolition of the TPDS these buyers lose out by Rs 315.9 billion ($US 5.4 billion) . However this calculation assumes zero transaction costs for consumers buying at the subsidized price from the fair price shops, even though it is well established that transaction costs are considerable. The size and characteristics of transaction costs are important determinants of the

[56] To quantify these PS changes while keeping the calculations simple using linear supply and demand curves, I have arbitrarily assumed that supply would go to zero at price Rs 10/kg. Alternative values for this parameter don't change the PS estimates very much

[57] This is an oversimplification in that some of the diverted rice may be consumed by the diverters. However consumption decisions in these cases are the same or at least similar since the opportunity cost of this rice is the open market price.

economic welfare consequences of the TPDS. The higher they are, the less is the welfare loss to TPDS cardholder users from the abolition of the TPDS, or looked at the other way round, the less is the welfare gain from the introduction of the TPDS. In the model, the share of CS that is used up by transaction costs is denoted by α. When α=0.2[58] (the case reported in Table 1) 20% of the CS of these TPDS consumers is lost to transaction costs, so the CS benefit forgone when the TPDS is abolished is reduced to 0.8*315.9 billion or Rs 252.7 billion. As can be seen by comparing Cols 5, 6 and 7 of Table 1, this initial first stage consumer surplus loss is the same regardless of the rice farmer supply responsiveness assumed in the simulation. Note also that transaction costs of 0.2*315.9 or Rs 63.2 billion are no longer incurred, so the policy reform removes this second major contributor to the dead-weight economic losses created by the TPDS.

Consumer surplus, TPDS cardholders users (second stage) As described above, in a first stage TPDS cardholder users lose out with the abolition of the TPDS since they no longer are able to obtain rice at the subsidised (Rs 3.5/kg) price. However the open market price in this simulation is lower, so there is an offsetting CS benefit. In the low supply elasticity variant (col 5 of Table 1) the open market price declines by 18.8% to Rs 13.8/kg, providing a CS benefit to this group of buyers of Rs 65.9 billion. As noted previously, this estimate is based on a demand function that is guessed to shift inward by 14.5% at the initial base scenario open market price. Because the open market price declines by less in the two other variants of this policy simulation (Table 1, cols 6 and 7) the offsetting CS benefits are also lower.

Consumer surplus, TPDS cardholder users' market purchases. There is ample evidence that cardholders who buy rice at subsidised prices from the FPSs, also buy rice at much higher prices on the open market, even though the quantities t they buy from the FPSs are on average well below their TPDS quotas. The obvious explanation for this at first sight irrational behaviour is that beyond some point the marginal cost of buying from the FPSs (i.e. the subsidised price plus the marginal transaction cost) exceeds the open market price. A number of the studies which report this behaviour by TPDS cardholder- users estimate that the quantities they purchase at open market prices considerably exceed the quantities they purchase at subsidised prices. In the base scenario it has been assumed that 55% of cardholder-user total purchases are at the open market price, equivalent to 28.6 million MT. At the simulated lower equilibrium free market price (low supply elasticity variant) of Rs 13.8/kg, this group of consumers increase their demand to 30.2 million MT, equivalent

[58] α values of 0.2 or higher are not implausible if transaction costs are seen in relation to the base scenario market price rather than the difference between that price and the subsidised price. For example, when α=0.2, transaction costs are just 14.1% of the total value of TPDS rice at the base scenario price.

to a CS benefit of Rs 93.4 billion. The CS benefits corresponding to the other two variants of this experiment (see Cols 6 and 7 of Table 1) are lower but still substantial.

Consumer surplus, TPDS cardholder users, net. Cardholders who in the base scenario purchased rice from the fair price shops at the subsidised price, lose out when the TPDS is abolished, but this welfare loss is to varying extents compensated by the welfare gains resulting from the reduction in the open market price. In the low supply elasticity variant of this experiment (Table 1 col 5), the CS gains from the reduced open market price are very substantial (Rs 65.9 billion and Rs 93.4 billion) , so that the net CS loss for TPDS cardholder-users is cut by two two-thirds, from Rs 252.7 billion to Rs 93.4 billion. In the other two variants of this experiment (Table 1, cols 6 and 7), the new open market prices are higher, so the offsetting CS benefits to this group of rice consumers are lower.

Consumer surplus, non-TPDS buyers. In the base scenario, buyers who don't use the TPDS consumed 30.4 million MT when the open market price was Rs 17/kg. In the first policy reform experiment (low supply elasticity variant) at the simulated lower equilibrium free market price (Rs 13.8/kg) they increase their consumption to 31.5 million MT, providing a CS benefit of Rs 98.4 billion. As with the other rice consumption groups, the CS benefits from the simulated policy changes are lower for this group of buyers when the equilibrium free market price is higher (Table 1, cols 6 and 7).

Consumer surplus, total (all buyers) This consolidates all the CS effects including the initial welfare loss resulting from the abolition of the TPDS (Rs 252.7 billion) and the economic welfare benefit of the reduced open market prices to the consumers who before the reforms purchased rice from the diverters. In the low supply elasticity simulation, total demand at the new lower open market price (Rs 13.8/kg) is 90.2 million MT, 1.2 million MT more than base scenario demand, and the total CS benefit is Rs 279.3 billion. This benefit more than offsets the initial welfare loss from the abolition of the TPDS, so there is a net CS gain from all these changes of Rs 26.6 billion. However the offsetting CS benefits are lower in the two experiments with higher equilibrium open market prices, so in the aggregate consumers experience substantial CS losses.

Government expenditure (TPDS) Centre. The total cost to the central government of running the TPDS system for rice (see previous discussion) is the purchase price (Rs 17/kg) plus 20% of this (Rs 3.4/kg) minus the selling price to the fair price shops (Rs 5/kg). Over the 30 million MT rice "offtake" , the total cost to the central government is Rs 462 billion ($US 8.9 billion). With the simulated abolition of the TPDS system, this cost is no longer incurred, so the central government fiscal position improves by this amount.

Government expenditure (TPDS) states. As discussed previously, in the absence of better information it has been assumed that during 2011/12 state government expenditure on TPDS subsidies for rice was 19% of the total central government rice subsidy i.e. Rs 87.8 billion. The predominantly rice consuming states such as Tamil Nadu and Andhra Pradesh have been especially active in expanding the depth and scope of their food subsidies, so it is likely that this underestimates total state government subsidies to rice consumption. Like the central government rice subsidies, it is assumed that these state subsidies would no longer be incurred if the TPDS system were to be abolished.

Government expenditure (stocks). During the crop year (Oct 2011-Sept 2012) rice production (estimated at 95 million MT after removing basmati rice production) exceeded demand (89 million MT) and officially held stocks increased by 6 million MT. At the support price of Rs 17/kg, the government spent Rs 102 billion on buying this rice. In addition it incurred an annual cost of holding these extra stocks. Assuming interest and storage costs to be 20% of their value at the domestic free market price, this is equivalent to Rs 20.4 billion, giving a total annual cost of support and storage operations of Rs 122.4 billion. In the simulation, since the government is no longer procuring at the announced minimum support price, it no longer accumulates excess stocks and no longer incurs this cost. Hence the government's fiscal position improves by this amount. There are many alternative scenarios to this estimate, including alternative (higher or lower) stock holding costs, and the possibility that the government exports the excess stocks, perhaps at a profit if fob prices exceed procurement prices plus handling costs to the ports.

Government expenditure, rice input subsidies. In the base scenario, the total cost to the central and state governments of the fertiliser and electricity subsidies is Rs 191.9 billion. In this experiment rice production falls by 4.8 million MT, so there is a corresponding reduction of Rs 9.7 billion in the cost of these subsidies. Just under half (Rs 4.7 billion) of this fiscal benefit goes to the central government which finances the fertiliser subsidy, and slightly over half (Rs 5 billion) goes to state governments in the form of a slightly improved (but still very bad) financial situation of the State Electricity Boards.

Dead weight loss. In the base scenario, in order to negotiate , manage and enforce the illegal arrangements under which large quantities of TPDS rice are siphoned off, diverters incur transaction costs. In addition, TPDS cardholders who buy rice from the FPSs incur transaction costs such as travel to distant fair price shops, infrequent and inconvenient opening times, long waits, having to finance and transport large quantities etc. When the TPDS is abolished in this policy experiment, these real economic costs (" dead weight losses") disappear, and are counted as a benefit of the policy reform. In this simulation the gain is calculated on the assumptions that transaction costs are 20% of gross diverter rent (α'=0.2) and 20% of TPDS cardholder-user

consumer surplus (α=0.2). This gives diverter transaction costs of Rs 15.8 billion and TPDS cardholder-user transaction costs of Rs 63.2 billion, a total of Rs 79 billion($US 1.52 billion). This benefit goes up sharply with the size of the pre-reform transaction costs. Alternative values can be calculated by varying the coefficients α' and α.

Consumers' surplus, TPDS_poor (first stage) According to one study (Jha and Ramaswami, 2011) in 2004/05 the share of "poor" consumers in the total TPDS implicit income transfer for rice was approximately 34% (p_t=0.34, see Table 1).[59] Using this share and assuming that there are no transaction costs of buying rice from the fair price shops, in the first stage of the reforms involving the abolition of the TPDS, the CS of "poor" consumers would decline by 34% of the total reduction in the CS of all TPDS participants, that is by Rs 107.4 billion. However this CS loss for poor households is lower when allowance is made for transaction costs. In the variant reported in Table 1, transaction costs are 20% of the potential available CS, so poor consumers lose out by Rs 85.9 billion. If transaction costs were 30% of CS (α=0.3) they would lose out by Rs 75.2 billion, and so on.

Consumers' surplus_ poor (second stage). Following the abolition of the TPDS, all rice purchases are from the open market at the going market price. In this policy simulation the open market price declines, so poor families benefit from the lower price along with all other consumers who buy or obtain rice at market prices. Working from data in the Jha and Ramaswami (2011) paper, the share of "poor" household rice consumption in total non-PDS consumption of rice during 2004/05 was 23.6%. Using the low supply elasticity variant of the simulated reforms (Table 1, col 5) the total second stage CS benefit for all rice consumers is Rs 279.3 billion (the sum of ΔCS_{dc}, ΔCS_t_post, ΔCS_m, and ΔCS_n). If the poor household share of this CS benefit is 23.6%, the CS benefit to them is Rs 65.9 billion. These CS benefits to poor families are lower in the two policy experiments with higher open market prices (Table 1, cols 6 and 7).

Consumers' surplus_ poor NET_1. In a first stage, poor consumers who participate in the TPDS lose out when the TPDS is abolished, but in a second stage poor consumers who buy their rice at market prices benefit when

[59] Jha and Ramaswami estimate that the total TPDS implicit income transfer for rice in 2004/05 was shared as follows: "poor" households 17.6%, "non-poor" households 34.4% , and "illegal diversion" 48%. Their estimates allow for poor households wrongly classified as APL, and for non-poor households wrongly classified as poor (BPL or AAY). The present paper differs from theirs by treating diversion and sales by the fair price shops to TPDS cardholder-users, as separate activities. Adjusting for this, their estimates indicate that 34% of the implicit income transfer (in this paper's terminology consumer surplus) for rice that was not diverted went to "poor" households and 66% went to "not-poor" households. A recent paper (2013, II) by Himanshu and Sen (Table 5) estimates the share during 2004/05 of poor (bottom 40%) households in the total (wheat plus rice) implied value of PDS food transfers at 50.1 %, compared to 35.8% estimated by Jha and Ramaswami. The absolute values of the transfers to poor households (Rs 38.95 billion) and total transfers (Rs 77.8 billion) estimated by Himanshu and Sen are also much larger than the estimates reported by Jha and Ramaswami (Rs 21.4 billion and Rs 59.6 billion). As both these studies were working with the same NSS data relating to the same year, it would be helpful if the reasons for these major discrepancies were checked.

market prices come down as a consequence of the abolition of both the support price policy and the TPDS. In the low supply elasticity variant of the reforms, and when TPDS buyer transaction costs are zero, poor consumers lose out in the aggregate by Rs 41.5 billion. But the net loss to poor consumers depends on transaction costs and post-reform open market prices. In the case reported in Table 1, col 5, pre-reform TPDS transaction costs were 20% of the gross CS benefit from the TPDS subsidy, so consumers lose less when the TPDS is abolished. In addition the reform results in a fairly large reduction in the open market price and a corresponding fairly large increase in aggregate consumer welfare which offsets nearly all of the initial CS loss resulting from the abolition of the TPDS. Hence the net CS loss for poor consumers is modest, only 20 billion. However the policy experiments which result in higher open market equilibrium prices (cols 6 and 7 of Table 1) generate smaller offsetting CS benefits and so the net CS costs of the simulated reforms for poor households are higher.

The net CS loss for poor consumers is inversely related to the level of transaction costs. At high rates of 40% (α=0.4) and above , the net CS change for poor consumers turns positive, *indicating that poor consumers as a group benefit when both the price support policy and the TPDS are abolished*. Note however that these results do not suggest that there is a conflict of interest between all poor consumers who before the reforms participated in the TPDS, and poor consumers who buy rice in the open market, since many studies show that households that are eligible for and buy TPDS rice at subsidized prices, also buy open market rice.

Consumers' surplus_poor NET_2. This set of calculations uses an alternative estimate (50% instead of 34%) of the share of poor households in the total CS generated by the TPDS, and a higher share (40% instead of 23.6%) in the share of poor households in total rice purchases at open market prices. In the low supply elasticity variant (Table 1, Col 5), compared with the first estimates, the first stage CS loss of poor households from the abolition of the TPDS is higher (Rs 126.4 billion) , but the offsetting benefit of the poor household share of lower open market prices (Rs 111.7 billion) is also higher, so the net CS loss of poor consumers (Rs 14.6 billion) is lower. In this simulation the net CS change for poor consumers also turns positive at a somewhat lower transaction cost rate –approximately 30% ($\alpha\approx0.3$). Poor household welfare worsens considerably, however, when the free market equilibrium price is higher in the two simulations using alternative rice supply functions (Table 1, Col 6 and Col 7).

Alternative interpretation: costs and benefits of present policies This policy experiment can also be interpreted as a simulation of the welfare and fiscal effects starting from a situation in which there is no price support policy and no TPDS, to a situation in which the price is supported at Rs 17/kg and the TPDS is introduced with a subsidized price for TPDS consumers of Rs 3.5/kg. The welfare effects can then just be read

off by changing the signs for the various actors. For example, consider the low supply elasticity case with transaction costs α'=0.2 and α=0.2 and poor household shares p_t=0.236 and p_c=0.236. Rice producers are better off by Rs 294.3 billion, diverter rents of Rs 63.4 billion are created, TPDS cardholder-users are better off by Rs 252.7 billion, rice consumers who buy at the going open market price are worse off by Rs 279.3 billion, the central government and state governments incur new fiscal outlays of Rs 462 billion and Rs 87.8 billion respectively in support of the TPDS, there is a new central government expenditure to cover the cost of purchasing and holding rice stocks of Rs 122.4 billion, a new (central and state) government expenditure of Rs 9.7 billion to cover the additional costs of the fertiliser and electricity input subsidies, and dead weight economic costs of Rs 79 billion are generated. As regards poor consumers, the net CS benefit is very low: only Rs 20 billion in the aggregate, with CS benefits to poor consumers who use the new TPDS of Rs 85.9 billion, largely offset by CS losses of Rs 65.9 billion to poor consumers who now have to pay higher prices for the rice they purchase on the open market. These results indicate that the main beneficiaries of the very large fiscal cost of the two policies (price support plus TPDS) are rice farmers and illegal diverters. By contrast the net benefit of poor rice consumers is only around 3% of the fiscal cost.

6. SECOND POLICY SIMULATION : SUPPORT PRICE REGIME ABOLISHED, TPDS RETAINED, EXPORTS NOT ALLOWED

In this simulation the new equilibrium open market prices are higher than they were when both the support price and the TPDS are abolished. This is because there is still extra demand from the TPDS consumption subsidies. The economic welfare and fiscal outcomes with the diverter and TPDS buyer transaction cost coefficients (α' and α) put at 0.2 are given in Table 2, cols 5,6 and 7 and are illustrated in Figs 7 and 8. As for the first policy simulation, results are reported for three assumptions about rice farmer price responsiveness i.e. a low supply elasticity variant, a high supply elasticity variant, and a case (S_noG) in which the absence of a guaranteed price causes the rice supply curve to shift inwards by 5 million MT. Unless otherwise indicated, the discussion below refers to the low supply elasticity variant (col 5 of Table 2). The market clearing prices are higher with the other two variants, which have fairly obvious consequences for the welfare and fiscal outcomes shown in cols 6 and 7 of Table 2.

Producer surplus, **rice farmers.** The equilibrium market clearing price (Rs 14.5/kg) is Rs 0.7/kg above the market clearing price in the first simulation, and correspondingly the equilibrium production (91.2 million MT) exceeds equilibrium production (90.2 million MT) in the first simulation. Consequently rice farmer producer welfare (ΔPS) falls by Rs 231.7 billion, less than the reduction under the first policy simulation (Rs 294.3

billion). In other words, keeping the TPDS while removing the price support benefits rice farmers by Rs 62.6 billion.

Diverter rent. Diverters are intermediaries: they resell the rice they obtain illegally at market prices. If there are no transaction costs, the reduction in the value of their sales is entirely due to the decline in the market price. If there are transaction costs, the quantity obtained illegally and resold also declines (in this simulation from 6.6 to 6.4 million MT) and so there is a further cut in their economic rent. Allowing for transaction costs, when α'=0.2 the diverters' net economic rent is less by Rs 15.0 billion than it was in the base scenario (Rs 63.4 billion).

Consumer surplus, diverter customers. This is the CS of the customers who in the base scenario purchased 6.6 million MT rice at open market prices from the diverters. They benefit from the lower open market price and increase their total rice purchases to 7.0 million MT. The diverters only supply them with 6.4 million MT of this, since their rice purchases at the subsidised price have fallen to 6.4 million MT.

Consumer surplus, TPDS cardholder-users (first stage). Before the removal of the support price, TPDS cardholder-users purchased 23.4 million MT of rice at Rs 3.5/kg which was valued at Rs 17/kg. Assuming zero transaction costs, this provided a CS benefit[60] of Rs 280.8 billion. In the new scenario, TPDS demand falls to 22.9 million MT and the free market equilibrium price is Rs 14.5/kg. Consequently the CS benefit to TPDS consumers is now Rs 217.6 billion. So the policy change has reduced the CS of TPDS cardholder-users by Rs 63.7 billion. This at first counter-intuitive result is because the demand for rice by TPDS participants is upward sloping . That is, demand is an increasing function of the excess of the free market price over the subsidized TPDS price. In this simulation, the subsidized price is fixed at Rs 3.5/kg, so the attractiveness of qualifying for TPDS supplies increases as the free market price rises, and conversely the demand for subsidized rice declines as the gap between the free market price and the subsidized price narrows. This CS estimate assumes that none of the CS benefit is used up in transaction costs incurred to obtain the subsidized rice. Transaction costs reduce the change in the net benefit e.g. from minus Rs 63.7 billion to minus Rs 51 billion (Col 5 of Table 2) when they are 20% of the gross CS benefit before and after the new policy. The estimated changes in cardholder-user CS are lower when equilibrium open market prices are relatively high(Table 2, cols 6 and 7).

Consumer surplus, TPDS cardholder-users (second stage). The TPDS continues to function, so there is no second stage in which TPDS cardholder_users switch to buying rice on the open market.

[60] In the literature this is often called the "implicit income transfer" or "implicit subsidy".

Consumer surplus, TPDS cardholder- users' market purchases. At the simulated lower equilibrium free market price of Rs 14.5/kg, this group of consumers increase their demand to 29.9 million MT, giving a CS benefit of Rs 72.7 billion. The CS benefits corresponding to the other two variants of the experiment (Cols 6 and 7 of Table 2) are considerably lower, especially the variant in which farmers respond to the lack of a price guarantee by cutting back their rice production, which generates a high market clearing equilibrium price (Rs16.6/kg).

Consumer surplus, TPDS cardholder- users, net. Following the removal of the price support policy, compared to the base scenario, TPDS cardholder-users are worse off by Rs 51 billion. However the reduction in the price they pay for their open market purchases provides a CS benefit of Rs 72.8 billion, so on balance they are better off by Rs 21.8 billion. In the other two variants of this experiment , the new open market prices are higher, but there is still a positive (although smaller) net benefit for TPDS cardholder-users.

Consumer surplus, non-TPDS buyers . Non-TPDS buyers benefit from the lower equilibrium free market price, but as this price is still supported by TPDS demand it does not come down as far as in the simulation in which the price support policy and the TPDS are both abolished. Even so in the low supply elasticity variant there is a substantial CS benefit to non-TPDS buyers (Rs 76.9 billion).

Consumer surplus, total (all buyers) This consolidates all the CS effects, including the second stage welfare loss of the TPDS cardholder-users (Rs 51 billion) and the economic welfare benefit of the reduced open market prices for the consumers who before the reforms purchased rice from the diverters. In the low supply elasticity simulation, total demand at the new lower open market price (Rs 14.5/kg) is 91.2 million MT, 2.2 million MT more than base scenario demand, and the total CS net benefit is Rs 111.7 billion. The net changes are lower but still positive in the two experiments with higher equilibrium open market prices.

Government expenditure (TPDS) Centre. In this simulation (low supply elasticity variant) it is assumed that the government (through FCI) buys rice to feed the TPDS at the new going free market price of Rs 14.5/kg. It buys less rice (0.7 million MT) than in the base scenario, because the demand from diverters and from FPS customers have both declined as a result of the fall in the open market price. The government incurs procurement, storage, transport and other costs which are assumed to be the same per kg as in the base scenario. After selling the rice at the subsidized TPDS price, the total annual cost of these operations is Rs 377.7 billion, compared with a cost of Rs 462 billion in the pre-reform scenario. Therefore, removing the support price reduces the fiscal cost to the government of running the TPDS by Rs 84.3 billion. The reasons

for this fiscal benefit are the lower price at which FCI purchases the rice supplied to the fair price shops, and the reduction in the quantity purchased.

Government expenditure (TPDS) States. As discussed previously, in the absence of better information it has been assumed that the aggregate state government rice subsidy is 19% of the central government subsidy. Therefore in this simulation state government expenditure declines by Rs 16 billion (19% of Rs 84.3 billion).

Government fiscal effect, stocks. As in the first simulation, in this second simulation the absence of a support price equilibrates supply and demand without the accumulation of government held stocks. The resulting fiscal benefit (Rs 122.4 billion) is the same as in the first simulation.

Government expenditure, rice input subsidies. Rice output declines by 3.8 million MT, so the fertiliser and electricity subsidies go down by Rs 7.6 billion.

Reduction in dead weight loss. The TPDS still operates, so it still generates above-normal transaction costs for TPDS beneficiaries. But the total potential economic rent is lower than it was when prices were supported at Rs 17/kg, so it is less worthwhile for diverters to spend time and resources negotiating and managing illegal diversion arrangements, and for people who buy from the FPSs to incur above normal transaction costs to obtain rice at the subsidized price. Hence economically inefficient transaction costs are still occurring , but they are lower than they were when open market prices were supported at Rs 17/kg. In the simulation with an equilibrium price of Rs 14.5/kg and both α' and α put at 0.2 (Table 2, col 5) the diverter and TPDS cardholder- buyer transaction costs are respectively Rs 3.8 billion and Rs 12.7 billion lower than they are in the base scenario, and the total of these two is shown as an Rs 16.5 billion reduction in the dead weight loss generated by the TPDS. This benefit is higher for higher values of α' and α, but is considerably lower for the simulations which produce higher market clearing equilibrium prices (Table 2, cols 6 and 7).

Consumer surplus, TPDS_poor (first stage). The reduction in the open market price reduces the value of the TPDS subsidies to TPDS cardholder-users. When α=0.2, the net reduction after subtracting transaction costs is Rs 51 billion, and the share of poor households (assumed to be 34%) in this reduction is Rs 17.3 billion.

Consumer surplus_poor (second stage). The reduction in the open market price benefits the non-TPDS purchases of rice consumers by Rs 162.7 billion. Assuming the share of poor households is 23.6 % of this, they are better off by Rs 38.4 billion.

Consumer surplus_poor NET. In the low demand elasticity simulation, due to the reduction in the open market price, poor cardholders who buy from the TPDS lose out by Rs 17.3 billion, but this loss is more than

offset by the CS benefit (Rs 38.4 billion) on the non-subsidised purchases of poor consumers, so there is net gain for poor consumers of Rs 21.1 billion. However, this net welfare gain of poor consumers is very small by comparison with the welfare loss of rice farmers (Rs 231.7 billion), and with the fiscal improvement for the central and state governments (Rs 84.3+16+122.4+7.6=230.3) billion.

Summary. In this simulation the market price falls by 14.7 % and producers (rice farmers) lose out heavily. In the first stage of the new policy TPDS cardholder-users are not affected (see Fig 8) but in the second stage they lose out because they still buy at the subsidized TPDS price, but the value to them of these subsidized purchases declines due to the reduction in the free market price. However the lower open market price provides substantial CS benefits to non-TPDS consumers which considerably outweigh the initial first stage CS losses, producing an overall net CS benefit for rice consumers. There are also (Fig 7) central and state government fiscal benefits, due firstly to the reduction in the running cost of the TPDS, secondly to the elimination of the cost to the government of buying and holding increased stocks, and thirdly to the reduction rice input subsidies. There is a modest (Rs 21.1 billion) CS benefit for poor consumers, but this gain for them is far outweighed by the PS loss of rice farmers. Reversing the simulation and thinking of the policy reform as the introduction of a support price for rice, there is a large increase in central and state government expenditure of which the main beneficiaries are rice farmers, while rice consumers in general and also low income poor rice consumers are worse off.

7. THIRD POLICY SIMULATION: SUPPORT PRICE (MSP) REGIME CONTINUES, TPDS ABOLISHED, EXPORTS NOT ALLOWED

In this policy experiment (see Table 3 and Figs 9 and 10) the support price (=the going market price) and the quantity supplied don't change, so the abolition of the TPDS only affects diverter rents, the CS of TPDS consumer-users, transaction costs , and the outlays of the central government and the state governments which finance the TPDS. In sum:

- As regards rice farmers, there is no change in the support price, no change in the supply, and so no change in PS.
- Diverter rents disappear with the abolition of the TPDS. The net loss for diverters depends on how much of the gross rent was used up by transaction costs in the base scenario. If transaction costs were 20% of the gross rent (as assumed in Table 3 and Fig 9) the net loss is Rs 63.4 billion ($US 1.22 billion)
- The TPDS is abolished, so TPDS consumer-users lose this benefit. Their gross loss (Rs 315.9 billion) is the difference between the support price (Rs 17/kg) and the price they pay at the fair price shops (Rs

3.5/kg), multiplied by their total demand (23.4 million MT). Their net CS loss is lower the greater the importance of TPDS transaction costs. If in the base scenario these used up 20% of the gross benefit of the subsidies, the net loss from the abolition of the TPDS is Rs 252.7 billion

- Since the free market price is unaltered, the new policy does not changed the welfare of diverter customers, TPDS users who also buy open market rice, and rice consumers who do not use the TPDS
- The aggregate CS reduction is the initial welfare loss from the abolition of the TPDS (Rs 252.7) billion, since open market prices are unchanged and so there are no offsetting CS benefits .
- Before the reform, the government spent Rs 462 billion to finance the TPDS. With the abolition of the TPDS this cost is no longer incurred, so the government's fiscal situation improves by this amount.
- With the abolition of the TPDS, state government expenditure on consumer rice subsidies are also abolished. Assuming these are 19% of the central government's rice subsidy, state government expenditure declines by Rs 87.8 billion.
- The support price doesn't change, so farmers supply the same quantity of rice (95 million MT) as in the base scenario. However because of the abolition of the TPDS subsidies, aggregate demand has fallen by 3.4 million MT from 89 million MT to 85.6 million MT, so to continue supporting the price at Rs 17/kg the government purchases and stores an additional 3.4 million MT (Table 3, Col 5). At the purchase price of Rs 17/kg and storage costs of 20% annually, this requires an annual new government outlay of Rs 69.4 billion ($US 1.33 billion).
- Since there is no change in rice production, there is no change in the quantities of fertiliser and electricity used in rice production, and so no change in government expenditure on these input subsidies
- Transaction costs, both of diverters and of cardholder –buyers, disappear following the abolition of the TPDS. The corresponding reduction of dead weight losses depends on the size of the base scenario transaction costs. When they are 20% of diverter gross rents and 20% of TPDS customer gross CS (as assumed in Table 3) the welfare benefit from their removal is Rs 79 billion ($US 1.51 billion)
- In this experiment, without allowing for transaction costs, abolishing the TPDS reduces the total TPDS CS for rice by Rs 315.9 billion, and so the CS loss for "poor" consumers is 34% of this, or Rs 107.4 billion. However, the CS loss is lower when allowance is made for transaction costs e.g. when (as assumed in Table 3) transaction costs are 20% of the potential available CS, poor consumers lose out by Rs 85.9 billion, when transaction costs are 30% of gross CS (α=0.3) they lose out by Rs 75.2 billion, and so on.

- There is no change in the support price, and therefore no change in the CS of poor consumers who buy rice in the open market.
- As there are no reductions in the open market price, there are no offsetting welfare benefits resulting from the open market rice purchases of poor consumers. Hence the net welfare change of poor consumers is identical to the CS loss they experience from the abolition of the TPDS.

General comments. The net fiscal gain (Rs 480.4 billion) of this policy package is the sum of the no-longer-incurred outlays on the TPDS by the central government (Rs 462 billion) and state governments (Rs 87.8 billion), minus the additional expenditure (Rs 69.4 billion) of the central government needed to support the market price at Rs 17/kg. This fiscal benefit substantially exceeds the CS loss (Rs 252.7 billion) of TPDS consumers, so abolishing the TPDS has fiscal benefits that exceed the loss of CS of TPDS buyers by about 90%. This aggregate net benefit is an increasing function of the share of transaction costs in TPDS consumer surplus. Part of the reason for this outcome is that a substantial part of the government TPDS subsidy is captured by diverters who benefit from a rental income of Rs 63.4 billion, while another part is lost in the form of dead weight loss transaction costs.

These results can be interpreted in the reverse direction, as estimates of the welfare effects of introducing the TPDS from a starting point with no TPDS. For example, with transaction costs using up 20% of TPDS consumer surplus, the benefit to TPDS consumers would be Rs 252.7 billion and the fiscal cost would be Rs 480.4 billion, a ratio of fiscal cost of Rs 1.90 for each Rupee of TPDS consumer benefit. However the objective of the TPDS is to benefit poor consumers, and on the assumption that they receive 34% of the total increase in consumer welfare (Rs 85.9 billion) , the ratio of fiscal cost to each Rupee of poor consumer benefit is 5.59. Even if the share of poor consumers in the total CS generated by the introduction of the TPDS is much higher-say 50%-the fiscal cost/poor consumer benefit ratio is still very high (3.80). Part of the reason for this high cost-benefit ratio is that about 12% of the total government spending on TPDS rice disappears as diverter rents. Reductions in the illegal diversion rate have the potential to lower this cost-benefit ratio, provided the benefits of improved administration of the system are not outweighed by the additional government expenditures that these improvements require (on for example surveillance and controls over grain distribution).

8. AN EXPORT TAX? SOME GENERAL CONSIDERATIONS

In the three policy simulations discussed so far, the base scenario includes the long standing practice under which trade policies are managed independently by FCI as part of its general price support and buffer stocking operations, and domestic prices are insulated from international prices by FCI's monopoly over rice imports and exports. Because of the isolation of the domestic market from international trade, in the first two policy simulations which include the removal of the support price, supply and demand equilibrate at "open market" wholesale prices which are lower than the base scenario wholesale price of Rs 17/kg, and in the third policy simulation which continues the support price policy, wholesale prices remain at Rs 17/kg.

For many years varying combinations of export prohibitions and controls have suppressed the domestic prices of common rice varieties in India below the world prices of similar varieties: for example (see Fig 3) during 13 of the 18 years between 1995 and 2013 Thai export prices were well above Indian domestic wholesale prices, especially after January 2008. On average since then Thai export prices have exceeded Indian wholesale prices by about 50%, and during MY 2011/12 by approximately 65%. This suggests that lucrative and economically valuable export opportunities were being lost as a result of India's export controls during this period. In partial recognition of this, in 2012 FCI began exporting very substantial quantities from its large excess rice stocks (Fig 1), but the export prices it received were not allowed to feed back into and influence domestic wholesale prices and domestic rice production, which continue to be controlled by the support price regime[61].

In order to explore the fiscal and welfare consequences of opening the rice market to exports, the spread sheet model was initially run assuming the abolition of the TPDS and of the MSP regime, the removal of the restrictions on private exports, and that Indian rice exports would not affect the world price. In this simulation the export parity price was assumed to be Rs 24/kg, approximately 41% higher than the base scenario free market wholesale price of Rs 17/kg. Rs 24/kg was chosen for this simulation because it was a rough approximation of likely export parity prices given the actual average level of Thai export prices during this period. Expressed in Rupees, the average Thai price during MY 2011/12 was Rs 28.7/kg fob Bangkok, so assuming an average export parity price of Rs 24/kg in the simulation implies a quite generous allowance of almost Rs 5/kg (about $US 96/MT) for possible quality differences between average quality Indian and exported (15% broken) Thai rice, as well as handling and port charges to bring the Indian rice to the fob stage in an Indian port. The model was also run assuming the same conditions and policies, except that the TPDS continued to function.

[61] It should be noted here however that the level and projected trend of world prices is one of the factors that influence decisions on the level of MSPs.

World trade in rice has been in a steady upward trend for the past 30 years, increasing from about 11-12 million MT in the second half of the 1980s to about 39 million MT in 2011/12, and from around 3.5%-4% of world production to about 8-9% of world production at present[62]. Despite this increase, the quantities exported from current production by India in these two simulations are very large relative to actual international trade in rice: in the first of the two simulations (low supply elasticity variant) about 77% , and in the high supply elasticity variant 41.8 million MT, more than the total exports of all other rice exporters! It also should be borne in mind that these simulated export quantities are separate and additional to FCI's actual exports of non-basmati rice from its excess buffer stocks, in FY 2012 about 4 million MT and in FY 2013 6.5 million MT (see Fig 1)[63]. The simulated additional exports in this experiment are still a small share (between 5 and 9 percent) of total world rice production, but it seems highly unlikely (starting from zero) that quantities of this magnitude could be exported without affecting world prices. The simulated exported quantities were less in the second simulation due to higher domestic demand resulting from the continuation of the TPDS consumption subsidies, but were still very large.

The very high probability that Indian rice exports affect the world price means that, from India's perspective[64], there is a case for an export tax. By cutting export expansion, such a tax would (a) reduce the extent to which the exports depress the world price (b) keep the domestic price below the export price by the amount of the export tax (c) provide the government with revenue. If the demand for exported Indian rice as a function of the export price were known or knowable, in theory an export tax could be set at an "optimum" rate so as to equate the marginal revenue from rice exports with the supply price, which in turn would equal the domestic price. As the optimum export tax rate is inversely related to the demand elasticity, the tax would be relatively low for elastic demand functions and relatively high for inelastic demand functions.

In practice however there are many difficulties in the way of setting or even approximating an optimal export tax. For a start, econometric demand studies of the same countries over similar periods give widely varying estimates. As regards rice, the most studied country is Thailand, and the export price elasticities estimated by different authors have varied from -1.25 to -8 , implying "optimum" export taxes ranging from

[62] Data on world trade and production from All India Rice Exporters Association website at www.airea.net . Includes all rice varieties including basmati. Total exports for 2011/12 include large exports from India: in addition to basmati these were from excess buffer stocks held by FCI.

[63] In 2012/13 Indian rice exports were about 22% of total world exports, and Indian rice production was approximately 22% of world production. Between them, China and India account for about 53% of world rice production. Indian exports during 2012/13 were from FCI's buffer stock which, following three years of export restrictions, were considered to be excessive.

[64] An export tax that is optimal for India by raising India's export prices will make importing countries worse off and will in general be suboptimal for the world as a whole. It may also trigger countervailing import duties by large rice importers. For a survey of the extensive and long established literature on this topic see Corden (1997).

80% to 12.5%. As pointed out by Warr (2001), these estimates used historical data which do not capture potential future supplies from new producers were the world price to rise in response to a Thai export tax[65]. As Warr also points out, rice policies worldwide –including especially rice trade policies-are highly politicised, further increasing the unreliability of econometric demand models as predictors of the future situation in world rice markets. An example of this was the extreme spike in world rice prices in 2008 (Fig 3), which to a large extent was caused by panic actions aimed at protecting domestic consumers , in particular export bans imposed by India, Vietnam, and China in late 2007 and early 2008.

A second difficulty in thinking about the likely optimum rate for an export tax is the possibility that exports are already taxed by an overvalued exchange rate. This was the case for many years in India, and if rice exports had been permitted during that period, whatever export tax rate had been set should have been adjusted downwards to take account of the exchange rate overvaluation. However the protection of manufacturing and other import substitution industries which was the basic cause of India's overvalued exchange rate, largely disappeared during the early 1990s, and since then exchange rate overvaluation has not qualified as a general significant second best reason for subsidising exports or (in the case of rice exports) for taxing them less.

A third complication is that (as previously discussed) rice production in India benefits from the provision of key inputs-notably fertilisers and electricity- at very low subsidised prices. In the base scenario described in this paper and in the first three policy experiments these subsidies are equivalent to an output subsidy of about 12%, but they have no direct connection with and do not affect rice exports. In the fourth and fifth policy experiments which allow rice exports, they are equivalent to an output subsidy of approximately 8.5% of the export parity price (Rs 24/kg) and increase rice output, some of which is sold domestically and some of which is exported, but it is assumed that there is no impact on the world price. However in the sixth and seventh experiments in which Indian exports reduce the world price, the input subsidies expand production and increase exports, thereby working in the opposite direction from an export tax. In principle this effect would need to be allowed for in computing an "optimum" export tax i.e the tax would need to be higher than otherwise in order to offset the expansionary effect of the input subsidies.

A fourth complication is that even if an export tax is correctly set so as to optimize gross foreign exchange earnings by equating the supply price of rice with the marginal revenue from rice exports, this may not maximise economic welfare if there are other policy interventions which affect the domestic rice market

[65] The emergence of India as a major rice exporter was not captured in the early (pre-2000) econometric studies, including those cited by Warr.

and/or other related markets. Two such interventions are the fertiliser and electricity input subsidies mentioned above, and another is the TPDS which (for the rice supplied to the fair price shops) removes the connection between the export price and the subsidised domestic price, affects the fiscal balance, and generates transaction costs for both diverters and fair price shop customers. These effects are taken into account in the fourth and fifth policy experiments , and it turns out that (assuming equal welfare weights) the apparent optimum export tax in fact does not maximise aggregate economic welfare. If these non-trade policy interventions were fixed and the sole policy change being considered were the opening of the rice market to exports subject to an export tax, there would be a second best welfare maximising tax which would not be the same as the conventional optimum trade theoretic tax Estimating such a tax would be complicated: the most that can be said is that relative to a "first best" tax the rice input subsidies imply a higher tax, while the TPDS consumption subsidies and the associated transaction costs imply a lower tax.

A fifth complication in designing and implementing an export tax regime for a product such as rice, is that to influence production decisions the tax rate has to be decided and announced before the annual sowing season. Even if this tax is approximately optimal (or second- best optimal) in relation to the information on market conditions available at that time, it is highly likely that domestic and international conditions will change over the following year such that had they been known in advance the optimal export tax would have been different. If as a result the actual tax turns out to be higher than the optimal tax, the quantity of rice exported will be excessively restricted , the domestic price excessively suppressed, and government revenue from the tax will be higher than it would be with an optimal tax. Conversely if the actual tax turns out to be lower than the optimal tax, rice exports and also domestic prices will be too high and government revenue from the tax will be suboptimal. In both cases –assuming equal welfare weights for the various actors-economic welfare will be less than it would be if the actual export tax had accurately predicted the optimal tax.

Finally, an export tax on rice will provide an incentive to reduce or avoid the tax by under or mis-invoicing export shipments, as regards quantities, qualities or prices. Before India liberalised its manufacturing trade policies by removing QRs and substantially reducing industrial tariffs, its export subsidy systems provided very substantial incentives to over invoice exports and was a major source of corruption involving exporters, foreign importers, and Customs and other officials involved in the administration of the

system[66]. This history suggests that the rates should err on the low side if an export tax regime were to be instituted for rice.

Despite these complications and difficulties, because of the scale of potential Indian rice exports, the fourth and fifth policy simulations below use a guessed downward sloping export demand function and calculate the welfare and fiscal consequences for three export tax rates: zero and two alternative positive rates. The positive export taxes in two of these cases work in the opposite direction from the expansionary effect of the rice input subsidies, even though high tax rates far beyond this point may be risky because of the possibility of large welfare losses should the rate exceed the "true" optimal level.[67] Section 9 below discusses the simulated welfare and fiscal consequences when both the MSP and TPDS are abolished and exports are allowed and are either exempt from tax, subject to the conventional trade theoretic "optimal" export tax, or to an arbitrary higher export tax. Section 10 discusses the three sets of welfare and fiscal consequences when the MSP is abolished, the TPDS remains in place, and exports are either allowed tax free, are subject to and "optimal" export tax, or an arbitrary higher export tax.

9. FOURTH POLICY SIMULATION: MSP AND TPDS BOTH ABOLISHED, EXPORTS ALLOWED SUBJECT TO AN EXPORT TAX

Tables 4.1 and 4.2 summarise some of the welfare and fiscal consequences of this policy package when it is combined with three alternative export taxes. For all three simulations a guessed (linear) export demand function is assumed such that export demand starts at zero at price Rs 24/kg (about $US 462/MT) and increases by 5 million MT for each 1 Rupee per kg (approximately $US 19/MT) price reduction. With respect to the proportionate increase in the world export supply of rice resulting from Indian rice exports[68], the average elasticity over the relevant range is about minus 5, and with respect to the simulated new Indian export supply (starting from zero) the average elasticity is about minus 24. In the first of the three simulations the marginal revenue function corresponding to this export demand function is summed horizontally with the domestic demand function and together with the rice supply function is used to calculate the "optimal" values of the export price, domestic price, export tax, quantity produced, and quantity exported. This solution is "optimal" in the sense that by assumption this export tax is based on an accurate prediction of actual

[66] Exporters were allowed to import duty free inputs which would normally be restricted by import licensing and subject to high tariffs, and so had a motive to overstate the quantity and value of the export shipments which justified these imports.

[67] In his study of an optimum rice export tax for Thailand, Warr (2011) found an asymmetrical relationship between export tax rates and economic welfare, in which the initial welfare gains from low to moderate export taxes quickly turn into large welfare losses as the optimum rate was exceeded. This finding assumes constant elasticity demand functions for exported rice and is based on a general equilibrium model of the Thai economy. It appears to be the result of resource flows from the rice sector to protected sectors and/or less disprotected sectors of the economy caused by the rice export tax.

[68] World export supply of non-Basmati rice prior to the simulated Indian exports was about 35 million MT.

domestic and international market conditions, and is set so as to equate the marginal revenue and marginal cost of rice exports. However it is not a "second best" optimum because it does not attempt to take account of the other policy interventions built into the model i.e. the rice input subsidies and the TPDS. As indicated in Table 4.2, the "optimum" export tax given this export demand function turns out to be Rs 1.89/kg , approximately 8.6% of the export price. The two other sub-experiments show the consequences when "incorrect" (too low and too high) export taxes are imposed in the light of the actual effects of Indian exports on the world price. In the "low " example the tax is put at zero, and in the "high" example it is put at double the optimal tax (Rs 3.78/kg or 17.6% of the resulting export price). The spread sheet model can be used to calculate the welfare and fiscal consequences when the reform package includes any other export tax. Note however that the principal components of the policy packages being considered are the abolition of the MSP and the TPDS and the abolition of the ban on rice exports, so there is no reason to expect that the reform package that includes the "optimum" export tax will necessarily maximise the change in aggregate economic welfare. In fact (Table 4, row (k)) the increase in aggregate welfare with a "high" export tax (Rs 3.78/kg) very slightly exceeds the increase in aggregate welfare with the "optimum" export tax (Rs 1.89/kg).

However whether or not a reform package includes an export tax and the rate of the tax, substantially affects the detailed outcomes of the policy experiments, including how the resulting welfare changes are distributed among the principal actors. In the first of these counterfactual exercises (the optimum export tax case) , starting from the base scenario, exports expand from zero to 19 million MT, the domestic free market price increases by approximately 18.9% from Rs 17/kg to Rs 20.22/kg, the export price is Rs 22.11/kg, and the export tax is Rs 1.89/kg, approximately 8.6 % of the export price. The 19 million MT export expansion comes from a combination of reduced domestic demand (8.1 million MT), surplus production no longer purchased by FCI (6 million MT), and increased production (4.9 million MT). The shift of substantial quantities of rice from domestic consumption to exports is to a large extent due to the guessed downward adjustment of domestic demand as a result of the abolition of the TPDS. The effects which the values assumed for this parameter have on the level of exports and on welfare outcomes are apparent if these results are compared with the outcomes of the fifth policy experiment (see Section 10 below) where there is no downward demand adjustment since the TPDS continues.

Compared to the first sub-experiment, in the second sub-experiment (the zero export tax case) the domestic price is higher, so more rice is shifted from domestic consumption to exports and production which is exported expands by more. In the third sub-experiment (the" high" export tax case) the domestic price goes

up by less (by just 10%) so these effects are less marked and the export expansion (while still considerable - 15.2 million MT) is lower than in the other two simulations.

As well as affecting export volumes, export taxes have a major influence on farmer and consumer welfare. Regardless of the export tax rate farmers benefit very substantially from the opening of the market to exports, but their PS benefit is inversely related to the tax, varying from Rs 460.8 billion (about $US 8.9 billion) in the zero tax example, to Rs 163.6 billion (about $3.1 billion) in the high tax example. Conversely, rice consumers lose out in these experiments regardless of the export tax rate due to (i) the abolition of the TPDS, and (ii) the increase in the domestic rice prices caused by the opening to exports. As the export tax rate affects the domestic price level, rice consumers are worse off when export taxes are low, and better off when they are high. This is apparent from the examples summarised in Table 4.2 , according to which(row (h)) rice consumers are worse off by Rs 632.2 billion (about $US 12.2 billion) with a zero export tax, and worse off by Rs 395.4 billion (about $US 7.6 billion) with a "high" export tax of Rs 3.78/kg.

Export taxes also affect the government fiscal situation, but the very substantial overall fiscal improvement (equivalent to $US 12.6 billion to $US 13.9 billion) in each of the three policy sub-experiments is predominantly due to expenditure no longer incurred in support of the now abolished MSP regime and TPDS. By comparison (Table 4.1) the net fiscal effects attributable to export taxes(i.e. export tax revenue and expenditure on the rice input subsidies) are relatively minor.

In general (as is apparent from a comparison of the last" high tax" column of Table 4.2 with the other two columns), higher export taxes:

- Reduce the Indian supply to the world market and therefore reduce the consequent reduction in the world price
- Reduce the increase in the domestic free market price caused by the opening of the rice market to exports (row (c))
- Reduce the quantity of rice exported(row (e)) by cutting the volume of domestic demand switched to exports and reducing the increase in rice production (row (d))
- Reduce the increase in rice farmer welfare (row (g))
- Reduce the aggregate CS loss of rice consumers (row (h))
- Improve the fiscal balance as a result of the increased receipts from the export tax (in this example to Rs 57.5 billion or approximately $US 1.1 billion) and a smaller increase in expenditure on the rice input subsidies

10. FIFTH POLICY SIMULATION: MSP ABOLISHED, EXPORTS ALLOWED SUBJECT TO AN EXPORT TAX, TPDS CONTINUES

Tables 5.1 and 5.2 summarise some of the welfare and fiscal consequences of these reforms when the export demand function is the same as in the fourth set of simulations discussed above, and the reforms are combined with three alternative export taxes. The first export tax rate used (Rs 1.39/kg) is the trade theoretic "optimum". It is lower than the "optimum" tax (Rs 1.89/kg) calculated for the sixth policy simulation because domestic demand no longer shifts back because of the abolition of the TPDS, and is also is very inelastic, with the TPDS component of total domestic demand actually increasing as the domestic free market price goes up[69]. Consequently, domestic rice consumption declines much less than in the sixth policy simulation and less rice is shifted from domestic consumption to exports. The second and third export tax rates (zero and Rs 3.78/kg) are the same as those used in the sixth set of simulations and as before are arbitrarily chosen to illustrate the welfare and fiscal consequences with lower and higher tax rates than the theoretical optimum. Comparing Tables 4.1 and 4.2 with Tables 5.1 and 5.2, opening the market to exports while retaining the TPDS changes the policy outcomes in a number of substantial ways:

- Rice exports are much lower, by between 5 and 7.2 million MT, depending on the rice export tax
- The export price (and therefore the world price) declines, but by less than the decline when the policy package removes the TPDS
- The domestic price also comes down, but (for the same export tax rates) by less than when the TPDS is abolished
- Rice farmers are large winners in both policy experiments, but (due to the higher domestic price) they win much more when the TPDS is retained
- In the aggregate, rice consumers are major losers even when the TPDS is retained, but their aggregate loss is much less
- Diverter rents increase when the TPDS is retained, whereas in the sixth policy experiment they disappear along with the TPDS
- When the TPDS is retained, the fiscal balance worsens in two simulations (the "optimum" and zero export tax examples) , and (mainly due to export tax receipts) improves in the "high" export tax (Rs

[69] The demand elasticity of the three groups combined was about -0.26.

3.78/kg) simulation. This compares with a very large fiscal improvements when TPDS abolition is included in the policy package

- Aggregate welfare goes up substantially with both reform packages and for each of the illustrative export tax rates, but the aggregate welfare improvement when the TPDS is abolished (of the order of Rs 425 billion or $US8.2 billion) is two and half times the improvement when the TPDS is retained.
- Setting the export tax at the conventional optimum trade theoretic rate (Rs 1.39/kg) does not maximise the increase in net aggregate economic welfare. The increase in aggregate welfare is higher when the tax is set at the "high" rate or is zero. However the export tax rate affects how the welfare change is distributed between the main actors.
- Poor rice consumers lose out under both policy packages, but their CS loss is considerably greater when the TPDS is abolished, and larger still on alternative assumptions about the participation of low income consumers in the TPDS and their share of open market rice purchases.
- However in both experiments, for all of the export tax rates considered, the ratios of the winners' winnings (including rice farmer PS gains and fiscal improvements) to poor household CS losses are very high, indicating considerable scope for compensatory transfers to poor households while still maintaining positive welfare outcomes for rice farmers, the net government fiscal position, and also at least partially compensating the CS losses of not-poor rice consumers.

11. RECAPITULATION AND SOME COMPARISONS

Introduction. Table 6 summarises and compares some of the outcomes of the five policy experiments discussed above. Policy experiments which treated India as a price taker in world markets are omitted from these comparisons, as it seems implausible that the simulated export expansions they generate could occur without affecting world prices. As previously, changes in the economic welfare of four principal actors are aggregated as follows (1) The combined fiscal situation of the central and state governments (2) Rice farmers (3) All rice consumers (4) Diverters. Assuming provisionally that each of these groups has the same welfare weight, the welfare changes are aggregated (row (j)) to give the change in combined net welfare benefit (or loss if negative) for each of the five policy experiments.

Before comparing these results, recall that the first three experiments assume that the base scenario policy which prohibits international trade in rice remains in place, whereas in the fourth and fifth experiments international trade is permitted, but subject to an export tax. Because base scenario production exceeds domestic demand, in the first and second experiments the removal of the MSP regime equilibrates

demand and supply at substantially lower wholesale prices, whereas in the third experiment FCI continues to support the price at its original base-scenario level. During and before MY 2011/12 Indian domestic rice prices were far below world prices, so opening the market to international trade in the fourth and fifth policy experiments means opening it to exports. The initial guesstimated export parity price in these two experiments (Rs 24/kg or about $US 462/MT) is considerably (41.2%) above the base scenario (MSP) procurement and wholesale price (Rs 17/kg or $US 327/MT). However it is assumed that this initial export parity price declines by one Rupee per kg ($US 19.2/MT) for each 5 million MT increase in Indian exports. Using this guesstimated export demand function, it turns out (see discussion above) that the trade theoretic "optimum" export tax is Rs 1.89/kg ($US 36.3/MT) when both the MSP and TPDS are abolished, and Rs 1.39/kg ($US 26.7/MT) when the MSP is abolished but the TPDS continues. Using the policy experiments that incorporate these export tax rates, in the fourth experiment exports expand from zero to 19 million MT, rice production goes up by 5.2%, and the domestic free market price rises by 18.9%. In the fifth experiment, rice exports increase from zero to 13.9 million MT, production rises by 6.7%, and the domestic free market price increases by 24.7%.

In the fourth experiment, part of the increased exports is from increased production (4.9 million MT), part (6 million MT) from exporting the excess production that was previously purchased and stored by FCI, and part (8.1 million MT) is from the decline in domestic demand in response to the higher domestic wholesale price. In the fifth experiment the contributions to exports are increased production (6.4 million MT), production previously purchased and stored by FCI (6 million MT), and rice diverted from the domestic market to exports (1.5 million MT). The principal reason for the much lower level of exports in the fifth simulation is that domestic demand is supported by the continued operation of the TPDS, so the increased free market wholesale price diverts a substantially smaller quantity of rice from the domestic market to exports.

Comparisons, general. Comparing the economic welfare changes caused by the five experiments (Table 6, rows (f) to (j)) brings out the following:

- All five policy packages substantially improve overall aggregate economic welfare
- The biggest improvement (Rs 427.7 billion) comes with the fourth experiment, in which the MSP regime and the TPDS are both abolished and exports are allowed subject to an export tax
- The second largest improvement in aggregate economic welfare (Rs 350.8 billion) is associated with the first experiment, which abolishes both the MSP regime and the TPDS, but retains the ban on exports

- The third largest welfare improvement (Rs 171.3 billion) comes with the fifth experiment, which removes the MSP and allows exports subject to an export tax, but retains the TPDS. The principal reason for the lower overall welfare improvement compared with the welfare improvement caused by the fourth experiment, is that retaining the TPDS substantially worsens the government fiscal position (by Rs 90.1 billion) compared with a very substantial fiscal improvement (Rs 698.2 billion) in the fifth experiment
- The fourth largest improvement in aggregate economic welfare (Rs 164.3 billion) is associated with the third experiment which retains the MSP regime, removes the TPDS, but retains the ban on exports. There is a substantial fiscal benefit from the abolition of the TPDS, but consumer welfare worsens considerably
- The smallest overall welfare improvement (Rs 95.3 billion) is associated with the second experiment which removes the MSP, but retains the TPDS and the export ban. Partly because wholesale prices are lower than in the base scenario, there is a decline in the cost of financing the TPDS, and rice consumers are better off.
- All except the fifth policy experiment improve the government fiscal position. The government fiscal position worsens in the fifth experiment (by Rs 90.1 billion) mainly due to the impact of the much higher wholesale price of rice on the cost of financing the TPDS
- Rice farmer welfare declines in the first two experiments, along with the decline in the wholesale price, but improves very considerably in the fourth and fifth experiments (by Rs 313.7 billion and Rs 414.4 billion respectively) because of the big increases (respectively 18.9% and 24.7%) in the price of rice which follows the removal of the export ban.
- Rice consumers as a group are better off in the first and second policy experiments but are worse off in the other three simulations, especially in the fourth experiment in which CS declines by Rs 520.8 billion.
- Diverter rents (Rs 63.4 billion) disappear in the three policy experiments which include the abolition of the TPDS, decline moderately in the second experiment, but increase (by Rs 27.8 billion) in the seventh experiment due to the widening of the already large gap between the subsidised FPS price (Rs 5/kg) and the increased wholesale price (Rs 21.2/kg). This brings the total diverter rent resulting from this policy experiment to Rs 91.2 billion (Rs 63.4 billion base scenario +Rs 27.8 billion policy induced increase) or about $US 1.8 billion.
- Likewise (Table 6, row (k)) the dead weight losses (Rs 79 billion) associated with the transaction costs of diverters and FPS customers disappear in the three simulations involving the abolition of the TPDS.

In the second experiment the TPDS is retained but transaction costs go down (by Rs 16.5 billion) with the decline in the wholesale price of rice. In the fifth simulation however, the reverse occurs and dead weight losses increase by RS 29.7 billion due to the increase in the open market wholesale price. Adding this to the base scenario dead weight loss brings the total dead weight loss up to Rs 108.7 billion (or approximately $US 2.1 billion)

As noted above, each of the five policy packages improves net aggregate economic welfare, where the latter is defined assuming that all the actors (including subsets of the four groups distinguished in Table 6) have the same welfare weights, provisionally put at 1. Alternatively, the net aggregate welfare benefits can be interpreted as potential Pareto improvements in which the winners are potentially able to compensate the losers while remaining better off. All five policy experiments easily pass this test, but the political economy would be more difficult if actual compensation rather than potential compensation were required. For example, the welfare maximising policy package (the fourth) which abolishes the MSP regime and the TPDS and permits rice exports subject to an export tax, creates large fiscal benefits for the central and state governments (Rs 698.2 billion) and a large PS benefit for rice farmers (Rs 313.7 billion), but also large CS losses for rice consumers who as a group lose more (Rs 520.8 billion or $US 10 billion) than rice farmers gain. This is because the CS loss of rice consumers includes the effects of TPDS abolition as well as the effects of the increase in the open market price. If rice consumers were to be fully compensated for this welfare loss, transfers from government fiscal resources or transfers from both the government and rice farmers would be required.

The political economy would also probably require actual compensation for rice farmers who lose out in the first and second experiments. This could be done by a deficiency payment system under which the government would compensate farmers for the difference if the market price at which they sell their rice were to go below a pre-announced target price. If such a target price were the same as the (abolished) minimum support price, in the first simulation the total deficiency payment would exactly compensate the initial PS loss (Rs 294.3 billion) of the rice farmers and would be easily covered by the improvement in the government fiscal position (Rs 681.9 billion). In the second simulation, however, owing to the continuation of the TPDS, the government fiscal gain (Rs 230.2 billion) is not quite sufficient to cover the farmer CS loss (Rs 231.7 billion), so other financing sources would be needed.

Comparisons, poor (BPL) consumers. The principal objective of the TPDS (and its successor the NFSA) are to provide rice and wheat to poor (below the poverty line) households and individuals at very low fixed prices, in the process protecting them against fluctuations (especially increases) in open market prices

such as those that result from these five policy experiments affecting the rice market. Table 6 separates out the economic welfare consequences of the policy experiments for poor households, from the aggregated welfare effects for the other principal actors i.e. the fiscal consequences for governments, the PS consequences for rice farmers, the CS consequences for not-poor rice consumers, and the consequences for diverter rents. These calculations are shown for two sets of assumptions about the share of BPL households in TPDS implicit income transfers (p_t) and their share in total national rice consumption (p_c) which is not subsidized.

In the first set of calculations (Table 6, cols (l)-(n)) which uses p_t=0.34 and p_c=0.234, one of the policy experiments (the second) improves the welfare of poor (BPL) households but the other four worsen it, in one case (the sixth) very considerably (by Rs149.2 billion).In the second experiment which retains the export ban and the TPDS but abolishes the MSP, the open market price falls and the share of BPL households in the resulting general CS benefit outweighs the decline in BPL consumer surplus from participation in the TPDS. In the fourth experiment which abolishes both the MSP and the TPDS and permits exports, BPL consumers lose out on both counts: first they lose the TPDS subsidies, and secondly the rice they buy on the open market sells at much higher prices than the base scenario open market prices. The welfare changes for BPL consumers are negative in the other three experiments, including the seventh experiment which retains the TPDS. In this case BPL consumers are to a large extent protected by the TPDS, but lose out on balance owing to their purchases of non-TPDS rice on the open market

The impact of the policy experiments on the welfare of BPL consumers contrasts with the aggregate net welfare impact on the other actors, including the impact on not-poor consumers. For all five experiments, the net impact is positive (Table 6, row (m)), and except for the second experiment this welfare improvement exceeds the aggregate welfare improvement before separating out the BPL consumer welfare change (Table 6, row (l)). In the fourth experiment, the net welfare improvement is very large (Rs 576.9 billion ≈ $US 11.1 billion), consisting of a government fiscal benefit (Rs 698.2 billion), a rice farmer PS benefit (Rs 313.7 billion), a CS loss for non-poor rice consumers (Rs 670 billion) , and the loss of Rs 63.4 billion in diverter rents following the abolition of the TPDS.

In all the five policy experiments, the aggregate welfare improvement of the non-BPL group exceeds the welfare changes of BPL consumers, which except for the second experiment are negative. Table 6, row (n) shows the relation between these welfare outcomes as a ratio. Taking the first experiment (which abolishes the MSP and the TPDS) as an example, for each Rupee welfare loss by BPL consumers, there is a Rs 18.5 welfare gain by the non-BPL group. As discussed previously, benefit loss ratios such as this suggest

that the winners' winnings from this policy package could easily cover the financial cost of transfers to BPL households that would eliminate their welfare loss and also improve their welfare status, even if the transfer method adopted (for example food stamps or conditional cash transfers) has non-negligible administration, transaction and leakage costs . The benefit cost ratios associated with the third and fourth policy experiment are not as dramatic as this, but are still significant. In particular the benefit/cost ratios of the fourth policy experiment (minus 3.87) which produces a very high welfare improvement for the non-BPL group, also leaves plenty of scope to compensate BPL consumers.

The welfare outcomes for the BPL group and the non-BPL group (Table 6, rows (o) to (q)) have also been calculated using (1) a higher guesstimate for the share of BPL rice consumers in the total cardholder user CS generated by the TPDS (p_t=0.5 instead of 0.34) and (2) a higher guesstimate of the share of BPL households in total not-subsidized national rice consumption (p_c=0.4 instead of 0.234). Some comments on these alternative coefficients are in Annex 2. Using these coefficients (compare Table 6, row (o) and row (l)) worsens the CS welfare changes for poor consumer, especially in the fourth policy experiment. However, except in the second experiment, net aggregate not-poor welfare also increases, and in all five experiments there is an ample financial margin which in theory could be used to compensate or more than compensate the losing BPL consumers. This is also apparent from the average benefit/cost ratios of these experiments (row (q) of Table 6), which for example in the fourth experiment indicate that for each Rupee lost by poor consumers as a group there is an aggregate welfare improvement of Rs 2.83 for the non-poor group of actors.

The TPDS and domestic demand and prices. By providing large quantities of rice through the fair price shops at prices that are far below open market prices, the TPDS supports domestic demand at higher levels than would be the case if the TPDS were not operating. Domestic demand is also less elastic, so open market prices are more responsive to changes in supply. This has a number of consequences which can be seen if the first and second policy experiments are compared (Table 6), since the two experiments are identical except for the absence of the TPDS in the first experiment and its presence in the second experiment.

- The equilibrium open market price is higher when the TPDS is operating. In this example it declines from the base scenario price by less : to Rs 14.5/kg versus Rs 13.8/kg in the absence of the TPDS. This suggests that the TPDS was increasing the free market price by about Rs 70/quintal, or Rs 700/MT (approximately $US 13.5 /MT)

- Using the first assumptions (Table 6, rows (l) to (n)) on the shares of poor households in rice consumption, the TPDS improves the welfare outcome for poor consumers by Rs 41.1 billion : from a CS loss without the TPDS of Rs 20 billion, to a CS gain with the TPDS of Rs 21.1 billion.
- On the same assumption on the shares of poor households in rice consumption, the TPDS improves the welfare outcome of not-poor households by Rs 44 billion, from a CS loss of Rs 46.6 billion without the TPDS, to a CS gain of 90.6 billion with the TPDS. The at first sight paradoxical result according to which the TPDS benefits not-poor households by as much as it benefits poor households is due to the not-poor household share in the total TPDS implicit subsidy adjusted for transaction costs. This benefit is augmented by the not-poor household CS gain from their rice purchases at the lower open market price.
- Using the second set of assumptions (Table 6 rows (o) to (q)) both poor and not-poor households are better off with the TPDS, but the CS improvement this time is greater for poor households (Rs 54.2 billion) than for not-poor households (Rs 30.9 billion). This is because of the higher share of poor households (50%) in the total TPDS implicit subsidy, augmented by their higher share of purchases at the now reduced open market price.
- Because of the decline in the open market price, rice farmers lose out in both policy simulations, but their loss is less (by Rs 62.6 billion) when the TPDS is operating.
- There is a substantial fiscal benefit in both policy experiments, but the benefit is much less (Rs 451.6 billion less) when the TPDS is operating.
- Diverter rents decline by Rs 16.5 billion when the TPDS is operating , but they disappear if the TPDS is abolished
- Net aggregate welfare increases in both experiments, but by considerably less when the TPDS continues, principally due to a much smaller fiscal benefit.

The demand augmenting effects of the TPDS also influence the outcomes of the policy experiments in which the rice market is opened to exports. This explains most of the differences between the outcomes of the fourth and fifth experiments, even though these differences are also in part due to the higher export tax used in the fourth simulation. To summarise (for details see Table 6) :

- The TPDS explains why the domestic free market price in the fifth experiment is approximately Rs 0.98/kg higher (about Rs 98/quintal or Rs 980/MT≈$US 18.9 /MT) than in the fourth experiment.

- The TPDS explains why rice consumers lose out by much less in the fifth experiment than in the fourth experiment in which the TPDS is discontinued
- The presence of the TPDS in the fifth experiment reduces the CS loss of both poor and not-poor households, but not-poor households benefit by much more (by Rs 224 billion) than poor households (by Rs 116 billion)[70]
- Using the alternative (higher) assumptions on the CS shares of poor households (Table 6 rows (o) to (q)), both poor households and not- poor households benefit from the TPDS
- Rice farmers benefit substantially (by RS 100.7 billion) from the higher open market price which is mainly attributable to the TPDS
- Diverter rents increase when the TPDS continues
- The fiscal balance improves very substantially (by Rs 698.2 billion) when the TPDS is abolished in the fourth experiment, but worsens (by 90.1 billion) when the TPDS continues in the fifth experiment
- The increase in net aggregate welfare in the fourth experiment (Rs 427.7 billion) is one and half times the increase in the fifth experiment (Rs 171.3 billion) in which the TPDS continues to operate

Transaction costs. The simulated welfare and fiscal outcomes of the five policy experiments all assume that transaction costs are 20% of diverter rents (α'=0.2) and 20% of cardholder _user CS (α=0.2). Using lower or higher transaction cost coefficients than this substantially changes some of the numerical results but doesn't alter the conclusions of the analysis. This is illustrated in Table 7, which reports the summary results of the first policy simulation for five alternative values of α'and α.

At an unlikely extreme with zero transaction costs, in the base scenario rice diverters keep all the economic rent generated by their illegal activity, and rice consumers who buy from the FPSs (including poor BPL families) fully benefit from these low price purchases. Consequently, when the TPDS is abolished, both diverters and cardholder_ users have more to lose i.e. they lose more than they would if they incurred positive transaction costs in the base scenario. This explains why the net aggregate CS change for all rice consumers (row (c)) is Rs-36.6 billion when transaction costs are zero, compared to Rs+26.6 billion when the transaction cost ratio is 20%, and the CS gain from non-FPS purchases at reduced open market

[70] Not-poor households lose out by Rs 371.6 billion in the fourth experiment in which the TPDS is abolished, and by Rs 147.6 billion in the fifth experiment in which the TPDS continues. The difference (a CS improvement mostly attributable to the TPDS) is Rs 224 billion. The CS improvement for poor households (also mostly attributable to the TPDS) is the difference (Rs 116 billion) between the CS loss in the fourth simulation (Rs 149.2 billion) and the CS loss in the fifth experiment (Rs 33.2 billion).

prices exceeds the first stage CS loss from the abolition of the TPDS. Similarly net diverter rents (row (d)) go down by Rs 79.2 billion with zero transaction costs, compared with a decline of Rs 63.4 billion when transaction costs are 20%. By contrast, when transaction costs are higher, diverters and cardholder_users have less to lose when the TPDS is abolished. To take a probably extreme example, if diverter and cardholder transaction cost rates were 40%, diverter rents decline by Rs 47.5 billion, and the CS loss from TPDS abolition (189.5 billion) is less than the CS gain from the reduction in free market prices caused by the simulated reform package.

In the policy experiments which include the abolition of the TPDS, transaction costs are treated as real economic costs ("dead weight losses") which are no longer incurred, so their disappearance is counted as a benefit of the reform. When there are no transaction costs the benefit is zero, but as is apparent from Table 7 (row (f)) the benefit goes up sharply with the transaction cost rate, for example from Rs 39.5 ($US 0.76 billion) when the average transaction cost rate is 10%, to Rs 118.5 billion ($US 2.28 billion) when the average transaction cost rate is 30%.

As is the case with rice consumers in the aggregate, poor (BPL) consumers have more to lose from the abolition of the TPDS when transaction costs are low than when transaction costs are high (Table 7, rows (g) and (j)). If transaction costs are very high, abolishing the TPDS may actually benefit poor consumers, because their net CS loss (after taking account of transaction costs) from no longer purchasing at low subsidised prices from the FPSs, is more than offset by their CS gain from the reduced prices of the rice they purchase on the open market. This explains why in the first policy simulation poor consumers are better off when the transaction cost rate is 40%, either by Rs 1.5 billion or by Rs 17 billion depending on what assumptions are made about p_t and p_c.

As noted above the net welfare loss of poor rice consumers from the first policy package is inversely related to the transaction cost ratio: for example (Table 7, row (g)) poor consumers' CS declines by Rs 20 billion when the transaction cost rate is 20% and by Rs 41.5 billion when the transaction cost ratio is zero. At the same time the aggregate net welfare change of all the other actors after separating out BPL consumers also declines, *but remains large and positive*. This indicates that the net welfare improvement of the non-poor actors (that is the central and state governments, rice farmers, not-poor rice consumers and diverters) is more than sufficient to compensate the losing BPL consumers regardless of the transaction cost ratio. This is illustrated by the average benefit/cost ratios (Table 7, rows (i) and and (l)) which indicate that (for example when α=0.10) the net gain of the non-poor actors is 11.1 or 11.2 times the net loss of BPL consumers. In this example, the net fiscal benefit of the policy package (Rs 681.9

billion) is more than sufficient to compensate the losers (mainly rice farmers) while still leaving Rs 342 billion (row (h)) or 341.7 billion (row (k)) to compensate BPL consumers.

Managing unstable prices. As well as affecting the level of rice prices, the MSP regime aims to stabilise the prices received by rice farmers and paid by not-poor rice consumers, and the TPDS is intended to stabilise prices paid by low income rice consumers. However, in four of the five policy experiments the government discontinues the MSP regime, and this causes large changes in the domestic wholesale price. When the export ban remains in place, in the first and second experiments, the price declines by 18.7 % when the TPDS is also abolished, and by 14.6% when the TPDS continues. The main reason for these sharp declines is that FCI no longer intervenes to support the market by buying 6 million MT of surplus production. When the export ban is lifted, in the fourth and fifth experiments the surplus rice is exported by the private sector, and the domestic price rises to equal the export price minus the export tax, an increase of 18.9% when both the MSP and TPDS are abolished, and an increase of 24.7% when the MSP is abolished but the TPDS continues to function.

In calculating the fiscal and welfare consequences of these large changes, no allowance has been made for the possibility that price stability may be valued for its own sake, in particular that the welfare function of rice consumers may value prices which are higher but more predictable, more than prices which are on average lower but less predictable. Likewise, rice farmers may value lower but less variable selling prices more than higher but more variable selling prices. Of course their attitudes to price risk and their capability of managing it will vary considerably as between individual rice consumers and individual rice farmers, but for Indian governments there is a long history of policy statements and policy actions which clearly indicate that price stability has a very high weight in the design of policies affecting some (but not all) agricultural commodities, especially rice and wheat. In this regard, international commodity prices are considered to be especially volatile, and trade policies have been managed so as to insulate domestic prices from changes in world prices. Rice is a clear example of this: for example (Fig 3) over the 18 years since 1995 domestic wholesale prices in real terms have fluctuated within a price band of about Rs 15/kg to Rs 20/kg, whereas during the same period there have been very large fluctuations in international prices, with peaks in late 1995 and 1998, a trough in early 2001, a massive spike in 2008 during which the world price was for a while three times the domestic price, and peaks in 2011 and 2012.

In view of these concerns about price stability, how realistic are the policy simulations which maximise aggregate welfare by abolishing both the MSP regime and the TPDS regime so that rice farmers and rice consumers would have to live with potentially large fluctuations in domestic prices which would be linked

to international prices? There are a number of mitigating policies that could deal with some but not all of these questions.

Firstly, if India were to open its rice market to the world market, it would greatly increase both the quantity of the world's rice that is internationally tradeable and also increase (as illustrated in the spread sheet model) the quantity that is actually traded, and thereby reduce the impact on world prices of events such as droughts, floods, and unexpected political and other events. For example, if in late 2007 India had freed up rice exports instead of banning them, that action alone would possibly have been sufficient to eliminate the 2007/08 world price spike, or if not greatly reduce its severity.

Secondly, according to the policy experiments discussed in this paper, the fiscal and welfare benefits of abolishing the MSP regime and the TPDS would be more than sufficient to finance alternative schemes which could offset or more than offset the resulting CS losses of BPL families and individuals. Alternative schemes that have been discussed in the literature are food stamps and conditional cash transfers[71]. To maintain their welfare impact, both of these in any event would need to be indexed to inflation: in addition to that they could be adjusted to take account of cyclical fluctuations in the prices of "essential" commodities such as rice.

Thirdly, the main concern of rice farmers is to be protected against price downswings: they don't object to price upswings. However as noted elsewhere in this paper, the current MSP regime for rice, as well as preventing the paddy price and the corresponding price of rice from falling below the announced support prices, also prevents wholesale prices from rising (at least by far) above the announced support price. This is done by rice sales from FCI stocks when open market wholesale prices appear to be diverging "too far" above the announced MSPs, and much more importantly by the ban on private sector rice exports and the corresponding FCI export monopoly, which does not allow export sales to feed back and affect domestic prices. In both these ways, the MSP regime is actually a price fixing regime which sets both minimum and maximum prices. In view of this, an obvious way to accommodate rice farmer concerns about unexpected price downturns would be to treat the announced prices as genuine minima only. As long as actual prices exceed these minima, domestic prices would be free to move as influenced by export prices, whatever export tax rate (if any) is set, and domestic supply and demand conditions. The government would only intervene if prices were to go below the announced support level. Intervention could take the form of FCI open market purchases, or perhaps a deficiency payment system under which

[71] See for example Svedberg (2012) and Gulati et al (2012)

sellers would be paid the difference between their selling prices and the announced minimum prices. For such systems to be effective and worthwhile, the target prices would have to be set well below prevailing market prices so that intervention would be the exception rather than the rule. Moving to such a system would probably be politically easier during periods of high international prices when there is a large gap between the existing controlled domestic prices and potential export prices.

Left out of these suggestions which focus on protecting BPL consumers and rice farmers, are not-poor rice consumers who would be fully exposed to prices fluctuating at levels above the government intervention prices, while not benefiting in the event that a price downswing is prevented from going lower by hitting the floor price. However there would be no way of linking domestic prices to world prices if the prices paid by all not-poor Indian consumers were to be controlled and managed so as to remove or reduce price instability. That would require a regulatory regime similar or the same as the present regime and would be incompatible with the welfare maximising strategies proposed in this paper.

14. CONCLUSIONS AND CAVEATS

There is a large literature on various aspects of India's food grain policies, and one aspect that has attracted special attention and generated a very considerable volume of extremely detailed empirical research and lively debate, revolves around the food consumption subsidies for rice and wheat implemented initially through the PDS, subsequently through the TPDS, and now under the provisions of the NFSA. Much of this research has been concerned with measuring the efficacy of, and trends in, the food consumption subsidies, focussing on topics such as the extent to which the subsidised grains actually reach their intended low income target households, are illegally diverted, and their budgetary cost. Somewhat separately from this, there is another extensive literature which focuses on the policies which affect rice and wheat farmer incentives, including support prices, trade policies, and input subsidies. In both these areas it is recognized that FCI, the Ministry of Consumer Affairs, Food and Pubic Distribution, and the Ministry of Agriculture have central roles, but apart from that recognition, most of the research and also the policy discussion does not treat the consumer subsidies and grain farmer incentives in an integrated fashion.

Using a simple, comparative static model of the rice market roughly calibrated to the situation in MY 2011/12, this paper attempts to remedy this deficiency by tracing through and quantifying the economic welfare effects of five simulated policy initiatives on some of the principal actors, distinguishing the fiscal positions of the central government and state governments, rice farmers, rice consumers in general, poor

(BPL) rice consumers, not_poor rice consumers, and "diverters". The model does not include FCI's buffer stock operations and its policies on rice exports from those stocks. These are assumed to be going on in the background and do not affect the policy simulations. The simulations include various combinations of (1) abolition of the MSP regime (2) abolition of the TPDS (3) opening of the market to exports by the private sector. Some principal findings are:

- Starting from the state of the Indian and world markets for rice in MY 2011/12, potential Indian exports (additional to FCIs exports from its buffer stocks) were too large to take place without significantly affecting the world price. Consequently, given the big gap between domestic and world prices during that period, the fiscal and welfare consequences (not shown in the paper) of two policy simulations which treat India as a price taker in world rice markets, are of limited relevance and interest.
- Aggregate welfare increases substantially in each of the other five policy simulations. The biggest increase (Rs 427.7 billion ≈ $US 8.23 billion) is in the simulation which abolishes both the MSP and the TPDS and allows rice exports without restriction subject to an export tax
- The improvement in aggregate welfare is much larger when the policy simulations include the abolition of the TPDS
- Welfare maximising policies would link domestic prices to world prices and make domestic prices much less stable. However alternative ways to the TPDS of subsidising BPL consumers (such as food stamps or conditional cash transfers-not discussed in this paper) could also be used to protect them against large fluctuations in the prices of "essential" commodities such as rice. Rice farmers could be protected against exceptionally low domestic prices by setting genuine minimum support prices well below the expected future price level. However not-poor rice consumers would have to adjust to an environment of more variable prices.
- Poor (BPL) households lose out when the TPDS is abolished, and also in one policy simulation in which the TPDS continues to operate. However the aggregate net welfare benefits of the other actors affected by these policies (i.e. the central and state governments, rice farmers, not-poor rice consumers, and diverters) are by wide margins sufficient to compensate or more than compensate the BPL losers.
- The TPDS rice consumption subsidies augment domestic rice demand and in the absence of price controls implemented through the MSP regime, support open market prices at higher levels than would be the case if the TPDS were not operating. Consequently rice farmers are major beneficiaries of

the TPDS, while both poor BPL households and not-poor households lose out (or gain less) on their purchases of open market rice

- Diverters are also major beneficiaries of the TPDS. In the policy simulations which includes the abolition of the TPDS, they lose economic rents of Rs 63.4 billion (about $US 1.2 billion). In a simulation in which exports are allowed and the TPDS continues, total diverter rents are Rs 91.2 billion (approximately $US 1.75 billion)
- The consensus of most TPDS research studies is that the transaction costs incurred by buyers of subsidised grains from the fair price shops are considerable, but there are no systematic empirical estimates of their incidence and size at the all India level. The higher they are, the less is the net welfare gain from purchases from the FPSs. The policy simulations for rice estimate the welfare effects of different assumptions about the size of transaction costs. When the transaction costs of using the FPSs are high, on some assumptions about other parameters, poor (BPL) consumers are worse off as a result of the TPDS and would benefit from its abolition.
- Diverters also incur transaction costs in negotiating, managing, and enforcing the arrangements under which large quantities of rice are "siphoned off" and sold illegally. There is even less information on the size and incidence of these transaction costs than on the transaction costs of FPS customers, but both involve real economic costs ("dead weight losses") which disappear in the policy experiments which include the abolition of the TPDS. The possibility that the dead weight losses generated by the TPDS may be around Rs 39.5 billion or Rs 79 billion (Table 7) seem plausible, but much higher losses cannot be excluded.

Three important findings that come through in all the policy simulations for rice are that (1) aggregate welfare increases by much more when the TPDS is abolished (2) when the TPDS is abolished, the net aggregate welfare improvement of the winners is more than sufficient to compensate the net welfare losses of poor (BPL) rice consumers (3) the TPDS benefits rice farmers, diverters, and not_poor rice consumers , in the aggregate by more than it benefits the low income rice consumers who are "targeted". This is not surprising since the TPDS is a cumbersome and expensive of way of transferring income to poor consumers. In particular:

- A large share of the rice "offtake" from FCI (assumed to be 22% in the policy simulations) is illegally "siphoned off" and never reaches the intended low income consumers. Instead the very substantial fiscal cost of procuring, storing and distributing this rice benefits "diverters" i.e. the FPS owners and others involved in diversion activity.

- Of the remaining rice which is not "siphoned off" and which is sold at the controlled low subsidised prices by the FPSs, only 34% (or in an alternative simulation 50%) actually reaches the targeted low income consumers. Thus "not_ poor" consumers obtain at least half of the subsidised rice.
- Transaction costs of buying from the FPSs reduce the net benefit from the low subsidised prices, including the net benefit of low income rice consumers. By how much is not known, but the resulting welfare cost could be substantial
- The difference between the cost of procuring rice at market prices and selling it at low prices to FPSs throughout India is substantial , in addition to which the "economic cost" of FCI and the other central and state organisations involved in these purchase, storage, transport and delivery operations, exceeds the equivalent private sector wholesaling and distribution costs. Financing the PDS therefore involves substantial fiscal costs for both the central and state governments. These disappear in the policy simulations which include the abolition of the TPDS.

The spread sheet model which is used to calculate the welfare and fiscal outcomes of the various policy experiments depends on a number of assumptions and parameters which are listed and discussed in section 4 and Annex 2. All of these are guesstimates with varying degrees of empirical support, but for the most part inserting plausible alternative assumptions and values in the model does not significantly change the general nature of the results described in this paper. They include :

- Supply and demand elasticities
- Diversion rates
- The shares of poor (BPL) rice consumers in subsidised rice sales
- The shares of poor (BPL) consumers in open market rice sales
- FPS customer transaction costs
- Rice farm input subsidies
- The use of a single price to represent FPS buying prices
- The use of a single price to represent FPS resale prices

However some assumptions and parameters are more consequential and the model would benefit from better information and also research in some cases. They include:

- The treatment of FCI's apparent excess " economic cost" over private sector wholesaling costs
- The role and budgetary costs of the TPDS at the state level
- The likely reaction of rice farmers to the lack of a price guarantee if the MSP were abolished
- The likely shift in the rice demand function if the TPDS were abolished

- Alternative assumptions on the likely effect of Indian rice exports on world rice prices

A major simplification of the spread sheet model is that it covers rice only, even though the TPDS consumption subsidies are for both wheat and rice. Simulations of policies involving large changes –in particular the abolition of the TPDS-are assumed to apply to wheat as well as rice, without specifying exactly what those changes would be in the case of wheat. As substitution elasticities between rice and wheat are very low both on the demand and the supply side, this treatment probably doesn't greatly distort the fiscal and welfare outcomes for rice. It would be fairly easy (although time consuming) to run the same model with data and parameters for wheat instead of rice, but the results of such a "wheat only" model are likely to be even less favourable for the TPDS, owing to the much higher diversion rates (around 50%) reported for wheat. Ideally both rice and wheat would be included in one model, but this would require a much more complex modelling framework than the simple linear one-product model used for this paper. It is also highly likely that the fiscal and welfare outcomes of a two-product model would be unfavourable for the TPDS, principally once again due to the very high wheat diversion rates.

Two other major simplifications of the spread sheet model are that there is just one all-India market for rice and a single free market price, and that regional price, production and welfare change differences are not considered. Including detailed treatments of these topics in the research would be a massive task both as regards the modelling framework required and the collection and processing of the empirical material. Such an enterprise would doubtless produce many interesting and relevant results and insights, but *a priori* it is difficult to see obvious ways that the major conclusions of this paper might be altered.

Before this paper was prepared, the TPDS was replaced by the NFSA, which became effective in September 2013. The NFSA is to be phased in state by state over a number of years. Its main provisions continue and expand the TPDS food subsidies by reducing the Central Issue prices for rice and wheat (to Rs 3/kg and Rs 2/kg respectively), including coarse grains in the system (Central Issue price Rs 1/kg), changing to a per person (5 kg/month) rather than a per household entitlement except for AAY ("poorest of the poor") households, and making the subsidised grains available to people belonging to "priority households". The number of "priority household" individuals in each state is to be determined by the central government, and the lists of people belonging to priority households and therefore eligible for the food subsidies (presumably with the use of the equivalent of the present ration cards) are to be decided by each individual state government on the advice of a State Food Commission. The aim of the NFSA (by what date is not clear) is to

more than double the all-India coverage of the food subsidies to 75% of the rural population, 50% of the urban population, and 67% of the total population.

When this paper was being written, the transition to the NFSA was in its very early stages, and there was no readily available data on how this new food subsidy scheme is functioning. When data eventually become available, there should be no problem in using the spreadsheet model to identify the winners and losers, and to approximate size of their winnings and losses. Unfortunately the NFSA has much in common with the TPDS, so the prospect that it will be more effective and less costly in supplying low price food grains to very poor and poor individuals does not look good. On the contrary, the planned increases in the scale of the system and the size of the subsidies, with subsidised prices set at a small and declining fraction (currently about one eighth) of open market prices, is likely to worsen the performance of the system. This will probably show up in increased diversion activity and further increases in the economic rents of the diverters, a substantial increase in the fiscal cost of the system, both for the central government and the states, and (unless price controls are used) higher free market prices for wheat and rice, which will benefit rice and wheat farmers but disadvantage consumers who buy some or all of their food grain supplies from the open market. The already serious problem of the illegal diversion of subsidised rice and wheat to neighbouring countries (notably to Bangladesh) is likely to be exacerbated, especially during periods when domestic prices in those countries exceed open market prices in India.

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TABLE 1: SUMMARY OF FIRST POLICY SIMULATION
COUNTERFACTUAL ESTIMATES OF WELFARE AND FISCAL CHANGES

			Base scenario with TPDS	**First simulation Support price and TPDS both abolished, trade banned**		
				Low ε	**High ε**	**S_noG**
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Free market wholesale price	P_m	Rs/kg	17	13.8	15	15.5
Subsidised Central Issue price	P_t	Rs/kg	5			
Subsidised FPS resale price	Pr	Rs/KG	3.5			
TPDS diversion demand	D_d	MillionMT	6.6	0	0	0
Diverter customer demand	D_{dc}	MillionMT	6.6	7	6.8	6.8
TPDS cardholder-user demand	D_s	MillionMT	23.4	21.5	21	20.6
TPDS cardholder-user market price demand	D_m	MillionMT	28.6	30.2	29.6	29.3
TPDS participant total demand	D_t	MillionMT	58.6	58.7	57.4	56.7
Non-TPDS demand	D_n	MillionMT	30.4	31.5	31.1	31
Total demand	D_T	MillionMT	89	90.2	88.5	87.9
Quantity supplied (=production)	S	MillionMT	95	90.2	88.5	87.9
Change in FCI stocks	Δstocks	MillionMT	6	0	0	0

ESTIMATED CHANGES FROM BASE SCENARIO					
Producer surplus, rice farmers	ΔPS	Rs billion	-294.3	-185.9	-167.9
Diverter rent	ΔDR	Rs billion	-63.4	-63.4	-63.4
CS, diverter customers	ΔCS_{dc}	Rs billion	21.6	13.6	10
CS, TPDS cardholder- users (first stage)	ΔCSt_pre	Rs billion	-252.7	-252.7	-252.7
CS, TPDS cardholder- users (second stage)	ΔCSt_post	Rs billion	65.9	41.5	30.4
CS, TPDS cardholder-users market purchases	ΔCSm	Rs billion	93.4	59	43.3
CS, TPDS cardholder-users, net	$\Delta CS_{(t+m)}$	Rs billion	-93.4	-152.3	-179
CS, non-TPDS buyers	ΔCSn	Rs billion	98.4	62.3	45.9
CS, total (all buyers)	ΔCS_T	Rs billion	26.6	-76.4	-123.1
Govt expenditure (TPDS) Centre	ΔGFt_centre	Rs billion	-462	-462	-462
Govt expenditure (TPDS) states	ΔGFt_states	Rs billion	-87.8	-87.8	-87.8
Government expenditure (stocks)	ΔGF_stocks	Rs billion	-122.4	-122.4	-122.4
Govt expend rice input subsidies	ΔGF_rice inputs	Rs billion	-9.7	-13.1	-14.4
Dead weight loss	ΔDWL	Rs billion	-79	-79	-79
Welfare effects_poor (p_t=0.34, p_c=0.236)					
Cons surp TPDS_poor (first stage)	ΔCSt_poor	Rs billion	-85.9	-85.9	-85.9
Cons surp _ poor (second stage)	ΔCSn_poor	Rs billion	65.9	41.6	30.6
Cons surp _poor NET_1	**ΔCS_poor_NET_1**	Rs billion	-20	-44.3	-55.3
Welfare effects_poor (p_t=0.5, p_c=0.4)					
Cons surp TPDS_poor (first stage)	ΔCSt_poor	Rs billion	-126.4	-126.4	-126.4
Cons surp _ poor (second stage)	ΔCSn_poor	Rs billion	111.7	70.5	51.9
Cons surp _poor NET_2	**ΔCS_poor_NET_2**	Rs billion	-14.6	-55.8	-74.5

Notes: Diverter transaction cost coefficient (α') =0.2, cardholder user transaction cost coefficient (α)=0.2

ε is rice supply elasticity

S_noG means rice supply when there is no government price guarantee

Input subsidy (fertiliser and electricity) per kg of rice supplied is Rs 2.02

P_t is share of poor in TPDS subsidy=34% or 50%

p_c is share of poor in CS of non-TPDS expenditure=23.6% or 40%

TABLE 2: SUMMARY OF SECOND POLICY SIMULATION

COUNTERFACTUAL ESTIMATES OF WELFARE AND FISCAL CHANGES

			Base scenario	**Second simulation MSP abolished, TPDS continues, trade banned**		
				Low ε	High ε	S_noG
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Free market wholesale price	P_m	Rs/kg	17	14.5	15.5	16.6
Subsidised Central Issue price	P_t	Rs/kg	5	5	5	5
Subsidised FPS resale price	Pr	Rs/KG	3.5	3.5	3.5	3.5
TPDS diversion demand	D_d	MillionMT	6.6	6.4	6.5	6.6
Diverter customer demand	D_{dc}	MillionMT	6.6	7	6.9	6.7
TPDS cardholder-user demand	D_s	MillionMT	23.4	22.9	23.1	23.3
TPDS cardholder-user market price demand	D_m	MillionMT	28.6	29.9	29.3	28.8
TPDS participant total demand	D_t	MillionMT	58.6	59.8	59.3	58.7

Non-TPDS demand	D_n	MillionMT	30.4	31.5	31.0	30.6
Total demand	D_T	MillionMT	89	91.2	90.3	89.3
Quantity supplied (=production)	S	MillionMT	95	91.2	90.3	89.3
Change in FCI stocks	Δstocks	MillionMT	6	0.0	0.0	0.0
ESTIMATED CHANGES FROM BASE SCENARIO						
Producer surplus, rice farmers	ΔPS	Rs billion		-231.7	-135.8	-72.2
Diverter rent	ΔDR	Rs billion		-15.0	-9.0	-2.6
CS, diverter customers	ΔCS_{dc}	Rs billion		13.0	6.3	2.7
CS, TPDS cardholder- users (first stage)	ΔCSt_pre	Rs billion		-51.0	-30.3	-8.6
CS, TPDS cardholder- users (second stage)	ΔCSt_post	Rs billion		0.0	0.0	0.0
CS, TPDS cardholder-users market purchases	ΔCSm	Rs billion		72.7	42.4	11.9
CS, TPDS cardholder-users, net	$\Delta CS_{(t+m)}$	Rs billion		21.8	12.2	3.3
CS, non-TPDS buyers	ΔCSn	Rs billion		76.9	45.0	12.6
CS, total (all buyers)	ΔCS_T	Rs billion		111.7	63.5	18.6
Govt expenditure (TPDS) Centre	ΔGFt_centre	Rs billion		-84.3	-50.1	-12.4
Govt expenditure (TPDS) states	ΔGFt_states	Rs billion		-16.0	-9.5	-2.4
Government expenditure (stocks)	ΔGF_stocks	Rs billion		-122.4	-122.4	-122.4
Govt expend rice input subsidies	ΔGF_rice inputs	Rs billion		-7.6	-9.4	-11.4
Dead weight loss	ΔDWL	Rs billion		-16.5	-9.8	-2.8
Welfare effects_poor (p_t=0.34, p_c=0.236)						
Cons surp TPDS_poor (first stage)	ΔCSt_poor	Rs billion		-17.3	-10.3	-2.9
Cons surp _ poor (second stage)	ΔCSn_poor	Rs billion		38.4	22.1	4.4
Cons surp _poor NET_1	**ΔCS_poor_NET_1**	Rs billion		21.1	11.8	1.5
Welfare effects_poor (p_t=0.5, p_c=0.4)						
Cons surp TPDS_poor (first stage)	ΔCSt_poor	Rs billion		-25.5	-15.1	-4.3
Cons surp _ poor (second stage)	ΔCSn_poor	Rs billion		65.1	37.5	10.9
Cons surp _poor NET_2	**ΔCS_poor_NET_2**	Rs billion		39.6	22.4	6.6

Notes:

Diverter transaction cost coefficient (α') =0.2, cardholder user transaction cost coefficient (α)=0.2

ε is rice supply elasticity S_noG means rice supply when there is no government price guarantee

Input subsidy (fertiliser and electricity) per kg of rice supplied is Rs 2.02

P_t is share of poor in TPDS subsidy=34% or 50%. p_c is share of poor in CS of non-TPDS expenditure=23.6% or 40%

TABLE 3: SUMMARY OF THIRD POLICY SIMULATION
COUNTERFACTUAL ESTIMATES OF WELFARE AND FISCAL CHANGES

			Base scenario with TPDS	**Third simulation Support price continues, TPDS abolished, trade banned**
(1)	(2)	(3)	(4)	(5)
Free market wholesale price	P_m	Rs/kg	17	17
Subsidised Central Issue price	P_t	Rs/kg	5	
Subsidised FPS resale price	Pr	Rs/KG	3.5	
TPDS diversion demand	D_d	MillionMT	6.6	0.0
Diverter customer demand	D_{dc}	MillionMT	6.6	6.6

TPDS cardholder-user demand	D_s	MillionMT	23.4	20.0
TPDS cardholder-user market price demand	D_m	MillionMT	28.6	28.6
TPDS participant total demand	D_t	MillionMT	58.6	55.2
Non-TPDS demand	D_n	MillionMT	30.4	30.4
Total demand	D_T	MillionMT	89	85.6
Quantity supplied (=production)	S	MillionMT	95	95.0
Change in FCI stocks	Δstocks	MillionMT	6	9.4
ESTIMATED CHANGES FROM BASE SCENARIO				
Producer surplus, rice farmers	ΔPS	Rs billion		0.0
Diverter rent	ΔDR	Rs billion		-63.4
CS, diverter customers	ΔCS_{dc}	Rs billion		0.0
CS, TPDS cardholder- users (first stage)	ΔCSt_pre	Rs billion		-252.7
CS, TPDS cardholder- users (second stage)	ΔCSt_post	Rs billion		0.0
CS, TPDS cardholder-users market purchases	ΔCSm	Rs billion		0.0
CS, TPDS cardholder-users, net	$\Delta CS_{(t+m)}$	Rs billion		-252.7
CS, non-TPDS buyers	ΔCSn	Rs billion		0.0
CS, total (all buyers)	ΔCS_T	Rs billion		-252.7
Govt expenditure (TPDS) Centre	ΔGFt_centre	Rs billion		-462.0
Govt expenditure (TPDS) states	ΔGFt_states	Rs billion		-87.8
Government expenditure (stocks)	ΔGF_stocks	Rs billion		69.4
Govt expend rice input subsidies	ΔGF_rice inputs	Rs billion		0.0
Dead weight loss	ΔDWL	Rs billion		-79.0
Welfare effects_poor (p_t=0.34, p_c=0.236)				
Cons surp TPDS_poor (first stage)	ΔCSt_poor	Rs billion		-85.9
Cons surp _ poor (second stage)	ΔCSn_poor	Rs billion		0.0
Cons surp _poor NET_1	**ΔCS_poor_NET_1**	Rs billion		-85.9
Welfare effects_poor (p_t=0.5, p_c=0.4)				
Cons surp TPDS_poor (first stage)	ΔCSt_poor	Rs billion		-126.4
Cons surp _ poor (second stage)	ΔCSn_poor	Rs billion		0.0
Cons surp _poor NET_2	**ΔCS_poor_NET_2**	Rs billion		-126.4

Notes:

Diverter transaction cost coefficient (α') =0.2, cardholder user transaction cost coefficient (α)=0.2

Input subsidy (fertiliser and electricity) per kg of rice supplied is Rs 2.02

P_t is share of poor in TPDS subsidy=34% or 50%

p_c is share of poor in CS of non-TPDS expenditure=23.6% or 40%

TABLE 4.1. SUMMARY OF FOURTH POLICY SIMULATION ASSUMING "OPTIMAL" EXPORT TAX
COUNTERFACTUAL ESTIMATES OF WELFARE AND FISCAL CHANGES

(1)	(2)	(3)	**Base scenario with TPDS** (4)	**Exports allowed s.t. "optimal" export tax, MSP & TPDS abolished** (5)
Free market wholesale price	P_m	Rs/kg	17	20.22
Subsidised Central Issue price	P_t	Rs/kg	5	n.a.
Subsidised FPS resale price	Pr	Rs/kg	3.5	n.a.
Export price	Px	Rs/kg	n.a.	22.11
Export tax	X-tax	Rs/kg	n.a.	1.89
TPDS diversion demand	D_d	MillionMT	6.6	0
Diverter customer demand	D_{dc}	MillionMT	6.6	6.2
TPDS cardholder-user demand	D_s	MillionMT	23.4	18.5
TPDS cardholder-user market price demand	D_m	MillionMT	28.6	27.0
TPDS participant total demand	D_t	MillionMT	58.6	51.7
Non-TPDS demand	D_n	MillionMT	30.4	29.2
Total domestic demand	DH	MillionMT	89	80.9
Exports	X	MillionMT	0	19.0
Total demand	DT	MillionMT	89	99.9
Quantity supplied (=production)	S	MillionMT	95	99.9
Change in FCI stocks	Δstocks	MillionMT	6	0.0
ESTIMATED CHANGES FROM BASE SCENARIO				
Producer surplus, rice farmers	ΔPS	Rs billion		313.7
Diverter rent	ΔDR	Rs billion		-63.4
CS, diverter customers	ΔCS_{dc}	Rs billion		-20.6
CS, TPDS cardholder- users (first stage)	ΔCSt_pre	Rs billion		-252.7
CS, TPDS cardholder- users (second stage)	ΔCSt_post	Rs billion		-62.0
CS, TPDS cardholder-users market purchases	ΔCSm	Rs billion		-89.5
CS, TPDS cardholder-users, net	$\Delta CS_{(t+m)}$	Rs billion		-404.2
CS, non-TPDS buyers	ΔCSn	Rs billion		-96.0
CS, total (all buyers)	ΔCS_T	Rs billion		-520.8
Govt expenditure (TPDS) Centre	ΔGFt_centre	Rs billion		-462.0
Govt expenditure (TPDS) states	ΔGFt_states	Rs billion		-87.8
Government expenditure (stocks)	ΔGF_stocks	Rs billion		-122.4
Govt expend rice input subsidies	ΔGF_rice inputs	Rs billion		9.8
Govt Centre export tax receipts	ΔGF_X tax	Rs billion		-35.8
Dead weight loss	ΔDWL	Rs billion		-79.0
Welfare effects_poor (p_t=0.34, p_c=0.236)				
CS, TPDS_poor (first stage)	ΔCSt_poor	Rs billion		-85.9
CS _ poor (second stage)	ΔCSn_poor	Rs billion		-63.3
CS _poor NET_1	**ΔCS_poor_NET_1**	Rs billion		-149.2
Welfare effects_poor (p_t=0.5, p_c=0.4)				
CS, TPDS_poor (first stage)	ΔCSt_poor	Rs billion		-126.4
CS _ poor (second stage)	ΔCSn_poor	Rs billion		-107.2
CS _poor _NET_2	**ΔCS_poor_NET_2**	Rs billion		-233.6

Notes:Diverter transaction cost coefficient (α') =0.2, cardholder user transaction cost coefficient (α)=0.2
Input subsidy (fertiliser and electricity) per kg of rice supplied is Rs 2.02
Optimal export tax is Rs 1.89/kg approx 8.6% of export price. ΔX/ΔPx=-5

Table 4.2. Summary and comparison of some policy outcomes when the MSP and TPDS are abolished and exports are allowed subject to an export tax

			"Optimum" export tax Rs 1.89/kg	"Low" export tax Zero	"High" export tax Rs 3.78/kg
(a)	Export tax	Rs/kg	1.89	0	3.78
(b)	Export tax/export price	%	8.6	0	16.8
(c)	Δ domestic price	%	+18.9	+27.5	+10
(d)	Δ supply	%	+5.2	+7.5	+2.7
(e)	Δ exports	Million MT	+19	+23.3	+15.2
(f)	Fiscal benefit	Rs billion	+698.2	+657.9	+724.5
(g)	Δ PS rice farmers	Rs billion	+313.7	+460.8	+163.6
(h)	Δ CS all rice consumers	Rs billion	-520.8	-637.2	-395.4
(i)	Δ diverter rents	Rs billion	-63.4	-63.4	-63.4
(k)	Δ Welfare benefit _all	Rs billion	+427.7	+418.1	+429.3
(l)	Δ Dead weight loss	Rs billion	-79	-79	-79
(m)	**P_t=0.34,p_c=0.234**				
(n)	Δ CS (poor)	Rs billion	-149.2	-176.7	-119.6
(o)	Δ Net W benefit_ excl poor	Rs billion	+576.9	+594.8	+548.9
(q)	ΔW_all/ΔCS_poor	Ratio	-3.87	-3.37	-4.58
(r)	**P_t=0.50,p_c=0.40**				
(s)	Δ CS (poor)	Rs billion	-233.6	-281.3	-183.9
(t)	Δ Net W benefit_ excl poor	Rs billion	+661.3	699.4	613.2
(u)	ΔW_all/ΔCS_poor	Ratio	-2.83	-2.49	-3.33

TABLE 5.1: SUMMARY OF FIFTH POLICY SIMULATION ASSUMING Rs 1.39/kg "OPTIMAL" EXPORT TAX
COUNTERFACTUAL ESTIMATES OF WELFARE AND FISCAL CHANGES

(1)	(2)	(3)	**Base scenario with TPDS** (4)	**Exports allowed s.t. "optimal" export tax, MSP abolished, TPDS continues** (5)
Free market wholesale price	P_m	Rs/kg	17	21.2
Subsidised Central Issue price	P_t	Rs/kg	5	5
Subsidised FPS resale price	Pr	Rs/kg	3.5	3.5
Export price	Px	Rs/kg	n.a.	22.61
Export tax	X-tax	Rs/kg	n.a.	1.39
TPDS diversion demand	D_d	Million MT	6.6	7.0
Diverter customer demand	D_{dc}	Million MT	6.6	6.2
TPDS cardholder-user demand	D_s	Million MT	23.4	24.2
TPDS cardholder-user market price demand	D_m	Million MT	28.6	27.7
TPDS participant total demand	D_t	Million MT	58.6	58.1
Non-TPDS demand	D_n	Million MT	30.4	29.4
Total domestic demand	DH	Million MT	89	87.5
Exports	X	Million MT	0	13.9
Total demand	DT	Million MT	89	101.4
Quantity supplied (=production)	S	Million MT	95	101.4
Change in FCI stocks	Δstocks	Million MT	6	0.0
ESTIMATED CHANGES FROM BASE SCENARIO				
Producer surplus, rice farmers	ΔPS	Rs billion		414.4
Diverter rent	ΔDR	Rs billion		27.8
CS, diverter customers	ΔCS_{dc}	Rs billion		-26.9
CS, TPDS cardholder- users (first stage)	ΔCSt_pre	Rs billion		91.0
CS, TPDS cardholder- users (second stage)	ΔCSt_post	Rs billion		0.0
CS, TPDS cardholder-users market purchases	ΔCSm	Rs billion		-118.7
CS, TPDS cardholder-users, net	$\Delta CS_{(t+m)}$	Rs billion		-27.8
CS, non-TPDS buyers	ΔCSn	Rs billion		-126.2
CS, total (all buyers)	ΔCS_T	Rs billion		-180.8
Govt expenditure (TPDS) Centre	ΔGFt_centre	Rs billion		151.5
Govt expenditure (TPDS) states	ΔGFt_states	Rs billion		28.8
Government expenditure (stocks)	ΔGF_stocks	Rs billion		-122.4
Govt expend rice input subsidies	ΔGF_rice inputs	Rs billion		12.9
Govt Centre export t tax receipts	ΔGF_X tax	Rs billion		19.3
Dead weight loss	ΔDWL	Rs billion		29.7
Welfare effects_poor (p_t=0.34, p_c=0.236)				
CS, TPDS_poor (first stage)	ΔCSt_poor	Rs billion		30.9
CS _ poor (second stage)	ΔCSn_poor	Rs billion		-64.1
CS _poor NET_1	**ΔCS_ poor_NET_1**	Rs billion		-33.2
Welfare effects_poor (p_t=0.5, p_c=0.4)				
CS, TPDS_poor (first stage)	ΔCSt_poor	Rs billion		45.5
CS _ poor (second stage)	ΔCSn_poor	Rs billion		-108.7
CS _poor NET_2	**ΔCS_poor_NET_2**	Rs billion		-63.2

Notes:
Diverter transaction cost coefficient (α') =0.2, cardholder user transaction cost coefficient (α)=0.2
Input subsidy (fertiliser and electricity) per kg of rice supplied is Rs 2.02

"Optimal" export tax is Rs 1.39/kg approx 6.1 % of export price. ΔX/ΔPx=-5

Table 5.2. Summary and comparison of some policy outcomes when the MSP is abolished, exports are allowed subject to an export tax, and the TPDS continues

			"Optimum" export tax Rs 1.39/kg	"Low" export tax Zero	"High" export tax Rs 3.78/kg
(a)	Export tax	Rs/kg	1.39	0	3.78
(b)	Export tax/export price	%	6.1	0	16.4
(c)	Δ domestic price	%	+24.7	+31.7	+12.9
(d)	Δ supply	%	+6.7	+8.6	+3.6
(e)	Δ exports	Million MT	+13.9	+16.1	+10.2
(f)	Fiscal benefit	Rs billion	-90.1	-126.5	+61.5
(g)	Δ PS rice farmers	Rs billion	+414.4	+534	+213.3
(h)	Δ CS all rice consumers	Rs billion	-180.8	-228.2	-96.5
(i)	Δ diverter rents	Rs billion	+27.8	+36.0	+14.2
(k)	Δ Welfare benefit _all	Rs billion	+171.3	+215.3	+192.5
(l)	Δ Dead weight loss	Rs billion	+29.7	+38.3	+15.3
(m)	**P_t=0.34,p_c=0.234**				
(n)	Δ CS (poor)	Rs billion	-33.2	-41.7	-17.9
(o)	Δ Net W benefit_ excl poor	Rs billion	+204.5	+257.0	+210.4
(q)	ΔW_all/ΔCS_poor	Ratio	-6.16	-6.16	-11.8
(r)	**P_t=0.50,p_c=0.40**				
(s)	Δ CS (poor)	Rs billion	-63.2	-80.8	-34.4
(t)	Δ Net W benefit_ excl poor	Rs billion	+234.5	+296.1	+226.9
(u)	ΔW_all/ΔCS_poor	Ratio	-3.71	-3.66	-6.59

Table 6: Comparison of some policy outcomes							
			First experiment	**Second experiment**	**Third experiment**	**Fourth experiment**	**Fifth experiment**
			MSP and TPDS abolished, trade banned	MSP abolished, TPDS continues, trade banned	MSP continues, TPDS abolished, trade banned	MSP and TPDS abolished, exports allowed, export tax Rs 1.89/kg	MSP abolished, TPDS continues, exports allowed, export tax Rs 1.39/kg
(a)	Export tax	Rs/kg	n.a.	n.a.	n.a.	1.89	1.39
(b)	Export tax/export price	%	n.a.	n.a.	n.a.	8.6	6.1
(c)	Δ domestic price	%	-18.7	-14.6	0	+18.9	+24.7
(d)	Δ supply	%	-5.1	-3.6	0	+5.2	+6.7
(e)	Δ exports	Million MT	0	0	0	+19	+13.9
(f)	Fiscal benefit	Rs billion	+681.9	+230.3	+480.4	+698.2	-90.1
(g)	Δ PS rice farmers	Rs billion	-294.3	-231.7	0	+313.7	+414.4
(h)	Δ CS all rice consumers	Rs billion	+26.6	+111.7	-252.7	-520.8	-180.8
(i)	Δ diverter rents	Rs billion	-63.4	-15.0	-63.4	-63.4	+27.8
(j)	Δ Welfare benefit _all	Rs billion	+350.8	+95.3	+164.3	+427.7	+171.3
(k)	Δ Dead weight loss	Rs billion	-79	-16.5	-79	-79	+29.7
	P_t=0.34,p_c=0.234						
(l)	Δ CS (poor)	Rs billion	-20.0	+21.1	-85.9	-149.2	-33.2
(m)	Δ Net W benefit_ excl poor	Rs billion	+370.8	+74.2	+250.2	+576.9	+204.5
(n)	ΔW_all/ΔCS_poor	Ratio	-18.5	+3.52	-2.91	-3.87	-6.16
	P_t=0.50,p_c=0.40						
(o)	Δ CS (poor)	Rs billion	-14.6	+39.6	-126.4	-233.6	-63.2
(p)	Δ Net W benefit_ excl poor	Rs billion	+365.4	+55.7	+290.7	+661.3	+234.5
(q)	ΔW_all/ΔCS_poor	Ratio	-25.0	+1.41	-2.30	-2.83	-3.71

Table 7: First policy simulation: support price and TPDS both abolished, trade banned. Comparison of some policy outcomes for alternative assumptions about transaction costs							
	Transaction cost coefficients (α' and α)		**0**	**0.10**	**0.20**	**0.30**	**0.40**
(a)	Fiscal benefit	Rs billion	+681.9	+681.9	+681.9	+681.9	+681.9
(b)	Δ PS rice farmers	Rs billion	-294.3	-294.3	-294.3	-294.3	-294.3
(c)	Δ CS all rice consumers	Rs billion	-36.6	-5.0	+26.6	+58.2	+89.8
(d)	Δ diverter rents	Rs billion	-79.2	-71.3	-63.4	-55.4	-47.5
(e)	Δ Welfare benefit _all	Rs billion	+271.8	311.3	+350.8	+390.4	+429.9
(f)	Δ Dead weight loss	Rs billion	0	-39.5	-79	-118.5	-158.0
	P_t=0.34,p_c=0.234						
(g)	Δ CS (poor)	Rs billion	-41.5	-30.7	-20.0	-9.3	+1.5
(h)	Δ Net W benefit_ excl poor	Rs billion	+313.3	+342.0	+370.8	+399.7	+428.8
(i)	ΔW_all/ΔCS_poor	Ratio	-7.55	-11.1	-18.5	-43.0	+285.8
	P_t=0.50,p_c=0.40						
(j)	Δ CS (poor)	Rs billion	-46.2	-30.4	-14.6	+1.2	+17.0
(k)	Δ Net W benefit_ excl poor	Rs billion	+318.0	+341.7	+365.4	+391.6	+412.9
(l)	ΔW_all/ΔCS_poor	Ratio	-6.88	-11.2	-25.0	+226.3	+24.3

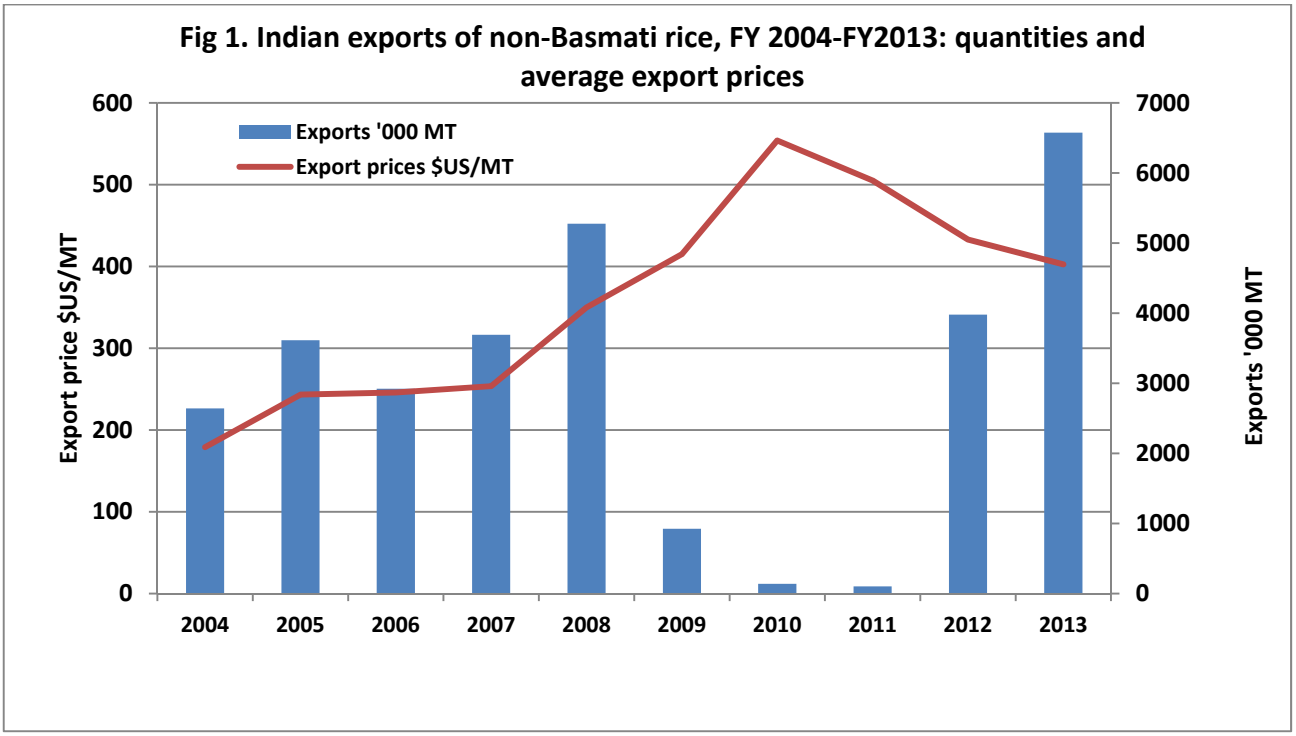


Fig 1. Indian exports of non-Basmati rice, FY 2004-FY2013: quantities and average export prices
Exports '000 MT
Export prices $US/MT
Export price $US/MT
Exports '000 MT
600
500
400
300
200
100
0
7000
6000
5000
4000
3000
2000
1000
0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

Fig 2. Monthly average domestic rice prices Jan 1995 to July 2013 in constant April 2011 Rs/Quintal. Comparisons of open market Andhra Pradesh wholesale prices with subsidised "Central Issue" prices. Single PDS price before June 1997.

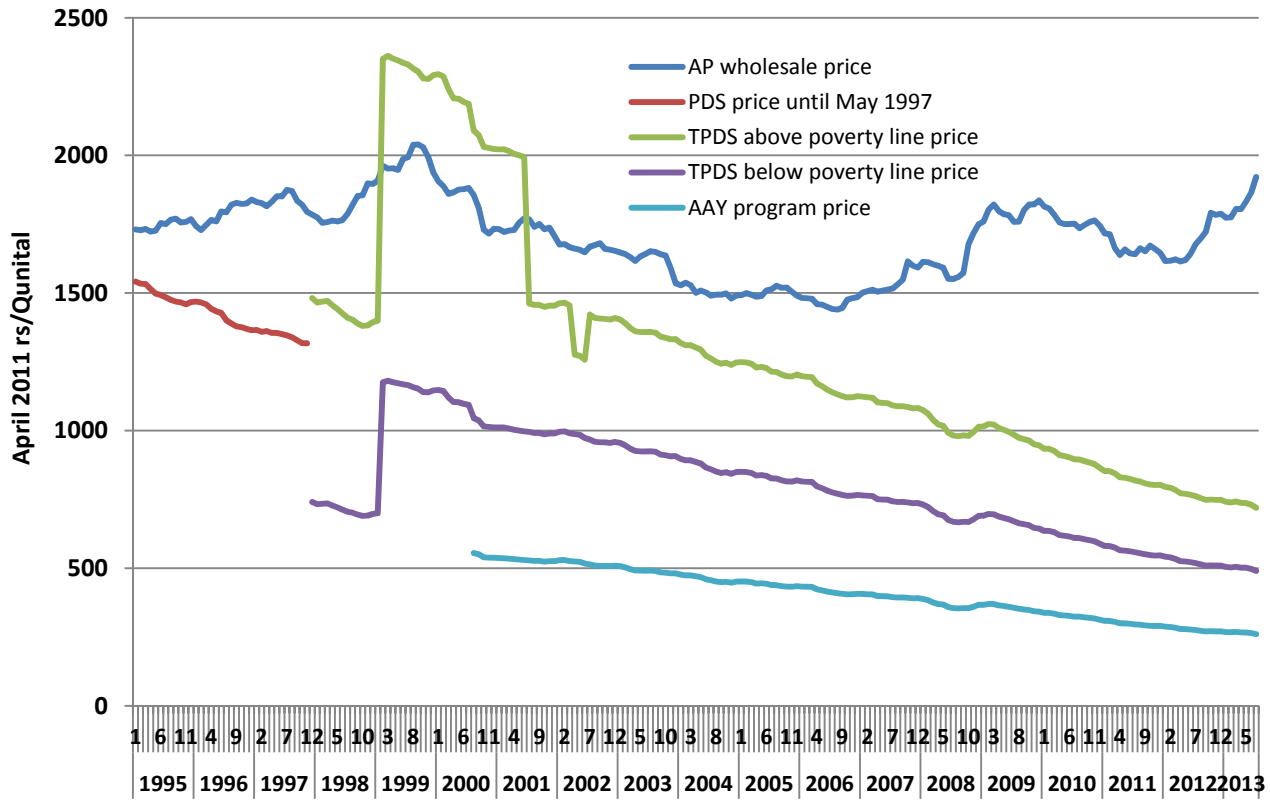


Fig 3. Estimated average monthly rice prices Jan 1995 to Feb 2014: Thai export prices fob Bangkok compared with wholesale prices of Indian common rice in Andhra Pradesh. Both in constant April 2011 Rs/Quintal

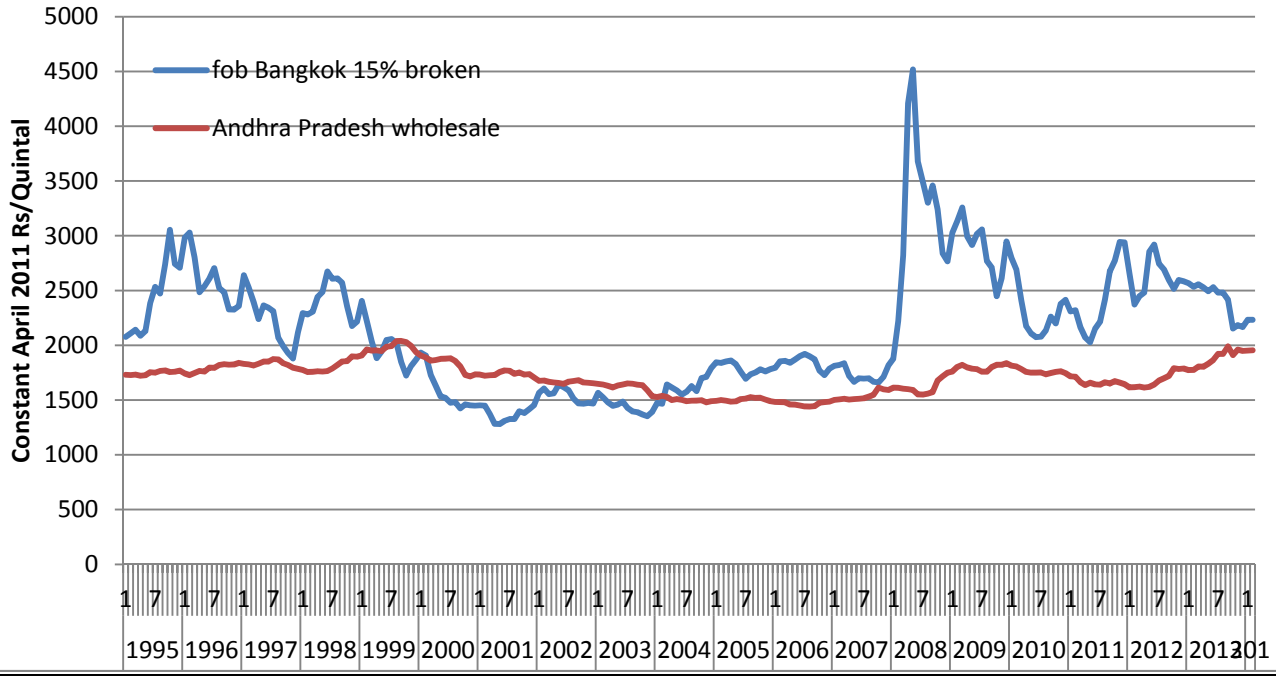
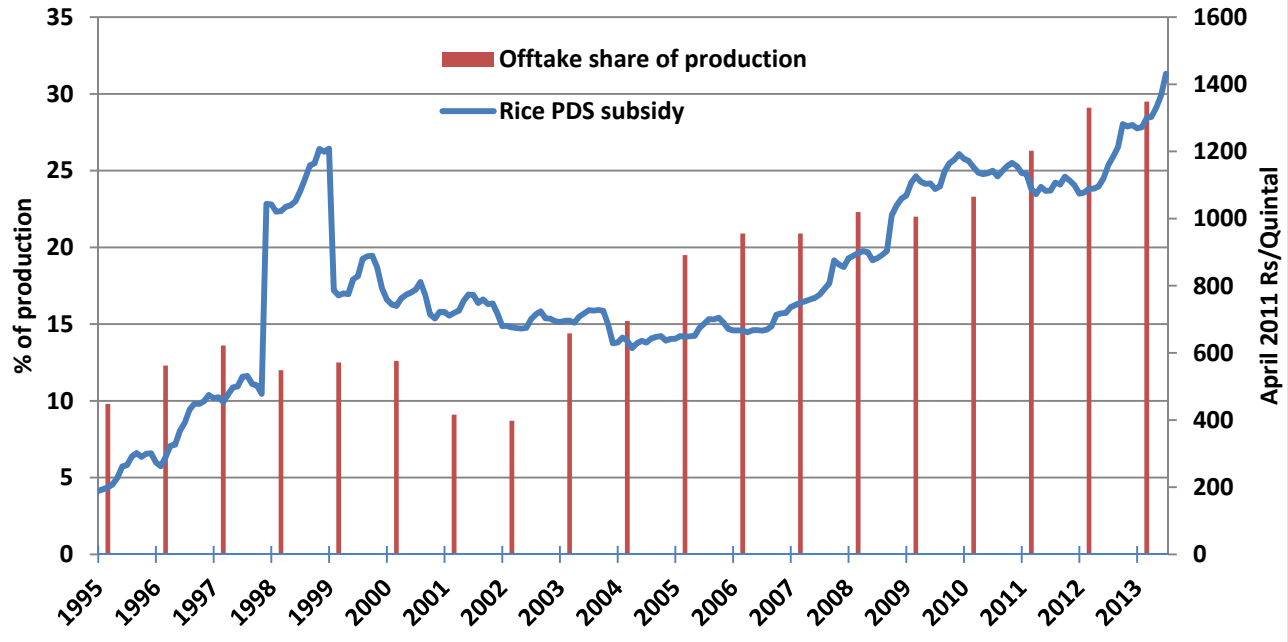
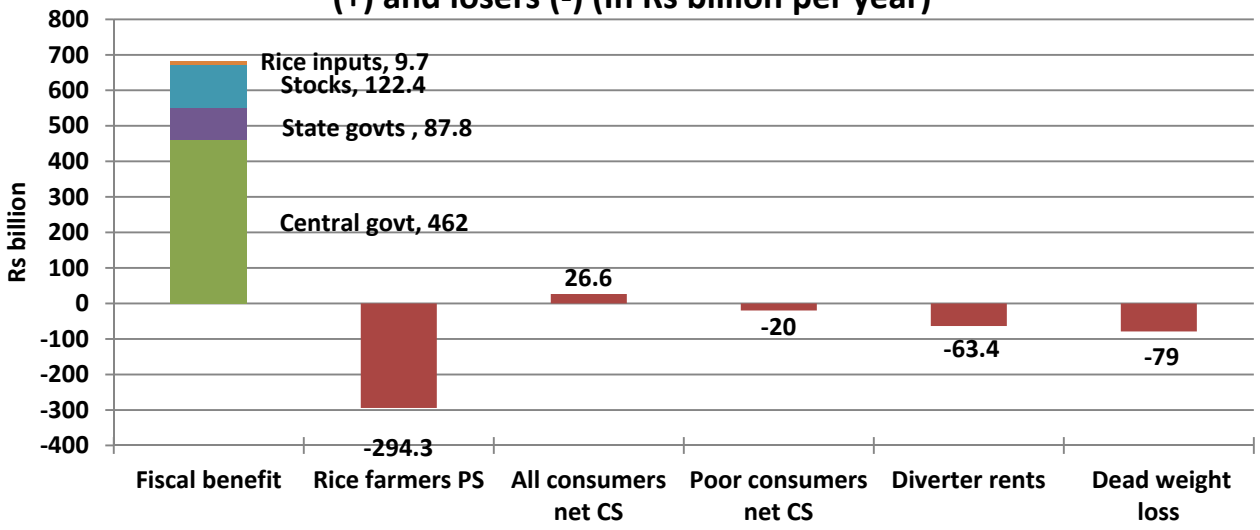


Fig 4. Rice FY 1995-2013: TPDS subsidy in constant April 2011 Rs/Quintal and percent share of TPDS rice offtake in total rice production



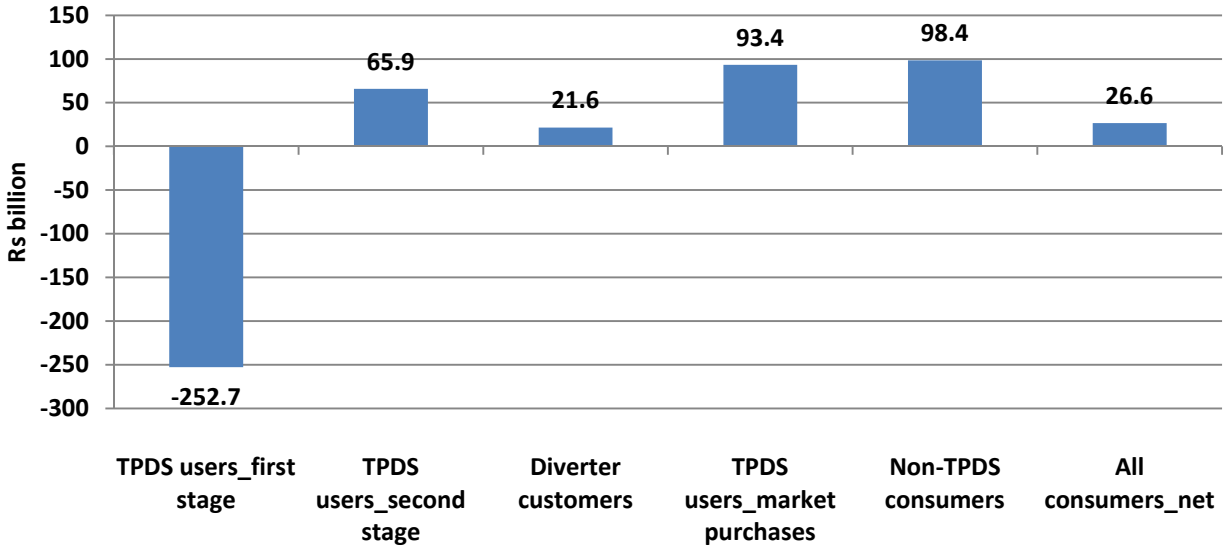
The TPDS subsidy (monthly) is the excess of the Andhra Pradesh wholesale price over (1) The PDS price until May 1997 and (2) the BPL price from June 1997 to July 2013. All prices and the subsidy margin in constant April 2011 Rs/Quintal. Deflator WPI. Offtake share of production (annual) estimated from data on rice offtake for the TPDS in FCI annual reports and the *Economic Survey* (various issues). Rice production from Ministry of Agriculture website.

Fig 5. Abolition of TPDS and MSP, exports not allowed: Winners (+) and losers (-) (In Rs billion per year)



This run assumes that in the base scenario transaction costs are 20% of diverter rents and 20% of TPDS cardholder CS. The fiscal and and welfare changes are calculated using the low supply elasticity variant (Table 1, Col 5).

Fig 6. Abolition of TPDS and MSP, exports not allowed: Changes in rice consumer welfare (In Rs billion per year)



This run assumes that both the TPDS and MSP have been abolished and that in the base scenario transaction costs are 20% of diverter rents and 20% of TPDS cardholder CS. The fiscal and welfare changes are calculated using the low supply elasticity variant.

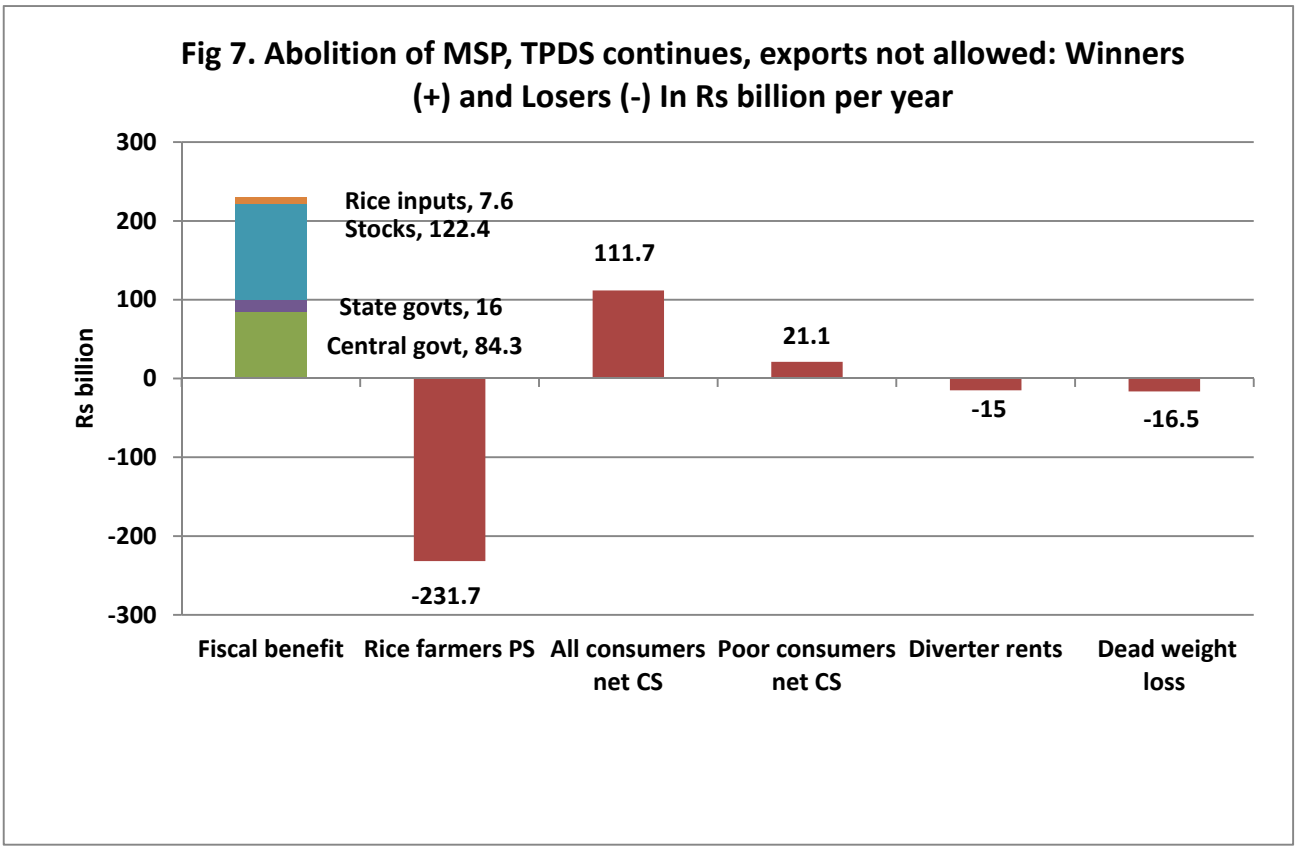
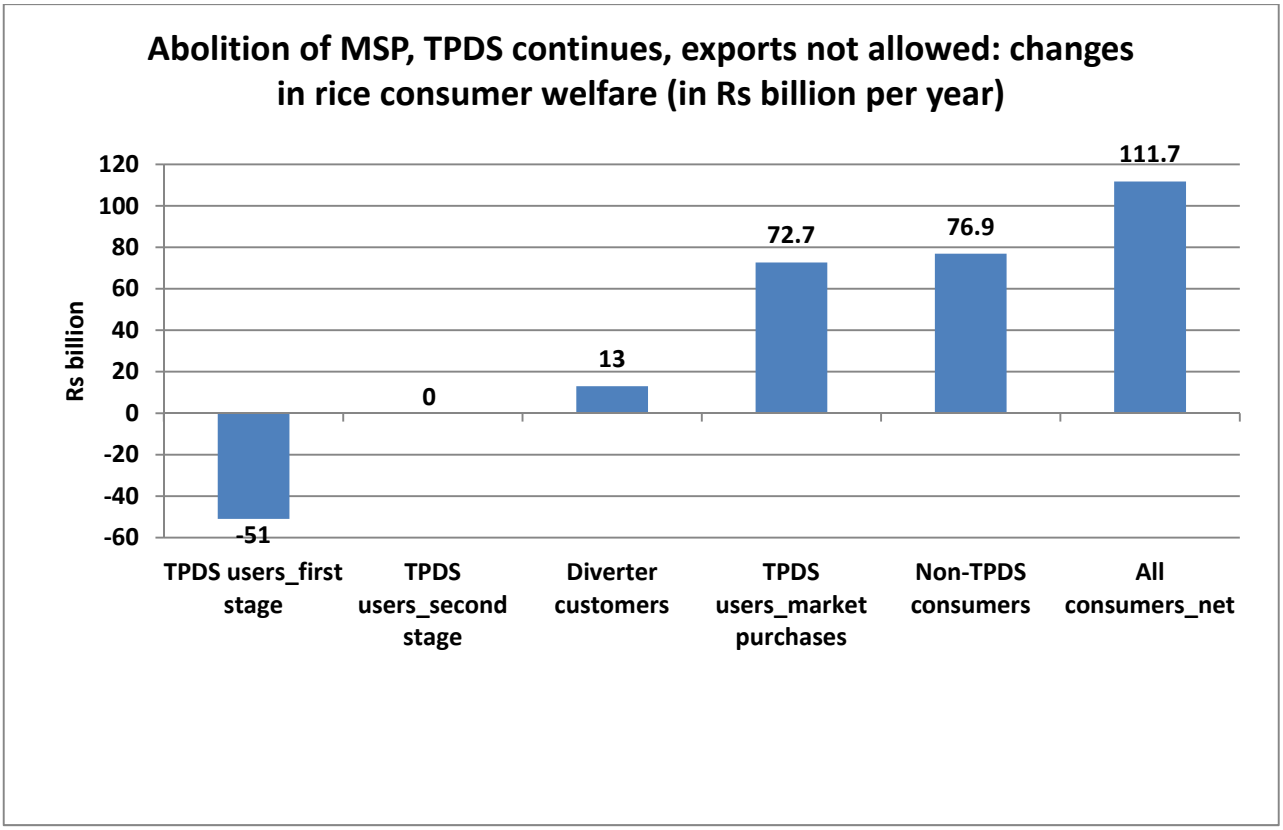


Fig 7. Abolition of MSP, TPDS continues, exports not allowed: Winners (+) and Losers (-) In Rs billion per year
Rs billion
300
200
100
0
-100
-200
-300
Rice inputs, 7.6
Stocks, 122.4
State govts, 16
Central govt, 84.3
-231.7
111.7
21.1
-15
-16.5
Fiscal benefit
Rice farmers PS
All consumers net CS
Poor consumers net CS
Diverter rents
Dead weight loss


Abolition of MSP, TPDS continues, exports not allowed: changes in rice consumer welfare (in Rs billion per year)
Rs billion
120
100
80
60
40
20
0
-20
-40
-60
-51
0
13
72.7
76.9
111.7
TPDS users_first stage
TPDS users_second stage
Diverter customers
TPDS users_market purchases
Non-TPDS consumers
All consumers_net

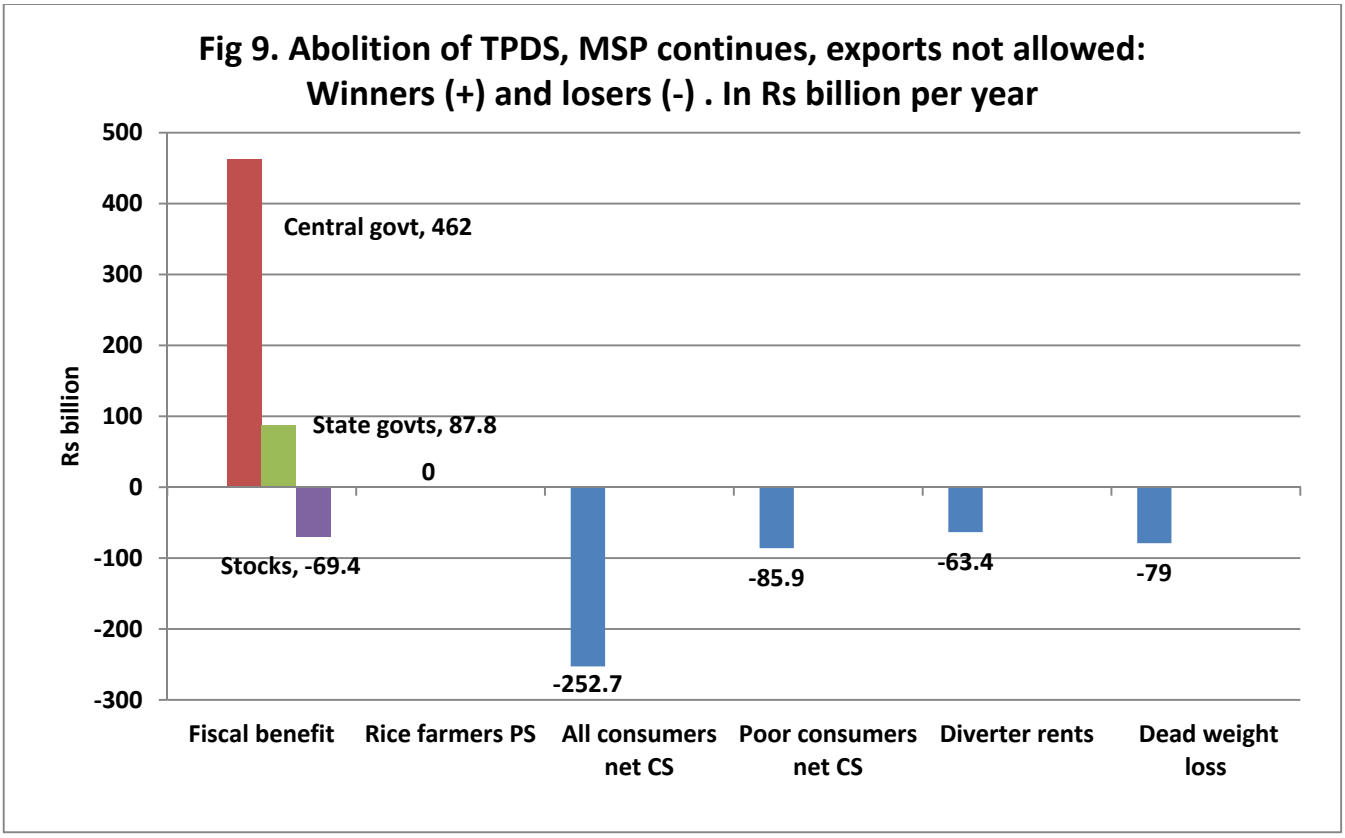
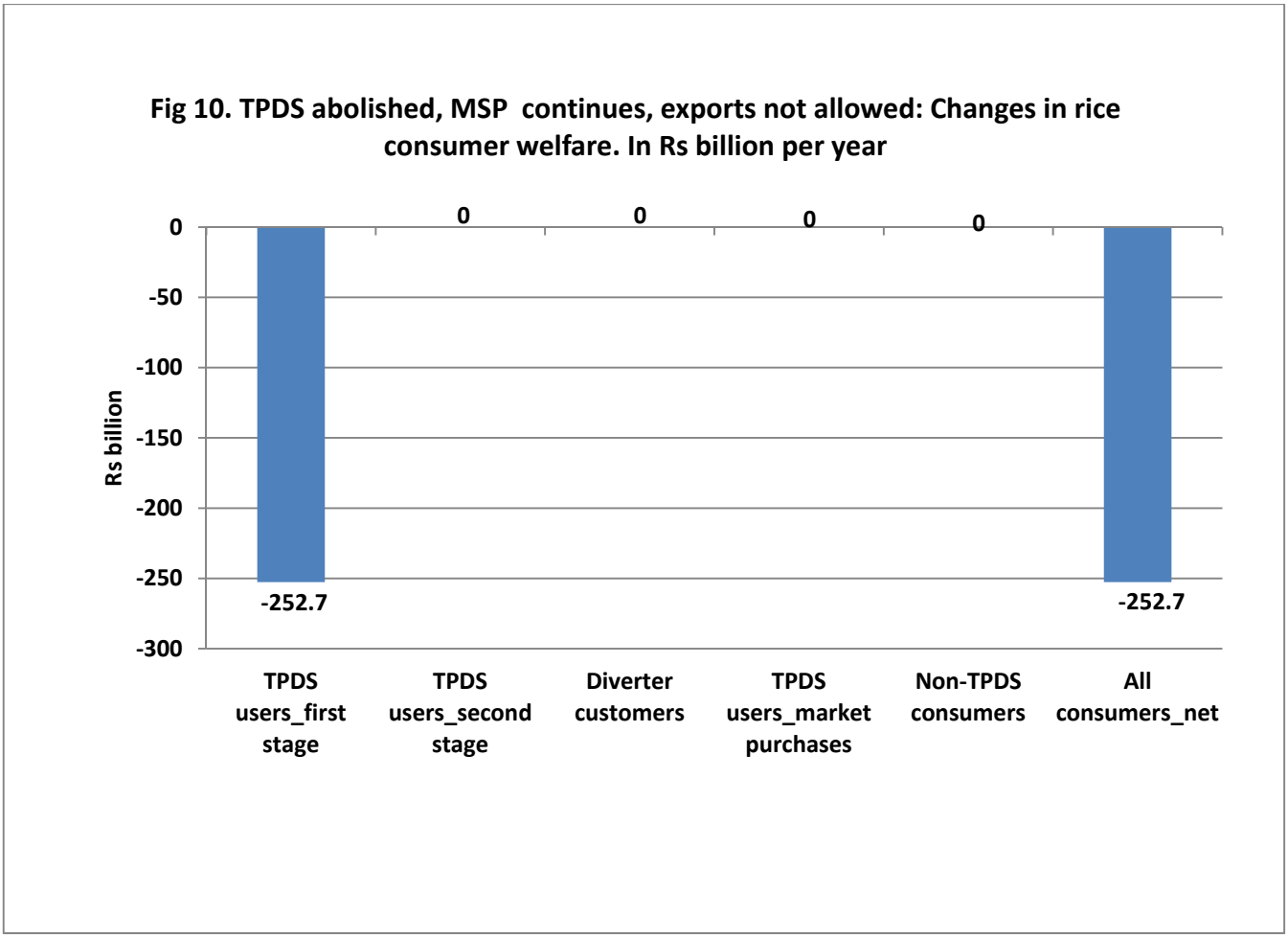


Fig 9. Abolition of TPDS, MSP continues, exports not allowed: Winners (+) and losers (-) . In Rs billion per year
Rs billion
500
400
300
200
100
0
-100
-200
-300
Central govt, 462
State govts, 87.8
0
Stocks, -69.4
-252.7
-85.9
-63.4
-79
Fiscal benefit
Rice farmers PS
All consumers net CS
Poor consumers net CS
Diverter rents
Dead weight loss



ANNEX 1: MODEL DESCRIPTION

How the model works is illustrated in Annex, Figure 1, which describe the base scenario and the first three policy simulations. To simplify the diagram, the FPS resale price is assumed to be the same as the Central Issue price paid by the FPSs. In the spreadsheet application of the model, the FPS resale price is lower than the Central Issue price. Annex 2 describes and comments on some of the principal parameters,

In the base scenario, oa is the open market support price, ob is the subsidised central issue price (CIP) , as is TPDS participant demand(="offtake"), aj is total demand, and ak is supply (=production). All of these are approximations of actual quantities during MY 2011/12. These and the other base scenario quantities along line ak which are derived from them, are described below.

TPDS diversion demand (distance ad) is an estimated quantity which assumes that the share of rice offtake diverted during MY 2011/12 was the same as in the latest available empirical study (22% during MY

2011/12). As with other parameters, alternative values for this coefficient can be inserted in the empirical spread sheet implementation of the model. The diversion demand function $\sim D_d$ is represented by the curved line bmd , which shows the subsidised purchase price plus the marginal transaction costs of negotiating, enforcing and otherwise implementing illegal diversion arrangements. The transaction cost function aggregates the transaction costs of all the firms and individuals involved in the illegal arrangements, including FPS owners, private traders, local, state and central government officials, employees of FCI etc[72]. The curve shows that it is profitable to divert quantities up to, but not beyond, ad. The total of the transaction costs associated with diversion is the area dmbt , i.e. the excess of the marginal transaction costs over the subsidised price. As discussed previously, it is appropriate to exclude bribes from these costs, since while bribes paid are a cost to the payer, they are a receipt or benefit to the payee and increase the payee's willingness to incur non-bribe (real) transaction costs.

Diverters are intermediaries who sell to rice consumers at the going market price. In the first policy simulation in which both the support price and the TPDS are abolished, these former customers of the diverters benefit from the reduction in the open market price. The CS benefit is estimated using the demand curve dm' (see below).

TPDS cardholder-user subsidised demand ($\sim D_s$) in the base scenario is distance ae. $\sim D_s$ describes the behaviour of "participant" cardholder-users only, in recognition of the fact that many cardholders do not use the TPDS at all. The baseline quantity ae is derived from TPDS offtake as by deducting diversion demand i.e. ae=as-ad. The demand function ~Ds is represented by the curve elb. This shows the fixed subsidised price plus the rising marginal transaction cost of cardholders who buy subsidised rice from the fair price shops (travel time, waiting time, quality problems etc). It can be seen that it is worthwhile buying subsidised rice from the FPSs as long as the cost of doing so is less than the open market price. At point e, however the marginal cost of obtaining more subsidised rice is equal to the open market support price, and so in the base scenario this determines the quantity demanded through the TPDS system. When this quantity is purchased, total transaction costs of the cardholders is area elbu.

In Fig 3 diverter transaction costs are represented by area dmbt and cardholder_user transaction costs are represented by area elbu. However, except that they are important, very little is known about the incidence, size and behaviour of transaction costs, so no attempt has been made to model them in empirically estimating the welfare and fiscal consequence of various policy reform packages. Instead, the results are calculated for alternative shares of transaction costs in diverter rents (denoted by α') and alternative shares in

[72] An especially detailed and informative description and analysis of these transaction costs is in Khera (2011), especially in the section of her paper dealing with corruption.

cardholder_users consumer surplus (denoted by α). This creates a problem for the diverter equilibrium at point d if diverter transaction costs are assumed to be zero, and for the cardholder_user equilibrium at point e if cardholder _user transaction costs are assumed to be zero. An unsatisfactory way of resolving this inconsistency is to allow α' and α to approach but not reach zero, so that sharply increasing marginal transaction costs ensure equilibrium. Alternatively α' and α could be constrained to not go below some minimum rate. Either way, further research on this topic would be helpful.

For both diverters and participating cardholders, the demand for subsidized rice increases as the per kilo subsidy increases i.e. it is an increasing function of the gap between the free market price and the subsidized price. [73] As discussed later, a consequence of this is inelastic aggregate rice demand which affects the outcome of the second policy experiment in which the MSP is abolished but the TPDS is retained.

TPDS participant cardholder market price demand ($\sim D_m$) in the base scenario is distance af. It shows the quantity of rice purchased at market prices by participating TPDS cardholders. Empirical studies have consistently shown that BPL and other cardholder households which buy subsidised rice on average buy less than their quotas, and also buy rice (more than half of total purchases) on the open market at much higher prices than the central issue prices. The obvious explanation for this behaviour is that at some point transaction costs no longer justify buying more from the FPSs. In contrast to $\sim D_d$ and $\sim D_s$ the demand curve associated with the function $\sim D_m$ has the normal downward slope. In the empirical implementation of the model it is assumed to be linear with a slope corresponding to an elasticity of approximately -0.36 over the relevant range (see Table 1).

$\sim D_t$ (distance ah in the base scenario) is the total demand of TPDS participants. It is the sum of diverter demand, cardholder-user demand , and cardholders market price demand. Because $\sim D_d$ and $\sim D_s$ are upward sloping w.r.t. the free market price, $\sim D_t$ is very inelastic .

Non-TPDS demand ($\sim D_n$) is the demand of all households that don't use the TPDS system, including rice payments-in-kind (e.g. for wages), farmer own consumption etc. In the base scenario it is distance ag=aj-ah. Since aj and ah are approximations of actual MY 2011/12 total demand and TPDS demand respectively, ag is a residual.

[73] Gulati's study of the wheat market (Gulati 1987, equation 7.10, p.116) estimates the elasticity of wheat "Issues" (i.e. "offtake") by the states from FCI stocks with respect to the ratio of the free market price to the "Issue" price at 0.558. That is, for the years he considered (1965-1979) a 10 percent increase in the subsidy rate was associated with approximately a 5.58% increase in the quantity requested for sale at subsidized prices in fair price shops. Kehra (2011) found a similar relationship between TPDS cardholder wheat demand and subsidy levels in Rajasthan, but only up to a certain point beyond which TPDS cardholder demand declined with increasing subsidy levels. She attributes this to the increased payoff from cheating by FPS owners and the reduced relative bargaining power of BPL and other cardholders as the subsidy rate increased beyond this point. However this finding is compatible with increasing aggregate demand for subsidised wheat as subsidy rates go up, if both cardholder and illegal FPS owner demand are included.

$\sim D_T$ is total rice demand when the TPDS is operating. In the base scenario it approximates actual total common rice demand during MY 2011/12 (distance aj.) It is the horizontal sum of $\sim D_t$ and D_n. As is apparent from the dashed demand curve in Fig 1, it is quite inelastic w.r.t. the open market price because of positive $\sim D_d$ and $\sim D_s$ elasticities.

D_s represented by line e'l' is the hypothetical demand function of TPDS cardholder-users following the abolition of the TPDS. It shows the rice demand of this group of buyers if they no longer had access to subsidised rice and so paid for rice at the going market price. At price oa ,D_s is guessed to be somewhat lower (in the first policy experiment 14.5% lower) than $\sim D_s$. The plausibility of this and alternative guesstimates could be checked in the light of rice consumption income elasticities and the value (after allowing for transaction costs) of the withdrawal of the TPDS price subsidies.

D_t represented by line yv is the hypothetical demand function which aggregates diverter customer demand, TPDS cardholder-user demand, and TPDS cardholder –user open market demand on the assumption that the TPDS has been abolished. At price oa it is the horizontal sum of ad, ae',and af. As indicated in Fig 3, at the support price oa, D_t is guessed to be somewhat lower than $\sim D_t$ (in the first policy experiment 4.9 % or 3.2 million MT lower).

D_N is the demand function which aggregates the demand of all rice consumers if the TPDS were abolished. It is the horizontal sum of D_n and D_t

S is the rice supply function. In the base scenario at the support price oa, ak metric tons of rice are produced and supplied. ak approximates actual "common rice" (excluding basmati) production during MY 2011/12. Production exceeds demand by jk MT, which is purchased by FCI in order to support the price at oa. In the numerical implementation of the model the results of the first and second sets of policy simulations are reported (see Table 2) for three alternative specifications of the supply function, corresponding to a low (short run) supply elasticity case, a high (long run) supply elasticity case, and an alternative case which assumes that because of farmer risk aversion the announcement of the abolition of the support price causes the supply function to shift inwards. This alternative supply function (S_noG) is not shown in Fig 1, but some notes on its role in the first and second sets of policy simulations are given in Annex 2. The third policy simulation assumes no change in the support price, so only one set of numerical outcomes is reported.

The share of rice in the cost to the government of running the TPDS (i.e. the share of TPDS rice in the annual food subsidy given in the national accounts) is the amount the government pays for quantity oy purchased at price oa, i.e. area aoys, plus procurement, storage and distribution expenses (area wasx), minus receipts from sales to the FPSs at price ob (area boyz).

In the first policy experiment, both the support price and the TPDS are abolished. In the first (low supply elasticity) version of this experiment, the supply function represented by S doesn't change, but in the absence of access to subsidised rice, total demand shifts back and is represented by $D_N=D_n+D_t$, where D_n the demand function of TPDS non-participants and D_t is the demand function of the buyers previously participating in the TPDS. As FCI is no longer intervening, the market clears at the intersection of the new demand curve and the supply curve at point r. At this market clearing equilibrium, compared with the base scenario, the open market price oc is lower by distance ca, and supply (=production) falls from distance ak to distance cr. Economic welfare and the government's fiscal position change as follows:

- Producer surplus (rice farmers) goes down by area acrk
- Without the TPDS there are no diversion opportunities, and so there are no longer any economic rents accruing to diverters. The money value of their economic welfare declines by area abtd before allowing for transaction costs, and by area abmd after allowing for transaction costs.
- Diverter customers who previously paid price oa now obtain more rice (cm' MT) for a lower price (oc) and benefit by CS area acm'd
- The consumer surplus of TPDS cardholder-users who previously purchased rice at the subsidised price declines by area able minus area acl'e'. Here able represents the loss of their base scenario net economic rent after allowing for transaction costs. This loss is partly offset by the consumer surplus generated for the same group of buyers (area acl'e') by the new lower equilibrium free market price oc. Note that this consumer surplus benefit is estimated w.r.t. the demand function D_s which originates at point e'to the left of point e, in order to recognise the downward influence on demand of TPDS abolition.
- TPDS cardholder-users who in the base scenario also purchased open market rice, benefit from the reduced open market price by area acpf
- Consumer surplus (non-TPDS users) increases by area acng
- Because the TPDS is abolished, the government's fiscal position improves by the cost of running it i.e. by areas (aoys+wasx-boyz)
- FCI no longer accumulates rice stocks, so it no longer incurs the cost of buying and holding an additional jk metric tons
- Without the TPDS, there are no excess transaction costs of using it, so there are no longer any dead weight economic losses incurred by diverters (area dmbt) or by cardholder –users(area elbu)

In the second policy experiment, the support price is abolished but the TPDS continues. In the first (low supply elasticity) version of this experiment, the supply function doesn't change, but demand (D_T=~D_t+D_n) represented by the dashed demand curve, is greater than in the first experiment, since TPDS participants still have access to subsidised rice. The market clears at point r' at price oa'. At this equilibrium, the new open market price is aa' less than the base scenario price, but higher by distance ca' than the open market price in the first simulation when both the support price and the TPDS were abolished. Rice production (distance a'r') is less than in the base scenario, but is more than in the first simulation. Compared with the base scenario, economic welfare and the government fiscal position change as follows:

- Producer surplus declines by area aa'r'k, since farmers produce less and receive a lower price. However they are better off than in the first policy experiment by area a'crr', since demand for rice is still supported by the TPDS subsidies.
- Since the TPDS is still operating, economic rents can still be earned by illegally diverting and selling subsidised rice. However diverters earn less from reselling than in the base scenario, both because the free market price has declined (from oa to oa')and because (due to transaction costs) the quantity they divert to resell has also declined (by distance t't). Consequently total diverter economic rent goes down by the difference between the pre-reform economic rent (area abmd) and the post reform economic rent (area abm'd').
- The consumer surplus of TPDS cardholder-users declines by the area aa'e'e, which is the difference between the consumer surplus net of transaction costs in the base scenario (area able) and the net consumer surplus in this experiment (area a'bl'e'). This at first counter-intuitive result is because (as is apparent from Fig 2) the demand for rice by TPDS participants is upward sloping . That is, demand is an increasing function of the excess of the free market price over the subsidized TPDS price.
- Cardholders who buy subsidised rice from the FPSs and also buy unsubsidised rice on the open market benefit from the decline in the open market price. The consumer surplus on their open market purchases is area aa'f'f
- Non-TPDS buyers also benefit from the lower free market price, by consumer surplus area aa'g'g.
- At the new, lower free market price oa', TPDS demand for rice is distance(a'd+a'e')=as'=y'y, slightly less than in the base scenario. To meet this demand, FCI buys this quantity at price oa' per kg. In addition it incurs procurement, storage, transport and other costs of aw per kg: the per kg costs of these activities are assumed to be the same as in the base scenario. After allowing for the sale of the rice at the subsidized TPDS price (ob per kg), it can be seen that the total annual cost of these operations is substantially less than in the base scenario. There are two main reason for this fiscal

benefit: first and principally the lower price at which FCI purchases the rice it supplies to the fair price shops, and secondly the reduction in the required quantity.

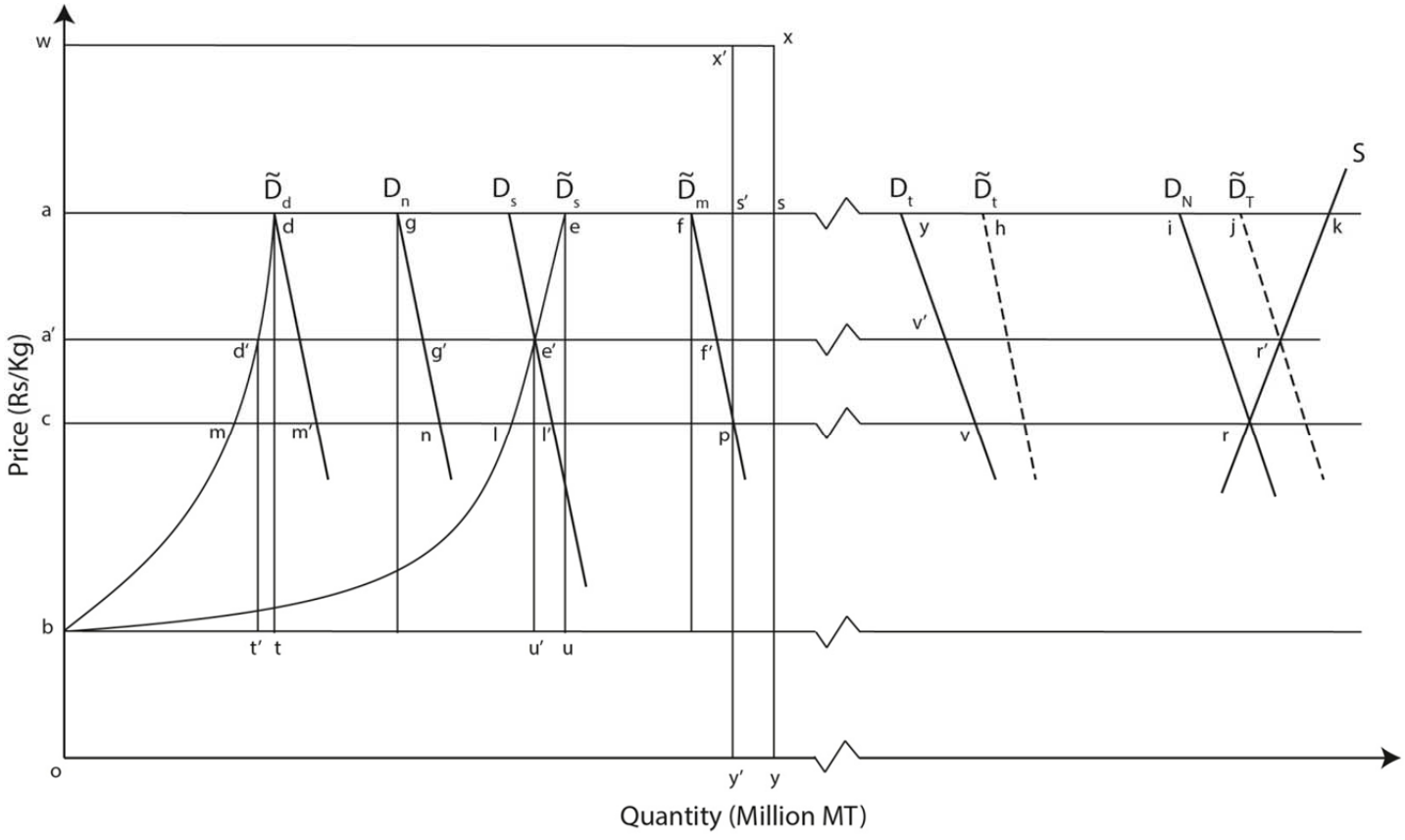
- As in the first simulation, FCI no longer accumulates rice stocks, so it no longer incurs the cost of buying and holding the stocks represented by distance jk
- Since the TPDS is still operating, buyers still incur excess ("dead weight loss") transaction costs. However they are lower than in the base scenario, since TPDS demand has gone down along with the decline in the gap between the free market price and the subsidised TPDS price. In the diagram the resulting net benefit is the sum of the reduction in diverter transaction costs (area dd't't) plus the reduction in cardholder-user transaction costs (area ee'u'u) . The dimensions and shapes of these two transaction cost curves are unknown. Alternative guesstimates of the distances t't and u'u can be inserted in the spread sheet to get some feel for likely size of dead weight losses associated with the TPDS.

In the third policy experiment, the support price continues but the TPDS is abolished. Demand at the support price oa is distance ai, at the intersection of the demand function $D_N=(D_t+D_n)$ with the horizontal price support line, where D_t is the demand function of the groups of buyers who previously participated in the TPDS, and D_n is the demand function of non-TPDS buyers. With the supply function S, rice production is the distance ak>consumption ai, so to support the price FCI buys and adds to its stocks quantity ik. Relative to the base scenario, welfare and the government's fiscal position compare as follows:

- There is no change in farmer producer surplus: both the quantity produced and sold and the selling price are the same
- Since the TPDS has been abolished, there are no longer any diversion opportunities, and so diverter economic rents (area abmd after allowing for transaction costs) disappear
- With the abolition of the TPDS ,TPDS cardholder-users lose out by the net amount of the consumer surplus (net economic rent) they previously received after allowing for transaction costs i.e. by area abue minus area elbu. In contrast to the first policy experiment, however, in this case there is no offsetting consumer surplus benefit, since the open market price doesn't change and remains at oa. As in the other policy experiments, the net loss of consumer surplus goes down the larger is the share of transaction costs in the economic rent generated by the TPDS.

- Since the support price doesn't change, there is no change in the consumer surplus of open market purchases by TPDS participant cardholders who buy both subsidised rice from the FPSs and open market rice.
- Consumer surplus of non-TPDS buyers also doesn't change, since they face the same price and consume the same quantity of rice as in the base scenario.
- Since the TPDS has been abolished, the government fiscal position improves by the amount previously spent to run it i.e. by areas (aoys+wasx-boyz).
- However, since demand is no longer supported by subsidised rice sales under the TPDS, in order to support the open market price at oa, FCI purchases and adds to its stocks a larger quantity (ik) than in the base scenario (jk). The interest and other storage costs of holding these extra stocks (ij) worsens the government's fiscal position by comparison with the base scenario.
- The TPDS has been abolished, so the excess transaction costs of TPDS buyers disappear, and there is a welfare benefit (reduction of dead weight economic loss) represented in Fig 2 by the sum of α'(diverter transaction costs) and α (cardholder-user transaction costs)

Annex 1, Fig 1



ANNEX 2: RICE MODEL PARAMETERS: VALUES, EXPLANATIONS AND COMMENTS				
Base scenario demand and supply		**Million MT**	**Explanation/comments**	**Other comments including slope coefficients and implied and guessed demand elasticities**
TPDS offtake	D_o	30	Estimated actual TPDS rice "offtake" from FCI stocks during MY 2011/12	
TPDS diversion demand	D_d	6.6	Quantity "diverted" ("siphoned off"). Assumed to be 22% of "offtake". D_d/offtake estimated at 0.22 in MY 2009/10 by Himanshu and Sen (2013)	Assuming linear demand and positive demand elasticity ≈0.25 over Rs14-17/kg price range, have used $\Delta\sim D_d/\Delta P=0.1$ in second simulation.
TPDS cardholder-user demand at subsidised FPS resale prices	D_s	23.4	$D_s=D_o-D_d$. Offtake that is not diverted	Assuming linear demand and positive demand elasticity ≈0.15 over Rs14-17 price range, have used $\Delta\sim D_d/\Delta P=0.2$ in second simulation.
TPDS cardholder-user market price demand	D_m	28.6	Purchases at market price by TPDS cardholders who also buy subsidised rice. $D_m/(D_s+D_m)=0.55$	Assuming normal linear demand and negative demand elasticity ≈-0.3 over Rs14-17 /kg price range, have used $\Delta\sim D_m/\Delta P=-0.5047$ in second simulation.
TPDS participant total demand	D_t	58.6	$D_t=D_d+D_s+D_m$.	In second simulation $\Delta\sim D_t/\Delta P$ is -0.4797 (sum of slope coefficients of $\sim D_d$,$\sim D_s$, and $\sim D_m$). Very inelastic demand =-0.137 due to positive $\sim D_d$ and $\sim D_s$ elasticities
Non- TPDS demand	D_n	30.4	Demand from households that don't use the TPDS system (Includes wage and other rice payments –in-kind and farmer own consumption). Derived from D_T (exogenous) and D_t.	Assuming normal linear demand and negative demand elasticity ≈-0.25 over Rs14-17 price range, have used $\Delta\sim D_n/\Delta P=-0.4227$ in first policy simulation.
Total demand with TPDS subsidy	D_T	89	$D_T=\sim D_t+D_n$. Total consumption 94 million MT (USDA 2013) minus estimated basmati rice consumption (5 million MT)=89 million MT	In second simulation $\Delta D_T/\Delta P=-0.8842$, corresponding to a low elasticity (-0.169) of total demand. This is due to positive $\sim D_d$ and $\sim D_s$ elasticities
Supply	S	95	Total production (103 million MT) minus estimated basmati production (8 million MT). Supply curve doesn't shift when MSP is abolished.	Implied supply elasticities used 0.27 (short run) and 0.7 (long run). Sources: Gulati (1987) p.76 and Kumar et al (2010) Table 7.Slope coefficients $\Delta S/\Delta P=1.5091$ (short run), 3.1924 (long run)
Supply: no price guarantee	S_noG	90	Guesstimate of total production at baseline price (Rs17/kg) if this price were not guaranteed by the MSP system. Supply curve shifts in by 5 million MT	Assuming same supply elasticities as for S, slope coefficients $\Delta S\_noG/\Delta P=1.4297$ (short run), 3.7065 (long run). Long run simulation results for S_noG case not reported in Tables 1-5.
FCI purchases to support the wholesale price	Δstocks	6	$\Delta stocks=S-D_T$. Excess of supply over demand from the TPDS system. The excess supply is purchased during the year (after the harvest) in order to support the market price at P_m	Annual cost of purchases =quantity purchased valued at support price+holding cost for one year at 20% interest and storage costs
Base scenario prices	**Price**	**Price Rs/kg**		
Support price=Average free market wholesale price	P_m	17	Wholesale price including paddy milling charges and procurement expenses.	Assumed constant at Rs 17/kg during the rice marketing year.
Average subsidised (CIP) price paid by fair price shops	P_t	5	Approximate average of AAY, BPL and APL "Central Issue" prices weighted by quantities supplied to fair price shops during the marketing year.	Assumed constant during the rice marketing year. Fiscal cost of TPDS is net of "offtake" sold to FPSs at Rs 5/kg

Average subsidised resale price charged by FPSs to cardholder customers	P_r	3.5	Guess based on discussion in Himanshu (2013)	Assumed constant during the rice marketing year. Cardholder customer subsidy=Rs 17-3.5 =13.5/kg.
Policy simulations		**Million MT**		
Diverter customer demand	D_{dc}	6.6	In the base scenario diverter customers buy 6.6 million MT from diverters at Rs 17/MT. Their purchases vary with the open market price along a linear demand curve through this point.	Assumes demand elasticity ≈-0.3 over Rs 14-17 /kg price range. Slope coefficient $\Delta D_{dc}/\Delta P$=-0.1165
Previous TPDS participant cardholder demand at market prices	D_s'	20	Demand function of TPDS participants when TPDS is abolished. Demand when rice price=Rs 17/kg is guesstimated to be 20 million MT (14.5% less than demand at subsidised price)	Linear demand with $\Delta Ds/\Delta P$=-0.4702. Assumes high demand elasticity (-0.4) : some (majority of ?) TPDS participants low income and sensitive to price?
Previous TPDS participant total demand at market prices	D_t'	55.2	$D_t'= D_{dc}+ D_s'+D_m$=55.2 million MT when open market price is Rs 17kg	Linear demand with $\Delta Dt/\Delta P$=-1.0914. Elasticity ≈-0.34
Total demand without TPDS	D_N	85.6	$D_N=D_{dc}+D_s'+D_m+ D_n$ when rice price =Rs17/kg. Removal of TPDS subsidies cuts total demand by 3.4 million MT.	Used in simulations which assume the TPDS is abolished. Slope coefficient $\Delta D_N/\Delta P$=-1.4490 corresponds to demand elasticity ≈-0.29
Miscellaneous parameters and assumptions				
Diverter transaction cost coefficient	α'	$0\leq\alpha'\leq1$	Diverter transaction costs as share of diverter rents	Have assumed α'=0.2 for estimates reported in Tables 1-7
Cardholder user transaction cost coefficient	α	$0\leq\alpha\leq1$	Cardholder user transaction costs as share of cardholder user CS	Have assumed α=0.2 for estimates reported in Tables 1-7
Dead weight loss	DWL		Sum of diverter transaction costs and cardholder user transaction costs	DWL goes to zero in policy simulations in which the TPDS is abolished
Share of poor in TPDS CS	p_t	$0\leq p_t \leq1$	Have used p_t=0.34 for estimates reported in Tables 1-5. Share of rice CS assumed the same as the share of (rice+wheat) estimated by Jha and Ramaswami (2011).	Alternative estimates use p_t=0.50. Share of rice CS assumed the same as the (rice+wheat) share reported in Himanshu and Sen, 2013, II.
Share of poor in total change of CS following abolition of TPDS and /or abolition of MSP	p_c	$0\leq p_c \leq1$	Have used p_c=0.234 for estimates reported in Tables 1-5. Coefficient derived from Jha and Ramaswami (2011).	Alternative guesstimate uses p_c=0.40
FCI excess "economic cost"	f_t	Rs 3.4/kg	Excess of FCI's storage, distribution etc costs over P_m (wholesale price)	Estimated from FCI website and annual reports.
Government expenditure (TPDS) Centre	GFt _centre	$D_o*(P_m+ f_t-P_t)$	$D_o =D_d+D_s$ is "offtake" in million MT i.e. quantity distributed to FPSs some of which is diverted(D_d) and some of which (D_s) is purchased by TPDS cardholders.	Some FCI procurement and other expenditures include state government taxes and fees (Ganesh-Kumar and others, (2007) and Acharya S.S. and others (2012))
Government expenditure (TPDS) states	GFt _states	0.19*GFt _centre	Guess based on estimates for rice and wheat in Himanshu and Sen (2013)	
Government expenditure (stocks)	GF_ stocks	$(S-D_T)* (P_m* (1+h))$	Central government reimbursement of FCI price support operations. Annual holding cost (h) guesstimated at 20% (h=0.2) in simulations summarised in Tables 1-5	Holding cost in 2011/12 ≈11-12% short term borrowing cost plus FCI storage costs (including pest damage pilferage etc) ≈8-9%.
Government expenditure , rice input subsidies	GF_rice inputs	S*k	Fertiliser plus electricity subsidy per kg of rice produced (k) estimated at Rs 2.02 in simulations summarised in Tables 1-5	Fertiliser subsidy (Centre) and electricity subsidy (states) can be separated
$US exchange rate			Average during rice MY 2012-13 ≈ Rs 52 per USD	