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Welfare Effects of Preferential Trade under
Heterogeneity and Imperfections: Theory and
Evidence *

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30 May, 2026

Abstract

We study wage and welfare effects of preferential trade under heterogeneous firms and labour market imperfections, both empirically and theoretically. Using data from the Consumer Pyramids Household Survey (CPHS) and the UK-India Generalised System of Preferences (GSP) observed over the period 2014-2019, we show that trade exposure through GSP graduation reduces household wage income but increases business profit income and overall income. We then examine potential welfare effects theoretically in a generalised oligopoly equilibrium model with labour and product market imperfections and heterogeneous firms. We find that trade-induced joint effects of market size and competition do not reduce union wage. However, specialisation arising from heterogeneous productivity distribution across trading partners disincentivises labour-intensive firms and hence unambiguously dampens wages. The drop in union wage reduces price and their volatility, reinforcing welfare gains. The welfare gain increases with competition and differences in productivity across trading partners.

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1 Introduction

Preferential trade has played a major role in international development policies of countries for decades. The practice of allowing market access to developing economies through a system of trade preferences in order to encourage economic development has been common and widespread. The UK and the EU's Generalised System of Preferences (GSP), the UK's Developing Country Trading Scheme (DCTS), and the US's African Growth and Opportunity Act (AGOA) are examples of such policies.

In recent years, such policies, in particular, and trade liberalisation in general, have come under increased scrutiny from both facilitators and beneficiaries. The political discourse in the facilitator countries has changed from benevolence and a strong commitment to free trade to protectionism.¹ Scholars analysing labour market impact on beneficiary countries have also questioned the premise that trade unambiguously improved wages and employment in these countries (Delesalle et al., 2025).

Despite increasing interest in trade liberalisation and trade preferences, the welfare effects of these policies in developing economies with firm heterogeneity and labor market imperfections are not well understood. In this paper, we empirically and theoretically explore the welfare and wage effects of trade preferences in a developing economy characterised by unionised labour, heterogeneous firm productivity, and significant frictions to labour migration across firms. To empirically motivate the question of trade preferences, we focus on the GSP for UK-India trade over the period 2014-2019. Note that the 2014-2019 period coincides with two rounds of India's sectoral graduations from the GSP in 2014 and 2017. Using individual-level information across households from the Consumer Pyramids Household Survey (CPHS), we compute a UK-India trade exposure measure at the district level. In particular, we aggregate labour supply at the district level by sector and years. We then compute the share of this district-sector-year labour supply to the aggregate labour supply. This is then multiplied by the share of exports to the UK from India in this sector to derive district-sector-year level UK-India trade exposure. We regress the trade exposure measure on household per capita wage income, total income, and business profit income, respectively, after controlling for household and year fixed effects. We find that GSP graduation linked trade exposure has an unambiguously negative effect on wage income, with the effect predominantly driven by urban households.

We then explore the theoretical underpinnings behind this empirical pattern in a generalised oligopolistic general equilibrium model. Building on Neary (2016) and Maiti (2024), we assume that firms in each sector, arranged in the continuum of productivity, face a union that counts as 'right-to-manage'². Each sector is characterised by a fixed

¹See Woolcock (2026) for an analysis of how American trade diplomacy has changed under Donald Trump - LSE Business Review.

²Right-to-manage (RTM) is a framework used in trade theory and labour economics to analyse bar-

number of competing firms to accommodate strategic competition. Trade increases competition between rivals as well as the size of the market for domestic firms. The joint effect of competition and market size depends on whether the labour market is unionised. If the joint effect increases production, then labour demand increases. Under unionised labour, the bargaining power of the workers increases, thereby increasing the union wage. However, union wage tends to fall if the joint effect in response to trade preferences and market integration is labour saving. The level of comparative advantage and specialisation under heterogeneous productivity leads to the expansion of the most productive firms. This unambiguously reduces labour demand and wage income. The fall in union wages unambiguously reduces product price levels and their volatility, thereby ensuring welfare gains.

Our paper is close to Kreickemeier and Meland (2013), Neary (2016), and Maiti (2024) to the extent that it investigates whether trade leads to welfare gains in an imperfect labour-market environment using a generalised oligopolistic framework. Neary (2016) approaches this question without union labour and finds that the specialisation effect could not dominate the joint effect of competition and market size, and therefore wages increase. Despite wage increase, welfare can still improve, conditional on the relative strength of the specialisation effect. Kreickemeier and Meland (2013) consider unionised labour but in a segmented market with an exogenous set of non-traded goods and find that trade cost reductions in open sectors unambiguously lead to higher union wages and lower aggregate welfare. Maiti (2024) shows that the union wages unambiguously fall, thereby reducing prices, but does not show the implications on welfare. Neary (2016) ignores labour market imperfections, whereas Kreickemeier and Meland (2013) consider them, but in the context of segmented markets and homogeneous productivity distribution of firms between trading partners. In contrast, in this paper, we are able to accommodate unionised labour, product-market heterogeneity, and firm heterogeneity to study the wage and welfare implications of trade liberalisation. To the best of our knowledge, this is entirely new. Furthermore, we can test the impact of GSP graduations in the context of UK-India trade on household wage income, overall income, and business profit income using high-frequency, longitudinal household data from India, which is entirely new.

Classical trade theory by and large demonstrate gains from trade induced by comparative advantage under perfect competition (Dornbusch et al., 1977). This literature ignores the role of strategic competition in product and factor markets with imperfections. New trade theory literature, in contrast, integrates returns to scale, monopolistically competitive product markets, and competitive labour market but abstracts away from

gaining between unions and firms regarding employment and wages. Under this framework, the firms retain the unilateral right to make employment decisions.

specialisation under homogeneous or heterogeneous distributions of firms in generating lower prices and gains from trade (Krugman, 1980; Melitz and Redding, 2014). The generalised oligopolistic framework adopted here incorporates heterogeneous firms, market imperfections, and unionised labour to demonstrate the welfare effects of competition, market size, and specialisation within one model.

Our paper is related to the empirical literature on labour market effects of trade in developed and developing countries. The wage effect of trade reported by this literature can be classified as mixed, with several but not all studies revealing an overall negative effect. For example, using data for the period 1983 to 2000 from India, Dutta (2007) shows that workers employed in industries with high tariff protection receive higher wages relative to identical workers in low tariff protection industries. In contrast, Feenstra (2007) reports substantial improvement in wage earnings in the USA and Canada during the 1980s and 1990s following tariff reduction. Cragg and Epelbaum (1996) observe rapid growth in skilled wages in Mexico due to the tariff reduction in the 1990s. In a study of 89 developed and developing countries observed over the period 1970 to 2009, Guerriero and Sen (2012) find that trade openness, along with technological innovation, has a positive and significant impact on the share of labour income. Gibson (2019), however, reports a decline in the share of wage income in the US over the period 1960-2015.

Theoretical predictions of the welfare effects of international trade are mainly based on perfect and monopolistic competition. However, a body of literature close to our paper documents that firms enjoy some market power and that productivity varies across firms. There has been growing evidence in this regard. Using disaggregated country-level data from 43 countries, De Loecker and Eeckhout (2018) find that in 2016, the average markup exceeds 1 in all countries. In particular, it ranges from 2.84 in Denmark to 1.19 in Portugal. Furthermore, they report that markup increased steadily in most nations during the last two decades. Using a different dataset, Weche John et al. (2021) and Calligaris et al. (2017) also find similar results. Diez et al. (2018) using data from publicly listed firms across 33 advanced economies, find that corporate market power increased steadily since the 1980s. They also find that the pace of this increase accelerated since the mid-2000s, largely driven by a relatively small number of “superstar” firms in the upper tail of the distribution. Needless to say, perfectly competitive or monopolistically competitive market structures in standard trade models cannot explain the results mentioned above. A generalised oligopolistic framework with heterogeneous firms and labour-market imperfections, as presented in this paper, is better suited to explain the empirical results mentioned above.

Finally, our paper also relates to the literature on bargaining power of workers under trade. For example, Dumont et al. (2006) report presence of significant bargaining power of workers in five European countries. Besley and Burgess (2004) and Maiti and

Neogi (2024) show that manufacturing workers in India have significant bargaining power, though declining. Abraham et al. (2009) estimate union bargaining power in Belgian firms to be approximately 0.2-0.3. Using a similar methodology, Maiti (2014) reports union bargaining power to vary between 0.1 and 0.5 in the organised sector of Indian manufacturing.

Other notable studies of market power effects of trade are Melitz and Ottaviano (2008), Arkolakis et al. (2012), Restuccia and Rogerson (2008), Hsieh and Klenow (2009), and Edmond et al. (2015), mainly using the monopolistically competitive markets. Brander and Spencer (1988), Huizinga (1993) and Sørensen (1993) focus on the effects of unionisation on the gains from trade under strategic competition. In contrast, Yeaple (2005), Davidson et al. (2014), and Amiti and Konings (2007) focus on the effects of the composition of the workforce, search and matching frictions, and the efficiency wage on the gains from trade, respectively. However, none of these studies consider trade effects of welfare under strategic competition among heterogeneous firms and labour market imperfections.

The remainder of the paper is organised as follows. Section 2 empirically motivates the question of welfare and wage effects of preferential trade. In doing so, it presents the data, discusses descriptive statistics and measurement of trade exposure at the district level, introduces estimation method and evidence. Section 3 presents the theoretical model. Sections 4 and 5 introduces labour market and product price effects and presents welfare effects. Section 7 calibrates the model and computationally derives welfare effects. Section 8 concludes.

2 UK-India Preferential Trade: Empirical Patterns

The UK exited the EU on 31 January 2020. Prior to the exit, UK was following the EU's GSP in its trade with India. Therefore, our sample period of 2014-2019 sits within the timeframe when the UK was still an EU member state. Our intention is to map the effect of preferential trade exposure with the UK on welfare in India, measured by household income per capita. We are also interested in mapping the effects of GSP linked trade exposure on household income per capita from wages, business profits and self-production. We can construct a district-sector-year-level trade exposure measure and relate it to household total income, wage income, and business profit income. Given that our sample period coincides with two rounds of India's sectoral graduations from GSP in 2014 and 2017, we are able to distinguish between patterns involving graduated sectors, and those involving non-graduated sectors. Furthermore, we are also able to map heterogeneous patterns by household location (rural – urban) and income distribution. Appendix A1 – A5 also presents details on concordance across datasets, which we discuss below. An earlier working paper version of this detailed empirical work is available as

Saha (2025). In what follows, we carefully illustrate our data, data concordance, and any adjustments made. We discuss empirical strategy and present results.

2.1 Data

Household and trade exposure data are two core elements of our empirical strategy. Household data is sourced from the Consumer Pyramids Household Survey (CPHS) of the Centre for Monitoring Indian Economy (CMIE). CPHS is a large-scale, nationally representative longitudinal survey that includes granular information on employment, income, expenditure, asset ownership, demography and beliefs. It was initiated in 2014 and provides monthly data on households and individuals. Surveys are conducted 3 times annually, and the respondents are asked to recall information on the above-mentioned variables for the last 4 months. The survey covers 95 per cent of India’s population across 28 States and uses a consistent stratified random sampling methodology across rounds to ensure representativeness. Despite its advantages, CPHS also has methodological and design limitations, as discussed by Somanchi (2021) and Sinha Roy and Van Der Weide (2022).

For the purpose of this study, we use total income per capita, wage income per capita, and business profit and self-production income per capita of households from CPHS as proxies of welfare. Furthermore, our sample includes only those 139,937 households that have participated in the survey for at least three years and across the two waves of graduation (2014–16 and 2017–19). Working members of a household are defined as those aged 15 and above. Finally, CPHS also records household characteristics, which we use as control variables. Control variables are described below, following the introduction of the estimation equation.

The other core element of empirical strategy is the construction of the district-sector-time level trade exposure variable. To this effect, export data are sourced from Comtrade at the HS two-digit level and are harmonized with the CPHS industry classification. We conduct mapping of both graduated and non-graduated sectors from Comtrade HS two digit to a specific CPHS category. A full record of this mapping exercise is presented in Appendix A1 to A5.

District-sector-year level trade exposure with the UK accounts for both graduated and non-graduated sectors for the period 2014 to 2019. Using concordance between Comtrade HS two digit codes and CPHS as reported in Appendix A3, we are able to compute aggregate labour supply at the district-sector level and weight them by the sector’s share of exports to the UK. The trade exposure measure is computed using the following formula.

$$TE_{dit} = \frac{Workers_{dit}}{Total\ Worker\ Population_{dt}} \times \frac{Export\ UK_{it}}{Export\ World_{it}}$$

where TE_{dit} is trade exposure in district d , sector i , and year t ; $Workers_{dit}$ is workers working in district d , sector i , and year t ; $TotalWorkerPopulation_{dt}$ is total working age population in district d and year t ; $ExportUK_{it}$ is Indian exports to the UK in sector i and year t ; and $ExportWorld_{it}$ is Indian exports to the world in sector i and year t . Note that sector i could be either a graduated or a non-graduated sector.

We find that trade exposure to the UK declined over the period 2014 to 2019. However, the decline in the non-graduated sectors (agriculture, jewellery, home décor, and others) is much sharper than that in the graduated sectors (precious metals, iron and steel, automobiles, leather, chemicals, mineral products, and others). Figure 1 presents a map of district-level trade exposure over the two graduation periods, 2014-16 and 2017-19. Predictably, districts within more industrialised and mining states such as Tamil Nadu, Gujarat, Goa, Delhi, Telangana, Chandigarh, and Chhattisgarh exhibit greater trade exposure relative to districts within less industrialised states such as Assam, Odisha, and Uttarakhand.

2.2 Empirical Strategy

We estimate the following reduced-form model to map patterns in the data relating trade exposure to indicators of household welfare, measured by per capita total income, per capita wage income, and per capita business profit and self-production income. All key variables are measured on a log scale, and therefore, the estimated coefficients could be interpreted as elasticities. The baseline model that controls for household and year fixed effects takes the form as below.

$$\ln(Y)_{hdit} = \alpha_h + \beta_t + \gamma_1 \ln(TE)_{dit} + \Gamma X_h t + \varepsilon_{ht} \quad (2)$$

where $\ln(Y)_{hdit}$ is natural log of welfare in household h , district d , sector i , and year t ; $\ln(TE)_{dit}$ is natural log of trade exposure in district d , sector i , and year t ; and X is a vector of household characteristics (that includes age of household head, female household head dummy, household head with no education dummy, household size, proportion of young, household bank account dummy, number of non-working household members, number of household working members in services, and number of household working members in agriculture). Coefficient γ_1 captures the relationship between trade exposure and household welfare. Also note that α_h and β_t represents household specific unobservables and time varying common shocks respectively.

Note that our intention here is to map empirical patterns between the key variables of trade, welfare, and wage income. Therefore, we make no claim of empirically establishing causality, although we do control for potential covariates and confounding factors.

2.3 Empirical Patterns

Table 1 presents estimation results using the full sample based on the baseline model as presented in equation (2). Panel A reports effects on total income per capita. In column 1, we find that the estimated elasticity of trade exposure to total per capita income is positive and statistically significant. A percentage point increase in trade exposure leads to 0.3 percent increase in household total income per capita. To put this into perspective, a one percentage point increase in trade exposure is equivalent to 0.03 in terms of trade exposure. This is still a small increase, well within the low exposure range of 0 to 0.7 (see Figure 1). A 0.3 percent increase in household per capita income approximately translates into 6 dollars and 20 cents, assuming the annual per capita income in India to be 2,053 US dollars. This is undoubtedly a significant effect for a poor household, assuming their income is 1 per day. Under that assumption, an increase of 6 dollars and 20 cents would account for 1.7 percent of the dollar-a-day poverty line. In column 2 of panel A, we examine potential distributional heterogeneity using quantile regression. We find that the positive association is primarily driven by households in the upper 50 percent of the income distribution.

Panel B of table 1 examines the association between trade exposure and wage income. We find that the association with wage income is unambiguously negative. The estimated coefficient is reported to be almost 5 times bigger than the coefficient reported in panel A, column 1. In column 2 panel B, we again report heterogeneity of this coefficient by income. We find that the negative wage effect is driven by the bottom 50 percent of the income distribution. The effect on the top end of the distribution appears to be positive. Finally, in panel C we correlate trade exposure with profit and self-production income and find that the estimated coefficient is positive. The overall effect and effects by quantile are also presented in Figure 2.

Table 2 examines association between trade exposure and the three indicators of household welfare by dividing the sample into graduated and non-graduated sectors. Results are also presented diagrammatically in Figure 3. Figure 3 reveals that the nature of effects on total income per capita is largely similar across graduated and non-graduated sectors. Despite a similar distribution of the wage effect across quintiles, Figure 3 shows that the effect is negative in all quintiles in the graduated sectors. In contrast, for the non-graduated sectors, it is only the lower quintiles that experience negative wage effects. This indicates that the negative effect of trade exposure on wage income is linked to GSP graduation, not trade exposure per se. Finally, the effect on business profit for both

graduated and non-graduated sectors appear to be positive.

Table 3 examines the association between trade exposure and welfare by dividing the sample into rural and urban. It is expected that urban households are likely to be more trade-exposed than their rural counterparts. We find, in column 1 and panels A and B, that trade exposure has a negative effect on total income and wage income for the urban sample. There is some degree of heterogeneity in the effects across quintiles, which is also reported in Figure 4.

3 The Model

In order to structurally explore the mechanism behind empirical patterns reported in section 2, we build a generalised oligopolistic general equilibrium model with product and labour market imperfections. The model computes welfare gains and captures effects of specialisation, market size, and competition. We assume that consumers have a 'continuum-Pollak' preference over goods produced in a sector, denoted by z , ranging from 0 to 1 by productivity. A fixed number of firms, n , within each sector produce homogeneous goods. In other words, there is restricted entry in each sector. This allows rival firms to retaliate against a positive surplus, and the labour union has scope to bargain for a share of it. The utility function of a representative consumer can be represented as follows:

$$U[x(z)] = \int_0^1 u(x(z))dz \quad (3)$$

where $u(x(z)) = ax(z) - \frac{1}{2}bx(z)^2$.

One can derive the 'Frisch' demand function that accommodates strategic competition of oligopolistic characteristics in general equilibrium. In every z th sector, a fixed, limited number of firms compete strategically to endogenously find an equilibrium price, $p(z)$, through Cournot competition. Note that this takes the marginal utility of income as given. The prices of all sectors endogenously determine the marginal utility of money, effectively serving as the basis for the 'perceived' and 'actual' demand functions in the general equilibrium framework. In the presence of the Lagrangian multiplier λ and income I , the inverse and direct demand functions are derived as follows:

$$p(z) = \frac{1}{\lambda}[a - bx(z)]; x(z) = \frac{1}{b}[a - \lambda p(z)] \quad (4)$$

Integrating the direct demand function, we can solve for the value of λ , the marginal utility of money.

$$\lambda = \frac{a\mu_1^p - bI}{\mu_2^p} \quad (5)$$

where I represents income. The following two terms capture the effect of price on λ :

$$\mu_1^p = \int_0^1 p(z)dz; \mu_2^p = \int_0^1 p(z)^2 dz \quad (6)$$

This expression suggests that a rise in income, uncentered price variation, and a fall in the average prices lead to a drop in the marginal utility of money. This derivation endogenises the income effect. Here, λ is chosen as the numeraire.

The indirect utility function can express the equivalent variation of the change in welfare. Neary (2016) found the following expression for The Frisch indirect utility function

$$V^F[\lambda, p(z)] = \int_0^1 x(z)[a - \frac{1}{2}b(z)]dz = \frac{1}{2b}(a^2 - \lambda^2 \mu_2^p) \quad (7)$$

where, $\mu_2^p \equiv \int_0^1 p(z)^2 dz$

$$\tilde{U} = -\lambda^2 \mu_2^p \quad (8)$$

Where, $\tilde{U} = 2bV^F - a^2$

This implies that utility is a negative product of the squared marginal utility of income and the second moment of prices. So, if the second moments for the two regimes, before and after trade, are estimated, we can derive welfare changes. However, the price and its variation across sectors depend on the condition of the labour market, which we explore next.

4 Labour Market and Product Prices

4.1 Autarky

We specify market conditions in order to solve for wage. There are n firms producing similar goods in the z th sector. Each has an exogenously fixed labour requirement per unit of output, denoted by $\alpha(z)$ in the domestic economy. If each product produces $y(z)$ and w is the wage paid to workers (where $x(z) = ny(z)$), then using the demand function a representative firm's profit in the sector can be expressed as follows:

$$\pi(z) = p(z)y(z) - w\alpha(z)y(z) \quad (9)$$

Assuming $\acute{a} = a/\lambda$ and $\acute{b} = b/\lambda$, we find the sectoral output and price as follows:

$$x(z) = ny(z) = n \frac{\acute{a} - w\alpha(z)}{\acute{b}(n+1)}; p(z) = \frac{\acute{a} + nw\alpha(z)}{n+1} \quad (10)$$

Note that sectoral outputs are inversely related to the wage rate. Moreover, the higher the labour requirements, the lower the productivity and sectoral output. There must be

sectors where labour requirements are so high that firms are unprofitable. Then, those inefficient firms cannot survive in the market. However, prices are the same for all firms within a sector and are positively related to the wage rate. The prices are higher for less productive firms (or those with higher labour requirements).

Substituting the equilibrium output and price, the aggregate profit of firms can be expressed as follows:

$$\Pi = \int_0^1 n\pi(z)dz = b(y(z))^2 \quad (11)$$

Where $\pi(z) = [p(z) - w\alpha(z)]y(z)$ is the profit of an individual firm. Therefore, output is increasing in the sectoral profit. Thus, it is suggestive that wage formation plays a detrimental role in determining prices, output, and profit levels. The degree of labour market imperfection gives rise to the differential outcomes under autarky and trade.

Now, assume that the workers participate in a union that collects dues from all sectors and seeks to extract rent from the surplus. When the market expands, the demand for workers increase, and the union negotiates for a higher rent. For simplicity, we assume the workers have a utility function that counts 'right-to-manage' the production. The union maximises the wage rent with an outside option of working in the informal sector or minimum social security available to unemployed workers at a wage of w_0 . Then, the union's utility function can be expressed as follows:

$$H_a = (w - w_0) \int_0^1 \alpha(z)ny(z)dz \quad (12)$$

This expression suggests that the utility of the union increases directly with employment and with its rent. Note that Neary (2016) does not consider labour market rigidity and assume all workers are employed. The issue of unemployment and the informal sector is entirely new to the literature, which we consider here. Maximising this with respect to wage (w), we find the equilibrium union wage under autarky as follows:

$$w_a \equiv (\lambda w)_a = \frac{1}{2} \left(\frac{a\mu_1}{\mu_2} + \lambda w_0 \right) \quad (13)$$

where μ_1 and μ_2 present the first and second moments of the technology distribution in the domestic economy, $\mu_1 = \int_0^1 \alpha(z)dz$ and $\mu_2 = \int_0^1 \alpha(z)^2 dz$.

The wage rent is directly related to the total labour requirement per unit of production or is inversely associated with the average level of productivity. Furthermore, this is also inversely related to the extent of the productivity distribution. Note that if the productivity variation across sectors is high, the less productive firms tend to survive. Workers in lower-productivity firms can only negotiate a little. On the other hand, productive firms do not demand much labour. The combined force of these together pulls down the union wage. This is different from Neary (2016)'s formulation in the

absence of a union. The number of rival firms in each sector does not directly affect the wage rate unless it affects average productivity. The union serves as a monopsonist in the labour market, and the equilibrium wage is higher than the outside wage.

Substituting the value of w_a , we find the sectoral outputs and prices as follows:

$$x_a(z) = \frac{n}{b(n+1)}[(a - \alpha(z)w_a] \quad (14)$$

$$p_a(z) = \frac{1}{(n+1)}[(a + n\alpha(z)w_a] \quad (15)$$

It is apparent from above that higher wage increases prices and reduces production. Multiplying labour requirements by sectoral output yields employment at the sectoral level. Integrating sectoral output yields total employment as follows:

$$L_a = \frac{n}{b(n+1)}[a\mu_1 - w_a\mu_2] = \frac{n}{2b(n+1)}[a\mu_1 - \lambda\mu_2w_0] \quad (16)$$

Employment falls with higher union wages. Moreover, it increases the first moment of the technological distribution, which is negatively related to the second moment. With the rise of the first moment, the demand for labour rises. Higher dispersion of technology, in the presence of both highly productive and low-productive firms, reduces labour demand and shrinks employment levels. Wage is increasing in the outside option and employment is decreasing in the same.

4.2 Trade

As market size expands due to trade, competition increases and thereby affecting wages and factor share. Cournot competition ensues between domestic and foreign firms in each sector. Under free trade, each firm faces an increased demand (market size effect) and a higher number of competitors (competition effect). The combination of these two forces determines the impact on wages and labour share. Moreover, comparative advantage and specialisation arising from differences in productivity distribution between the two countries play an important role. Since highly productive firms demand fewer workers, comparative advantage induced specialisation leads to differential labour market outcomes.

Under free trade, the aggregate demand faced by each firm would be a sum of demand functions observed in the two countries at an internationally determined sectoral market price $p(z)$ and a common marginal price b . If $x^*(z) = \frac{1}{b}(a^* - \lambda^*p(z))$, then the aggregate demand would be:

$$\bar{x}(z) \equiv x(z) + x^*(z) = \frac{\lambda + \lambda^*}{b} \left(\frac{a + a^*}{\lambda + \lambda^*} - p(z) \right) \quad (17)$$

The aggregate demand function can be expressed as $p(z) = \left(\frac{a+a^*}{\lambda+\lambda^*}\right) - \frac{b}{\lambda+\lambda^*}\bar{x}(z)$. Note that the slope of the perceived demand curve has fallen from $\frac{b}{\lambda}$ to $\frac{b}{\lambda+\lambda^*}$. Moreover, $\bar{x}(z)$ is much bigger now than $x(z)$ observed under autarky. This allows foreign competitors to enter the domestic market. These two changes affect market price and, in turn, influence the labour market. However, not all foreign firms can compete effectively with domestic firms. Thus, it is essential to determine the productivity level that differentiates firm specialisation or competition across the continuum of sectors.

Sectoral specialisation depends on labour costs per product, as in the Ricardian definition of comparative advantage. The marginal cost of labour in a sector depends on labour requirement ($\alpha(z)$) and wage after trade (w_T^*). Since labour requirements are assumed to be sector-specific, the degree of specialisation would depend on the distribution of technologies and on how the market wage is determined endogenously. There are no other costs for trade and transportation of goods. The fixed labour requirements per unit of output are denoted by $\alpha(z)$ and $\alpha^*(z)$, respectively, in domestic and foreign countries. We further assume that goods are ordered so that the home country is more efficient in producing goods at lower values of z and the foreign country is more efficient in producing goods at higher values of z . Similarly to Dornbusch et al. (1977), we assume that the ratio $\frac{\alpha(z)}{\alpha^*(z)}$ rises in z . These specifications help us define the specialisation range across sectors and countries.

We divide the sectors into specialisation and competition, influenced by marginal labour costs in the home and foreign countries, determined by market conditions and union presence. Labour requirements per unit of output ($\alpha(z)$ and $\alpha^*(z)$), number of firms (n and n^*) and wage (w and w^*) engaged in the z th sector are given, respectively, in both domestic and foreign economies. Then, we can solve for equilibrium outputs and the international market price for each sector using Cournot competition. The equilibrium outputs of the representative firm in the z th sector in the domestic and foreign economies are:

$$y_T(z) = \frac{\acute{a} - (n^* + 1)w\alpha(z) + n^*w^*\alpha^*(z)}{\acute{b}(n + n^* + 1)} \quad (18)$$

$$y_T^*(z) = \frac{\acute{a} - (n + 1)w^*\alpha^*(z) + nw\alpha(z)}{\acute{b}(n + n^* + 1)} \quad (19)$$

Note that the sectoral output of domestic firms is inversely related to their own labour cost and directly related to their rival cost. These taken together give us the total marketed output, $\bar{x}_T = ny_T(z) + n^*y_T^*(z)$. The equilibrium market price is:

$$p_T^*(z) = \frac{\acute{a} + nw\alpha(z) + n^*w^*\alpha^*(z)}{n + n^* + 1} \quad (20)$$

Given equilibrium output and market price, sectoral level profits in domestic and foreign countries are derived as $\Pi_T(z) = n(y_T(z))^2$ and $\Pi_T^*(z) = n^*(y_T^*(z))^2$. These specifications

suggest that the market price is higher when labour costs are high in a particular sector, due to higher wages or inferior technology. Hence, both the sector output and profit must be lower. In this case, the sectors with better technology would enjoy a comparative advantage over the others.

To determine the range of sectors for specialisation and competition between countries, we identify a borderline sector that survives at zero profit in both domestic and foreign markets. Such critical sectors can be identified from their respective profit expressions. We plot the marginal cost of domestic firms against that of foreign firms (Figure 5). In the plane, foreign firms gradually lose comparative advantage along the horizontal axis, whereas domestic firms lose the same along the vertical axis. However, both types of firms are equally competitive along the 45-degree line. We first plot the threshold level of the sector that survives in the plane in terms of marginal cost ($w\alpha(z)$) for the domestic firm against ($w^*\alpha^*(z)$) of the foreign firms. We then derive the loci of the threshold marginal cost of the domestic firm in the sector, z , relative to that of foreign rivals, where the domestic firm's profit becomes zero (along with CC in Figure 5). We find,

$$w\alpha(z)|_{\Pi(z)=0} = \frac{\acute{a}}{n^* + 1} + \frac{n^*}{n^* + 1}w^*\alpha^*(z) \quad (21)$$

Note that the CC line originates from a positive intercept on the axis of the marginal cost of domestic firms and then rises gradually with a positive slope of more than one, along with the marginal cost of a foreign firm. Domestic firms cannot produce and survive in the market for any sector z with a marginal cost higher than the CC locus. Since the ratio of $\alpha(z)/\alpha^*(z)$ is higher above the locus, foreign firms prefer to produce in this region (say F). In this region of z , the foreign firm would completely specialise. If this critical z along the locus CC is defined by \tilde{z} , then the foreign country specialises in the sectors within the range, $\tilde{z} > z > 1$.

Similarly, there could be sectors with a lower range of z in which foreign firms cannot survive, but domestic firms can. This threshold z with domestic marginal cost versus that of the foreign firm can be drawn from the foreign firm's profit expressions, which is represented as follows (along with the locus C^*C^*):

$$w\alpha(z)|_{\Pi^*(z)=0} = -\frac{\acute{a}}{n} + \frac{n+1}{n}w^*\alpha^*(z) \quad (22)$$

This condition is satisfied along the line C^*C^* , originating at a negative marginal cost of the domestic firm (on the vertical line). Then it increases monotonically with a slope of less than one. Since the negative value of marginal cost has no meaning, we ignore the range until it turns zero (cut on the horizontal axis). Moreover, this locus is rising faster than CC because $\frac{\partial w\alpha(z)}{\partial w^*\alpha^*(z)}|_{\Pi^*(z)=0} > \frac{\partial w\alpha(z)}{\partial w^*\alpha^*(z)}|_{\Pi(z)=0}$. It should also be noted that foreign companies become unprofitable for any z having a marginal cost lower than the level at the C^*C^* locus. However, the domestic firms in those sectors are still profitable

due to their lower marginal cost or higher productivity in this region. Suppose that the threshold value of z attached to the locus C^*C^* is defined by \tilde{z}^* . In that case, the domestic economy specialises in the range, $0 < z < \tilde{z}^*$, shown in the region H. Within the region between two lines, CC and C^*C^* , both foreign and domestic firms compete in each sector. This falls within the range, $\tilde{z}^* < z < \tilde{z}$. There is Cournot competition between n domestic and n^* foreign firms in each sector.

The ranges between competition and specialisation discussed above depend on the marginal labour costs in the respective economies. It suggests that the degree of competition lies in the technology gap and the conditions of the product and labour markets that determine marginal costs. The firms in the sector, z representing the 45-degree line, have identical marginal costs because they use the same technologies in both countries. Then, the effects of market size and competition jointly determine the wages. For any other sector where technologies differ between countries, the degree of comparative advantage plays an additional role. Both countries are assumed to be almost identical to investigate the combined effects of the three forces on the factor income.

For simplicity and without loss of generality, assuming that both countries are symmetric but differ only in the productivity distribution we get the same labour force, $L = L^*$; similar tastes, $a = \hat{a}$; same industrial structure, $n = n^*$; and similar moments of technology distribution, $\mu_1 = \mu_1^*$ and $\mu_2 = \mu_2^*$. In effect, the countries must have the same marginal utility of income, $\lambda = \lambda^* = \frac{1}{2}\bar{\lambda}$, and the same wage, $w = w^*$. Even if both countries are assumed to be symmetric, the asymmetric technology distribution will create differences on at least two grounds.

One, the pattern of technology distribution across sectors may be different, somewhat inverse. This suggests that labour requirements, at least for some sectors, could differ between two countries, meaning that the comparative advantage of producing some goods would be higher in one country than in the other. To specifically investigate the role of this, let us define the un-centred covariance of the two technology distributions as:

$$\gamma \equiv \int_0^1 \alpha(z)\alpha^*(z)dz \quad (23)$$

Given these specifications, we can define the degree of technological dissimilarity as follows:

$$\delta \equiv \int_0^1 \alpha(z)(\alpha(z) - \alpha^*(z))dz = \mu_2 - \gamma \quad (24)$$

This captures the degree of technological dissimilarity between two countries or a measure of comparative advantage. The higher the value of δ , the higher the comparative advantage. When $\delta = 0$, comparative advantage is absent, and the countries are identical in all aspects.

Second, the aggregate demand functions faced by each firm would be different from

those under autarky. Under similar conditions, the demand function can be represented as:

$$\bar{x}(z) \equiv x(z) + x^*(z) = \frac{2\lambda}{b} \left[\frac{a}{\lambda} - p(z) \right] \quad (25)$$

This expression suggests that the market would differ in two respects, unlike autarky. (i) The domestic firm can now face the foreign market and vice versa. This is captured by a drop in the slope of the combined demand function, keeping the autonomous part identical, i.e., $a = a^* = \frac{1}{2}\bar{a}$. As a result, the size of the proportional demand effectively increases. (ii) The slope of the perceived demand function falls from $\frac{b}{\lambda}$ to $\frac{b}{2\lambda}$.

The sectoral output of domestic producers and prices are solved, respectively, as follows:

$$x(z) = \frac{2n}{b(2n+1)} [a - \lambda n w [\alpha(z) - \alpha^*(z)] - \lambda w \alpha(z)] \quad (26)$$

$$p(z) = \frac{1}{\lambda(2n+1)} [a + \lambda n (w(\alpha(z) - \alpha^*(z)) + 2\lambda n)] \quad (27)$$

Notably, the dissimilarity of the technology distribution or the degree of comparative advantage now directly influences the sectoral output. If foreign firms are more productive in the z th sector, the outputs of domestic firms in that sector would be lower, depending on the degree of the technology gap. Low sectoral production demands less labour and thereby affects the equilibrium wage. The technology gap would indirectly affect output through wage changes after trade. The union's presence in the labour market tends to have a differential impact compared to the absence of a union.

Following the assumption of 'right-to-manage' production, the union utility function can be expressed in terms of the sum of total wage rent derived by the workers as follows:

$$H_T = (w - w_0) \frac{2n}{b(2n+1)} \int_0^1 \alpha(z) (a - \lambda n w [\alpha(z) - \alpha^*(z)] - \lambda w \alpha(z)) dz \quad (28)$$

Maximising this, the union fixes the wage at:

$$w_T = \frac{a\mu_1}{2(n\delta + \mu_2)} + \frac{\lambda w_0}{2} \quad (29)$$

Now, the number of rivals in each sector can help determine the equilibrium wage. Comparing the autarky wage with the post-trade wage, we find that the union wage unambiguously falls after the trade. There are, again, three sources of differentiating the impact on wage determination. *First*, the market-size effect increases labour demand and thereby raises the union wage. *Second*, each firm experiences reduced demand and lower market share due to increased competition from foreign rivals. Competition from foreign firms reduces union strength and lowers wages to their previous level. The union fixes the wage at the monopsony level. Due to increased international competition, the reduced price is fully compensated for by the increase in market size. As a result, the combined

effect of these two forces does not affect the union wage at all. Hence, when $\delta = 0$, we find $w_{T|\delta=0} = w_a$, which confirms that the wages are the same without comparative advantage. *Third*, the effect of the comparative advantage that occurs with δ after trade seems to be detrimental to making the difference between the two regimes. For $\delta > 0$, we get $w_T < w_a$. In other words, the wage falls after the trade for any positive level of comparative advantage. The higher the value of δ , the greater the market share of the most productive rivals in the international market, and the lower the demand for labour. Productive firms require less labour, thereby depressing wages. Therefore, the net effect of these three forces unambiguously depresses wages. This differs from the wage rise reported in Neary (2016), but is similar to that reported in Maiti (2024) and also what we observe in the data.

Lemma 1 *The combined effects of market size, competition, and the degree of specialisation (owing to comparative advantage) arising from trade unambiguously depress union wages.*

The drop in the equilibrium wage essentially reduces the market price and increases sectoral production. The sectoral output of domestic producers and price are solved, respectively, as follows:

$$x_T(z) = \frac{2n}{b(2n+1)}[a - \lambda n w_T[\alpha(z) - \alpha^*(z)] - \lambda w_T \alpha(z)] \quad (30)$$

$$p_T(z) = \frac{1}{\lambda(2n+1)}[a + \lambda n(w_T^U(\alpha(z) - \alpha^*(z)) + 2\lambda n)] \quad (31)$$

Again, multiplying labour requirements by sectoral output and integrating over all sectors, the total employment has been found as follows.

$$L_T = \frac{2n}{b(2n+1)}[a\mu_1 - (\mu_2 + n\delta)w_T] = \frac{n}{b(2n+1)}[a\mu_1 - \lambda(\mu_2 + n\delta)w_0] \quad (32)$$

A higher degree of comparative advantage reduces worker demand but increases production. The net effect of trade on employment is uncertain. *First*, the effect of market size increases the demand for labour from n to $2n$. *Second*, the increased competition reduces the demand from $\frac{1}{n+1}$ to $\frac{1}{2n+1}$. The combined effects of these two would be favourable for raising employment from $\frac{n}{n+1}$ to $\frac{2n}{2n+1}$. *Third*, the effect of comparative advantage reduces the demand by the degree of λ . The net effect of these three forces has been ambiguous. If the positive effects of market size and competition outweigh the negative effects of comparative advantage, then total employment can rise after trade; otherwise, it cannot. The combined effects of market size, competition, and comparative advantage arising from trade have been ambiguous regarding equilibrium employment in the presence of a union. If $\frac{1}{2(n+1)}(a\mu_1 - \mu_2 w_0) < n\delta w_0$, then $L_T < L_a$. This suggests that the wage drop after trade does not necessarily reduce unemployment. This issue does not arise in Neary (2016), as there was no unemployment.

Lemma 2 *Employment is directly related to average productivity, but inversely related to productivity dispersion and degree of specialisation.*

5 Welfare

We need to derive the welfare levels from the utility expression under two scenarios to investigate the gains from trade. By substituting $p_a(z)$ from (13) into (6), we get the welfare under the autarky as follows:

$$\tilde{U} = -\frac{1}{(n+1)^2}(a^2 + 2n\mu_1w_a + n^2\mu_2w_a^2) \quad (33)$$

It suggests that a higher wage raises the second moment of prices and hence lowers welfare. Similarly, the direct effect of the technology distribution, captured by the second moment of $\alpha(z)$, seems to favour welfare. However, it does not capture the total effect and requires the substitution of the autarky wage. Let us assume that σ is the variance of the home technology distribution, where $\sigma = \int_0^1[\alpha(z) - \mu]^2 dz = \mu_2 - \mu_1^2$. The economy is featureless if $\sigma = 0$ and the allocation of labour across sectors is absent. For simplicity, we assume that $w_0 = 0$, and this would affect our results. After substituting w_a , we get

$$\tilde{U}_A = -\frac{a^2(\mu_1^2(n+2)^2 + 4\sigma)}{4(n+1)^2(\mu_1^2 + \sigma)} \quad (34)$$

The domestic welfare in Autarky is influenced by σ given μ_1 and n . A means-preserving spread of technology unambiguously raises welfare. In terms of the effect of σ , there are two conflicting effects. First, the utility function in (5) shows that consumers dislike heterogeneous consumption levels. They do not like heterogeneous prices because heterogeneous technology leads to different costs. Hence, a rise in σ^2 tends to reduce welfare at given wages. Second, greater heterogeneity in technology across sectors implies that the autarky wage tends to fall, which reduces the second moment of prices in (21) and hence raises welfare. If the second effect dominates over the first effect, the σ^2 would increase welfare. The derivative of welfare with respect to σ^2 becomes positive (see equation 33), which confirms the positive relationship between them.

$$\tilde{U}_{A\sigma} = \frac{a^2\mu_1^2n(n+4)}{4(n+1)^2(\mu_1^2 + \sigma)^2} \quad (35)$$

Similarly, the effect of competition, captured by an increase in n , seems to have a favourable effect on welfare. The partial derivation of U_A with respect to n confirms this result. Even if the union wage does not change with n , the competition effect would reduce price, thereby directly increasing welfare.

$$\tilde{U}_{An} = \frac{a^2(\mu_1^2(n+2) + 4\sigma)}{2(n+1)^3(\mu_1^2 + \sigma)} > 0 \quad (36)$$

After trade, the wages and prices are different. Substituting the prices (from equation 29) into welfare (equation 6), we find

$$\tilde{U}_T = -\frac{1}{(2n+1)^2} [a^2 + 4an\mu_1 w_f + 2n^2(2\mu_2 - \delta)w_f^2] \quad (37)$$

Similarly to the previous case, welfare is influenced by competition (n), wages, and the distribution of technology. It is clear that the wage drop will increase welfare after trade. To continue, the wage (found in equation 27) has been replaced, giving us the following expression.

$$\tilde{U}_T = -\frac{a^2(\mu_1^2(\delta n(3n+4) + 2(n(n+2) + 2)\sigma) + 2(\delta n + \sigma)^2 + 2\mu_1^4(n+1)^2)}{2(2n+1)^2(\mu_1^2 + \delta n + \sigma)^2} \quad (38)$$

As in the previous case, welfare increases in both n and σ (see equations 37 and 38). The same explanation will go through for the following.

$$\begin{aligned} \tilde{U}_{Tn} &= \frac{a^2(\mu_1^2(6\delta^2 n^2(n+2) + \delta n(4n(n+3) + 23)\sigma + 2(n+5)\sigma^2))}{(2n+1)^3(\mu_1^2 + \delta n + \sigma)^3} \\ &\quad \frac{a^2(\mu_1^2 2\mu_1^6(n+1))}{(2n+1)^3(\mu_1^2 + \delta n + \sigma)^3} > 0 \end{aligned} \quad (39)$$

$$\tilde{U}_{T\sigma} = \frac{a^2\mu_1^2 n(n(\delta + \delta(-n) + \sigma) + \mu_1^2(n+2) + 2\sigma)}{(2n+1)^2(\mu_1^2 + \delta n + \sigma)^3} > 0 \quad (40)$$

Let us first discuss whether trade offers any favourable benefit when economies are featureless. When $\sigma = \delta = 0$ and $\mu_2 = \mu_1^2$, we find $w_a^1 = w_T^1 = \frac{a}{2\mu_1}$, suggesting that the wages are equal. The union wage is independent of competition and cannot be influenced by trade. On the other hand, we find that $U_A^1 = -\frac{a^2(n+2)^2}{4(n+1)^2}$ and $U_T^1 = -\frac{a^2(n+1)^2}{(2n+1)^2}$. Comparing them, we find that $UG^1 = U_T^1 - U_A^1 = \frac{a^2 n(n(4n+9)+4)}{4(n+1)^2(2n+1)^2} > 0$, suggesting that there exists a gain from trade even if the economies are featureless. Even if wages do not fall, prices would drop due to increased competition after trade. This has resulted in a trade surplus. This result is different from Neary (2016). In the absence of a union, all workers are employed and the increased competition after trade raises the wage, negating the gain from trade.

Proposition 1 *The wages are identical in the featureless world where $\sigma = \delta = 0$, but the welfare improves after the trade.*

Now assume that the second moment of technology distribution is positive but similar in both economies, i.e., $\sigma > 0$ and $\delta = 0$. In this case, we find that $w_a^2 = w_T^2 = \frac{a\mu_1}{2(\mu_1^2 + \sigma)}$, meaning that wage does not change after trade. However, comparing the wages between these two special cases, we find that $w_a^1 = w_T^1 > w_a^2 = w_T^2$, meaning that the union

wage in the case of featureless is higher than that with a positive, similar technology distribution. Under heterogeneous technology, the demand for workers decline from firms with higher productivity and, therefore, wages decline. On the other hand, we find that $U_A^2 = -\frac{a^2(\mu_1^2(n+2)^2+4\sigma)}{4(n+1)^2(\mu_1^2+\sigma)}$ and $U_T^2 = -\frac{a^2(2\mu_1^2(n(n+2)+2)\sigma+2\mu_1^4(n+1)^2+2\sigma^2)}{2(2n+1)^2(\mu_1^2+\sigma)^2}$, Comparing utility, we find that $UG^2 = U_A^2 - U_T^2 = \frac{a^2n(n(4n+9)+4)}{4(n+1)^2(2n+1)^2}$, suggesting that the welfare rises after trade because of the drop in price. Even if wage in the second case is lower, we find that $UG^1 = UG^2$. Therefore, the welfare gains are identical.

Proposition 2 (i) *The wages are identical in the featureless world where $\sigma > 0$ and $\delta = 0$, but welfare gains after the trade.* (ii) *Even if the wage declines compared to the featureless case, the welfare gains are identical.*

Finally, let us assume that $\sigma > 0$ and $\delta > 0$, and that the economies are full of features. If we take the partial derivative of the welfare (\tilde{U}_T) with respect to the technology similarity (δ), we find as follows:

$$\tilde{U}_{T\delta} = \frac{a^2\mu_1^2n^2(3\delta n + \mu_1^2(4n + 5) + 4n\sigma + 5\sigma)}{2(2n + 1)^2(\mu_1^2 + \delta n + \sigma)^3} > 0 \quad (41)$$

This result suggests that the higher the value of δ , the higher the welfare. Because labour demand declines with higher δ (or the specialisation effect), this depresses the union wage. Therefore, welfare will improve unambiguously after trade in the presence of a union. There are two effects. First, the specialisation effect improves welfare by depressing the union wage. Second, the trade raises welfare under the featureless case because the lower price occurs when the wage remains fixed. Both of these effects improve welfare. Note that Neary (2016) did not find the gain in the featureless case and found a favourable effect only when the specialisation effect dominates the adverse effect of the wage increase. Therefore, the welfare gain in the presence of the union is unambiguous.

Proposition 3 *Trade unambiguously depresses union wages, thereby raising the welfare gain. The gain improves with the number of competitors and the degree of technological dissimilarity.*

6 Calibration

We have calibrated some results using assumptions about certain parameters to visualise the gain from trade. Assume that $a = 1$ and $\mu_1 = 1$. We find similar results by changing the values of σ and given n , and vice versa. The results are presented in Figure 6. The first column of Figure 6 shows the welfare impact of increased technological heterogeneity. It reveals that welfare rises with σ in both cases. However, the rate of increase is slower after

trade. This leads to a slower growth in welfare as technological heterogeneity increases. The results are similar when plotted against competition n (see Figure 6) .

Similarly, we simulate the results against technological dissimilarity or specialisation effect (see Figure 7). Welfare increases unambiguously with competition (n) and technological heterogeneity. Figure 8 demonstrates unambiguously positive gains from trade for specific parameter values. The drop in union wages drives such a gain. This result also differs from that of Neary (2016).

7 Concluding Remarks

Using the Consumer Pyramids Household Survey (CPHS) data and data on UK-India trade observed over the period 2014-2019, we find that GSP graduation linked trade exposure reduces household wage incomes. This motivates us to explore the theoretical mechanism behind such an empirical pattern. We present a generalised oligopolistic model to demonstrate that gains from trade are always positive. This is primarily driven by a fall in union wage. In the absence of a union, wages increase, thereby generating ambiguity about welfare gains (Neary, 2016). However, this paper finds that welfare gain from trade is unambiguous due to a drop in union wages and under technological dissimilarity. Augmenting the generalised oligopoly framework with both heterogeneity and strategic trade competition, the paper captures the effect of market size, competition, and specialisation arising from trade, along with labour-market imperfections and unemployment. The gap in sectoral productivity between the two countries offers an analytical tool to estimate the degree of specialisation and competition.

Theoretical analysis of the paper indicates that the trade-induced joint effects of market size and competition cannot reduce the union wage. However, specialisation arising from heterogeneous productivity distribution across trading partners appears to unambiguously dampen wages. The drop in union wage reduces price and their volatility, reinforcing welfare gains. The welfare gain increases with competition and differences in productivity across trading partners.

Our analysis implies nuanced and far-reaching labour market consequences of trade preference removal. Trade preference removal induced competition and specialisation unambiguously reduces wages disadvantaging workers even in the presence of unions. Overall, welfare improves largely driven by increased consumer surplus and producer surplus. Therefore distributional consequences of such policies cannot be overstated. In fact, in our empirical analysis we do find that the adverse effect is concentrated on the low-income workers.

Even though we analyse general equilibrium effects, we are unable to incorporate potential substitution effects of trade preference removal. For example, would the overall

volume of trade to third countries increase especially for the graduated firms. Furthermore, what is the impact of preference removal on trade to third countries from the non-graduated firms. These are questions of policy significance that undoubtedly would require further scrutiny.

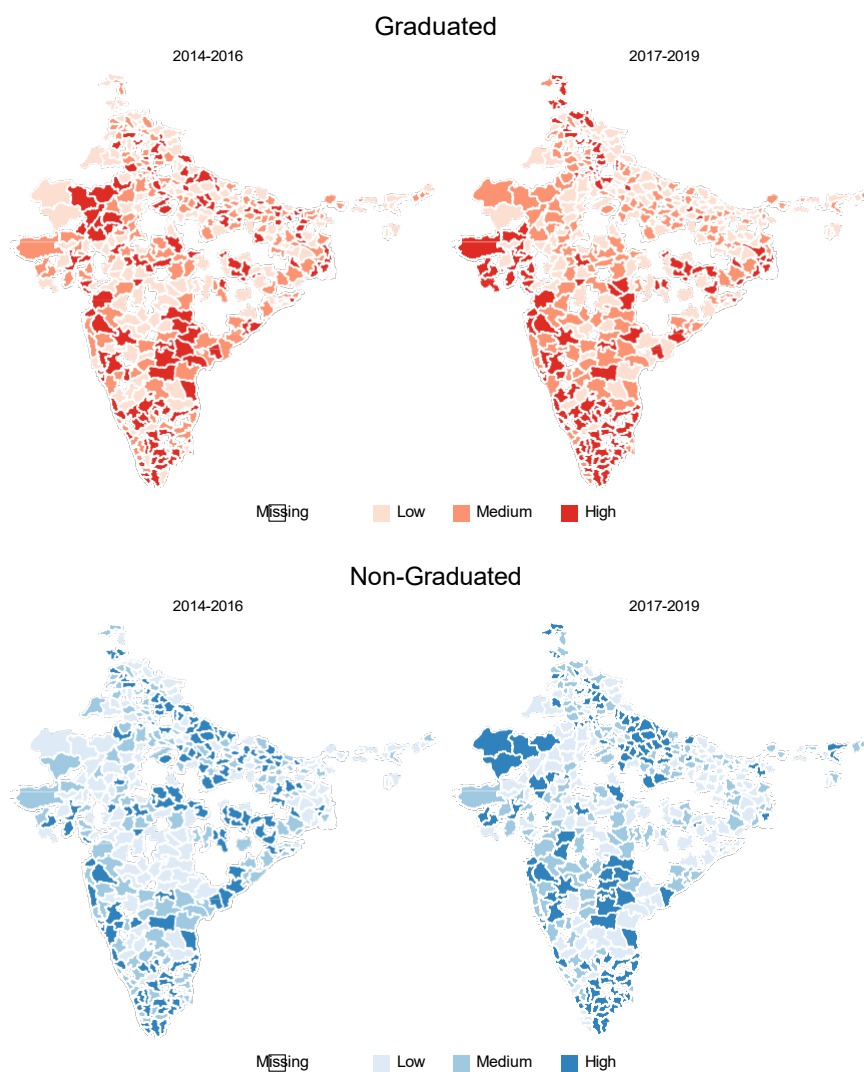
References

- Abraham, F., Konings, J., and Vanormelingen, S. (2009). The effect of globalization on union bargaining and price-cost margins of firms. *Review of World Economics*, 145(1):13–36.
- Amiti, M. and Konings, J. (2007). Trade liberalization, intermediate inputs, and productivity: Evidence from indonesia. *American Economic Review*, 97(5):1611–1638.
- Arkolakis, C., Costinot, A., and Rodríguez-Clare, A. (2012). New trade models, same old gains? *American Economic Review*, 102(1):94–130.
- Besley, T. and Burgess, R. (2004). Can labor regulation hinder economic performance? evidence from india. *The Quarterly journal of economics*, 119(1):91–134.
- Brander, J. A. and Spencer, B. J. (1988). Unionized oligopoly and international trade policy. *Journal of International Economics*, 24(3-4):217–234.
- Calligaris, S., Criscuolo, C., and Marcolin, L. (2017). Digital and market transformations. Technical report, Discussion paper, OECD Report.
- Cragg, M. I. and Epelbaum, M. (1996). Why has wage dispersion grown in mexico? is it the incidence of reforms or the growing demand for skills? *Journal of development Economics*, 51(1):99–116.
- Davidson, C., Heyman, F., Matusz, S., Sjöholm, F., and Zhu, S. C. (2014). Globalization and imperfect labor market sorting. *Journal of International Economics*, 94(2):177–194.
- De Loecker, J. and Eeckhout, J. (2018). Global market power. Technical report, National Bureau of Economic Research.
- Diez, M. F., Leigh, M. D., and Tambunlertchai, S. (2018). *Global market power and its macroeconomic implications*. International Monetary Fund.
- Dornbusch, R., Fischer, S., and Samuelson, P. A. (1977). Comparative advantage, trade, and payments in a ricardian model with a continuum of goods. *The American Economic Review*, 67(5):823–839.

- Dumont, M., Rayp, G., and Willeme, P. (2006). Does internationalization affect union bargaining power? an empirical study for five eu countries. *Oxford Economic Papers*, 58(1):77–102.
- Dutta, P. V. (2007). Trade protection and industry wages in india. *ILR Review*, 60(2):268–286.
- Edmond, C., Midrigan, V., and Xu, D. Y. (2015). Competition, markups, and the gains from international trade. *American Economic Review*, 105(10):3183–3221.
- Feenstra, R. C. (2007). Globalization and its impact on labour. Technical report, WIIW Working Paper.
- Gibson, D. (2019). Causes of the decline of the us wage share 1960-2015. *American Review of Political Economy*, 14(1).
- Guerriero, M. and Sen, K. (2012). What determines the share of labour in national income? a cross-country analysis.
- Hsieh, C.-T. and Klenow, P. J. (2009). Misallocation and manufacturing tfp in china and india. *The Quarterly journal of economics*, 124(4):1403–1448.
- Huizinga, H. (1993). International market integration and union wage bargaining. *The Scandinavian Journal of Economics*, 95(2):249–255.
- Kreickemeier, U. and Meland, F. (2013). Non-traded goods, globalization and union influence. *Economica*, 80(320):774–792.
- Krugman, P. (1980). Scale economies, product differentiation, and the pattern of trade. *The American Economic Review*, 70(5):950–959.
- Maiti, D. (2014). *Reform and productivity growth in India: issues and trends in the labour markets*. Routledge.
- Maiti, D. (2024). Trade, labor market rigidity, and distributive share in a generalized oligopolistic equilibrium model. *International Journal of Economic Theory*.
- Maiti, D. and Neogi, C. (2024). Endogeneity-corrected stochastic frontier with market imperfections. *Empirical Economics*, 67(3):1149–1183.
- Melitz, M. J. and Ottaviano, G. I. (2008). Market size, trade, and productivity. *The review of economic studies*, 75(1):295–316.
- Melitz, M. J. and Redding, S. J. (2014). Heterogeneous firms and trade. *Handbook of international economics*, 4:1–54.

- Neary, J. P. (2016). International trade in general oligopolistic equilibrium. *Review of International Economics*, 24(4):669–698.
- Restuccia, D. and Rogerson, R. (2008). Policy distortions and aggregate productivity with heterogeneous establishments. *Review of Economic dynamics*, 11(4):707–720.
- Sørensen, J. R. (1993). Integration of product markets when labour markets are unionized. *Recherches Économiques de Louvain/Louvain Economic Review*, 59(4):485–502.
- Weche John, P., Achim, W., et al. (2021). The fall and rise of market power in europe. *Journal of Economics and Statistics (Jahrbuecher fuer Nationaloekonomie und Statistik)*, 241(5-6):555–575.
- Yeaple, S. R. (2005). A simple model of firm heterogeneity, international trade, and wages. *Journal of international Economics*, 65(1):1–20.

Figure 1: District-level trade exposure in India, 2014–16 and 2017–19



Source: Authors' illustration based on CMIE and Comtrade data.

Notes: Figure 1 reports the intensity of trade exposure for districts in India by graduation status, in '000 units.

The darker colour intensity the higher the trade exposure in the district.

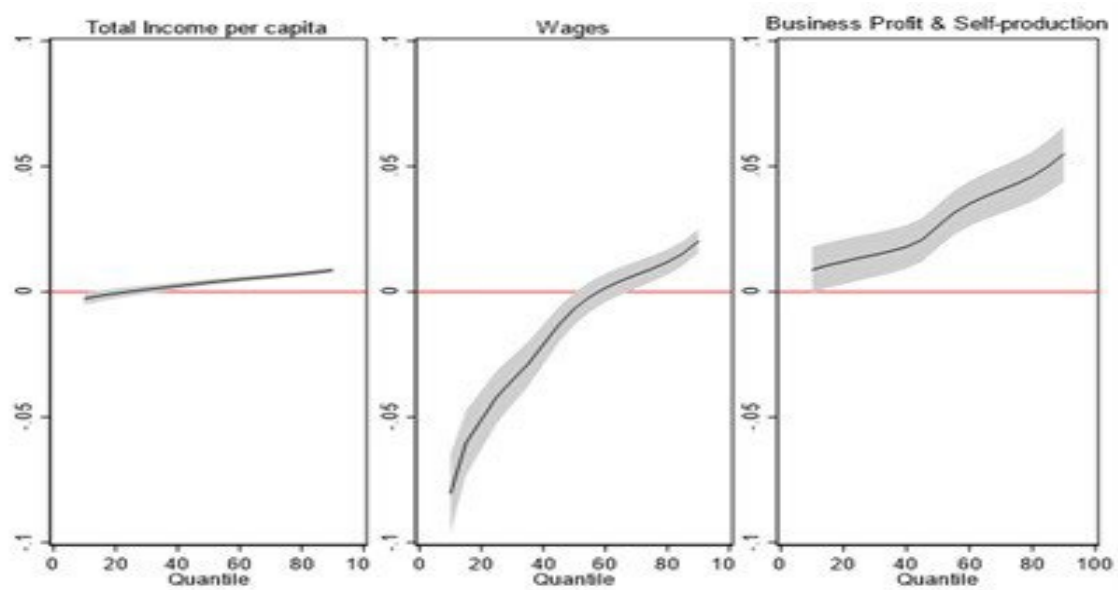
For graduated sectors in 2014–17: high ranges from 1.3 to 3.1; medium from 0.7 to 1.3; low from 0 to 0.7.

For graduated sectors in 2017–19: high ranges from 0.5 to 7.1; medium from 0.1 to 0.5; low from 0 to 0.1.

For non-graduated sectors in 2014–17: high ranges from 1.5 to 8.4; medium from 0.7 to 1.5; low from 0 to 0.7.

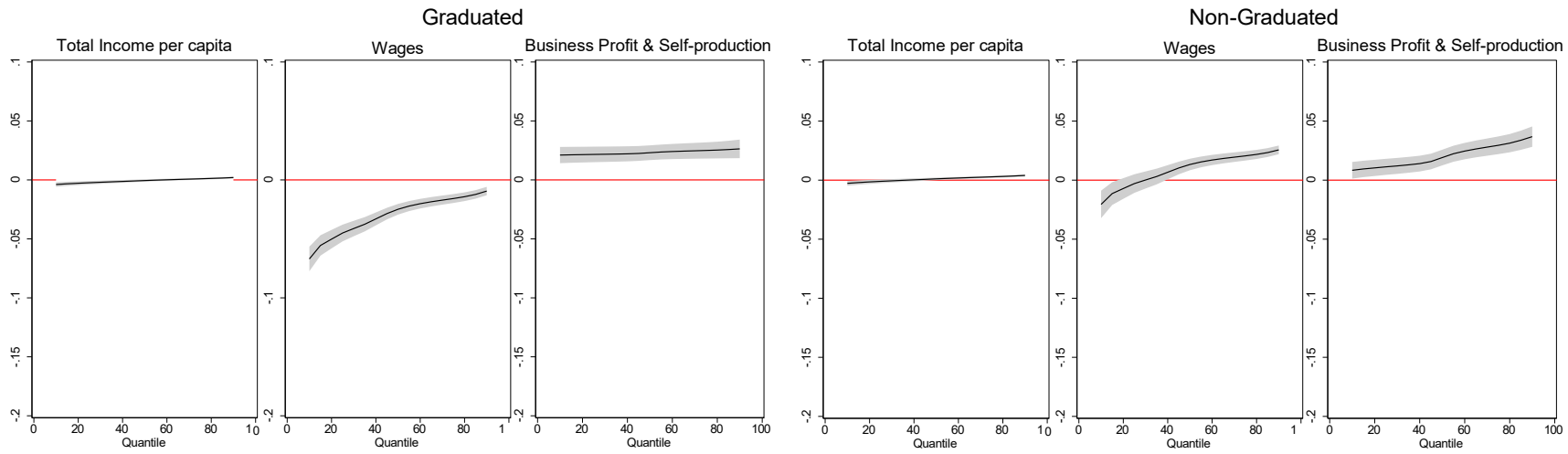
For non-graduated sectors in 2017–19: high ranges from 1.4 to 7.7; medium from 1.4 to 0.5; low from 0 to 0.5.

Figure 2: Trade exposure and welfare – All sample



Source: Authors' calculation using CPHS and Comtrade data. Notes: Figure 2 reports the plotted coefficients of the quantile regressions using the Generalized Methods of Moments (GMM).

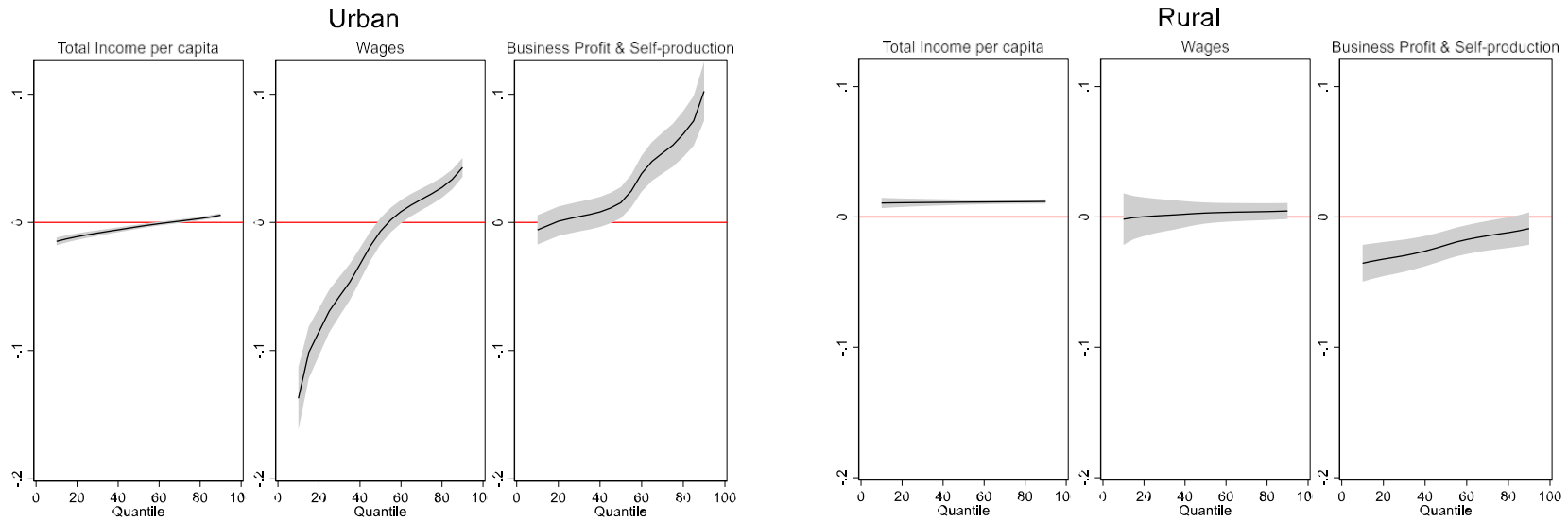
Figure 3: Trade exposure and welfare – all sample, by graduation status



Source: Author's calculation using CPHS and Comtrade data.

Notes: Figure 3 reports the plotted coefficients of the quantile regressions using the GMM.

Figure 4: Trade exposure and welfare – Urban and Rural Areas



Source: Authors' calculation using CPHS and Comtrade data. **Notes:** Figure 4 reports the plotted coefficients of the quantile regressions using the Generalized Methods of Moments (GMM).

Figure 5: Sectors for competition and specialisation

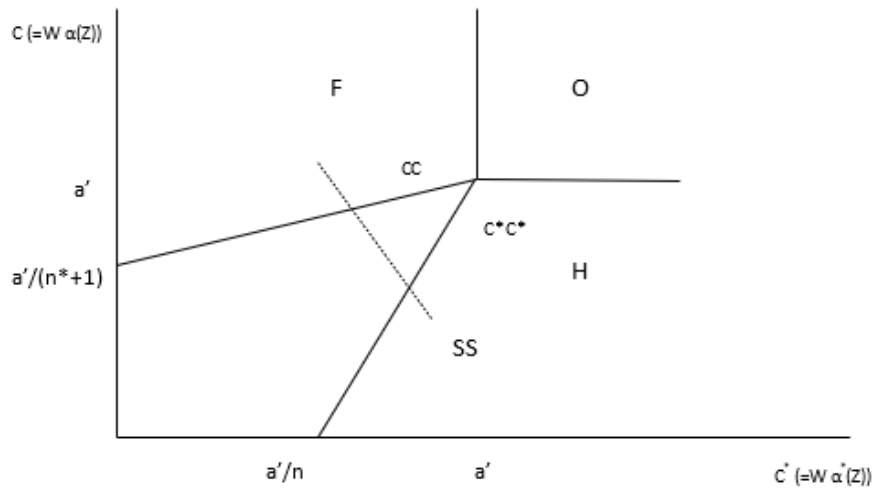
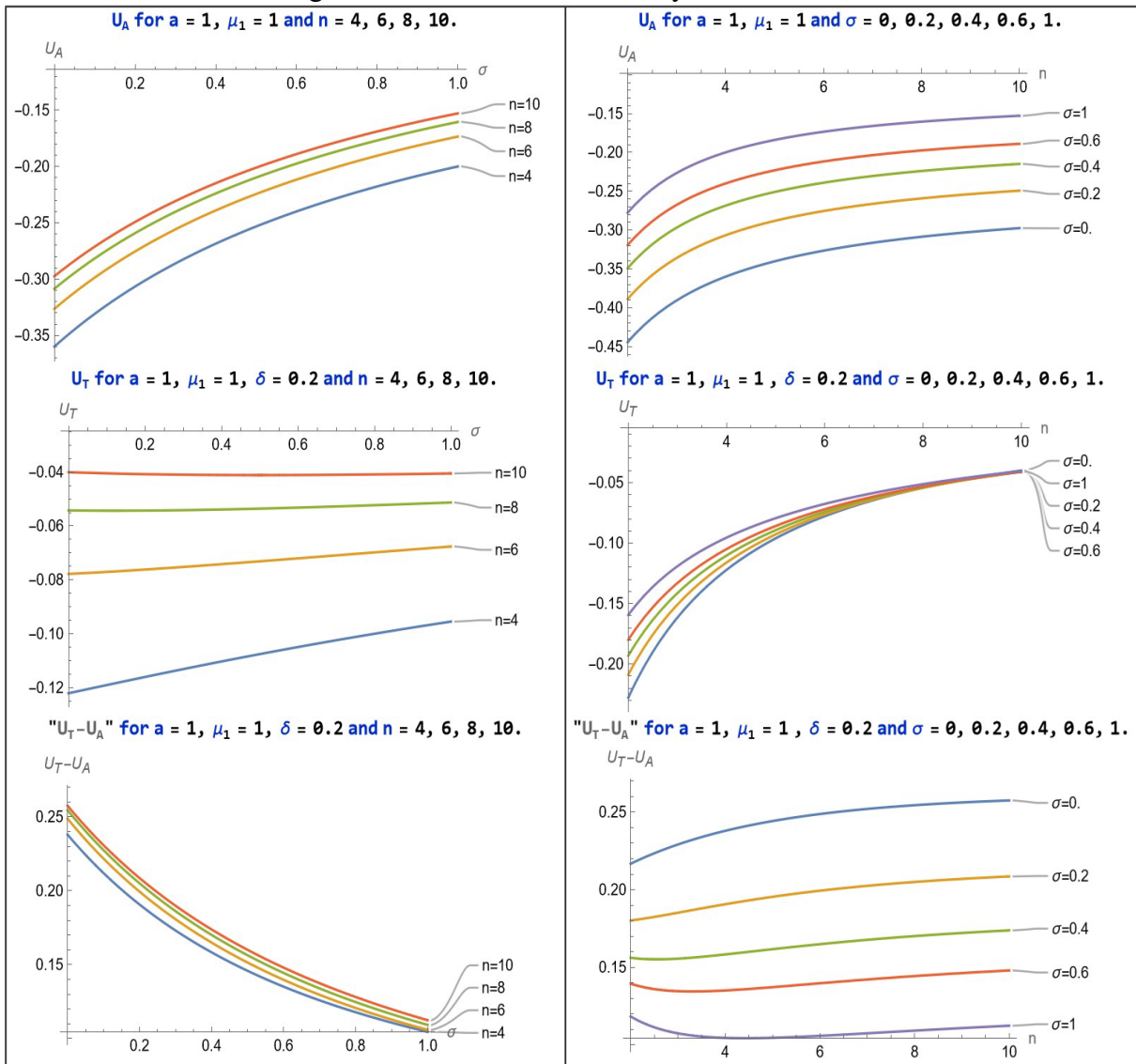
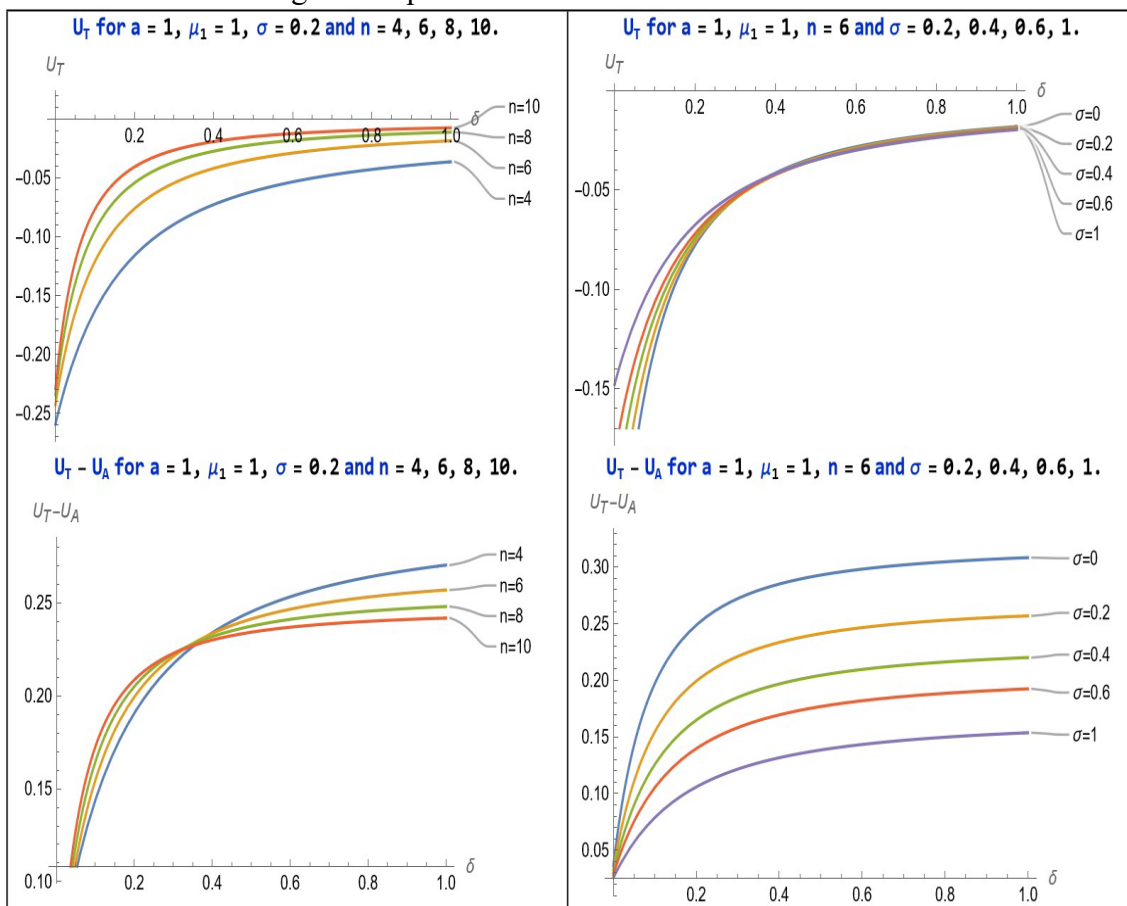


Figure 6: Welfare Under Autarky and Trade



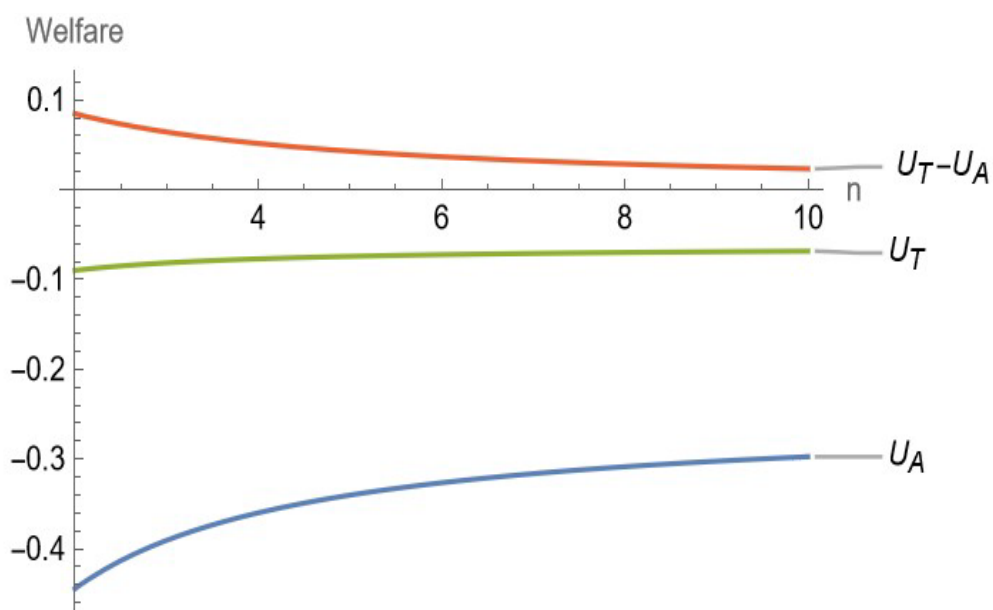
Note: $a = 1; \sigma = 1; n = 4, \delta = 0.2$

Figure 7: Specialisation and Gains from trade



Note: $a = 1; \sigma = 1; n = 4, \delta = 0.2$

Figure 8: Specialisation and Gains from Trade with Increasing Competition



Note: $a = 1; \sigma = 1; n = 4, \delta = 0.2$

Table 1 – Trade exposure and welfare – Full sample

	Panel A: Total Income per capita				Panel B: Income per capita from Wages				Panel C: Income per capita from Business Profit and Self-production			
	(1) OLS	(2) Quantile			(1) OLS	(2) Quantile			(1) OLS	(2) Quantile		
		25%	50%	75%		25%	50%	75%		25%	50%	75%
Trade exposure	0.003*** (0.001)	0.000 (0.001)	0.004*** (0.001)	0.007*** (0.001)	-0.014*** (0.005)	-0.042*** (0.005)	-0.007** (0.003)	0.009*** (0.003)	0.027*** (0.005)	0.013*** (0.005)	0.026*** (0.004)	0.043*** (0.005)
N	803,089				803,089				803,089			
R-squared	0.190				0.038				0.039			
Number of households	139,937				139,937				139,937			

Source: Authors' calculation using CPHS and Comtrade data.

Notes: *** 1%; ** 5%; * 1%. Table 2 reports the results of the OLS and of the quantile regressions using the Generalized Methods of Moments (GMM) with household and year fixed effects. Robust standard errors clustered by district-sector in parentheses.

Table 2: Trade exposure and welfare – by Graduation Status

	Panel A: Total income per capita				Panel B: Income per capita from wages				Panel C: Income per capita from business profit and self-production			
	(1) OLS	(2) Quantile			(1) OLS	(2) Quantile			(1) OLS	(2) Quantile		
		25%	50%	75%		25%	50%	75%		25%	50%	75%
Trade exposure graduated	-0.001 (0.001)	-0.002*** (0.001)	-0.001 (0.000)	0.001** (0.000)	-0.029*** (0.003)	-0.045*** (0.004)	-0.025*** (0.002)	-0.016*** (0.002)	0.023*** (0.004)	0.022*** (0.003)	0.023*** (0.003)	0.025*** (0.003)
Trade exposure non-graduated	0.001** (0.001)	-0.001 (0.001)	0.001** (0.001)	0.003*** (0.000)	0.010*** (0.003)	-0.003 (0.004)	0.013*** (0.002)	0.021*** (0.002)	0.020*** (0.004)	0.011*** (0.003)	0.019*** (0.003)	0.030*** (0.004)
N	803,089				803,089				803,089			
R-squared	0.190				0.038				0.039			
Number of households	139,937				139,937				139,937			

Source: Authors' calculation using CPHS and Comtrade data.

Notes: *** 1%; ** 5%; * 10%. Table 2 reports the results of the OLS and of the quantile regressions using the GMM with household and year fixed effects. Robust standard errors clustered by district-sector in parentheses.

Table 3: Trade exposure and welfare – Urban and Rural areas

	Panel A: Total Income per capita							
	(A1) Urban				(A2) Rural			
	(1) OLS	(2) Quantile			(1) OLS	(2) Quantile		
	Fixed Effects	25%	50%	75%	Fixed Effects	25%	50%	75%
Trade exposure	-0.004*** (0.001)	-0.010*** (0.001)	-0.003*** (0.001)	0.002*** (0.001)	0.011*** (0.001)	0.011*** (0.002)	0.011*** (0.001)	0.012*** (0.001)
R-squared	0.200				0.171			
	Panel B: Income per capita from Wages							
	(A1) Urban				(A2) Rural			
	OLS	Quantile			OLS	Quantile		
	Fixed Effects	25%	50%	75%	Fixed Effects	25%	50%	75%
Trade exposure	-0.019** (0.007)	-0.069*** (0.008)	-0.007 (0.005)	0.022*** (0.004)	0.003 (0.006)	0.001 (0.007)	0.003 (0.004)	0.004 (0.003)
R-squared	0.041				0.038			
	Panel C: Income per capita from Business Profit and Self-production							
	(A1) Urban				(A2) Rural			
	OLS	Quantile			OLS	Quantile		
	Fixed Effects	25%	50%	75%	Fixed Effects	25%	50%	75%
Trade exposure	0.027*** (0.008)	0.003 (0.006)	0.015** (0.006)	0.060*** (0.009)	-0.022*** (0.007)	-0.031*** (0.006)	-0.022*** (0.006)	-0.013** (0.006)
N	558,060				245,029			
R-squared	0.022				0.136			
Number of households	97,279				42,658			

Source: Authors' calculation based on CPHS and Comtrade data.

Notes: *** 1%; ** 5%; * 1%. Table 3 reports the results of the OLS and of the quantile regressions using the Generalized Methods of Moments (GMM) with household and year fixed effects. Robust standard errors clustered by district-sector in parentheses.

Appendix A: Concordances

Table A1: List of graduated GSP sections and years of graduation

GSP Section	Graduated products	Years of graduation	
S-5	Mineral products	2014–16	2017–19
S-6a	Inorganic and organic chemicals	2014–16	2017–19
S-6b	Chemicals, other than organic and inorganic chemicals	2014–16	
S-8a	Raw hides and skins and leather	2014–16	
S-11a	Textiles	2014–16	2017–19
S-14	Pearls and precious metals		2017–19
S-15a	Iron, steel and articles of iron and steel		2017–19
S-15b	Base metals (excluding iron and steel), articles of base metals (excluding articles of iron and steel)		2017–19
S-17b	Motor vehicles, bicycles, aircraft and spacecraft, ships and boats	2014–16	2017–19

Source: EU Regulation 2012-1213, EU Regulation 2016-330, EU Regulation 2019-249.

Table A2: List of HS two-digit products by graduated GSP sections

GSP Section	Graduated products	HS two-digit	HS2 description
S-5	Mineral products	25	Salt; sulphur; earths and stone; plastering materials
		26	Ores, slag and ash
		27	Mineral fuels, mineral oils and products of their distillation
S-6a	Inorganic and organic chemicals	28	Inorganic chemicals; organic or inorganic compounds of precious metals
		29	Organic chemicals
S-6b	Chemicals, other than organic and inorganic chemicals	31	Fertilisers
		32	Tanning or dyeing extracts; tannins and their derivatives
		33	Essential oils and resinoids; perfumery, cosmetic or toilet preparations
		34	Soap, organic surface-active agents, washing preparations
		35	Albuminoidal substances; modified starches; glues; enzymes
		36	Explosives; pyrotechnic products; matches; pyrophoric alloys
		37	Photographic or cinematographic goods
S-8a	Raw hides and skins and leather	38	Miscellaneous chemical products
		41	Raw hides and skins (other than furskins) and leather
S-11a	Textiles	50	Silk
		51	Wool, fine or coarse animal hair; horsehair yarn and woven fabric
		52	Cotton
		53	Other vegetable textile fibres; paper yarn and woven fabric
		54	Man-made filaments; strip and the like of man-made textile materials
		55	Man-made staple fibres
		56	Wadding, felt and nonwovens; special yarns; twine, ropes and cables
		57	Carpets and other textile floor coverings
		58	Special woven fabrics; tufted textile fabrics; laces
		59	Impregnated, coated, covered or laminated textile fabrics

		60	Knitted or crocheted fabrics
S-14	Pearls and precious metals	71	Natural or cultured pearls, precious or semi-precious stones, and metals
S-15a	Iron, steel and articles of iron and steel	72	Iron and steel
		73	Articles of iron or steel
S-15b	Base metals (excluding iron and steel), articles of base metals (excluding articles of iron and steel)	74	Copper and articles thereof
		75	Nickel and articles thereof
		76	Aluminium and articles thereof
		78	Lead and articles thereof
		79	Zinc and articles thereof
		80	Tin and articles thereof
		81	Other base metals; cermets; articles thereof
		82	Tools, implements, cutlery, spoons and forks, of base metal
		83	Miscellaneous articles of base metal
S-17b	Motor vehicles, bicycles, aircraft and spacecraft, ships and boats	87	Vehicles other than railway or tramway rolling stock
		88	Aircraft, spacecraft, and parts thereof
		89	Ships, boats and floating structures

Source: Authors' construction based on Comtrade data and Article 7 of Regulation (EU) No 978/2012.

Table A3: List of CPHS manufacturing sectors by graduation status

Non-graduated	Graduated
Agriculture-allied activities	Automobiles and other transport equipment manufacturers
Cement, tiles, bricks, ceramics, glass and other construct	Chemical industries
Defence services	Footwear and other leather industries (until 2017)
Food industries	Gems and jewellery (from 2017)
Handicraft industries	Metal industries (from 2017)
Machinery manufacturers	Mines
Pharmaceutical manufacturer	Textile industries
	Soaps, detergents, cosmetics, toiletries (until 2017)

Source: Authors' construction, mapped on CPHS data and GSP graduated sections. Each GSP graduated sector was mapped to a specific CPHS category and the group of non-graduated corresponded with CPHS sections.

Table A4: Harmonisation of GSP graduated two-digit sectors with CPHS industry classification and HS two-digit

CPHS	GSP section	Comtrade HS two-digit level	
Automobiles and other transport equipment manufacturers	S-17a	86	Railway or tramway locomotives, rolling stock and parts thereof
	S-17b	87	Vehicles other than railway or tramway rolling stock
	S-17b	88	Aircraft, spacecraft, and parts thereof
	S-17b	89	Ships, boats, and floating structures
Chemical industries	S6a	28	Inorganic chemicals; organic or inorganic compounds of precious metals
	S6a	29	Organic chemicals
	S-6b	31	Fertilizers
	S-6b	32	Tanning or dyeing extracts; tannins and their derivatives
	S-6b	33	Essential oils and resinoids; perfumery, cosmetic or toilet preparations
	S-6b	34	Soaps, organic surface-active agents, washing preparations
	S-6b	35	Albuminoidal substances; modified starches; glues; enzymes
	S-6b	36	Explosives; pyrotechnic products; matches; pyrophoric alloys
	S-6b	37	Photographic or cinematographic goods
	S-6b	38	Miscellaneous chemical products
Footwear and other leather industries	S-8a	41	Raw hides and skins (other than furskins) and leather
	S-8b	42	Articles of leather; saddlery and harness; travel goods, handbags, and similar articles of leather
	S-8b	43	Furskins and artificial fur; manufactures thereof
	S-12a	64	Footwear, gaiters, and the like; parts of such articles

Gems and jewellery	S-14	71	Natural or cultured pearls, precious or semi-precious stones, and articles thereof
Metal industries	S-15a	72	Iron and steel
	S-15a	73	Articles of iron or steel
	S-15b	74	Copper and articles thereof
	S-15b	75	Nickel and articles thereof
	S-15b	76	Aluminium and articles thereof
	S-15b	78	Lead and articles thereof
	S-15b	79	Zinc and articles thereof
	S-15b	80	Tin and articles thereof
	S-15b	81	Other base metals; cermets; articles thereof
	S-15b	82	Tools, implements, cutlery, spoons, and forks, of base metal or precious metal
S-15b	83	Miscellaneous articles of base metal	
Mines	S-5	25	Salt; sulphur; earths and stone; plastering materials
	S-5	26	Ores, slag, and ash
	S-5	27	Mineral fuels, mineral oils, and products of their distillation
Textile industries	S-11a	50	Silk
	S-11a	51	Wool, fine or coarse animal hair; horsehair yarn and fabric
	S-11a	52	Cotton
	S-11a	53	Other vegetable textile fibres; paper yarn and woven fabrics
	S-11a	54	Man-made filaments; strip and the like of man-made filaments
	S-11a	55	Man-made staple fibres
	S-11a	56	Wadding, felt and nonwovens; special yarns; twine, cordage, ropes, and cables
	S-11a	57	Carpets and other textile floor coverings
	S-11a	58	Special woven fabrics; tufted textile fabrics; laces; tapestries
	S-11a	59	Impregnated, coated, covered, or laminated textile fabrics
	S-11a	60	Knitted or crocheted fabrics
S-11b	61	Articles of apparel and clothing accessories, knitted or crocheted	

	S-11b	62	Articles of apparel and clothing accessories, not knitted or crocheted
	S-11b	63	Other made-up textile articles; sets; worn clothing
	S-12b	65	Headgear and parts thereof
	S-12b	66	Umbrellas, sun umbrellas, walking sticks, seat-sticks, whips, riding-crops and parts thereof
	S-12b	67	Prepared feathers and down and articles made of feathers or of down; artificial flowers; articles of human hair

Source: Authors' construction based on CPHS and Comtrade data.

Note: Table A4 shows each CPHS graduated sector mapped to a specific GSP section and HS two-digit sectors. The set of non-graduated sectors correspond to the other HS two-digit sectors.

Table A5: Alignment CPHS industry of occupation and GSP graduation sections

Industry of occupation (CPHS)	GSP section
Mines	S-5 Mineral products
Chemical industries	S-6a Inorganic and organic chemicals
	S-6b Chemicals, other than organic and inorganic chemicals
Footwear and other leather industries	S-8a Raw hides and skins and leather
	S-8b Leather, other than raw or semi-processed
	S-12a Footwear, gaiters and the like
Gems and jewellery	S-14 Pearls and precious metals
Textile industries	S-11a Textiles
	S11b Clothing and articles of apparel
	S12b Non-apparel textiles and accessories
Metal industries	S-15a Iron, steel and articles of iron and steel
	S-15b Base metals, etc
Automobiles and other transport equipment manufacturers	S-17a Railway or tramway locomotives, rolling-stock
	S-17b Motor vehicles, bicycles, aircraft and spacecraft, ships and boats

Source: Authors' construction.

Notes: Due to the difficulty of precisely matching the industry classifications from the CPHS with the EU GSP Sections, there are a few cases where products outside the scope of GSP graduation are within an industry of occupation. For example, trade data on products under GSP Section S-8b (Leather, other than Raw or Semi-Processed) and S-12a (Footwear, gaiters, and similar articles) have been accounted for under the 'Footwear and Other Leather Industries' industry. Exports under GSP Section S-11b (Clothing and Articles of Apparel) and S-12b (Non-Apparel Textiles and Accessories) have been included in the textile industry, while exports under S-17a (Railway or Tramway Locomotives, Rolling-Stock) are considered under the 'Automobiles and Other Transport Equipment Manufacturers' industry. While due to the industry classification system used in the CMIE survey, I was able to separate workers in the 'Soaps, Detergents, Cosmetics, Toiletries Industries' – along with the relevant products under Section S-6b – from those in the chemical industry. This allowed for distinct categorization regarding graduation, to account for the re-introduction of S-6b products into the GSP scheme in 2017.