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Free Trade Agreement (FTA) and Employment

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Free Trade Agreement (FTA) and Employment

Abstract

While FTA negotiations are proliferating, our paper shows that targeting the appropriate sector is crucial for generating employment opportunities subsequent to FTA. In particular, we show that, countering conventional wisdom, targeting skill-biased exports and not the sector that employs unskilled workers who usually constitute the large core of the unemployed, could ameliorate the unemployment problem. The mechanism hinges on how the demand for goods produced by the non-traded sector is stimulated by such a policy. If targeting the skilled sector with an FTA can stimulate local demand more, employment impact of FTA may be more significant.

JEL-Codes: C520, D500, F160, J210, J310.

Keywords: FTA, minimum wage, demand effect, non-tradable, employment, elasticity of substitution, factor-intensity.

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1. Introduction and Background

Proliferation of Free Trade Agreements (FTAs) and Preferential Trade Agreements (PTAs) and their multiple variants have brought the economies and regions closer tying them in every sphere, and affecting their national activities, viz., production, consumption, trade and organization of activities formally and informally. It affects employment, income, wage differentials, apart from facilitating international trade. FTAs aim to eliminate trade barriers and promote economic growth by fostering efficient resource allocation and specialization, and hence affecting labor market outcomes. However, concerns have been raised regarding the impact of FTAs on formal traded and informal sector activities, non-traded sectors, minimum wage and unemployment rates, especially in the context of the developing economies, where—unlike the developed economies as counterpart—informal sector activities and non-traded sectors have flourished with a huge share of GDP (national income). Informality is also a focus of SDG as SDG indicator 8.3.1.¹ According to ILO (2024): “The informal economy is a key challenge in today’s globalized economies for the rights of workers, sustainable enterprises, social protection and decent working conditions, the rule of law, public revenues and government’s scope of action. In that context, addressing informality by encouraging transition to formality is increasingly seen as an important dimension of inclusive development and growth strategies, and an important goal of employment policies.”² The existence of non-traded goods in the production set is not inconsistent with reality. In fact, most imported goods undergo local value-added processes before being made available for consumption, resulting in a situation where a significant portion of goods intended for final consumption are not considered traded items either—see Sanyal and Jones (1982). Often, it is

¹ <https://ilostat ilo.org/topics/informality/>

² <https://www ilo.org/ilo-employment-policy-job-creation-livelihoods-department/branches/employment-investments-branch/informal-economy> accessed on 28th August, 2024.

difficult to clearly differentiate or categorize the informal and non-traded activities as some unskilled workers work in there and their contribution is significant. Semi-skilled or unskilled workers are employed in these sectors as well as some formal sector manufacturing activities. In fact, ILO (ibid.) mentions that the informal economy occurs in a variety of forms across and within the countries and hence, policy needs to be tailored as per the specific circumstance of the countries and the work force. See Aggarwal (2023), Marjit and Kar (2011), ILO (2023). Often the connection between trade and informality is overlooked or inadequately addressed. Ernst and Leung (2023) mention that traditional trade theories--by assuming full employment and 'costless adjustment of the labor market'—do not offer adequate analysis by setting aside important but tenuous link. In particular, the emphasis has been laid on 'appropriate policy and regulatory framework' for structural transformation via export-led growth. This paper tries to fill this void.

The pertinent research question is: whether such FTAs have potential to address the unemployment problems looming large in the economies like India, China, Africa, and the alike, and if so, how and what should be the targeted objective so as to have positive aggregate employment effects. Why? This is because although almost non-existent in the Developed economies where fragmented labor markets are not so common—apart from skill heterogeneities—informal activities, existing side by side with the formal sectors, are almost everywhere in the emerging economies or the Southern Engines of Growth or the BRICSAM countries who have shown enormous growth in their real GDP over the past decades or so. Despite proliferation of PTA/FTA/RTA, the aspect of domestic employment generation through targeting appropriate sector is hardly touched upon.

The primary objective of this research is to find out the relative merits of signing FTA in skilled vis-à-vis the unskilled export sector for having positive aggregate employment effects for

the non-traded sectors employing the unskilled workers. By building a general equilibrium model (GEM), we show that if the country does FTA in the skilled sector as opposed to the formal export sector employing unskilled workers, it could generate aggregate employment in the economy. Thus, the ‘targeted sector’ for the FTA—on the contrary to the conventional wisdom—should be the skilled sector and their expansion with *a strong demand effect* resulting in more production of non-tradeable. This counter-intuitive result is derived by considering a general equilibrium structure in line with Jones and Marjit (1992), focusing on two distinct sectors: the skilled-intensive export sector and the unskilled-intensive manufacturing sector (also exportables). By analyzing these sectors separately, we aim to determine which sector benefits more from FTA implementation in terms of generating employment opportunities.

In recent decades, a significant amount of research, primarily based on empirical evidence, has extensively examined the impact of FTAs on employment. Given that free trade agreements are essentially mechanisms aimed at promoting trade between nations, empirical studies examining the impact of trade on employment are, in essence, similar to studies exploring the effects of free trade agreements on employment. Both types of research seek to understand how changes in trade patterns and volumes can influence employment outcomes. These studies have produced a range of outcomes, some of which are mixed and ambiguous. However, only a limited number of studies have focused on exploring the underlying reasons for these mixed results and identifying the policy measures that can influence and potentially alter these outcomes. In an interesting study French and Zylkin (2024) has shown using pooled product-level gravity model of 109 countries that post FTA there is trade-creation effects mostly for the ‘least-traded products’, i.e., the previously non-traded or small amount ones as opposed to the highly traded products.

Although no causal link has been explored, this has implications for re-alignment of dynamic comparative advantage in post-FTA scenario.

The study conducted by Malki and Thompson (2014) in the context of the free trade agreement between Morocco and the US revealed that the effects on national income and unemployment are indeterminate due to fluctuations in industrial prices. While export sectors in Morocco, such as mining, fishing, and manufacturing, are projected to experience advantages, import-competing industries like agriculture and textiles might face challenges. The urban wage is also expected to rise while the rural wage is likely to decline. Terzi (2011) has also reported similar ambiguous findings in their research. Song and Cieslik (2020) has studied the effects of FTAs on regional wages in China showing the different effects on firms' wages in border and coastal regions and contributing to increasing wage gap in general, and especially in the regions with more close proximity to the FTA partners. Mon and Kakinaka (2020) has explored such effects of bilateral Regional Trade Agreements (RTAs) and income inequality where for developing countries within-country inequality is reduced with not much effect for the developed ones. Plurilateral RTAs have no significant effects, though.

Pavcnik (2017) further supports this by highlighting the enduring and amplified adverse effects of trade on local labor markets in Brazil for up to 20 years after import liberalization. Similarly, Greenaway et al. (1999) researched the UK, utilizing a dynamic labor demand equation and a panel framework covering the years 1979 to 1991. Their findings reveal that increased trade volumes, both in imports and exports, contribute to a decline in derived labor demand, leading to higher levels of unemployment. In the context of NAFTA, Trachtenberg (2019) has estimated the positive employment effects of Mexican firms with more export opportunities and more so for the production workers with 32.8% increase in

employment. Also, Trachtenberg (2019) provided empirical evidence that increased import competition dampened the initial employment gains with a net positive impact of 13.7% in domestic employment. But they do not consider the case of minimum wage and non-tradable.

Contrarily, in the context of Vietnam, Kien and Heo (2009) discovered that the expansion of exports had a positive and statistically significant effect on derived labor demand. This indicates that the increased level of exports provided more employment opportunities for the country's abundant labor surplus. The estimated coefficient for imports is positive but statistically insignificant, implying that imports do not necessarily lead to adverse employment effects. As a result, the country's integration into the global market has generated new job opportunities, particularly in labor-intensive manufacturing sectors such as textiles, garments, and footwear. The substantial growth in exports within these industries has helped address the issue of labor surplus in Vietnam.

Nevertheless, the varied and uncertain outcomes observed in different countries' studies lack a well-established theoretical framework to explain such results. In response to this gap, our research delves deeper into providing a theoretical underpinning to comprehend the factors or determinants contributing to this mixture of results and offers potential solutions to address this issue. The foundation of this study lies in the seminal work by Marjit, Acharya, and Ganguly (2020), the impact of minimum wage hikes on employment levels in a general equilibrium framework. Their findings challenge the conventional belief that an increase in minimum wage necessarily led to higher unemployment rates. Their research reveals a positive relationship between minimum wage hikes and employment, suggesting that such policies can potentially stimulate job creation in the economy. Similar findings were discussed by Card and Krueger (1993) based on a case study of two adjacent cities. Wiltshire et al. (2024) reports similar findings

with a monopsonistic labor market effect, and more elastic labor supply in the tight labor market after the pandemic. In a recent empirical study Dubey and Lindner (2024) have surveyed the impact of minimum wage policies on earnings of low-wage workers, direct employment, wage inequality and income distribution for countries at different levels of development. They highlight the importance of such policies on employment and the role of other inputs like capital and high-skilled workers on employment of low-skilled workers.

Understanding the differential impact of FTAs on skilled and unskilled sectors is crucial for policymakers and stakeholders alike. The decision to grant trade preferences or concessions to a particular sector can have far-reaching consequences on employment rates, wage levels, and overall socio-economic well-being. This study aims to provide valuable insights that can guide policy formulation and optimize the benefits of FTAs via creating employment opportunities.

Building upon Marjit et al. (2021), this paper offers further analysis to include the effects of FTAs on employment dynamics. The key point of the paper is to show which of the exports sectors should be open to FTA so that employment opportunities expand. Contrary to the conventional wisdom that for generating employment of the unskilled or semi-skilled workers, negotiating FTA for the traditional or low-skill manufacturing exports, such as, light manufacturing (textiles, clothing, footwear, etc.) could be beneficial, we show that, in fact, under certain plausible scenarios, FTA in the skill-biased sector could serve the purpose fruitfully. We build a model where we show that in an economy having both skilled and unskilled exports and consuming imported goods and non-tradeable, targeting FTA in the skill-biased exports is conducive for generating aggregate employment provided there is enough trade surplus to sustain demand for the non-traded. We have 3 sectors, viz., specific skill-biased Z sector, a non-traded sector N, which is labor-intensive compared to relatively unskilled manufacturing sector, X.

[X-N] is a Heckscher-Ohlin nugget while Z is specific factor structure a la Jones ad Marjit (1992).

Section 2 presents the basic model with 3 sectors (skilled and unskilled export sector and a non-traded sector) and 3 factors (mobile unskilled and sector-specific immobile skilled workers and mobile capital), blending specific factors and Heckscher-Ohlin Nugget model. Section 3 presents the comparative static FTA scenarios with results. Section 4 concludes.

2. Core Model

A small open economy produces three goods: two export goods – X and Z and a non-traded good “N” under perfect competition, Constant returns to scale (CRS) technology and DMR to inputs. As a small open economy, World prices for X and Z are exogenous determined in the world market. Sector Z uses skilled labor(S) specific to the sector and mobile capital (K) to produce output whereas export good X and the non-traded good N are produced by sectorally mobile physical capital (K) and unskilled labor(L). Rate of return to capital (r) and skilled wage (w_s) are flexible. Competitive markets ensure that there is full utilization of the resources. On the other hand, since there is institutionally fixed minimum wage (nominal) for unskilled workers (\bar{w}), this leads to an initial equilibrium where some unskilled workers remain unemployed.

Furthermore, the country imports “M”. We assume that the domestic economy consumes the non-traded good (N) and imported good (M), *but not* the two export goods. Imported goods and the non-traded goods are consumed via homothetic demand structure, and the relevant price level (CPI) is a weighted average of price of non-tradables as well as imported consumption goods. They do not consume the export goods, but only “M” and “N”. We assume that the demand functions facing the consumers are based on underlying Cobb-Douglas preference or Utility function and hence, constant proportions of income are spent on N and M.

Fixed minimum wage is not allowed to change. However, it is quite likely that the negotiated contract wage might adjust to changes with the general price level. Thus, $\widehat{W}'(CPI) > 0$ and nominal wage might tend to rise independent of consumption as unskilled export sector – following the FTA negotiation—becoming lucrative might expand as well. Thus, \bar{W} might rise a bit (see Marjit, Ganguly and Acharya 2021).³ As \bar{W} adjusts, rate of return on capital will also change. If price of unskilled exports falls in the world market, that sector contracts and \bar{W} adjusts downward, ‘r’ will fall and there will be excess demand for non-traded goods (as its cost-determined price falls) equal to the surplus in trade balance. Employment will increase. On the contrary, with fixed \bar{W} , real wage does not change with sticky prices in the short run. Only with rise in CPI, real wages fall to generate more employment in a Keynesian fashion.

Perfect competition in the three sectors yields the following competitive equilibrium conditions or, Price-average cost relations (i.e., zero profit conditions):

$$\bar{W}a_{LX} + ra_{KX} = P_X \quad (1)$$

$$W_S a_{SZ} + ra_{KZ} = P_Z \quad (2)$$

$$\bar{w}a_{LN} + ra_{KN} = P_N \quad (3)$$

We can take prices of X (P_X^*) and Z (P_Z^*) as numeraire as the world prices are exogenously given. P_M is the world price of imported consumption good. P_N is the price of the non-traded good. X-N form a Heckscher-Ohlin Nugget (Jones and Marjit 1992).

$a_{ij}(i = L, K; j = X, N)$ and $a_{hz}(h = S, K)$ are per unit requirements of i^{th} input (or h^{th} input) in production of good j (good Z) and they depend on the relevant factor price ratios:

$$a_{ij} = a_{ij}(\bar{w}/r), i = L, K; j = X, N \quad (4a)$$

$$a_{hz} = a_{hz}(W_S/r), h = S, K \quad (4b)$$

³ See section 2.2 of Marjit et al. (2021) for the case of hike in minimum wage.

Full employment conditions for skilled labor and capital, and aggregate employment of unskilled labor are given as:

$$a_{sz}Z = \bar{S} \quad (5)$$

$$a_{kx}X + a_{kn}N + a_{kz}Z = \bar{K} \quad (6)$$

$$a_{lx}X + a_{ln}N = L_e \quad (7)$$

From (6), we can determine the value of Z & putting it in (6) we can get:

$$a_{kx}X + a_{kn}N = \bar{K} - \frac{a_{kz}\bar{S}}{a_{sz}} \quad (6a)$$

Based on (4a) and (4b), (6a) can be written as:

$$a_{kx}X + a_{kn}N = \bar{K} - \frac{a_{kz}}{a_{sz}} \left(\frac{W_s}{r} \right) \bar{S} \quad (6b)$$

For closing the model, we now specify the demand structure with Cobb-Douglas aggregate preferences for ‘M’ and ‘N’. Given the assumption that constant proportions of income are being spent on ‘N’ and ‘M’, i.e., Cobb-Douglas aggregate utility curve (CRTS), ratio of expenditures on imports and non-trade remain unchanged and depends on the price of non-traded goods (P_N) to the world price of the imported good (P_M), along with the aggregate real income (Ω). For the N-sector, the domestic market for non-traded goods must clear (i.e., equilibrium). This equilibrium condition can be represented as:

$$D_N \left(\frac{P_N}{P_M}, \Omega \right) = N \quad (8)$$

where Ω : Aggregate GDP/ income of the small open economy

Macroeconomic equilibrium implies trade balance and the aggregate income-expenditure balance where the right-hand side is the aggregate value of production or GDP (produced income) and left-hand side is the aggregate expenditure:

$$P_M D_M + P_N D_N = P_N N + P_X X + P_Z Z \quad (9)$$

Since non-traded good is consumed domestically only, $P_N D_N = P_N N$ must hold for equilibrium in the domestic market which implies, following Walras's Law, that trade is balanced *with prices set to unity*:

$$D_M = X + Z \quad (10a)$$

Now, for demand functions derived from Cobb-Douglas utility function with CRTS, as constant proportions of national income are spent on these goods, i.e., ' α ' and ' $(1 - \alpha)$ ' be the proportions spent on non-traded (N) and imported good (M) respectively.⁴ Hence, if $P_x = P_z = 1$,

$$D_M = (1 - \alpha)(P_N N + X + Z) / P_M, D_N = \frac{\alpha (P_N N + X + Z)}{P_N} \quad (11)$$

However, GDP from factor-income side or at factor cost is given by:

$$W_s S + r.K + \bar{W}.L_e = \Omega \quad (10b)$$

Based on National Income accounting, GDP from income, expenditure, and production side should ensure be equal for macroeconomic equilibrium in the circular flow of production/income so that

$$W_s S + r.K + \bar{W}.L_e = \Omega = P_N N + P_X X + P_Z Z \quad (10c)$$

Hence, we can write further: $D_N = \alpha \Omega / P_N, D_M = (1 - \alpha) \Omega / P_M$. (10d)

All these boils down with simplification to:

$$\frac{\alpha}{1 - \alpha} \frac{[W_s S + r.K + \bar{W}.L_e]}{P_N} = N \quad (12)$$

Equation system (1), (2), (3), (6b), (7) and (12) are 6 equations to determine W_s, r, P_N, X, N and L_e . Six a_{ij} s, and Z are determined via (4a), (4b) and (5). This determines the equilibrium. It is pertinent to note that, given the a_{ij} and a_{hz} , the world market price of Z and X , and \bar{W} , $P = AC$ conditions above fixes ' r ' uniquely and that, in turn, fixes the price of "N" sector (P_N). " D_N " does

⁴ $U = N^\alpha M^{1-\alpha}$ is Cobb-Douglas.

not affect P_N , as it is cost-determined.⁵ Interestingly, for the specific-factor skilled-sector ‘Z’—given skilled wage, and a_{hz} —output depends on supply of skilled labor and capital (K). But as ‘K’ is perfectly mobile across 3 sectors, outputs of ‘X’, and ‘N’ and the corresponding adjustments in intersectoral demand for ‘K’ will simultaneously determine the level of employment (L_e).

To show the aggregate employment effect (L_e), we consider Figure 1 below as the benchmark case for determination of equilibrium in the unskilled labor market.

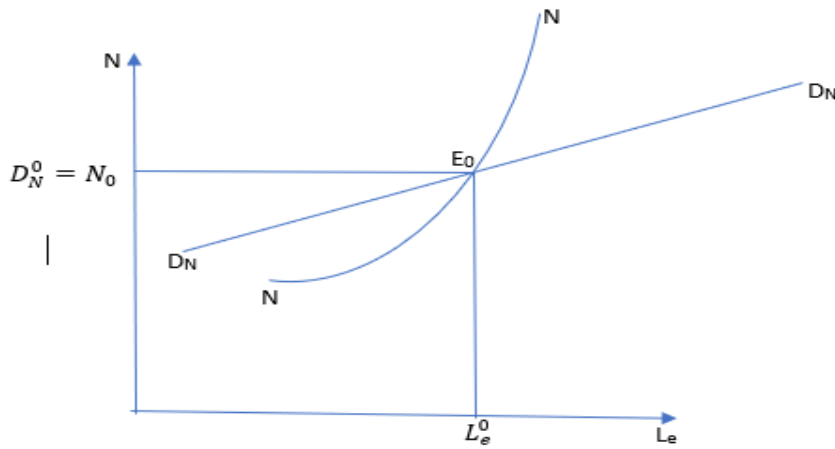


FIGURE 1: Aggregate employment determination in the Non-traded Sector

For the non-traded good, both the supply and demand for ‘N’ vary with the aggregate employment. With rise in the level of aggregate employment (L_e)—given ‘Z’ and technology coefficients—outputs “N” goes up as ‘N’-sector is relatively more L-intensive than ‘X’. Thus, we get an upward-sloping supply curve ‘NN’ as in Figure 1. The $D_N D_N$ curve is the upward-sloping demand for ‘N’ because a rise in aggregate employment (L_e) increases national income (Ω) with unambiguous expansion of N-production, and that is more so, if due to FTA-induced spillover effects via ‘Z’ and/or, ‘X’ sector creates dominant demand thrust. Then, ‘X’ might

⁵ See page 5 for discussion on the possibility of upwardly minimum wage adjustments.

contract. With Cobb-Douglas case, the demand for ‘N’ rises proportionately with Ω as L_e rises. $E_0(N_0, L_e^0)$ is the market-clearing point with flatter ‘ $D_N D_N$ ’ curve guaranteeing Marshallian stability. Adjustments and employment effects due to FTA targeting are explored in section 3 below. Here we consider the relative merits of doing FTA either in Z or X sector.

3. Comparative Statics effects of a Bi-lateral FTA

3.1 Targeting FTA in the Z-sector

The reciprocal FTA in the present context means that foreign country’s tariffs on ‘Z’ is reduced and local or domestic economy’s tariff on ‘M’ is also curtailed as reciprocal agreement. Thus, following bilateral FTA ratification in the local (home) economy prices of ‘X’ and ‘Z’ rise and that of ‘M’ falls. Hence, FTA implies that prices faced by the exporter rise and that of importer in respective countries fall. The country is forced to import more as the price of imported consumption goods declines. As ‘M’ is not produced internally in the home market, it might cause a balance-of-payments problem causing a squeeze on demand for the non-traded sector resulting in a fall in production of ‘N’ and aggregate employment might fall as L_e shrinks. However, given prices and other parameters our purpose is to explore aggregate employment effect of FTA in ‘Z’.

In particular, we can show how \hat{L}_e is related to $\hat{P}_Z > 0$. After totally differentiating (1), (2) and (3) we get the equations for competitive markets following Jones 1965, 1971 and 2018:

$$\Theta_{LX} \hat{\bar{W}} + \Theta_{KX} \hat{r} = \hat{P}_X \quad (1^*)$$

$$\Theta_{SZ} \hat{W}_S + \Theta_{KZ} \hat{r} = \hat{P}_Z \quad (2^*)$$

$$\Theta_{LN} \hat{\bar{W}} + \Theta_{KN} \hat{r} = \hat{P}_N \quad (3^*)$$

where,

Θ_{ij} : share of cost of input i in average cost of producing good j &

$\hat{a} = \frac{da}{a}$; “hat” over a variable denotes its proportional change

‘X’ has unemployed workers with fixed nominal wage due to minimum wage regulation. From (1*) we can see that if $\hat{P}_X = 0$, \hat{W} is 0, since \bar{W} is the institutionally fixed minimum wage with nominal wage rigidity, hence $\hat{r} = 0$ i.e., rate of return from capital does not change. Price of nontraded good is not changing so that $\hat{r} = 0$ & $\hat{W} = 0$ from (3*), $\hat{P}_N = 0$. Hence, this does not serve the purpose of generating employment opportunities as national income would not rise with unchanged ‘r’ and ‘W_s’ (when $\hat{P}_X = 0 \Rightarrow \hat{P}_N = 0$) and that might lead to contraction in demand and output for X as well as N, too.

Now if Z sector is targeted for FTA, there is a fall in tariff rate in the skilled sector (Z) *in the foreign country* with which the home country has an FTA. As mentioned before, the price of imports (P_M) falls in the home due to reciprocal FTA. Then $\hat{P}_Z > 0$, and from (2*) there is an increase in the wage of skilled labor ($\hat{W}_S > 0$). As $\hat{W}_S > 0$ & $\hat{r} = 0 \Rightarrow (\hat{W}_S - \hat{r}) > 0$; we can say $(\hat{a}_{kz} - \hat{a}_{sz}) > 0$, which implies $\frac{a_{kz}}{a_{sz}}$ will increase.

But the important thing to note is that—following Cobb-Douglas preferences, proportions spent on each of ‘M’ and ‘N’ remain unchanged with constant budget share, i.e., $P_M D_M, P_N D_N$ are just expenditures on two types of consumption from the national income (GDP/GNI) so that:

$$\beta \equiv (1 - \alpha)\Omega = P_M D_M \quad (13)$$

where $\Omega = W_S S + r.K + \bar{W}.L_e$.

As α and β are constant, if ‘ L_e ’ rises, both $P_M D_M, P_N D_N$ will rise. But, with *ex post* FTA and fall in P_M , D_M will rise in the local economy. If LHS of (13) is unchanged (i.e., $\Omega = \bar{\Omega}$) then

$P_M D_M, P_N D_N$ will not rise as well. Thus, a fall in P_M does not affect total spending on the non-

traded goods. Hence, consumption of non-traded goods is not altered even with favorable relative price changes between imported goods vis-à-vis the local production. In this case, if following the FTA demand for “N” increases significantly then only aggregate employment could rise.

However, a more comprehensive demand pattern could illustrate that our previous results are *not dependent on certain assumptions* and our findings hold true regardless of whether preferences are homothetic. See Marjit, Acharya and Ganguly (2021) for exposition on general demand structure in the context of minimum wage hike. For the current focus, it does not undermine our purpose.

We now turn to the case of Rybczynski ‘endowment’ effects, and output effects due to changes in price of Z, causing resource reallocation. Since (\bar{W}, r, P_N) are all fixed, following Jones (1965, 2018) we can derive:

$$\lambda_{KX} \hat{X} + \lambda_{KN} \hat{N} = -\lambda_{KZ} \sigma_Z \hat{W}_S \text{ where } \sigma_Z : \text{factor substitution elasticity.}$$

FTA in abroad increases the skilled wage rate for any given world price of the export goods X and Z, and the corresponding no change in the rate of return to capital ‘r’ ($\hat{r}=0$); thereby raising the wage rental ratio in the skilled sector: $\hat{W}_S = \frac{\hat{P}_Z}{\theta_{SZ}}$ (14a)

Thus:

$$\lambda_{KX} \hat{X} + \lambda_{KN} \hat{N} = -\lambda_{KZ} \sigma_Z \frac{\hat{P}_Z}{\theta_{SZ}} = -\mu \frac{\hat{P}_Z}{\theta_{SZ}} \quad (14b)$$

where $\mu = \lambda_{KZ} \sigma_Z$

$$\text{Also, } \lambda_{LX} \hat{X} + \lambda_{LN} \hat{N} = \hat{L}_e \quad (15)$$

$$\text{From (14b), } \hat{X} = \frac{-\mu \hat{P}_Z - \lambda_{KN} \hat{N} \theta_{SZ}}{\lambda_{KX} \theta_{SZ}} = \frac{-(\lambda_{KZ} \sigma_Z \hat{P}_Z + \lambda_{KN} \hat{N} \theta_{SZ})}{\lambda_{KX} \theta_{SZ}} \quad (15a)$$

Using (15), $\lambda_{LX} \left[\frac{-\mu \widehat{P}_Z - \lambda_{KN} \widehat{N} \theta_{SZ}}{\lambda_{KX} \theta_{SZ}} \right] + \lambda_{LN} \widehat{N} = \widehat{L}_e$, which simplifies to:

$$\frac{\lambda_{LX}}{\lambda_{KX} \theta_{SZ}} [-\mu \widehat{P}_Z] - \frac{\lambda_{LX}}{\lambda_{KX}} \lambda_{KN} \widehat{N} + \lambda_{LN} \widehat{N} = \widehat{L}_e$$

Collecting terms,

$$\widehat{N} \left[\lambda_{LN} - \frac{\lambda_{LX}}{\lambda_{KX}} \lambda_{KN} \right] = \widehat{L}_e + \frac{\lambda_{LX}}{\lambda_{KX} \theta_{SZ}} \mu \widehat{P}_Z \quad (16a)$$

$$\Delta \widehat{N} - \widehat{L}_e = \frac{\lambda_{LX}}{\lambda_{KX} \theta_{SZ}} \mu \widehat{P}_Z \quad (16b)$$

where $\Delta = \left[\lambda_{LN} - \frac{\lambda_{LX}}{\lambda_{KX}} \lambda_{KN} \right] = \frac{1}{\lambda_{KX}} [\lambda_{LN} \lambda_{KX} - \lambda_{LX} \lambda_{KN}] = \frac{1}{\lambda_{KX}} |\lambda| > 0$

As X is relatively K-intensive and N is L-intensive, $\lambda_{LN} > \lambda_{KN}, \lambda_{KX} > \lambda_{LX}$ therefore, $\Delta > 0$ and

$$\theta_{KX} > \theta_{KN}, \theta_{LN} > \theta_{LX}.$$

From (12), taking total differential and proportional changes (as $\widehat{P}_X = \widehat{P}_N = 0, \hat{r} = 0$ hence,

$\gamma_K \cdot \hat{r} = 0, \gamma_K \neq 0$) so that we get:

$$\gamma_S \cdot \widehat{W}_S + \gamma_L \cdot \widehat{L}_e = \widehat{N} \quad (17)$$

where γ_i = respective factor shares for i= S, L_e in the national income. As $\widehat{W}_S = \frac{\widehat{P}_Z}{\theta_{SZ}}$,

$$\gamma_S \cdot \frac{\widehat{P}_Z}{\theta_{SZ}} + \gamma_L \cdot \widehat{L}_e = \widehat{N} \quad (17a)$$

From (16b) we can rewrite, after manipulation, as below: -

$$\widehat{N} \cdot \Delta \cdot \lambda_{KX} - \lambda_{KX} \cdot \widehat{L}_e = \frac{\lambda_{LX}}{\theta_{SZ}} \mu \widehat{P}_Z \quad (18a)$$

Now $\Delta.\lambda_{KX} = |\lambda|$ where $|\lambda| = \lambda_{LN} - \lambda_{KN} = \lambda_{KX} - \lambda_{LX} > 0$. Hence, (18a) can further be simplified as:

$$|\lambda|.\widehat{N} - \lambda_{KX}.\widehat{L}_e = \frac{\lambda_{LX}}{\theta_{SZ}} \mu \widehat{P}_Z \quad (18b)$$

From (17), we can rewrite: $\widehat{N} - \gamma_L.\widehat{L}_e = \gamma_S.\frac{\widehat{P}_Z}{\theta_{SZ}}$ (19a)

$$\frac{1}{\gamma_L} \widehat{N} - \widehat{L}_e = \frac{\gamma_S}{\gamma_L} \frac{\widehat{P}_Z}{\theta_{SZ}} \quad (19b)$$

On further simplification, it yields the following *positive relationship* between \widehat{P}_Z and \widehat{L}_e (*see Appendix*): -

$$\widehat{L}_e = \frac{\widehat{P}_Z}{\theta_{SZ} D} [(\lambda_{KX} - \lambda_{LX})\gamma_S - \frac{\lambda_{LX}.\lambda_{KZ}\sigma_Z}{\lambda_{KX}.\gamma_L}] \quad (20a)$$

where $D = -\gamma_L|\lambda| + \lambda_{KX} > 0$ is the determinant of (18b) and (19) and the terms after

simplification yields: $\lambda_{KX}(1 - \gamma_L) + \lambda_{LX}\gamma_L > 0$. Thus, $\widehat{L}_e > 0$ with $\widehat{P}_Z > 0$ iff

$$(\lambda_{KX} - \lambda_{LX})\gamma_S > \lambda_{KZ}\sigma_Z \cdot \frac{\lambda_{LX}}{\lambda_{KX}.\gamma_L} \quad (21)$$

Equation (21) is quite intuitive. The adjustment mechanism following the signing of FTA in skilled export good Z is as follows. If the *factor intensities are far apart* between X and N (i.e., $\lambda_{LX} \cong 0, \lambda_{KN} \cong 0$), LHS of (21) will be stronger and RHS of (21) will be weaker. Here, as P_z rises, K moves to Z from Capital-intensive X sector, and $\widehat{P}_Z > \widehat{P}_X = 0 \Rightarrow \widehat{Z} > 0$. 'X' will not contract that much unless 'K' moves out substantially. 'N' is L-intensive and hence, not affected via supply-side effect, i.e., $\widehat{L}_e > 0$. Effects on 'Z' and L_e of a rise in P_z will depend on magnitudes of $\sigma_Z, \lambda_{KX}, \lambda_{KZ}$ and γ_S (representing the strength of demand following a rise in 'W_s' ,

i.e., whether σ_Z is high or low driving factor-substitution between ‘K’ and ‘L’, and endowment-shares of K and L in X vis-à-vis N. Two possibilities are discussed below.

High $\sigma_Z > 0$ means $\lambda_{KZ}\sigma_Z$ high, Z increases much via factor substitution in favor of ‘K’. In this case, as ‘K’ moves out from ‘X’ sector, Z expands, but “ L_e ” is not affected by contraction of ‘X’-sector as $\lambda_{KX} > \lambda_{KN} \cong 0$. However, much Stronger demand effect is necessary to dominate employment effect. Higher $\lambda_{KZ}\sigma_Z$ means \hat{Z} is higher and more capital will enter to the Z-sector, affecting “ L_e ” more severely. Labor might move out of ‘X’ to ‘N’ as $\lambda_{LN} > \lambda_{LX} \cong 0$. If capital cost increases, Z sector might be affected and then the extent of ‘net’ shift matters.

With very low $\sigma_Z \cong 0$, Z does not increase that much without factor substitution between (K, S). As ‘K’ does not leave the (X, N) nugget/enclave, X/N does not change at all and neither does Z expand. X will contract little or not at all due to endowment effect when factor-substitution scope is quite low or zero. No change in aggregate employment *from the supply side effects* (maintains at least the same level of ‘ L_e ’). (X, N) nugget production does not change. Rybczynski or endowment effect works here due to assumption of almost weak or negligible factor-substitution elasticity. For $\sigma_Z \cong 0$, $\hat{L}_e > 0$ as $\lambda_{KX} > \lambda_{LX}$. With rise in “ W_s ” as ‘ P_z ’ rises, $\lambda_{KX}\gamma_s$ is very high as X is K-intensive and

$$\hat{L}_e \cong \frac{\hat{P}_Z}{\theta_{SZ}D}(\lambda_{KX} - \lambda_{LX})\gamma_s > 0 \quad (20b)$$

When $\lambda_{LX} \cong 0$, $\hat{L}_e \cong \frac{\hat{P}_Z}{\theta_{SZ}D}(\lambda_{KX}\gamma_s) > 0$.

However, in both cases for any given world price of the export goods X and for given r ($\hat{r}=0$) and \bar{W} , an increase in W_s increases *the national income* “ Ω ” (since, $\Omega = \bar{W}L_e + rK + W_sS$). Given NN and L_e , increase in “ Ω ” increases the aggregate employment with $\hat{D}_N > 0$ (shifting it up),

which ultimately increases L_e . Also, there is *increased demand for imports*. To finance the additional import bill and maintain the trade balance, the aggregate value of exports $[P_x X + P_z Z]$ must rise. With Cobb-Douglas case, expenditure shares on non-traded and imported goods remain the same even though “ P_M ” falls or “ P_N ” changes a bit or not. For the *same* L_e , ‘N’-supply will rise depending on the extent of rise in ‘ D_N ’. Given $\hat{r} = 0, \hat{W} = 0, \hat{N} > 0 \Rightarrow \hat{L}_e > 0$.

Skill-based output Z increase is given by:
$$\hat{Z} = \hat{P}_z \sigma_z \theta_{KZ} / \theta_{SZ} \quad (20c)$$

At the initial production and exports of X, if the increase in the production and exports of Z is larger than the increased import bill, then there is *current account surplus*, excess demand for the non-traded good and corresponding increase in the output of ‘N’. If additional production of skilled intensive export good Z withdraws some capital from (X, N) nugget (i.e., $\sigma_z > 0$), increase in the output of non-traded good ($\hat{N} > 0$) in response to excess demand for it would necessitate a fall in the production of K-intensive X ($\hat{X} < 0$). Therefore, a sufficiently large expansion of ‘Z’ is required to cause ‘N’ and ‘ L_e ’ to expand.

Thus, there are various ways “ L_e ” *can increase* even if the target is skilled export sector where no unskilled worker is employed, and it is the unskilled workers who usually suffer from unemployment (in X and/or, N).

Figure 2 depicts the mechanism where the initial equilibrium is at point E_0 . With $\sigma_z \neq 0$, the Z sector absorbs a portion of capital from the capital-intensive X sector, with possible contraction in the X sector. Consequently, some unskilled laborers transition from the X sector to the labor-intensive N sector. Hence, *at a given level of employment (L_e^0) from supply side NN curve will shift up* unambiguously. ‘Z’ and ‘N’ will have production complementarity (see Marjit et al. 2021). As ‘ W_s ’ rises resulting in a rise in the overall income of the economy, it causes a upward shift in the $D_N D_N$ curve. To achieve an expansion in aggregate employment, it is crucial to have

an excess demand situation in the non-traded sector, where the additional demand for labor surpasses the additional supply of labor.

However, if D_N is the same and 'N' supply adjusts to that $D_N = \overline{D_N}$, L_e must shrink and P_N falls, too (due to lack of demand). As ' L_e ' is squeezed, D_N falls as $GNE = \Omega = W_s S + rK + \overline{W}L_e$ shrinks causing further decline in ' L_e ' below ' L_e^0 ' (see Figure 2). *This decline will be much less if D_N line is inelastic.* FTA in Z sector in that case will release less skilled labor by capital, hence capital shortage in the X sector and unskilled labor surplus in N sector will be less, N will expand less and hence shift of NN will be smaller. Therefore, the demand for non-traded goods continues to increase in line with aggregate employment, as observed previously.

Above result will be reversed if D_N rises (as $\widehat{W_s} > \widehat{W} = \hat{r} = 0$), GNE expands, demand effects dominate, and 'NN' supply adjusts accordingly due to demand push effect. The initial impact on ' L_e ' before demand changes should be relatively insignificant for favorable aggregate employment effect. For ' L_e ' not to move in the direction so that targeting Z is counter-productive or futile, the straight line ' D_N ' must be quite elastic so that the strength of the demand effect – and the shift in the $D_N D_N$ curve---reigns over supremely. Thus, it pushes ' L_e ' above ' L_e^0 ' to ' L_e^1 '. With almost zero factor-substitution, only the demand shifts and the condition for $\widehat{L_e} > 0$ is: share of expenditure of the skilled sector (Z) is greater than the share of the K-intensive sector (X) and relative cost shares in Z ($\frac{\theta_{KZ}}{\theta_{SZ}}$). Hence, we can have a case when targeting Z will raise employment.

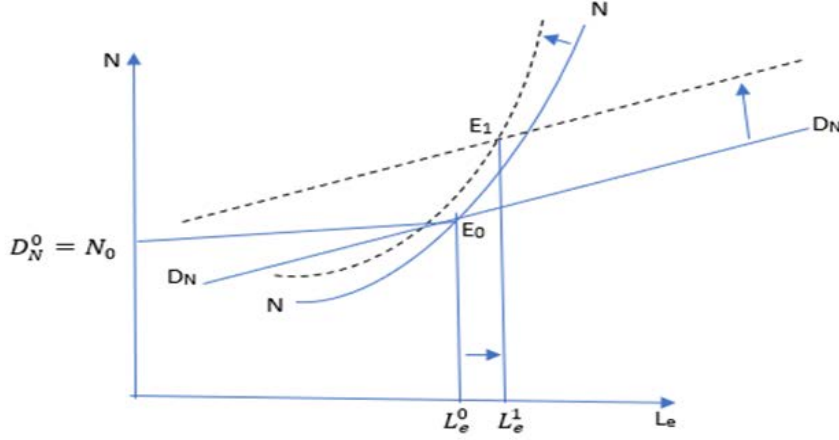


FIGURE 2: FTA targeted for Skilled sector Z and employment effect.

3.2 FTA in the Capital-intensive Unskilled Sector

Consider now a fall in tariff rate in the X-sector in the foreign country, being subject to FTA negotiations. Given fixed P_Z , we get the following equations:

$$\theta_{LX}\widehat{W} + \theta_{KX}\hat{r} = \widehat{P}_X \quad (1^*)$$

$$\theta_{SZ}\widehat{W}_S + \theta_{KZ}\hat{r} = 0 \quad (2^*)$$

$$\theta_{LN}\widehat{W} + \theta_{KN}\hat{r} = \widehat{P}_N \quad (3^*)$$

Based on Eq. (1^{*}), $\widehat{P}_X > 0$ and it can be inferred that $\widehat{W} = 0$. Consequently, $\hat{r} > 0$. According to Eq. (3^{*}), the *cost-determined* price of non-traded goods will rise. The fixed international price in the Z sector leads to a decrease in the wage of skilled labor ($\widehat{W}_S < 0$) following eq. (2^{*}). Now as $\widehat{W}_S < 0$ & $\hat{r} > 0 \Rightarrow (\widehat{W}_S - \hat{r}) = \left(\widehat{W^S/r}\right) < 0$; we can say $(\widehat{a_{kz}} - \widehat{a_{sz}}) < 0$. If X is targeted, Capital (K) flows in there as X is K-intensive ($\lambda_{KX} > \lambda_{LX}$).

For any given world price of the export goods X and Z, and fixed nominal wage \overline{W} :

$$\hat{r} = \frac{\hat{P}_X}{\theta_{KX}} \quad (22)$$

From the competitive market conditions in the skill-intensive Z sector. Considering the Eq. (2*), given no change in the world price of good 'Z'.

$$\hat{W}_S = -\frac{\theta_{KZ}}{\theta_{SZ}} \frac{\hat{P}_X}{\theta_{KX}} \quad (23)$$

With \bar{W} (fixed) and $\hat{r} > 0$, it raises the cost-determined price of the non-traded good:

$$\hat{P}_N = \theta_{KN} \frac{(\hat{P}_X)}{\theta_{KX}} \quad (24)$$

There is a change in demand for the non-traded goods (D_N), with a lowering of its demand and consequently its output. The aggregate employment *might fall* on this account. From (12) using (22), (23) and (24), after algebraic manipulation we can write (*see Appendix for detailed derivation*):

$$\gamma_s \left(-\frac{\theta_{KZ}}{\theta_{SZ}} \cdot \frac{\hat{P}_X}{\theta_{KX}} \right) + \gamma_K \frac{\hat{P}_X}{\theta_{KX}} + \gamma_L \hat{L}_e - \hat{P}_X \frac{\theta_{KN}}{\theta_{KX}} = \hat{N} \quad (24a)$$

And this boils down to:
$$\frac{\hat{P}_X}{\theta_{KX}} \left[-\gamma_s \frac{\theta_{KZ}}{1 - \theta_{KZ}} + \gamma_K - \theta_{KN} \right] + \gamma_L \hat{L}_e = \hat{N} \quad (25a)$$

And
$$\hat{X} = \frac{1}{|\lambda|} \left[\frac{\hat{P}_X}{\theta_{KX}} \left[\lambda_{LN} (\delta_K + \lambda_{KZ} \sigma_Z \frac{\theta_{KZ}}{\theta_{SZ}} + \lambda_{KN} \delta_L) \right] - \lambda_{KN} \hat{L}_e \right] \quad (25b)$$

Also,
$$\hat{L}_e = \frac{\hat{P}_X}{D \cdot \theta_{KX}} |\lambda| \left[-\gamma_s \frac{\theta_{KZ}}{1 - \theta_{KZ}} + \gamma_K - \theta_{KN} \right] + [\delta_L \lambda_{KX} + \lambda_{LX} (\delta_K + \lambda_{KZ} \sigma_Z \cdot \frac{\theta_{KZ}}{1 - \theta_{KZ}})] \quad (26)$$

Here $\delta_f, f = L, K$ is aggregate percentage saving in respective factor inputs ('f') due to 1% rise in relative factor returns at unchanged output (Jones 1965). It is related to elasticities of substitution ($\sigma_N, \sigma_X, \sigma_Z$) in sectors $i \neq j$ as factor price changes alter factor-proportions in $i \neq j$.

Thus, $\hat{L}_e < 0$, with $\hat{P}_X > 0$ iff

$$[\gamma_s \frac{\theta_{KZ}}{1-\theta_{KZ}} + \theta_{KN}] > [\gamma_K + (\delta_L \lambda_{KX} + \lambda_{LX} \delta_K + \lambda_{LX} (\lambda_{KZ} \sigma_Z \cdot \frac{\theta_{KZ}}{1-\theta_{KZ}}))] \quad (27)$$

The strength of the condition (27) depends on substitution elasticities. $\delta_L, \delta_K, \sigma_Z$ are three quantities for substitution elasticities. Here, $\delta_L = \lambda_{Lj} \theta_{Kj} \sigma_j + \lambda_{Li} \theta_{Ki} \sigma_i$, $\delta_K = \lambda_{Kj} \theta_{Lj} \sigma_j + \lambda_{Ki} \theta_{Li} \sigma_i$ ($i \neq j$) so that $\delta_L = \lambda_{LX} \theta_{KX} \sigma_X + \lambda_{LN} \theta_{KN} \sigma_N$ and $\delta_K = \lambda_{KX} \theta_{LX} \sigma_X + \lambda_{KN} \theta_{LN} \sigma_N$, depending on $\sigma_Z, \sigma_X, \sigma_N$.

If $\sigma_Z, \sigma_X, \sigma_N \cong 0 \Rightarrow \delta_L = 0, \delta_K = 0$. If $\delta_L, \delta_K, \sigma_Z > 0$ in (27) above, then the demand parameters

γ_s, γ_K become important with $\widehat{L}_e < 0$, with $\widehat{P}_X > 0 \Rightarrow \widehat{N} < 0$ iff

$$|\lambda| [\gamma_s \frac{\theta_{KZ}}{\theta_{SZ}} + \theta_{KN}] > \gamma_K + \lambda_{KX} \delta_L \text{ when } \lambda_{LX} \cong 0 \quad (28a)$$

Combinedly, given $|\lambda| > 0$ $\widehat{L}_e \geq 0$, with $\widehat{P}_X > 0 \Rightarrow \widehat{N} \geq 0$, iff

$$\gamma_K + \lambda_{KX} \delta_L \geq [\gamma_s \frac{\theta_{KZ}}{\theta_{SZ}} + \theta_{KN}]$$

If $\delta_L, \delta_K, \sigma_Z \cong 0$ in (27) above, then the demand parameters γ_s, γ_K become important with

$\widehat{L}_e < 0$, with $\widehat{P}_X > 0 \Rightarrow \widehat{N} < 0$ iff

$$|\lambda| [\gamma_s \frac{\theta_{KZ}}{\theta_{SZ}} + \theta_{KN}] > \gamma_K \quad (28b)$$

Then, combinedly, given $|\lambda| > 0$ $\widehat{L}_e \geq 0$, with $\widehat{P}_X > 0 \Rightarrow \widehat{N} \geq 0$, iff $\gamma_K \geq [\gamma_s \frac{\theta_{KZ}}{\theta_{SZ}} + \theta_{KN}]$ so that

demand parameters play important roles.

Thus, we can have a case when targeting Z increases employment but targeting X does not.

Assigning numerical values to $\lambda = \lambda_{KX} - \lambda_{LX}$ and θ_{ij} 's, γ_s, γ_K we can check the validity of this proposition.

We now show these changes via shifting of the curves. Since skilled labors are fully employed and now their wage has fallen, it leads to a contraction in the Z sector:

$$\hat{Z} = -\sigma_Z \Theta_{KZ} \frac{\hat{P}_X}{\Theta_{SZ} \Theta_{KX}} \quad (29)$$

As Z contracts, additional K flows into K-intensive X. At a given L_e , as X rises, N-production falls as labor moves to work with additional ‘K’ as there is rise in ‘r’. ‘N’ must contract and NN curve shifts down. Now, given \bar{W} , $\hat{W}_s < 0$ whereas $\hat{r} > 0$ increases aggregate income “ Ω ” (since, $\Omega = \bar{W}L_e + rk + W_s s$) unambiguously because $(\hat{r} - \hat{W}_s) > 0$. This boosts the aggregate employment as $\hat{D}_N > N > 0$. “N” starts increasing and this leads to an increase in the demand so that $\hat{L}_e > 0$. If ‘N’ comes back rising to the original level now, recovering due to the demand thrust, $\hat{L}_e > 0$ due to ‘coupled effect’ of expansion of (X, N). Employment boost will cause “ D_N ” to raise “ L_e ” more. Now, at a given L_e , as *except* income of the K-owners no other income rises, D_N will contract as ‘ P_N ’ rises (as $\hat{r} > 0$, $\hat{W}_s < 0$) and supply of ‘N’ will start falling causing ‘ L_e ’ to fall. If ‘NN’ curve is elastic, ‘ L_e ’ is very likely to be reduced due to a contraction in demand for ‘N’ (D_N). P_N rises, but $P_N D_N$ is fixed via Cobb-Douglas property. ‘N’ will contract from supply-side effect as ‘K’ moves from Z to X and ‘L’ moves from ‘N’ to X-sector to accompany mobile ‘K’. Supply curve shifts down for the same L_e . However, if demand straight line is ‘inelastic’, “ L_e ” will *not increase* much. This happens if the share of expenditure on N (as in Cobb-Douglas case, α_N) is substantial because it will need less rise in “ L_e ” to match increase in “N”.⁶ From the previous discussions, the following proposition is immediate: --

Proposition 1: Under acceptable conditions an FTA in the Z-sector will increase employment but FTA in X sector will not.

⁶ One can assume two different minimum wages in X and N with one in ‘N’ being lower. As same ‘Le’ is hired, those who do not find a job in X-sector go to N-sector accepting lower minimum wage (Cromwell 2015).

Proof: See the discussion above and Appendix for the Technical proof. (QED).

Intuition: First, consider an increase in \mathbf{Pz} and an increase in \mathbf{Px} , due to reciprocal FTA. Other things remaining the same, an increase in \mathbf{Pz} would increase the demand and output of N. With N being labor intensive, this effect would increase employment independent of changes in \mathbf{Pz} and \mathbf{Px} .

Next, to consider an increase in \mathbf{Pz} which raises W_s, r, k . \bar{W} remain the same. Increase in the income of skilled workers and the employment impact in the non-traded good-- as discussed above because of a rise in \mathbf{Pz} -- would further stimulate the demand for N. This works towards greater employment.

Finally, as K leaves X, L_x drops and unskilled workers crowd into N-sector. Also, lower wage bill in X reduces demand for N. This counters the first two effects and we derive the precise condition which would lead to a rise in the employment of unskilled workers.

FTA targeted for the skilled Z-sector will cause, ex post, $\widehat{W}_s > 0, \widehat{\Omega} > 0$ so that it translates into quite large demand for the non-tradables ($\widehat{D}_N > 0$). Thus, with $\widehat{P}_Z > 0, \widehat{L}_e > 0$ iff $(\lambda_{KX} - \lambda_{LX})\gamma_s > \lambda_{KZ}\sigma_Z \cdot \frac{\lambda_{LX}}{\lambda_{KX} \cdot \gamma_L}$ and $\lambda_{LX} \cong 0, \lambda_{KN} \cong 0$. For large $\sigma_z > 0$ and higher $\gamma_s, \widehat{Z} > 0$ and $\widehat{L}_e = \frac{\widehat{P}_Z}{\theta_{SZ}\lambda_{KX} \cdot D} \lambda_{KX}\gamma_s$. For $\sigma_Z \cong 0, \widehat{L}_e > 0$ as X does not contract but N could expand as $\theta_{KX} > \theta_{KN}$, $\theta_{LX} < \theta_{LN}$, and $\lambda_{KX} > \lambda_{LX}$. With FTA in the X-sector, $\widehat{P}_X > 0, \widehat{r} > 0, \widehat{W}_s < 0$ and $\widehat{L}_e < 0$, with $\widehat{P}_X > 0$ iff $|\lambda|[\gamma_s \frac{\theta_{KZ}}{1 - \theta_{KZ}} + \theta_{KN}] > [\gamma_K + (\delta_L \lambda_{KX} + \lambda_{LX} \delta_K + \lambda_{LX} (\lambda_{KZ} \sigma_Z \cdot \frac{\theta_{KZ}}{1 - \theta_{KZ}}))]$. If $\delta_L, \delta_K, \sigma_Z \cong 0$, then the demand parameters become important with $\widehat{L}_e < 0$, with $\widehat{P}_X > 0$ iff $|\lambda|[\gamma_s \frac{\theta_{KZ}}{\theta_{SZ}} + \theta_{KN}] > \gamma_K$. However, the effect on \widehat{L}_e depends on elasticity of the $D_N D_N$ and NN curves with less pronounced effect with inelastic demand.

Figure 3 illustrates the adjustments. The initial equilibrium is at point E_0 . From the figure, the expansion of the X sector alone leads to a rise in aggregate employment (L_e), even if the $D_N D_N$ curve remains static. Whether the $D_N D_N$ curve shifts upwards or downwards depends on factors such as changes in real income and the contraction of the N sector, and demand effect.

Despite a decline in Z output, aggregate employment would increase first due to the increase in the non-traded goods production. At the initial equilibrium level of employment, the

NN curve will shift downward because of the increase in prices faced by exporters due to the FTA in X. The Stolper-Samuelson effect causes an increase in the rental rate and capital is substituted by labor, resulting in a labor shortage. No Rybczynski effect is here. The demand for non-traded goods rises with an increase in aggregate employment as before. Due to demand contraction, boost in L_e is countered and L_e drops. As we see, more pronounced demand contraction causes “ L_e ” to even fall below the initial equilibrium level while smaller adverse demand shock causes “ L_e ” to fall drastically from “ L_e^1 ” point although *higher than* L_e^0 —see the orange and violet lines corresponding to two downward shifts of $D_N D_N$.

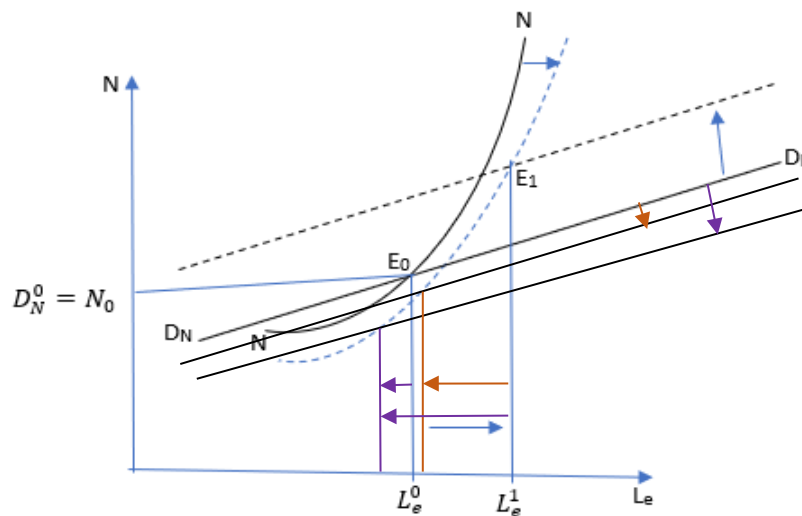


Figure 3: FTA in capital intensive X sector and aggregate employment

4. Numerical Illustration:

Based on the model and proposition 1, in this section we now proceed to illustrate some counterfactual analysis to support our conjectures. This purports to show the mechanism of our model with respect to parametric changes in two FTA cases separately for Z and X sectors. We

pick some key equations behind the results. In particular, we consider the output effects due to resource reallocation and the roles demand could play on outputs of N, X and Z and hence, aggregate employment (L_e). For example, in a simple case consider two scenarios and two key conditions viz., Eqns. (27), (28a&b) for FTA in X and Eqns. (20) and (21) for FTA in Z respectively when employment changes (\widehat{L}_e).

Let's see when $\widehat{L}_e < 0$, with $\widehat{P}_X > 0$. Consider $\lambda_{KX} = 2/3, \lambda_{LX} = 1/3$,
 $\Rightarrow \lambda_{KX} - \lambda_{LX} = 1/3 > 0, \gamma_S = 1/2 > \gamma_K = 1/4, \theta_{KZ} = \theta_{SZ}, \theta_{KN} = 1/2$, then, with
 $\sigma_Z, \sigma_X, \sigma_N \cong 0 \Rightarrow \delta_L = 0, \delta_K = 0$, left-hand-side (LHS) of (28a&b) = $1/3 (1/2 + 1/2) = 1/3$ and the right-hand side (RHS) = $\gamma_K = 1/4$. Hence, satisfying that condition means less demand in X-sector (K-intensive) $\gamma_S > \gamma_K$ causes employment to shrink so that $\widehat{L}_e < 0$. If $\gamma_K = 1/2 > \gamma_S = 1/4$ then, LHS = $1/3 [1/4 + 1/2] = 1/4 < \text{RHS} = \gamma_K = 1/2$, and hence, $\widehat{L}_e > 0$.

On the other hand, in case of $\widehat{P}_Z > 0$, from (21), when $\sigma_Z \cong 0$, with $\lambda_{KX} - \lambda_{LX} = 1/3 > 0$, $\gamma_S = 1/2$, LHS = $1/6 > \text{RHS} = 0$. With $\gamma_S > \gamma_K$ demand expansion causes $\widehat{L}_e > 0$. Hence, when $\gamma_K > \gamma_S > 0$, with $\widehat{P}_X > 0$, $\widehat{L}_e > 0$. In case of Z, $\widehat{L}_e > 0$ always.

Now, we consider two separate scenarios based on Sections 3.1 and 3.2. In the *first one*, we consider FTA targeting in skilled Z Sector where only " P_z " rises one off while in the *second one* we consider possible outcomes with FTA in unskilled export sector 'X', where " P_x " rises only. As a background, while considering the parametric changes the key assumptions underlying the values are mentioned. Relevant variables of interest, parameters and corresponding equations are summarily presented in table 1 below. Given the assumptions we assign some values to the parameters with reasonable range of variations for cost-shares and

endowment-shares respectively θ 's, λ 's (see Table 2, Block A). In Block B, we consider variations in range of values for: substitution elasticity σ_z, σ_x ; $\delta_L (= \lambda_{LX} \theta_{KX} \sigma_X + \lambda_{LN} \theta_{KN} \sigma_N)$; $\delta_K (= \lambda_{KX} \theta_{LX} \sigma_X + \lambda_{KN} \theta_{LN} \sigma_N)$; γ 's. The results due to the parametric variations for ensuing changes in the endogenous variables for outputs ($\hat{Z}, \hat{X}, \hat{N}$), employment (\hat{L}_e) and prices ($\hat{W}_s, \hat{r}, \hat{P}_N$) are tabularly presented below in Block C, Table 2.

Table 1: List of Parameters and Variables.

1st Scenario: FTA in Skilled Z-sector [$\hat{P}_Z = 10\% > 0 = \hat{P}_X$]		
<u>Parameters and assumptions</u>	<u>Variables of Interest (Endogenous)</u>	<u>Key Equations</u>
$\theta_{KX} > \theta_{KN}, \theta_{LN} > \theta_{LX} \Rightarrow \theta = \theta_{KX} - \theta_{KN} = \theta_{LN} - \theta_{LX} > 0$, $\theta_{KX} + \theta_{LX} = \theta_{KN} + \theta_{LN} = 1$ $ \lambda = \lambda_{LN} - \lambda_{KN} = \lambda_{KX} - \lambda_{LX} > 0$, $\lambda_{LX} + \lambda_{LN} = \lambda_{KX} + \lambda_{KN} = 1, \gamma_S + \gamma_K + \gamma_L = 1$ $D = -\gamma_L \lambda + \lambda_{KX} > 0 \quad \sigma_Z \geq 0$ P_Z is exogenous,	Factor returns: \hat{w}_s, \hat{r} , Employment: \hat{L}_e , Outputs: $\hat{N}, \hat{X}, \hat{Z}$	\hat{X} via (15a), \hat{Z} via (20c), \hat{N} via (17, 17a, when $\hat{P}_N = 0$), $\hat{N} = \gamma_S \hat{w}_s + \gamma_L \hat{L}_e + \gamma_K \hat{r}$ via (20a&b), \hat{w}_s (via 14a), $\hat{r} = 0, \hat{P}_N = 0$
<i>See Table 2 for Parameter values and simulations</i>		
2nd Scenario: FTA in Unskilled X-sector [$\hat{P}_X = 10\% > 0 = \hat{P}_Z$]		
<u>Parameters:</u> Same and assumptions as above, Additional ones: $\sigma_X, \sigma_N, \delta_K, \delta_L$	<u>Variables of Interest</u> Same as above	<u>Key Equations</u>
		\hat{X} via (25b), \hat{Z} via (29), \hat{N} via (25a), \hat{L}_e via (26 depending on values of parameters), \hat{w}_s (via 23), \hat{r} via (22), \hat{P}_N via (24)
<i>See Table 2 for Parameter values and simulation</i>		

Table 2: Parametric changes and Sensitivity of Variables.														
Block A Configurations of Cost-Share Parameters														
	$\theta_{KX} + \theta_{LX} = 1$		$\theta_{KN} + \theta_{LN} = 1$					$\lambda_{KX} + \lambda_{KN} + \lambda_{KZ} = 1$						
	θ_{LX}	θ_{KX}	θ_{LN}	θ_{KN}	$ \theta $	λ_{LX}	λ_{LN}	λ_{KX}	λ_{KN}	$ \lambda $	θ_{KZ}	θ_{SZ}	λ_{KZ}	λ_{SZ}
					$\theta_{LN} - \theta_{LX}$					$\lambda_{LN} - \lambda_{KN}$				
					$\theta_{KX} - \theta_{KN}$					$\lambda_{KX} - \lambda_{LX}$				
	0.2	0.8	0.8	0.2	0.6	0.0001	0.99	0.8	0.1	0.7999	0.2	0.8	0.1	1
	0.3	0.7	0.7	0.3	0.4	0.001	0.8	0.7	0.1	0.699	0.25	0.75	0.2	1
	0.4	0.6	0.6	0.4	0.2	0.1	0.7	0.6	0.1	0.5	0.3	0.7	0.3	1
	0.45	0.55	0.55	0.45	0.1	0.15	0.6	0.5	0.1	0.35	0.4	0.6	0.4	1
	0.5	0.5	0.5	0.4	0.1	0.2	0.5	0.55	0.1	0.35	0.5	0.5	0.5	1
Block B Configurations of Elasticity of Substitution and Demand Parameters														
							$\gamma_S + \gamma_K + \gamma_L = 1$							
	σ_N	σ_Z	σ_X	δ_K	δ_L	γ_S	γ_L	γ_K						
	0.0001	0.0001	0.0001	0.000024	1.98E-05	0.95	0.05	0						
	0.5	0.5	0.5	0.14	0.12035	0.85	0.1	0.05						
	0.6	0.7	0.7	0.204	0.21	0.75	0.15	0.1						
	0.7	1	1	0.2635	0.2715	0.7	0.2	0.1						
	0.8	1.5	1.5	0.4525	0.31	0.65	0.25	0.1						
Block C Changes in the Variables (Endogenous) with alterations of Parametric Values														
	See Table 1 for the corresponding equations in the text used for computed values													
	<i>Scenario 1</i>	$\hat{P}_Z = 10\%$	$\hat{P}_X = 0\%$	$\hat{P}_N = 0\%$			<i>Scenario 2</i>	$\hat{P}_X = 10\%$	$\hat{P}_Z = 0\%$					
	\hat{X}	\hat{Z}	\hat{N}	\hat{L}_e			\hat{X}	\hat{Z}	\hat{N}	\hat{L}_e				
Outputs and Employment	-0.080001	0.000005	0.124999	0.12498335			0.00729571	-0.000003125	-0.057604	-0.05832				
	-0.0910714	0.033333	0.125905	0.1257164			0.04020075	-0.023809524	-0.083106	-0.06915				
	-0.1061667	0.06	0.122052	0.09939516			0.08700977	-0.05	-0.113704	-0.06755				
	-0.12	0.133333	0.133037	0.08185185			0.19198836	-0.121212121	-0.16128	-0.06398				
	-0.1136364	0.3	0.145543	0.06217295			0.34917524	-0.3	-0.187153	0.011387				
Relevant Prices		\hat{W}_S	$\hat{r} = 0$	$\hat{P}_N = 0$			\hat{W}_S	\hat{r}	\hat{P}_N					
$\hat{W} = 0$		0.125	0	0			-0.03125	0.125	0.025					
		0.133333	0	0			-0.047619	0.142857143	0.042857					
		0.142857	0	0			-0.0714286	0.166666667	0.066667					
		0.166667	0	0			-0.1212121	0.181818182	0.081818					
		0.2	0	0			-0.2	0.2	0.08					

Source: Authors' simulations with fictitious data with values consistent with the assumptions of the model.

In scenario 1, in keeping with proposition we corroborate the effect of 10% change in price of Z and under plausible conditions, trace the effects on outputs and employments. To start with everywhere, all $\sigma_Z, \sigma_X, \sigma_N \cong 0 \Rightarrow \delta_L = 0, \delta_K = 0$, $\lambda_{LX} \cong 0$ is gradually increased ($\lambda_{KX} - \lambda_{LX} > 0$). $\sigma_Z, \sigma_X, \theta_{KZ}, \theta_{SZ}$ are varied from low to high (and vice versa). $\gamma_S, \gamma_K, \gamma_L$ are also altered from high to low (and vice versa) satisfying the condition $\gamma_S + \gamma_K + \gamma_L = 1$. All these ‘joint effects’ of variations of values (low to high and vice versa) satisfies the condition of Eqn. (21) for positive employment effects in this bigger simulation exercise with multiple linkages (alike the simple example at the start of this section showed). In particular, we see that “L_e” changes

due to capital reallocation from the unskilled sector ‘X’. Then, strong demand effects for high γ_s values shows $\widehat{L}_e > 0$ rises with $\widehat{P}_Z > 0$, causing ‘N’ to rise and ‘X’ to contract while ‘Z’ expands. With $\sigma_Z, \sigma_X, \sigma_N \neq 0 \Rightarrow \delta_L \neq 0, \delta_K \neq 0$, ‘Z’ rises, demand for ‘N’ rises along with its production. As excess supply could cause P_N to fall, there could be decline in aggregate demand, ceteris paribus, causing L_e to fall –as we see in the table with fall in γ_s —because as the curve shifts and demand is not strong, this might happen—see Table 2, Block C, columns 1—4 under scenario 1. Thus, γ_s needs to be high enough to boost the demand to make ‘ L_e ’ higher ultimately. If “Z” attracts too much ‘K’ then by Rybczynski effect ‘N’ will rise much more and ‘X’ contracts (as ‘L’ moves to N-sector)—as we see in the table 2, Block C, Columns 1—4. ‘K’ moves to ‘Z’ from ‘X’ and ‘L’ goes to ‘N’ from ‘X’ sector with some ‘K’ moving to ‘N’ to accompany ‘L’. As seen from the Table, with rise in θ_{KZ} and fall in θ_{SZ} for $\sigma_Z \gg 0$, ‘Z’ can increase substantially and this will cause ‘X’ to contract more. Hence, for robustness θ_{KZ} and θ_{KN} must be low—as see from the table—compares Columns 1—4, 11-14, in Blocks A and C. Then, much less ‘K’ will be drawn from ‘X’ even with higher elasticity of substitution, and ‘N’ will not rise much. Thus, the exercise shows that low $\theta_{KN}, \theta_{KZ}, \lambda_{KZ}$ and high $\sigma_Z \gg 0$, low σ_X, σ_N values with very strong demand effect (with higher γ_s) will dominate so that $\widehat{L}_e > 0$ as $\lambda_{KX} > \lambda_{LX} \gamma_s > 0$.

For the second scenario, same configurations of parameters are taken being assigned values as per the table with reasonable assumptions and approximations, but we implement the effect of 10% change in price of X. Share of capital endowment is high in X ($\lambda_{KX} - \lambda_{LX} > 0$). Here we see that with low σ_X, σ_N ‘N’ does not fall much given changes in employment and hence, the curve will not shift down much, ‘ L_e ’ will not fall much in the first shot. It will fall as

these values move from low to high values, ‘Z’ sector contracts, ‘X’ expands, and ‘N’ contracts with higher θ_{KN} , lower θ_{LN} , ‘r’ rises less. With higher θ_{KX} ‘r’ rises by more with stronger capital-income effect. From Eqn. (24), we can say—also via our numerical illustration—that “P_N” does not rise much when ‘r’ does not rise that much. Employment falls in this scenario, but not that much depending on sets of values assigned on the parameters. We could simulate much stronger effects with another set of values but that does not undermine our current focus.

From Table 2, the results exhibit that under some plausible benchmark conditions, the direction of established relationships is consistent with the model. We see that for both scenarios, $\gamma_S, \gamma_K, \gamma_L$ matter for $\widehat{L}_e, \widehat{N}, \widehat{X}$ via Eqns. (27), (28a&b). Furthermore, we used Eqn (20a,b&c) and verified condition of $\widehat{L}_e \geq 0, \widehat{P}_X > 0 \Rightarrow \widehat{N} \geq 0$ in Table 2 when we evaluate these expressions with values of parameters in Blocks A, B, and C in Table 2.

The above numerical exercise demonstrates the validity of our model by considering configuration of changes in values of the concerned parameters. This highlights the mechanism and offers some conjectures on trade policy as a tool for generating employment by choosing the right sector for FTA, here, the skilled Z-sector. Demand effect is crucial –in the absence of supply or output effect—to create employment in the non-traded or informal sector in the domestic economy. The intensity of such effects crucially hinges on elasticity of substitution of production and demand elasticity as the shapes of the curves show.

5. Conclusion:

This paper presents a comparative study examining the impact of signing free trade agreements in the skilled-intensive sector versus the capital-intensive manufacturing sector on aggregate employment. In the analysis of the skilled sector, we find that the expansion of the

skilled-intensive export sector, driven by an increase in skilled wages, leads to improvements in real income and trade balance. However, the effect on aggregate employment is uncertain due to the inflow of unskilled labor into the non-traded sector because of contraction in the capital-intensive (X) sector. To achieve an increase in aggregate employment, the demand for labor in the non-traded sector must exceed the increase in labor supply. Conversely, in the capital-intensive sector, signing a free trade agreement leads to a labor shortage in the non-traded sector, resulting in higher aggregate employment even if the demand for labor in the non-traded sector remains static. The effects on real income and trade balance, however, remain ambiguous. Investing in skill-biased exports or R&D improving marginal productivity of skilled and unskilled labor could increase exports to have spillover benefits. “Z” could be an ICT service sector or AI sector or high technology sector while “X” is light manufacturing like textiles, clothing and footwear sectors. FTA in either of these types could open opportunities for non-traded sectors to expand employing unskilled workers or informal economy laborers in abundance. For example, in a country like India or Philippines, or even China, where they are thriving on skill-worker based service sector in international trade, this policy is more appropriate. In our model, ‘Z’ could be conceived as a service sector like IT-sector where low physical capital content (i.e., low θ_{KZ} , high θ_{SZ}) makes return to skilled worker to go high as trade opens up i.e., $\hat{P}_Z > 0 \Rightarrow \hat{Z} = -\hat{a}_{SZ} = \theta_{KZ}\sigma_Z\hat{W}_S, \hat{r} \approx 0$. In a tight labor market situation, informal labor market in developing or poor economies provide cushion where labor shortage is not prolonged due to elastic supply of such labor types. This is unlike the case of developed economies where informal labor market hardly exists at all. This could one way provide “inclusive growth” as open unemployment ceases to exist for long term unemployment.

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APPENDIX

From the text, as we derived: $\widehat{N}[\lambda_{LN} - \frac{\lambda_{LX}}{\lambda_{KX}} \lambda_{KN}] = \widehat{L}_e + \frac{\lambda_{LX}}{\lambda_{KX} \theta_{SZ}} \mu \widehat{P}_Z$ (16a)

$$\Delta \widehat{N} - \widehat{L}_e = \frac{\lambda_{LX}}{\lambda_{KX} \theta_{SZ}} \mu \widehat{P}_Z \quad (16b)$$

where $\Delta = [\lambda_{LN} - \frac{\lambda_{LX}}{\lambda_{KX}} \lambda_{KN}] = \frac{1}{\lambda_{KX}} [\lambda_{LN} \lambda_{KX} - \lambda_{LX} \lambda_{KN}] = \frac{1}{\lambda_{KX}} |\lambda| > 0$

X is relatively K-intensive and N is L-intensive $\Delta > 0$. Also, $\gamma_S \widehat{W}_S + \gamma_L \widehat{L}_e = \widehat{N}$ and $\widehat{W}_S = \frac{\widehat{P}_Z}{\theta_{SZ}}$,

$$\gamma_S \cdot \frac{\widehat{P}_Z}{\theta_{SZ}} + \gamma_L \cdot \widehat{L}_e = \widehat{N} \quad (17)$$

$$\widehat{N} \cdot \Delta \cdot \lambda_{KX} - \lambda_{KX} \cdot \widehat{L}_e = \frac{\lambda_{LX}}{\theta_{SZ}} \mu \widehat{P}_Z \quad (18a)$$

$$(18a) \text{ is simplified as: } |\lambda| \cdot \widehat{N} - \lambda_{KX} \cdot \widehat{L}_e = \frac{\lambda_{LX}}{\theta_{SZ}} \mu \widehat{P}_Z \quad (18b)$$

From (17), we can rewrite: $\widehat{N} - \gamma_L \cdot \widehat{L}_e = \gamma_S \cdot \frac{\widehat{P}_Z}{\theta_{SZ}}$ (19a)

$$\frac{1}{\gamma_L} \widehat{N} - \widehat{L}_e = \frac{\gamma_S}{\gamma_L} \frac{\widehat{P}_Z}{\theta_{SZ}} \quad (19b)$$

Determinant ‘D’ of (18b) and (19a) is: $D = -\gamma_L |\lambda| + \lambda_{KX} = \lambda_{KX}(1 - \gamma_L) + \gamma_L \lambda_{LX} > 0$. This also conforms to the stability condition of two upward rising curves shown in Figure 1. The first one is related to D_N (at a given employment level) and the second one is related to Rybczynski effect as factors move owing to price changes causing supply to change. Refereeing to Figure 1 above,

considering equations (18b) and (19a), Stability requires: $\left. \frac{dN}{dL_e} \right|_{D_N} \prec \left. \frac{dN}{dL_e} \right|_{\text{Rybczynski effect}}$.

Using full-employment conditions and (22) — (24), via Jones (1965, 2018):

$$\lambda_{KX} \cdot \widehat{X} + \lambda_{KN} \cdot \widehat{N} = \lambda_{KZ} \sigma_Z \cdot \frac{\theta_{KZ}}{\theta_{SZ}} \cdot \frac{\widehat{P}_X}{\theta_{KX}} + \delta_K \frac{\widehat{P}_X}{\theta_{KX}} \quad (A)$$

$$\lambda_{LX} \cdot \widehat{X} + \lambda_{LN} \cdot \widehat{N} = -\delta_L \cdot \frac{\widehat{P}_X}{\theta_{KX}} + \widehat{L}_e \quad (B)$$

From Jones (1965, 2018), $(\delta_K, \delta_L) > 0$. As $\widehat{r} > 0$, capital is substituted by labor in (X, N) nugget, creating effectively *excess supply of capital and excess demand for labor*. Using (A) and (B), via Cramer’s rule:

$$\widehat{N} = \frac{\begin{vmatrix} \lambda_{KX} & \lambda_{KZ} \sigma_Z \cdot \frac{\theta_{KZ}}{\theta_{SZ}} \cdot \frac{\widehat{P}_X}{\theta_{KX}} + \delta_K \frac{\widehat{P}_X}{\theta_{KX}} \\ \lambda_{LX} & -\delta_L \cdot \frac{\widehat{P}_X}{\theta_{KX}} + \widehat{L}_e \end{vmatrix}}{|\lambda|} \quad (C)$$

Hence,
$$\hat{N} = \frac{\lambda_{KX}(\hat{L}_e - \delta_L \cdot \frac{\hat{P}_X}{\theta_{KX}}) - \lambda_{LX} \cdot \frac{\hat{P}_X}{\theta_{KX}} [\lambda_{KZ} \sigma_Z \cdot \frac{\theta_{KZ}}{\theta_{SZ}} + \delta_K]}{|\lambda|} \quad (D)$$

Similarly,
$$\hat{X} = \frac{\begin{pmatrix} \lambda_{KZ} \sigma_Z \cdot \frac{\theta_{KZ}}{\theta_{SZ}} \cdot \frac{\hat{P}_X}{\theta_{KX}} + \delta_K \frac{\hat{P}_X}{\theta_{KX}} & \lambda_{KN} \\ -\delta_L \cdot \frac{\hat{P}_X}{\theta_{KX}} + \hat{L}_e & \lambda_{LN} \end{pmatrix}}{|\lambda|} \quad (E)$$

Further simplifying,
$$|\lambda| \cdot \hat{N} - \lambda_{KX} \hat{L}_e = -\frac{\hat{P}_X}{\theta_{KX}} [\delta_L \lambda_{KX} + \lambda_{LX} [\delta_K + \lambda_{KZ} \sigma_Z \cdot \frac{\theta_{KZ}}{\theta_{SZ}}]] \quad (F)$$

$$\hat{N} - \gamma_L \hat{L}_e = \frac{\hat{P}_X}{\theta_{KX}} [-\gamma_s \frac{\theta_{KZ}}{1 - \theta_{KZ}} + \gamma_K - \theta_{KN}] \quad (G)$$

$$\hat{N} = \frac{\hat{P}_X}{\theta_{KX}} [-\gamma_s \frac{\theta_{KZ}}{1 - \theta_{KZ}} + \gamma_K - \theta_{KN}] + \gamma_L \hat{L}_e$$

For stability, Rybczynski line cuts demand line from below with “N” on the Y-axis and “ L_e ” on the X-axis. Using (E) and (F), via Cramer’s rule

$$\hat{L}_e = \frac{\begin{pmatrix} |\lambda| & -\frac{\hat{P}_X}{\theta_{KX}} [\delta_L \lambda_{KX} + \lambda_{LX} [\delta_K + \lambda_{KZ} \sigma_Z \cdot \frac{\theta_{KZ}}{\theta_{SZ}}]] \\ 1 & \frac{\hat{P}_X}{\theta_{KX}} [-\gamma_s \frac{\theta_{KZ}}{1 - \theta_{KZ}} + \gamma_K - \theta_{KN}] \end{pmatrix}}{D} \quad (H)$$

Considering Eq. (19a), $\left. \frac{dN}{dL_e} \right|_{D_N} = \gamma_L$ and from (18b), $\left. \frac{dN}{dL_e} \right|_{\text{Rybczynski effect}} = \frac{\lambda_{KX}}{|\lambda|}$.

Thus, $\gamma_L < \frac{\lambda_{KX}}{|\lambda|} \Rightarrow D = \lambda_{KX} - \gamma_L |\lambda| > 0$ (as before). Now, from (16b) and (19b), we solve for:

$$\widehat{L}_e = \frac{\begin{pmatrix} \Delta & \frac{\lambda_{LX}}{\lambda_{KX}\theta_{SZ}}\mu\widehat{P}_Z \\ \frac{1}{\gamma_L} & \frac{\gamma_S}{\theta_{SZ}}\widehat{P}_Z \end{pmatrix}}{D} = \frac{\frac{\widehat{P}_Z}{\theta_{SZ}}[\Delta\gamma_S - \frac{\lambda_{LX}\cdot\mu}{\lambda_{KX}\gamma_L}]}{D} \quad (\text{H})$$