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Sutirtha Bandyopadhyay, IIM, Indore.
Bharat Ramaswami, Ashoka University

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Spillover Effects of Import Competition: Edible Oils in India

Sutirtha Bandyopadhyay* and Bharat Ramaswami†

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Abstract

This paper examines, within a panel data setting, the spatial impacts on prices and on wages, of India's trade liberalization in edible oils. Starting, from near-autarkic policies that prohibited import of edible oils, imports surged to meet most of the domestic demand, following trade liberalization in the 1990s. While the domestic oils sector provides negligible employment, it uses domestically grown non-traded oilseeds which occupy 14% of cultivable land and are next in importance only to the cereal grains of rice and wheat. These oilseeds are grown in the dryland arid regions where farm incomes are low and precarious. To examine spillover effects, the paper constructs geographically varying exposure to trade shocks that depend on the cultivable area planted with oilseeds. Consistent with a model of spatial price competition, the paper finds greater price impacts in the high oilseed growing regions. On the other hand, spatial impacts on wages are not significant suggesting labor reallocation. While we do find significantly greater cropping pattern and production responses in the high oilseeds growing regions, such evidence does not extend to labor reallocation outside agriculture.

Keywords: Palm Oil, Border Price, Trade Liberalization, Wage Rate, Spillover Effects

JEL Codes: F63, F13, Q17, Q18

*Economics Area, Indian Institute of Management, Indore. Address: Prabandh Shikhar, Rau-Pithampur Road, Indore, Madhya Pradesh 453556, India. Email: sutirthab@iimidr.ac.in.

†Department of Economics, Ashoka University. Address: Plot No.2, Rajiv Gandhi Education City, Sonapat (National Capital Region of Delhi), Haryana 131029, India. Email: bharat.ramaswami@ashoka.edu.in.

1 INTRODUCTION

This paper examines, the spatial impacts on prices and on wages, of India's trade liberalization in edible oils that began in the early 1990s. Starting from near-autarkic policies that prohibited import of edible oils, restrictions were relaxed and tariffs reduced on edible oil imports. From the early 1990s, imports steadily increased from negligible amounts to over 15 million tons by the end of 2020s (see Figure 1). During this period, the relative price of edible oils in India declined by nearly 30% percent until the Ukraine war spiked global prices in 2020 (Figure 2). Today, imports supply about 55-60 % of domestic consumption (OECD/FAO, 2023).

The effect of import competition on agriculture and on the food sector, has been contentious in economic policy debates (Anderson (2014), Smith and Glauber (2020)). In developing countries where much of the unskilled workforce works in agriculture, the potential adverse effects on their welfare is feared (e.g., McMillan et al. (2007), Bank (2007), Cheong et al. (2013)). These concerns have constrained global trade negotiations (Glauber and Sinha (2021), Glauber et al. (2023)), Laborde and Martin (2012)). For the sake of competitive trade, the WTO Agreement on Agriculture prohibits governments from procuring agricultural commodities (including food) at administered prices. The G33 coalition of developing countries have, however, disputed this provision and have argued for exempting price supports from WTO restrictions. Their case is that low income farmers need market support. This dispute has not been resolved yet.

The opening up of India's food sector to edible oils imports is illustrative of this dilemma. 55% of India's agricultural workforce do not own any land and depend primarily on labor income. As for the land owning cultivators, 86% of them own less than 2 hectares. They too supplement their farm income with substantial amounts of labor income (NSSO, 2021). How has the sustained import competition for over two decades affected them?

Relative to the workforce, the domestic edible oils sector provides insignificant employment. It might, therefore, seem that trade liberalization in this sector confers gains to consumers while avoiding losses to workers. However, domestic oils are produced using domestically grown oilseeds (e.g., mustard, sesame, groundnut, cotton-seed). Oilseeds are not imported because of sanitary and phytosanitary barriers and is, thus, a non-traded good. At the time of opening up the sector, oilseeds were grown on 14% of India's cultivable land and were next in importance only to the cereal grains of rice and wheat. Moreover, these oilseeds are largely grown in the less productive rain-fed agricultural regions of the country (Rao et al., 2015). So while the direct wage and employment impacts of edible oil trade liberalization might be expected to be minor, the spill-over impact on the nontraded domestic

oilseeds sector could well be large.

The increased consumption of imported oils and palm oils, in particular, suggests that consumers benefited from trade liberalization. Import competition may have adversely affected domestic oil processors who are much fewer in number. Despite the possibly downward pressure on prices, the effect on oilseeds producers is not so clear because they may have had the opportunity to switch to alternative crops. The effect on wages is even less clear since labor could move to the faster growing sectors within agriculture and outside agriculture.

It is widely recognized that labour might escape the adverse effects of international competition if it can shift to economic activities in which the country has a comparative advantage. But, in practice, such shifts may be muted for a variety of reasons including the fact that labour might need substantial retraining. A literature has grown around the idea that the economic impact of trade liberalization can be identified by comparing industries or regions that are differentially exposed to trade ([Goldberg and Pavcnik, 2007](#)). The underlying premise is that labour is not mobile and so each region (or industry) can be regarded as a local labour market. Over the long run, labour could move – in which case this approach will not find large impacts of trade liberalization.

[Topalova \(2007\)](#) and [Topalova \(2010\)](#) pioneered this approach and applied it to study the effects of trade liberalization in India during the 1990s. Topalova constructed a district specific measure of trade exposure as the employment weighted average of tariffs over all traded goods. Although tariffs are uniform for all districts, the employment composition is not and hence this measure captures a district’s exposure to foreign trade. This is the key independent variable and the analysis seeks to uncover its effects on the dependent variable of interest. The differential trade exposure approach has been used to identify the impacts of trade liberalization or import competition on wages, poverty, unemployment, schooling, child labor and gender-specific outcomes (e.g., [Hasan et al. \(2007\)](#), [Edmonds et al. \(2010\)](#), [Autor et al. \(2013\)](#), [Hasan et al. \(2012\)](#), [Kovak \(2013\)](#), [Gaddis and Pieters \(2017\)](#)).

In this paper we use the differential trade exposure approach to analyse the impact of edible oils imports on edible oil prices, wages and a number of other economic variables relating to land allocation, labour allocation and economic welfare. In the agricultural trade literature, such a method was used by [He \(2020\)](#) who examined the impacts of US agricultural exports on US farm and non-farm employment. Time series econometric methods have also been used to examine the impacts of trade liberalization and tariffs on prices and wages (e.g., [Lasco et al. \(2008\)](#)). Model based analysis have relied on multi-market models, computable general equilibrium models and gravity models. The trade-offs between these different approaches are well known. The model-based simulation approaches can provide comprehensive answers while the econometric approaches are based on fewer assumptions

(Goldberg and Pavcnik, 2007).

Relative to the standard case, our application of the differential trade exposure methods is noteworthy in three ways. The literature measures trade exposure by the employment weighted average of tariffs over all traded goods. By this measure, the opening up of India's food sector to edible oil imports would be inconsequential as the domestic edible oils sector is insignificant in total employment. The nontraded good (oilseeds) is an essential intermediate input to the domestic import competing sector, i.e., edible oils. Import competition in edible oils transmits price pressure to oilseeds - a crop that is next in importance only to cereals in India's agricultural economy. The spillover impacts on this nontraded sector is therefore the primary interest. This mechanism stemming from vertical linkages is different from what has been noted in the literature.¹ Our trade exposure variable for the local labor market is, therefore, proportional to the area cultivated with oilseeds.²

A second aspect that deserves mention is that edible oils is not a homogenous category. While India primarily imports palm oil, it does not produce it. India produces many varieties of edible oils of which mustard, groundnut and soya oil are most prominent.³ The oils differ in flavor and other cooking properties.⁴ The imported varieties are, therefore, imperfect substitutes of domestic varieties.⁵ A priori, it is not clear how much of the movement in border prices would be transmitted to domestic prices. It is well known that local market structure affects price pass-through. In particular, price pass-through is expected to be higher, greater is the competition (Goldberg and Pavcnik (2007), Nicita (2009), Atkin and Donaldson (2015), Han et al. (2016)). If the extent of competition varies spatially (like trade exposure), then the extent of price pass-through can be established empirically by methods similar to the differential trade exposure literature.

The imported variety faces greater competition from domestic varieties in regions that produce local oils because of greater availability and also entrenched tastes for the local variety.⁶ Because of the wide prevalence of local small-scale units that retail locally, the avail-

¹In a specific factor model, Kovak (2013) showed that non-traded prices would move with traded prices because of demand shifts and inter-sectoral competition for labor. The implication is that the correct employment weighted tariff should omit nontraded sector employment in the denominator

²Data do not permit us to use the employment share of oilseeds

³The oilseeds that contribute most to edible oils production in India are mustard, soyabean, and groundnut. India also produces edible oils from sesame, nigerseed, safflower and sunflower. Except in negligible quantities, India does not produce palm oil. Imports are predominantly palm oil followed by soya oil and sunflower oil.

⁴<https://iopepc.org/products-edible-oils.php>

⁵Preferences for cooking oils vary by region and community, see Welch et al. (2008), chapter 5 of Jha et al. (2012)

⁶For correlation of tastes with local production see Srinivasan (2005).

ability of domestic varieties is correlated with local production and availability of oilseeds.⁷ The importance of small scale units is a legacy of a policy that disallowed large scale units in the oils that were traditionally consumed – such as mustard, groundnut and sesame. Hence, we hypothesize that regions that produce oilseeds are not only more vulnerable to imports but are also the regions that would offer most domestic competition to imported varieties. In other words, the local non-traded sector of oilseeds is not only a measure of trade (spillover) exposure but, because of vertical linkages, it is also a determinant of the local market structure of the traded good. The share of oilseeds in the local agricultural area serves a dual purpose – as a measure of differential trade exposure and as a measure of differential competitive market structure. We can, therefore, compare the price pass-through and the wage pass-through between regions that specialize in oilseeds to regions that do not.

A third feature of our work is that our analysis covers a period of sustained and varying import competition rather than a discrete episode of trade liberalization. While the initial impetus to import competition came from trade liberalization, the extent of it has varied in subsequent years because of variation in tariffs, exchange rates and world prices. The initial trade liberalization took the form of replacing quantitative restrictions with tariffs. Subsequently, tariffs have varied considerably with several rounds of reductions and hikes (Figure 3). With the abolition of quantitative restrictions, the border price captures the extent of import competition. Tariffs, of course, matter to import competition but so do world prices and exchange rates.

The net changes in import competition as captured by the border price (suitably deflated) is displayed in Figure 4. We construct a panel data set of India’s districts over the period 1993/94 to 2011/12 where we examine the effect of the variation in the border price on a number of variables including edible oil prices and wages. Over this period, the border price fell by 37%. Our differential exposure variable is based on local geographic variation in the share of oilseeds in cultivated area. During the early period of the study period, tariffs fell across the board especially in the manufacturing sector. In our controls, we include a composite tariff measure that is an employment weighted average of tariffs on all traded commodities.

In our results, we find that the pass-through of the border price to local edible oils prices is significantly greater in districts that grow more oilseeds. This is supportive of the hypothesis mentioned above that the extent of price-pass through depends on local competition. The finding means that workers in high oilseed producing districts face a double

⁷About the importance of local small-scale producers, see Persaud and Landes (2007), Jha et. al (2012), Reddy (2009). Dohlman et.al (2003) estimated that three-fifths of India’s domestic edible oil production “comes from a vast number of often antiquated village- level crushers (ghanis) or other small expellers.”

whammy. Firstly, their cropping pattern exposes them more to to import competition. In addition, the price pass-through is also greater in these regions. Despite the double disadvantage, it turns out that there are no significant spatial differences in the wage pass-through. Neither do we see significant spatial impacts on agricultural employment, total employment or the share of non-agricultural employment. We also do not find significant spatial impacts on per capita consumption. To look for mechanisms, we turn to the evidence on reallocation of labour within agriculture. The paper finds significant evidence that cropping pattern changed in response to price shocks. The greater adjustment, however, is on the intensive margin. As a result, districts with more trade exposure also see greater production response in oilseeds to border price changes.

The rest of the paper is structured as follows. The next section examines the institutional environment under which trade liberalization took place. We discuss the analytical challenge posed by the potential endogeneity of edible oil trade policies. Section 3 describes the data sources and descriptive statistics. Section 4 presents the empirical model and the theoretical framework that justifies it. Estimation findings and robustness checks are discussed in Section 5. Concluding remarks are gathered in Section 6.

2 THE EDIBLE OIL SECTOR AND TRADE LIBERALIZATION IN INDIA

Oils obtained from mustard (rapeseed), soybean, groundnut and cotton seed are the major edible oils varieties produced within India. India’s imports of oils are primarily palm oil (and its derivatives), soya oil and sunflower oil (Figure 5). Although the tariff rate of soya oil is typically lower than on palm oil, it is the latter that is mostly imported. Palm oil is cheaper (despite the tariff) and the major palm oil exporting countries (Indonesia and Malaysia) are much closer to India than the major soya oil exporting countries (South America and the US) ⁸.

Since imports account for more than half of consumption, the consumption pattern has shifted towards them. In the 1970s, palm oil and soya oil were unimportant. The traditional oils of groundnut, mustard and cotton dominated the market. By the end of the century, palm oil was the leading oil followed by soya oil (Dohlman et al., 2003). Consistent with the liberalization of edible oils trade and the dominance of palm oils in imports, we see a close association between the palm oil border price and the edible oil retail price (see Figure 6). The retail price displayed here is the average unit value of edible oil purchases by households calculated from nationally representative consumer expenditure survey data of India.

⁸Table A.1 in the appendix compares the world prices of different type of edible oils.

Although India allows the imports of oilseeds (non-genetically modified), such imports have not been important for several reasons. Tariffs on oilseeds have generally been higher than on oils and their imports are also governed by phytosanitary regulations. The ban on genetically modified seeds also rules out the import of soybeans since it is these varieties that are predominantly produced by the major exporting countries. Oilseeds producers have, therefore, not faced direct competition from foreign producers. However, the import of edible oils could have depressed the prices of domestically produced substitutes and thereby affected the demand and prices of domestic oilseeds.

In 1993/94, the three major oilseeds by area were groundnut, rapeseed- mustard and cotton and 27 million hectares (or 14% of total area) grew oilseeds. Since then, the area has fluctuated but without a trend. By the end of the 2010s, the area occupied by oilseeds was again around 27 million hectares. The stability, however, hides the fact that while the area under the traditionally consumed oilseeds (especially groundnut) declined substantially, the area under cotton and soybeans increased. In both these cases, the returns to their cultivation are not derived solely from oil extraction. Cottonseed oil is a secondary product; fibre is the main product of cotton. Cotton area expanded in the 2000s because profitability improved with the introduction of Bt Cotton varieties ([James et al. \(2015\)](#)). In the case of soybeans, soymeal feed is a joint product of oil extraction. Despite competition from imported oils, soybeans enjoyed robust demand because of domestic and overseas demand for soymeal feed ([Dohlman et al. \(2003\)](#)).

Before 1994, all imports of edible oils were on government account as private trade was banned. Imports were contracted whenever domestic supplies fell short. The official policy at this time was self-reliance and government programs were launched to increase productivity and production of oilseeds. In 1994, the government reversed policy and allowed free imports on private account subject to tariffs. The reversal of policy was directly due to the WTO Agreement on Agriculture in 1994. It should be noted India initiated a broad program of trade liberalization starting 1991. Tariffs were substantially reduced and the proportion of manufacturing products subject to non-tariff barriers steadily declined. However, agriculture was left out of that initial opening up process. Subsequently, the commitments to the WTO agreement drove trade liberalization in edible oils in the mid-1990s (([Reddy \(2009\)](#)), [Jha et al. \(2012\)](#), [Gulati and Narayanan \(2007\)](#), [Ghosh \(2009\)](#)).

Trade liberalization in edible oils can be therefore be regarded as exogenous to conditions within the agricultural sector. Two caveats, however, attach to this statement. When edible oils imports were liberalized in the mid-1990s, India maintained its quantitative restrictions on other agricultural imports citing balance of payment difficulties ([Gulati and Narayanan \(2007\)](#)). In a dispute, the WTO ruled against India's position and India lifted its quantitative

restrictions on other agricultural imports in 2001. Thus, the government chose to liberalize the edible oils imports before it did so for other food commodities.

Prior work has not addressed the question as to why this happened. However, it is well known that India has struggled with low productivity in oilseeds (Dohlman et al. (2003), Persaud and Landes (2007), Jha et al. (2012), Srinivasan (2005)). Indeed, even the success in increasing output (prior to liberalization) was achieved from pressing more area into cultivation (at the expense of pulses and millets) rather than higher yields (Gulati et.al, 1996). As a result, the protection required for edible oils was higher than for other food staples (Gulati et al. (1996)). Such a strategy was not sustainable in the face of rapidly growing demand spurred by income and population growth (Jha et al. (2012), Srinivasan (2005)). On average, edible oils constitute about 7-8% of household food budgets and inflation in its price matters to consumers. The comparative disadvantage of oilseeds, is in part because it is cultivated in dryland areas with limited access to irrigation (Dohlman et al. (2003) Jha et al. (2012)). This means that the differences in cropping pattern that measure differential exposure to trade and competition are in turn because of differences in irrigation and other region specific factors that may also directly matter to the dependent variable. Hence, controlling for these region differences is necessary for identification.

The second caveat is that while the government removed quantitative restrictions on edible oils starting 1994, palm oil tariffs have subsequently varied (Figure 3). As others have pointed out a varying import tariff is the government's way of keeping prices within a desired band and is therefore a function of domestic and international availability and prices (Reddy (2009), Chand et al. (2004), Dohlman et al. (2003)). As a specific instance of it, Gulati and Narayanan (2007)) argue that tariffs spiked during the period 1999 to 2004 because of a crash in world prices. Such government behaviour aimed at stabilizing domestic prices attempts to strike a balance between (edible oil) consumer and (oilseed) producer interests. This prevents the full transmission of world prices and exchange rates to domestic prices, wages and other variables. Indeed, if it was fully stabilizing, consumers and producers would be insulated from import competition beyond the initial shock of trade liberalization.

Figure 7 compares the border price (the product of global prices, the exchange rate and the tariff) with the zero tariff import price (the product of global prices and exchange rate alone). The two variables are highly correlated; however, the trends are not quite parallel. The gap between the variables widens in some years and narrows in others because of varying tariffs. The correlation between the zero tariff import price and tariffs is as high as -0.74. This could arise because of stabilizing behavior noted above.⁹ Lobbying by affected interests may

⁹Such stabilizing behavior has been noted for other commodities in India as well. In the case of wheat, Gouel et al. (2016) estimated the elasticity of tariffs to world prices to be -0.76

have mattered as well. In so far as the factors that determine government’s tariff decisions are time varying nationally (as would be if stabilization is the primary goal), they are controlled by a time fixed effect in the regressions. If the government decisions are affected by time varying factors specific to a state within India, they are controlled by state output of oilseeds and by state time trends.

Besides these controls for tariff endogeneity, we also check the robustness of our results by replacing the border price by the zero tariff import price. Since tariffs are not included in the latter, this serves to check whether our results are contaminated by the endogeneity of tariffs.

3 DATA DESCRIPTION

Our analysis spans the period between 1993-94 and 2011-12. The paper constructs a district level panel data set. As districts have been sub-divided over time, the paper sticks to the geographic boundaries that obtained in 1961. The district level analysis spans 258 districts that includes 14 major states in the sample: Punjab, Haryana, Uttar Pradesh (includes Uttarakhand), Madhya Pradesh (includes Chhattisgarh), Bihar (includes Jharkhand), Gujarat, Rajasthan, West Bengal, Maharashtra, Andhra Pradesh, Karnataka, Orissa, Tamil Nadu and Kerala.

The paper uses the National Sample Survey Organization (NSSO) employment and consumer expenditure surveys from 1993-94, 1999-2000, 2004-05, 2007-08 and 2011-12. The NSSO datasets are household level surveys that are representative of India’s population. The entire NSS sample is divided into two parts; rural sample and urban sample. In this paper, we consider the rural sample only. In rural areas, the first stratum is a district. Villages are primary sampling units (PSU) and are picked randomly in a district over an entire agricultural year (July to June) over quarters to ensure equal spacing of observations across the year. The households are randomly chosen in the selected PSU’s.

Wages and employment data are sourced from the employment survey. Prices of edible oils are sourced as unit values from consumer expenditure surveys also from NSSO. The consumer expenditure survey provides information on the household level’s total expenditure and quantity consumed of edible oil. The total expenditure and quantity consumed are aggregated at the district level. Dividing the district-level total expenditure by the district-specific total quantity consumed, we obtain the unit value of edible oil (for a district) which is a measure of the price of all edible oils - whether domestically produced or imported.¹⁰ We

¹⁰The consumption categories in the expenditure data do not have a separate category for palm oil and therefore it is not possible to separate out the imported palm oil price from all the domestic oils.

also use an alternative price measure for three traditionally consumed oils alone - mustard oils, groundnut oils, and coconut oils. None of these are imported. We aggregate them and derive the price of what we term traditional oils.

The consumer expenditure survey is not informative about the prices of oilseeds. We use data from farm harvest prices (source: ICRISAT database). Unfortunately, because of missing observations, the quality of data is patchy.

The consumer expenditure survey is also the source for per capita consumption. Educational attainments and social group composition (the percentage of low caste and tribal populations) are also obtained from NSSO survey.

The district wise cropping pattern is based on government records and is obtained from the ICRISAT database. The rainfall figures are taken from the gridded dataset of the Centre of Climatic Research at the University of Delaware, which includes monthly precipitation values on 0.5 degree intervals in longitude and latitude centered on 0.25 degree. This grid value is achieved by spatial interpolation using data from nearby weather stations and other sources of rainfall data. District level monthly rainfall estimates were arrived at by averaging the monthly precipitation value of all the grid points lying within the geographic boundaries of a district in a year.

The data on district-specific infrastructural variables such as the percentage of villages electrified, irrigated, connected by bus, rail, and paved roads (each as a separate variable) have been obtained from the census of India. For the period 1993-94, we use the census data of 1991. For the period 1999-2000, 2004-05 and 2007-08, the census data of 2001 is used. For 2011-12, we use the 2011 census figures. The district-level census boundaries for each of these periods are mapped to 1961 census boundaries.

Data on tariffs come from the World Integrated Trade Solution (WITS) database. The data is used to compute the trade exposure measure. It is also used to compute a composite tariff measure as an employment weighted average of tariff rates on different commodities. In our paper, the composite tariff measure is used as a control variable. In order to construct that composite tariff measure, we obtain the average employment share for each district at the three digits (NIC code) level from NSSO employment-unemployment survey data. The employment share corresponds to the initial period i.e., 1993-94. Data on ad-valorem tariff rate at the 6 digit commodity level is available from WITS (World Integrated Trade Solution) database. We match 3 digit NIC codes with the 6 digit trade codes to calculate the tariff rate at the 3 digit NIC code level (for almost 200 commodities). Then we multiply the tariff rate (computed at the 3 digit level) with the employment share (also at the 3 digit level) and sum it up for all commodities to compute the composite tariff rate.

The border price of palm oil is computed as the world price multiplied by one plus the ad-valorem tariff rate and exchange rate. All nominal quantities (domestic prices, wages, consumption, border price) are deflated by the consumer price index of agricultural laborers.

4 EMPIRICAL MODEL

The spatial pass through equation is estimated by running the following empirical specification:

$$Y_{dt} = \beta_0 + \beta_1 \ln BP_t * S_d + \beta_2 Z_{dt} + f_d + T_t + \varepsilon_{dt} \quad (1)$$

Y_{dt} is the dependent variable. It could refer to log of price of edible oils, log wages, log agricultural employment, share of non-farm employment, log per capita consumption, log of total land devoted to oilseeds cultivation or log of oilseeds production. The dependent variable varies across districts and over time. f_d and T_t stand for the district and time fixed effects respectively. ε_{dt} is the regression error term.

BP_t is the border price of palm oil at 't'th time period. S_d is district d 's share of oilseeds in agricultural area in 1993/94 - the initial year of our study. In the wages regression, the product of BP_t and S_d is our trade exposure variable. It is proportional to the area share of oilseeds. As mentioned earlier, even though oilseeds are not imported, it is an essential input to domestic oils and unlike them, it is an important employer of agricultural labor. In the prices regression, the product of BP_t and S_d is a measure of competitive market structure for reasons described earlier.

A theoretical model that justifies the area share of oilseeds as an index of competitive market structures is described in the appendix. In this model, the imported oil variety (palm oil) is an imperfect substitute of the domestic oil varieties. We consider a duopoly where in each district there is a single seller of the imported oil and a single seller of the locally produced oil. The marginal cost for the firm selling palm oil is its border price. This is uniform throughout the country. The marginal cost for the firm selling locally produced oil is lower in regions that grow more oilseeds. Our pass-through measure is elasticity of the price of local oils to the palm oil border price - the same as in the regression specification (1). In Bertrand competition, the appendix shows that the pass-through elasticity is higher when the per unit costs of local edible oils is lower.

β_1 is the coefficient of interest. It measures the differential transmission of border price to the dependent variable of interest. When the dependent variable is in logs, we can derive from (1) the difference in the transmission elasticity (elasticity of the dependent variable

to the border price) between high oilseed growing districts and low oilseed growing districts. When the dependent variable is a share, we can derive from (1), the difference in the impact from a percentage increase in border price. As is the case with all differential trade exposure literature, β_1 does not measure the impact of border price on the dependent variable for the country as a whole. Rather it measures the relative impact of import competition across high and low oilseed growing districts.

To control for the change in tariffs of commodities other than edible oils, the control variables in Z_{dt} includes a composite district specific tariff measure as the employment weighted average of tariffs over all traded goods. In addition, to capture the impact of removal of quantitative restrictions, we include a dummy variable for the period since 2001.

The district specific non-agricultural control variables in Z_{dt} include infrastructure variables (percentage of villages electrified, connected by bus, rail, and paved roads), educational attainments (literacy rate), social group composition (the percentage of scheduled caste and scheduled tribe populations). Agricultural variables include the percentage of villages irrigated in a district and district-wise average annual rainfall. If Indian tariffs adjust to domestic production, then the domestic oilseeds production may affect the palm oil border price via tariffs. To control for such feedback effects, we include aggregate (state level) oilseeds production.

In addition, the regressions also control for the state specific time trend and initial district wise composition of farm and non-farm employment, initial composition of area share belonging to cereals and non-cereals cultivation. A full description of the variables and their descriptive statistics are contained in Table 1.

5 FINDINGS

The benchmark price and wage regression results are shown in Table 2 and Table 3, respectively. The dependent variable is measured in logs. The dependent variable in Table 2 is the district average price for all edible oils. In each of these tables, we have four columns that correspond to four specifications that vary with respect to the controls that are used. The set of controls expands as we move from column 1 to column 4. In the first column, the controls are district and time fixed effects. The second column adds the district specific time varying variables in the vector Z_{dt} . These include the agricultural and non-agricultural variables discussed above. They also include a composite tariff measure. To address differential trends, column three adds a state time trend. To make sure the results are robust to differential trends owing to different initial conditions, the fourth column adds time trends interacted with district initial conditions (employment share of farm employment, land share

of cereals).

The price regression in Table 2 confirms the hypothesis that border price transmission is greater in districts with larger area shares devoted to oilseeds cultivation. The spatial effect is significant at the 1% level. This finding is consistent with the higher degree of price competition (and hence lower marginal cost) in high oilseeds producing regions. The difference in price elasticity between a region with a 50% oilseeds share and a region that does not grow oilseeds is about 0.17 (using column 4 estimates).

With regard to the wage regression, the point estimates suggest sizeable spatial differences with greater agricultural wage impacts in districts that are more exposed to trade. However, statistically, the evidence of a spatial wage impact is weak. The wage impacts are significant at the 10% level in specifications (2) and (3) but fall below this level of significance in column 4.

The lack of significant impacts on agricultural wages led us to look at the impacts of border price on employment variables. In the first five columns of Table 4, we present the results of specification (4) (corresponding to Table 2 and Table 3) for five different dependent variables: male, female and total agricultural employment, total non-farm employment and its share in total employment. The lack of statistical significance in these results is consistent with the statistically weak wage impacts. As a final check, we also looked at the impact on the per capita consumption expenditures of agricultural laborers. These are agricultural workers who do not own any land and work on other people's farms. Households that depend on unskilled labor (agricultural and other labor) are known to be over-represented among the poor. Not only are the impacts not significant, they are of the wrong sign as well (column 6 of Table 4).

When faced with import competition, oilseeds producers may have the option of muting the impacts by shifting land, labor and other resources to other crops. Tables 5 and 6 present the results from all four specifications for oilseeds area and production (both in logs). Spatial differences in response are significant for both area and production. The respective elasticities are greater in areas more exposed to import competition. The results show that responses on the intensive margin (production) are larger than the responses on the extensive margin (area).

During the period of analysis, border prices fell by almost 38%. A one-standard deviation increase in trade exposure (0.13) results in a loss of production by 6.6% (using the estimates of specification in the fourth column of Table 6).

The direct impact of import competition on farmers would be felt through oilseeds prices. However, as mentioned in the data section, the data on this variable is incomplete and patchy. Table A.2-A.4 (in the appendix) report the transmission of border price to the prices of three

oilseeds: rapeseed-mustard, sesame and groundnut. For the first two, the estimates show a strong spatial impact - price transmission is greater in areas that specialize in oilseeds. However, this is not true for groundnut.

Robustness

In this section, we consider the robustness of our price transmission results (Table 2) to (a) endogeneity of tariffs (b) omitted variables and (c) alternative measures of the dependent variable and the border price.

To address the issue of endogeneity of tariffs (discussed in section 2) we replace the border price by the zero tariff import price which is the product of the world price and the exchange rate. The results continue to be highly significant. Relative to Table 2, the spatial transmission in transmission elasticity is smaller as would be the case when tariffs are chosen to stabilize domestic prices (Table 7).

To check for omitted variables, Table 8 reports the outcome of a falsification test. Ideally, we would like to construct a placebo trade exposure variable based on the area share of an alternative crop. Oilseeds are typically grown during the monsoon growing season. As other crops grown during this time compete with oilseeds, their production shares could be correlated negatively with oilseeds. For this reason, we picked the share of wheat - the principal crop grown during the winter season - as the placebo trade exposure variable. Table 8 shows that the placebo effect is not different from zero.

India imports palm oil in both refined and crude (unrefined) forms. Crude oils are imported by domestic processors who refine them and sell in the domestic market. The tariffs on crude oils are typically lower. Table 2 employs the border price of refined oils. Table 9 examines the transmission of crude oil border prices. The results indicate smaller (relative to refined oils) and highly significant spatial price effects.

Besides palm oil, India also imports soya oil although in much smaller quantities. Table 10 replicates the price transmission regression of Table 2 with one difference. The border price of palm oil is replaced by a weighted average of the border prices of palm oil and soya oil where the weights are their respective shares in total oils imports in 1993/94. The results closely resemble the findings in Table 2.

The dependent variable in Table 2 is the average retail price for all edible oils (including imported oils). While the data does not allow us to compute a retail price for all domestically produced oils, we can obtain the price of some domestically produced oils - rapeseed-mustard, groundnut and coconut). Table 11 replicates all the price regressions when the dependent variable is recast as the price of the traditional oils alone (rapeseed-mustard, groundnut

and coconut) rather than the price of all edible oils. These regressions capture the spatial transmission of the palm oil border price on the prices of traditional oils. The table displays the benchmark regression corresponding to Table 2 (the specification in column 4) and the outcomes of all the robustness checks discussed above.

6 CONCLUDING REMARKS

Like many other countries, India's embrace of trade liberalization in food and agriculture has been cautious because of concerns how it may affect the interests of cultivators and agricultural workers. The WTO agreements on agriculture opened up India's food markets to external competition. The change was dramatic for edible oils. Relative to the consumer price index for agricultural labour, the border price of palm oil declined by 37% during the period of this study (1993/94 – 2011/12). Palm oil was cheap and was produced and exported by countries that were nearby. During the period of this study, per capita supply doubled. Much of the increase in supply came from imports because of which imports supply more than half of consumption today.

In this paper, we used the differential trade exposure approach to examine the impacts of increased import competition on prices and wages. While the proportion of workers employed in producing edible oils is very small, the number of workers growing oilseeds that are processed by the edible oils industry is not negligible. That's the basis for expecting spillover wage impacts.

We used the district proportion of agricultural areas growing oilseeds as the trade exposure variable. Because of government regulations, industry structure contained small scale oilseed crushers that only sold in local markets. Hence we conjectured that the trade exposure variable also measured the extent of competition. Our empirical findings confirmed the theoretical supposition that border price pass-through was greater in areas that specialized in oilseeds. On the other hand, the results failed to uncover significant differences in pass-through to wages. This was also the case for the consumption of landless agricultural workers and various measures of employment.

The findings also showed that producers adjusted their cropping pattern. Relative to areas that do not grow much oilseeds, the oilseeds area in regions that grow it came down in response to the decline in border price. These adjustments may have resulted in muting the wage impact. Overall, these results indicate that, on average, that import competition compressed edible oil prices but did not leave a statistically significant impact on wages or agricultural employment. Our data is too coarse to allow us to directly examine employment shifts within agriculture; however, we do observe strong production impacts especially on

the intensive margin.

REFERENCES

- ANDERSON, K. (2014): “The intersection of trade policy, price volatility, and food security,” *Annu. Rev. Resour. Econ.*, 6, 513–532.
- ATKIN, D. AND D. DONALDSON (2015): “Who’s getting globalized? The size and implications of intra-national trade costs,” Tech. rep., National Bureau of Economic Research.
- AUTOR, D. H., D. DORN, AND G. H. HANSON (2013): “The China syndrome: Local labor market effects of import competition in the United States,” *American economic review*, 103, 2121–2168.
- BANK, W. (2007): *World development report 2008: Agriculture for development*, The World Bank.
- CHAND, R., D. JHA, AND S. MITTAL (2004): “WTO and oilseeds sector: Challenges of trade liberalisation,” *Economic and Political Weekly*, 533–537.
- CHEONG, D., M. JANSEN, AND R. PETERS (2013): *Shared Harvets: Agriculture, Trade and Employment*, International Labour Office Geneva, Switzerland.
- DOHLMAN, E. N., S. C. PERSAUD, R. LANDES, ET AL. (2003): *India’s edible oil sector: Imports fill rising demand*, US Department of Agriculture, Economic Research Service.
- EDMONDS, E. V., N. PAVCNİK, AND P. TOPALOVA (2010): “Trade adjustment and human capital investments: Evidence from Indian tariff reform,” *American Economic Journal: Applied Economics*, 2, 42–75.
- GADDIS, I. AND J. PIETERS (2017): “The gendered labor market impacts of trade liberalization: evidence from Brazil,” *Journal of Human Resources*, 52, 457–490.
- GHOSH, N. (2009): “Effects of tariff liberalization on oilseed and edible oil sector in India: who wins and who loses?” *Online*. www.taerindia.com/pdf/working_paper_no_2.
- GLAUBER, J. AND T. SINHA (2021): “Procuring food stocks under World Trade Organization farm subsidy rules: Finding a permanent solution. IISD Report,” *International Institute for Sustainable Development*, Winnipeg.

- GLAUBER, J. W., D. LABORDE DEBUCQUET, A. MAMUN, E. OLIVETTI, AND V. PIÑEIRO (2023): “MC12: How to make the WTO relevant in the middle of a food price crisis,” *IFPRI book chapters*, 81–85.
- GOLDBERG, P. K. AND N. PAVCNİK (2007): “Distributional effects of globalization in developing countries,” *Journal of economic Literature*, 45, 39–82.
- GOUEL, C., M. GAUTAM, AND W. J. MARTIN (2016): “Managing food price volatility in a large open country: the case of wheat in India,” *Oxford Economic Papers*, 68, 811–835.
- GULATI, A. AND S. NARAYANAN (2007): “Managing Import Competition When Developing Countries Liberalize Trade: India’s Experience,” in *Reforming Agricultural Trade for Developing Countries*, ed. by A. F. McCalla and J. Nash, The World Bank, 220–243.
- GULATI, A., A. SHARMA, AND D. S. KOHLI (1996): “Self-sufficiency and allocative efficiency: case of edible oils,” *Economic and Political Weekly*, A15–A24.
- HAN, J., R. LIU, B. U. MARCHAND, AND J. ZHANG (2016): “Market structure, imperfect tariff pass-through, and household welfare in urban China,” *Journal of International Economics*, 100, 220–232.
- HASAN, R., D. MITRA, P. RANJAN, AND R. N. AHSAN (2012): “Trade liberalization and unemployment: Theory and evidence from India,” *Journal of Development Economics*, 97, 269–280.
- HASAN, R., D. MITRA, AND B. P. URAL (2007): “Trade Liberalization, Labor-Market Institutions, and Poverty Reduction: Evidence from Indian States,” in *India Policy Forum 2006*, vol. 7, 71–122.
- HE, X. (2020): “US agricultural exports and labor market adjustments,” *Agricultural Economics*, 51, 609–621.
- JAMES, C., P. TENG, M. ARUJANAN, R. R. ALDEMITA, R. B. FLAVELL, G. BROOKES, AND M. QAIM (2015): “Invitational Essays to Celebrate the 20th Anniversary of the commercialization of biotech crops (1996 to 2015): progress and promise,” *ISAAA Brief*.
- JHA, G. K., S. PAL, V. MATHUR, G. BISARIA, P. ANBUKANI, R. BURMAN, AND S. DUBEY (2012): *Edible oilseeds supply and demand scenario in India: Implications for policy*, Citeseer.

- KOVAK, B. K. (2013): “Regional effects of trade reform: What is the correct measure of liberalization?” *American Economic Review*, 103, 1960–1976.
- LABORDE, D. AND W. MARTIN (2012): “Agricultural trade: what matters in the Doha Round?” *Annu. Rev. Resour. Econ.*, 4, 265–283.
- LASCO, C. D., R. J. MYERS, AND R. H. BERNSTEN (2008): “Dynamics of rice prices and agricultural wages in the Philippines,” *Agricultural Economics*, 38, 339–348.
- MCMILLAN, M. S., A. P. ZWANE, AND N. ASHRAF (2007): “My policies or yours: does OECD support for agriculture increase poverty in developing countries?” in *Globalization and poverty*, ed. by A. Harisson, University of Chicago Press, 183–240.
- NICITA, A. (2009): “The price effect of tariff liberalization: Measuring the impact on household welfare,” *Journal of Development Economics*, 89, 19–27.
- NSSO (2021): “Situation assessment of agricultural households and land and livestock holdings of households in rural India, 2019,” .
- OECD/FAO (2023): “OECD-FAO agricultural outlook 2022-2032,” .
- PERSAUD, S. C. AND M. R. LANDES (2007): “The Role of Policy and Industry Structure in India’s Oilseed Markets,” .
- RAO, C. S., R. LAL, J. V. PRASAD, K. A. GOPINATH, R. SINGH, V. S. JAKKULA, K. L. SAHRAWAT, B. VENKATESWARLU, A. K. SIKKA, AND S. M. VIRMANI (2015): “Potential and challenges of rainfed farming in India,” *Advances in agronomy*, 133, 113–181.
- REDDY, A. A. (2009): “Policy options for India’s edible oil complex,” *Economic and Political weekly*, 22–24.
- SHUBIK, M. AND R. LEVITAN (1980): *Market structure and behavior*, Harvard University Press.
- SMITH, V. H. AND J. W. GLAUBER (2020): “Trade, policy, and food security,” *Agricultural Economics*, 51, 159–171.
- SRINIVASAN, P. (2005): “Impact of trade liberalization on India’s oilseed and edible oils sector,” *Report prepared for IGIDR-ERS/USDA Project: Indian Agricultural Markets and Policy*.

- TOPALOVA, P. (2007): “Trade liberalization, poverty and inequality: Evidence from Indian districts,” in *Globalization and poverty*, University of Chicago Press, 291–336.
- (2010): “Factor immobility and regional impacts of trade liberalization: Evidence on poverty from India,” *American Economic Journal: Applied Economics*, 2, 1–41.
- WANG, X. H. AND J. ZHAO (2007): “Welfare reductions from small cost reductions in differentiated oligopoly,” *International Journal of Industrial Organization*, 25, 173–185.
- WELCH, M., S. MOHANTY, AND S. PAN (2008): “India edible oil consumption: A censored incomplete demand approach,” .
- ZIMMERMAN, P. R. AND J. A. CARLSON (2010): “Competition and cost pass-through in differentiated oligopolies,” .

TABLES AND FIGURES

Figures

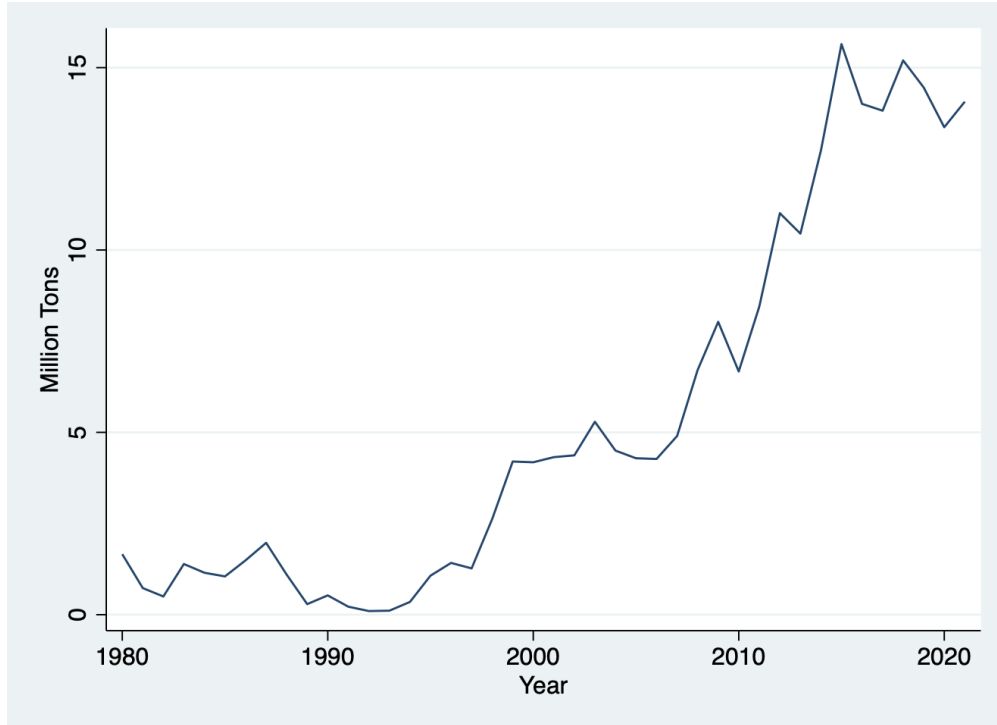


Figure 1: Edible Oils Imports in Million Tonnes. Drawn by the authors using official government of India data

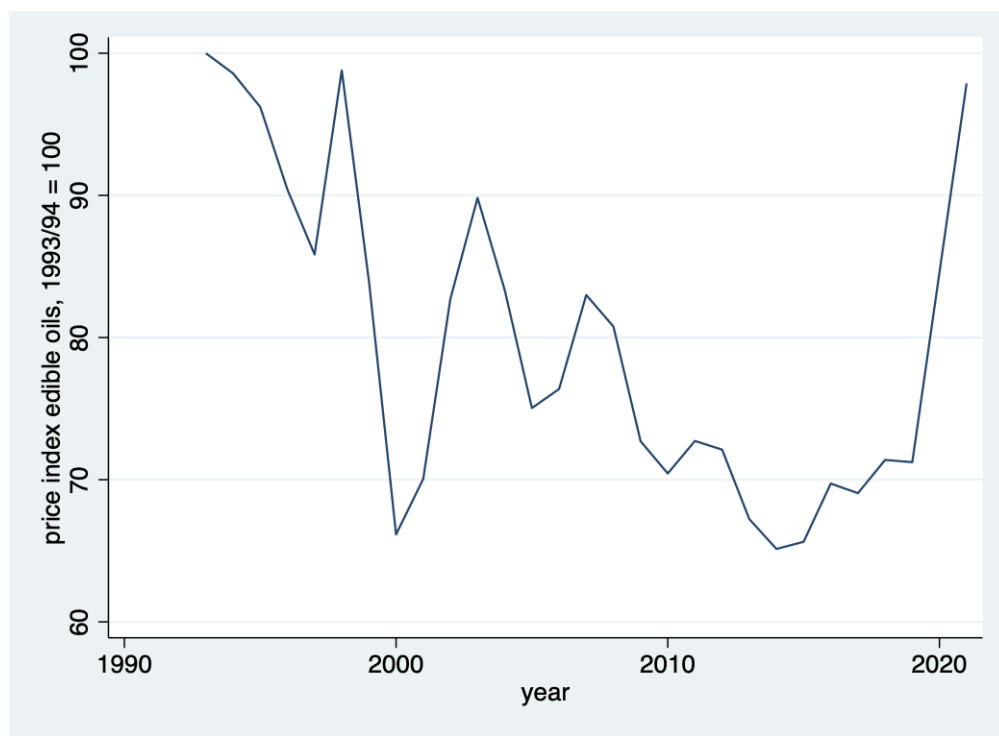


Figure 2: Domestic Price of Edible Oils. The graph plots the annual average wholesale price index of edible oils deflated by the wholesale price index of all commodities. Source: Economic Survey, Government of India

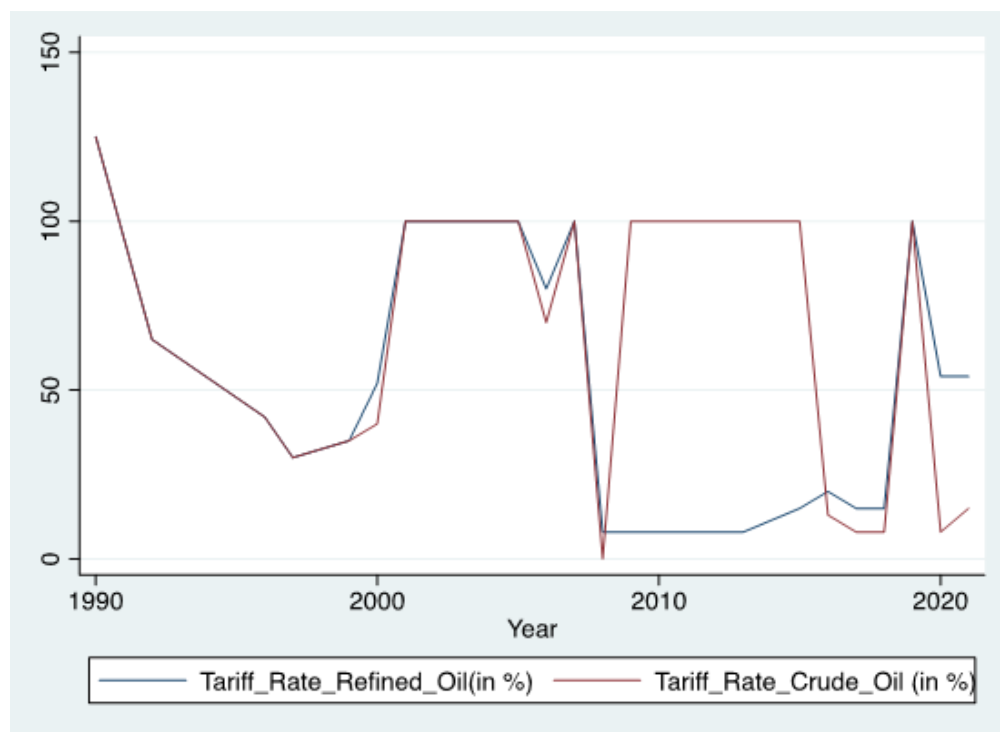


Figure 3: Tariff Rate of Refined and Crude Palm Oil. Source: WITS (World Integrated Trade Solution) Database



Figure 4: Border Price Deflated by Consumer Price Index

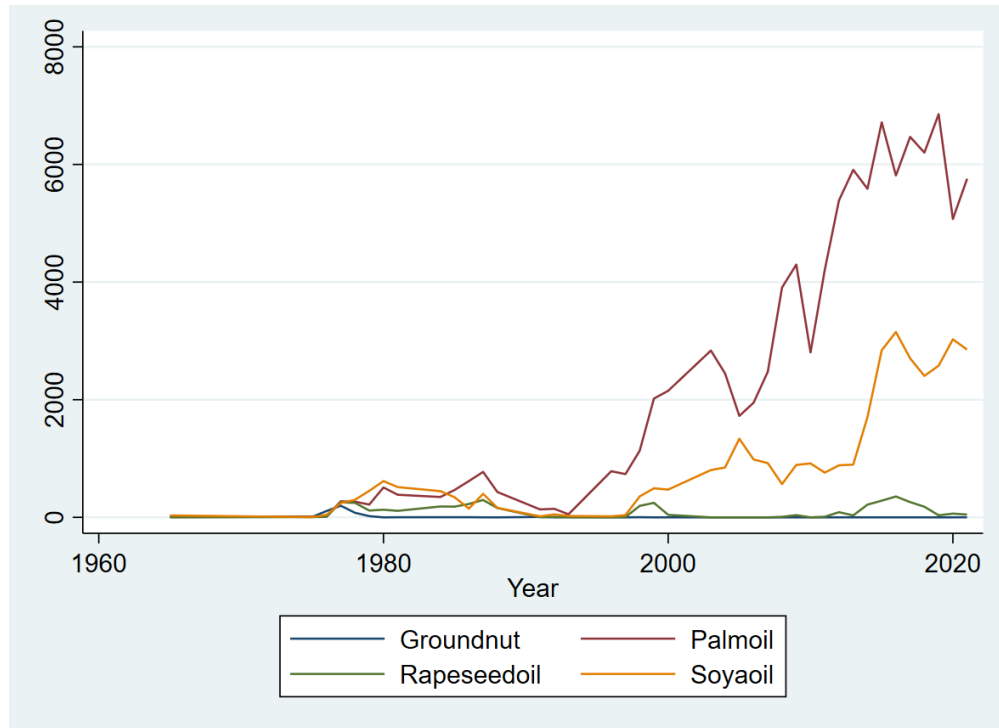


Figure 5: Import of Edible Oils of Various Types. The import values are measured in millions of dollars. Drawn by the authors from FAOSTAT data

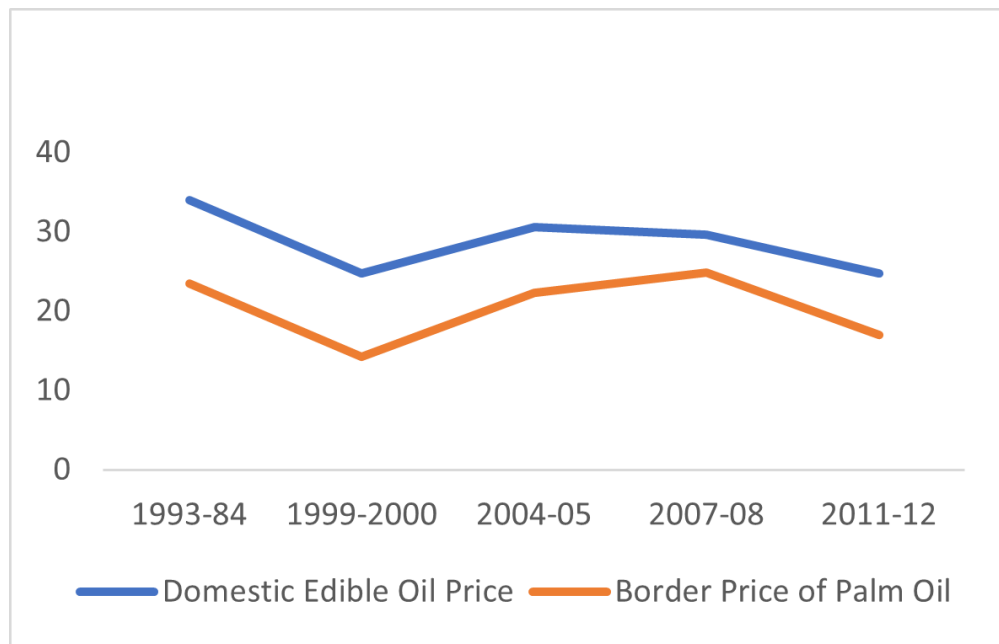


Figure 6: Domestic Edible Oil Price and Border Price of Palm Oil. Drawn by the authors.

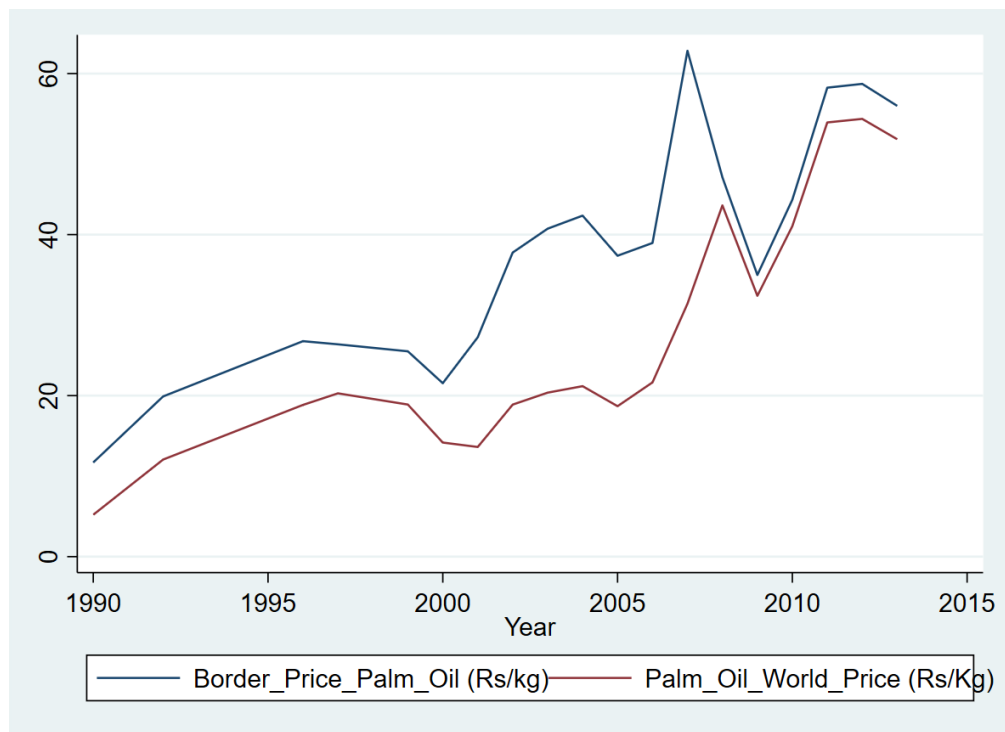


Figure 7: Border Price and the Zero Import Tariff Price (World Price/Border Price Excluding the Tariff Rate) of Palm Oil. Drwan by the authors

Tables

Table 1: Summary Statistics

Variables	Description	Mean	SD
All edible oil price (nominal)	The nominal unit value of all edible oils. This is calculated by dividing the district's total edible oil expenditure by quantity.	3.92	0.32
All edible oil price (real)	The nominal unit value of all edible oils at the district level divided by All India CPI.	3.32	0.16
Traditional edible oil price (nominal)	The nominal unit value of traditional oils. This is calculated by dividing the district's total traditional oil expenditure by total quantity. The traditional edibles oils are rapeseed-mustard oil, groundnut oil and coconut oil.	3.96	0.35
Traditional edible oil price (real)	The nominal unit value at the district level divided by all India Consumer Price Index (CPI).	3.36	0.15
Groundnut price (nominal)	The nominal farm harvest price of groundnut at the district level obtained from the ICRISAT Data.	2.87	0.46
Groundnut price (real)	The nominal groundnut price divided by all India Consumer Price Index (CPI).	2.26	0.20
Rapeseed-Mustard price (nominal)	The nominal farm harvest price of rapeseed-mustard at the district level obtained from the ICRISAT Data.	2.83	0.43
Rapeseed-Mustard price (real)	The nominal rapeseed-mustard price divided by all India Consumer Price Index (CPI).	2.24	0.18
Sesame price (nominal)	The nominal farm harvest price of sesame at the district level obtained from the ICRISAT Data.	3.24	0.59
Sesame price (real)	The nominal sesame price divided by all India Consumer Price Index (CPI).	2.64	0.41

Table 1 – continued from previous page

Variables	Description	Mean	SD
Palm Oil border price	Palm Oil World Price*(1+Ad-Valorem Tariff Rate)*Exchange Rate	10.5	0.38
Palm oil border price(real)	Nominal border price deflated by All India CPI	9.9	0.21
Nominal agricultural wage rate	District specific nominal average daily wage rate for the agricultural laborers.	2.46	1.04
Real agricultural wage rate	District specific nominal average daily wage rate for the agricultural laborers deflated by All India CPI	1.86	0.9
Total area under oilseeds cultivation	Total area under oilseeds cultivation (in thousand hectares) at the district level	6.17	0.79
Total oilseeds production	Total oilseeds production (in thousand tonnes) at the district level	6.45	1
Total agri emp	Total number of people employed in agricultural activities	13.31	0.72
Male agri emp	Number of males employed in agricultural activities	12.96	0.71
Female agri emp	Number of females employed in agricultural activities	11.79	1.31
Non-farm emp	Number of people employed in non-farm activities	12.27	0.84
Share of non-farm employment	Share of non-farm sector in total employment	0.28	0.15
Initial oilseeds share	Share of cultivable land belongs to oilseeds production in total agricultural production for each district in 1993-94.	0.13	0.15

Table 1 – continued from previous page

Variables	Description	Mean	SD
Average annual rainfall	District specific average annual rainfall.	7.04	0.59
Total agricultural production	Total production of all crops (in thousand tonnes) at the state level	9.81	0.87
Irrigated	Proportion of villages in a district under irrigation.	0.44	0.3
Consumption	Monthly real per-capita expenditure of the agricultural laborers	5.9	0.35
Literate	Fraction of people in a district who have completed secondary education	0.11	0.07
St/Sc	Fraction of population in a district belongs to scheduled caste, scheduled tribe and other backward classes	0.33	0.17
Bus	Proportion of villages in a district connected by bus	0.48	0.32
Train	Proportion of villages in a district connected by train	0.02	0.02
Paved roads	Proportion of villages in a district connected by paved roads	0.61	0.28
Electrified	Proportion of electrified villages in a district.	0.87	0.19
Composite trade exposure measure	District specific composite tariff measure (employment share weighted average of tariff rates)	0.24	0.15
Cereals	Share of cereals in total cultivable lands for each district in 1993-94.	0.57	0.21
Non-farm 93-94	Share of non-farm sector in total employment in 1993-94	0.22	0.13

Note:-Authors' calculation

Apart from the variables representing shares/proportions and composite trade exposure measure, the summary figures of the remaining variables are expressed in natural logarithm.

Table 2: Price Regression

Variables	ln All Edible Oil Price			
	(1)	(2)	(3)	(4)
$\ln BP_t * S_d$	0.364***	0.322***	0.338***	0.337***
	(0.0731)	(0.0751)	(0.0755)	(0.0763)
Observations	1,285	1,285	1,285	1,285
R-squared	0.786	0.811	0.836	0.836
Number of districts	257	257	257	257
District fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Controls	no	yes	yes	yes
State time trends	no	no	yes	yes
Initial conditions*Time trend	no	no	no	yes

Note:-The dependent variable is domestic price of all edible oils expressed in natural logarithm.
 BP_t stands for the border price of palm oil.
 S_d represents share of cultivable land belongs to oilseeds production at the district level in 1993-94.
Robust standard errors in parentheses.*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Standard errors are clustered by district; regressions are weighted by district' 1991 population

Table 3: Wage Regression

Variables	ln Real Agricultural Wage Rate			
	(1)	(2)	(3)	(4)
$\ln BP_t * S_d$	0.253	0.544*	0.541*	0.486
	(0.287)	(0.319)	(0.326)	(0.325)
Observations	1,285	1,285	1,285	1,285
R-squared	0.158	0.189	0.222	0.235
Number of districts	257	257	257	257
District fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Controls	no	yes	yes	yes
State time trends	no	no	yes	yes
Initial conditions*Time trend	no	no	no	yes

Note:-The dependent variable is real agricultural wage rate expressed in natural logarithm.
 BP_t stands for the border price of palm oil.
 S_d represents share of cultivable land belongs to oilseeds production at the district level in 1993-94.
Robust standard errors in parentheses.*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Standard errors are clustered by district; regressions are weighted by district' 1991 population

Table 4: Other Dependent Variables

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	male agri emp	female agri emp	total agri emp	total non- farm emp	non- farm emp share	per capita con- sump- tion
$\ln BP_t * S_d$	0.0324	-0.667	0.0623	-0.136	-0.019	-0.129
	(0.136)	(0.464)	(0.171)	(0.312)	(0.0583)	(0.167)
Observations	1,285	1,267	1,285	1,284	1,285	1,285
R-squared	0.811	0.355	0.776	0.490	0.486	0.489
Number of districts	257	256	257	257	257	257
District fixed effects	yes	yes	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes
State time trends	yes	yes	yes	yes	yes	yes
Initial conditions*Time trend	yes	yes	yes	yes	yes	yes

Note:-The six dependent variables are male agricultural employment, female agricultural employment, total agricultural employment, total non-farm employment, real per-capita consumption of agricultural laborers (all of them expressed in natural logarithm) and share of non-farm employment in total employment.
 BP_t stands for the border price of palm oil.
 S_d represents share of cultivable land belongs to oilseeds production at the district level in 1993-94.
Robust standard errors in parentheses.*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Standard errors are clustered by district; regressions are weighted by district' 1991 population

Table 5: Area Under Oilseeds Cultivation

Variables	ln Area Under Oilseeds Cultivation			
	(1)	(2)	(3)	(4)
$\ln BP_t * S_d$	0.538**	0.374*	0.367*	0.378*
	(0.216)	(0.225)	(0.216)	(0.213)
Observations	1,271	1,271	1,271	1,271
R-squared	0.115	0.522	0.578	0.589
Number of districts	257	257	257	257
District fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Controls	no	yes	yes	yes
State time trends	no	no	yes	yes
Initial conditions*Time trend	no	no	no	yes

Note:-The dependent variable is area under oilseeds cultivation (in thousand hectares) expressed in natural logarithm.
 BP_t stands for the border price of palm oil.
 S_d represents share of cultivable land belongs to oilseeds production at the district level in 1993-94.
Robust standard errors in parentheses.*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Standard errors are clustered by district; regressions are weighted by district' 1991 population

Table 6: Oilseeds Production

Variables	ln Oilseeds Production			
	(1)	(2)	(3)	(4)
$\ln BP_t * S_d$	1.548***	1.335***	1.353***	1.337***
	(0.399)	(0.379)	(0.392)	(0.394)
Observations	1,265	1,265	1,265	1,265
R-squared	0.048	0.462	0.485	0.489
Number of districts	256	256	256	256
District fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Controls	no	yes	yes	yes
State time trends	no	no	yes	yes
Initial conditions*Time trend	no	no	no	yes

Note:-The dependent variable is oilseeds production (in thousand tonnes) expressed in natural logarithm.

BP_t stands for the border price of palm oil.

S_d represents share of cultivable land belongs to oilseeds production at the district level in 1993-94.

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

Standard errors are clustered by district; regressions are weighted by district' 1991 population

Table 7: Price Regression:Border Price Replaced With the Zero Tariff Import Price

Variables	ln All Edible Oil Price			
	(1)	(2)	(3)	(4)
$\ln WP_t * S_d$	0.323***	0.342***	0.257***	0.258***
Observations	1,285	1,285	1,285	1,285
R-squared	0.787	0.813	0.835	0.836
Number of districts	257	257	257	257
District fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Controls	no	yes	yes	yes
State time trends	no	no	yes	yes
Initial conditions*Time trend	no	no	no	yes

Note:-The dependent variable is the domestic edible oil price expressed in natural logarithm. Instead of the border price, the share of oilseeds is interacted with the zero import tariff price (world price/border price excluding the tariff rate).

WP_t stands for the world price/zero tariff import price

S_d represents share of cultivable land belongs to oilseeds production at the district level in 1993-94.

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

Standard errors are clustered by district; regressions are weighted by district' 1991 population

Table 8: Price Regression:Falsification Test

Variables	ln All Edible Oil Price			
	(1)	(2)	(3)	(4)
$\ln BP_t * Swheat_d$	-0.0818	0.0117	-0.0148	-0.0130
	(0.0758)	(0.0789)	(0.0752)	(0.0755)
Observations	1,285	1,285	1,285	1,285
R-squared	0.781	0.806	0.832	0.832
Number of districts	257	257	257	257
District fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Controls	no	yes	yes	yes
State time trends	no	no	yes	yes
Initial conditions*Time trend	no	no	no	yes

Note:-The dependent variable is domestic price of all edible oils expressed in natural logarithm.
Border price is interacted with the share of cultivable land belongs to wheat cultivation in 1993-94
 BP_t stands for the border price of palm oil.
 $Swheat_d$ represents share of cultivable land belongs to wheat production at the district level in 1993-94.
Robust standard errors in parentheses.*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Standard errors are clustered by district; regressions are weighted by district' 1991 population

Table 9: Price Regression:Border Price of Crude Palm Oil

Variables	ln All Edible Oil Price			
	(1)	(2)	(3)	(4)
$\ln BPCrude_t * S_d$	0.0168	0.104*	0.177***	0.183***
	(0.0615)	(0.0598)	(0.0655)	(0.0666)
Observations	1,285	1,285	1,285	1,285
R-squared	0.780	0.807	0.833	0.834
Number of districts	257	257	257	257
District fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Controls	no	yes	yes	yes
State time trends	no	no	yes	yes
Initial Conditions*Time trend	no	no	no	yes

Note:-The dependent variable is domestic price of all edible oils expressed in natural logarithm.
Instead of the border price of refined palm oil, the share of oilseeds is interacted with the border price of crude palm oil.
 $BPCrude_t$ stands for the border price of crude palm oil.
 S_d represents share of cultivable land belongs to oilseeds production at the district level in 1993-94.
Robust standard errors in parentheses.*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Standard errors are clustered by district; regressions are weighted by district' 1991 population

Table 10: Price Regression: Average of the Border Price of Palm Oil and Soya Oil

Variables	ln All Edible Oil Price			
	(1)	(2)	(3)	(4)
$\ln BPAvg_t * S_d$	0.361***	0.339***	0.356***	0.354***
	(0.0752)	(0.0775)	(0.0784)	(0.0787)
Observations	1,285	1,285	1,285	1,285
R-squared	0.786	0.811	0.836	0.837
Number of districts	257	257	257	257
District fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Controls	no	yes	yes	yes
State time trends	no	no	yes	yes
Initial Conditions*Time trend	no	no	no	yes

Note:-The dependent variable is domestic price of all edible oils expressed in natural logarithm.
The share of oilseeds is interacted with the weighted average of the logarithm of border price of refined palm oil and refined soya oil.
The weights represent the share of palm oil and soya oil in total import value for the initial period i.e., 1993-1994.
 $BPAvg_t$ stands for the average of the border price of refined palm oil and soya oil.
 S_d represents share of cultivable land belongs to oilseeds production at the district level in 1993-94.
Robust standard errors in parentheses.*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Standard errors are clustered by district; regressions are weighted by district' 1991 population

Table 11: Regression: Price of Traditional Edible Oils

Variables	ln Traditional Edible Oil Price			
	(1)	(2)	(3)	(4)
$\ln BP_t * S_d$	0.175**			
	(0.0715)			
$\ln BPCrude_t * S_d$		0.260***		
		(0.0579)		
$\ln WP_t * S_d$			0.322***	
			(0.0639)	
$\ln BP_t * Swheat_d$				0.0919
				(0.0776)
Observations	1,255	1,255	1,255	1,255
R-squared	0.756	0.759	0.762	0.755
Number of districts	257	257	257	257
District fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Controls	yes	yes	yes	yes
State time trends	yes	yes	yes	yes
Initial conditions*Time trend	yes	yes	yes	yes

Note:-The dependent variable is the price of traditional/locally produced edible oils.
The traditional edibles oils used in our analysis are rapeseed-mustard oil, groundnut oil and coconut oil.
 BP_t and $BPCrude_t$ stands for the border price refined and crude of palm oil respectively. WP_t represents world price.
 S_d and $Swheat_d$ represent share of cultivable land belongs to oilseeds and wheat production at the district level in 1993-94.
Robust standard errors in parentheses.*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Standard errors are clustered by district; regressions are weighted by district' 1991 population

APPENDIX

In this section, we consider a simple model of spatial pass-through in the presence of domestic substitutes. The model is a variant of a differentiated product model with linear demand and asymmetric costs (e.g., [Shubik and Levitan \(1980\)](#), [Wang and Zhao \(2007\)](#), [Zimmerman and Carlson \(2010\)](#)). In every district, we assume that there is a single seller of palm oil who receives supplies at the port at a border price of c_1 . The border price is the product of the world price, the ad-valorem tariff and the exchange rate. Every district also contains a seller of the locally produced edible oil. The per unit cost of local oil production is denoted as c_2 . Due to the cheaper availability of oilseeds as inputs, we expect c_2 to be lower in high oilseeds producing regions relative to the cost in low oilseeds producing regions.

In notation, the seller of palm oil is denoted as firm 1 and the producer of local edible oil as firm 2. Similarly, the prices and quantities of palm oil and the local oil are subscripted by 1 and 2 respectively. Demand functions for the two oils are

$$q_1 = a_1 - b_{11}P_1 + b_{12}P_2 \tag{A-1}$$

$$q_2 = a_2 + b_{21}P_1 - b_{22}P_2 \tag{A-2}$$

where P_1 and P_2 are the respective prices. These are linear demand functions with the following parameter restrictions:

$$a_i \geq 0 \ \forall i = 1, 2 \ \text{and} \ b_{ij} \geq 0 \ \forall i, j = 1, 2$$

Using demand functions (A-1) and (A-2), we can write down the profit functions for firm 1 and firm 2 as

$$\pi_1 = (P_1 - c_1)(a_1 - b_{11}P_1 + b_{12}P_2) \tag{A-3}$$

$$\pi_2 = (P_2 - c_2)(a_2 + b_{21}P_1 - b_{22}P_2) \tag{A-4}$$

In Bertrand equilibrium, the first order conditions for profit maximization are

$$\frac{\partial \pi_1}{\partial P_1} = 0 \ \text{and} \ \frac{\partial \pi_2}{\partial P_2} = 0$$

Solving for these first order conditions, we get the equilibrium prices as follows.

$$P_1^* = \frac{2a_1b_{22} + a_2b_{12} + b_{12}c_2b_{22} + 2b_{22}c_1b_{11}}{4b_{11}b_{22} - b_{12}b_{21}} \quad (\text{A-5})$$

$$P_2^* = \frac{2a_2b_{11} + a_1b_{21} + b_{11}c_1b_{21} + 2b_{11}c_2b_{22}}{4b_{11}b_{22} - b_{12}b_{21}} \quad (\text{A-6})$$

For equilibrium to exist with positive prices, the denominator must be positive (i.e. $4b_{11}b_{22} - b_{12}b_{21} \geq 0$). This condition is satisfied whenever own price effects are greater than cross-price effects. The pass-through of palm oil border price c_1 to the price of local oil P_2 is given by

$$\frac{\partial \ln P_2^*}{\partial \ln c_1} = \frac{b_{11}b_{21}}{4b_{22}b_{11} - b_{12}b_{21}} \frac{c_1}{P_2^*}$$

The pass-through elasticity is positive. Furthermore, we can consider how this elasticity varies with the marginal cost of producing edible oil, i.e., c_2 . This is given by

$$\frac{\partial^2 \ln P_2^*}{\partial \ln c_1 \partial c_2} = -\frac{b_{11}b_{21}}{4b_{22}b_{11} - b_{12}b_{21}} \frac{c_1}{(P_2^*)^2} \frac{\partial P_2^*}{\partial c_2} \quad (\text{A-7})$$

(A-7) is negative as $\frac{\partial P_2^*}{\partial c_2} \geq 0$ (this follows from (A-6)). Hence the prediction that the pass-through elasticity of the local edible oil is greater in regions with lower costs. If we suppose that the marginal costs of producing edible oil are lower in areas that produce more edible oilseeds - the principal input - then we obtain the corollary that the pass-through of the palm oil border price to locally produced oils is greater in regions that produce more oilseeds. The reason is quite straightforward. Price of both palm oil and local edible oil increases with c_2 . Therefore more price elastic/price sensitive consumers are located where c_2 is higher and naturally that reduces the pass-through rate.

It can also be shown that

$$\frac{\partial^2 \ln P_1^*}{\partial \ln c_1 \partial c_2} = -\frac{2b_{22}b_{11}}{4b_{22}b_{11} - b_{12}b_{21}} \frac{c_1}{(P_1^*)^2} \frac{\partial P_1^*}{\partial c_2} \quad (\text{A-8})$$

(A-8) is also negative. The pass-through of palm oil border price to its own local price is also greater where the competing domestically produced oil has lower costs.

Appendix Tables

Table A.1: World Prices of Different Types of Edible Oils(US \$/Metric Ton)

Year	Groundnut Oil	Palm Oil	Soybean Oil
1993-94	881	453	548
1999-2000	751	373	383
2004-05	1111	447	580
2007-08	1742	864	1070
2011-12	2212	1062	1263

Source:-World Bank Commodity Price Data

Table A.2: Oilseeds Price Regression:Rapeseed-Mustard

Variables	ln Rapeseed-Mustard Price			
	(1)	(2)	(3)	(4)
$\ln BP_t * S_d$	0.776***	0.822***	0.873***	0.859***
	(0.193)	(0.209)	(0.225)	(0.220)
Observations	557	557	557	557
R-squared	0.599	0.618	0.639	0.640
Number of districts	157	157	157	157
District fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Controls	no	yes	yes	yes
Sate time trends	no	no	yes	yes
Initial conditions*Time trend	no	no	no	yes

Note:-The dependent variable is domestic price of rapeseed-mustard expressed in natural logarithm.
 BP_t stands for the border price of palm oil.
 S_d represents share of cultivable land belongs to oilseeds production at the district level in 1993-94.
Robust standard errors in parentheses.*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Standard errors are clustered by district; regressions are weighted by district' 1991 population

Table A.3: Oilseeds Price Regression:Sesame

Variables	ln Sesame Price			
	(1)	(2)	(3)	(4)
$\ln BP_t * S_d$	0.611***	0.588**	0.435**	0.434**
	(0.207)	(0.240)	(0.208)	(0.209)
Observations	739	739	739	739
R-squared	0.241	0.284	0.805	0.805
Number of districts	198	198	198	198
District fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Controls	no	yes	yes	yes
Sate time trends	no	no	yes	yes
Initial conditions*Time trend	no	no	no	yes

Note:-The dependent variable is domestic price of sesame expressed in natural logarithm.

BP_t stands for the border price of palm oil.

S_d represents share of cultivable land belongs to oilseeds production at the district level in 1993-94.

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

Standard errors are clustered by district; regressions are weighted by district' 1991 population

Table A.4: Oilseeds Price Regression:Groundnut

Variables	ln Groundnut Price			
	(1)	(2)	(3)	(4)
$\ln BP_t * S_d$	0.0238	0.0689	0.103	0.112
	(0.111)	(0.123)	(0.122)	(0.122)
Observations	685	685	685	685
R-squared	0.473	0.534	0.605	0.609
Number of districts	179	179	179	179
District fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Controls	no	yes	yes	yes
Sate time trends	no	no	yes	yes
Initial conditions*Time trend	no	no	no	yes

Note:-The dependent variable is domestic price of groundnut expressed in natural logarithm.

BP_t stands for the border price of palm oil.

S_d represents share of cultivable land belongs to oilseeds production at the district level in 1993-94.

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

Standard errors are clustered by district; regressions are weighted by district' 1991 population