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Labour-Market Reform, Skill-Based Exports and Employment: Some Unconventional Results Under Finite Change in General Equilibrium

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Labour-Market Reform, Skill-Based Exports and Employment: *Some Unconventional Results Under Finite Change in General Equilibrium*

Abstract

This paper highlights the critical role that demand-shock and policy-shock induced finite changes play for the unconventional employment consequences of such shocks at a general equilibrium of a multi-sector competitive economy. A labour market reform that lowers the institutional costs of hiring workers for the firms in traditional import-competing sectors, and a secular rise in world-demand for non-traditional skill-based exports that raises its world price, are the two specific and pertinent shocks that we consider. We show a small or minor labour market reform can paradoxically result in a larger unemployment of unskilled labour due to one of the import-competing sectors shutting down as it fails to cope up with the import competition. Subsequent reforms however raises aggregate employment. Thus, we may have a J-curve like employment response to gradual and sequential labour market reforms. A big-bang approach to policy reform may work better by avoiding such an initial adverse employment effect. Our findings add to the growing body of literature that challenges conventional wisdom about labour market flexibility having favourable impact on employment. These also emphasize the need for policymakers to carefully consider the broader economic context and potential sectoral shifts when designing labour market reforms. On the other hand, contrary to apprehensions, we show that global-demand-driven hike in the world price of the skill-based export goods may initially raise aggregate employment of unskilled workers due to a similar finite change.

JEL-Codes: D500, F160, J320, J640.

Keywords: labour market reforms, finite change, skilled-based exports, employment.

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1. Introduction

This paper is about the employment consequence of labour market reform in a general equilibrium system with a novel feature which may allow some sectors to shut down, thus accommodating for “Finite” change instead of small or local changes. Such a view of the production system under competitive conditions can drastically change the result of a policy change. We rigorously characterize the possibility of such an outcome and the rich set of results that can follow. This is the primary and new contribution of the paper.

An important area of economics and public policy research is how labour market reforms have changed employment patterns within and across nations. The labour market institutions and policies shape the nature of employment globally and most of the differences in unemployment levels across countries and time are often explained by the differences in domestic labour market institutions and policies. At the same time, Blanchard and Wolfers (2000) and Bassanini and Duval (2006) emphasize the interaction of typical economic shocks with the domestic labour market institutions in shaping the labour market outcomes. Our theoretical analysis contributes in this particular context by demonstrating some unconventional results that may arise *at a general equilibrium* due to finite changes caused by labour market reforms and world-demand shocks.

The vast growing literature on employment effects of labour market reforms (see Betcherman (2012), Elmeskov et al. (1998), Nickell (1997) Layard et al(1991) among others) discusses how different labour markets institutions and policies such as minimum wage laws, employment protection legislation (EPL), collective bargaining agreements, active labour market policies (ALMP), labour unions, and unemployment benefits, potentially introduces some elements of rigidity into the labour market thereby impacting the labour market outcomes. For instance, a strict EPL, which includes regulations on hiring and firing practices, can make it challenging and costly for employers to adjust their workforce, thereby impacting the employment and unemployment rate.

International Organizations like the Organisation for Economic Co-operation and Development (OECD), the International Labour Organization (ILO), the World Bank, and the International Monetary Fund (IMF) have consistently emphasized labour market flexibility & reforms for enhanced growth and better labour market outcomes. Hence, many countries (e.g., Germany, Italy, Japan, France, etc.) have introduced several labour market reforms to address the inefficiencies arising from labour market rigidities. These reforms aim to improve

working conditions for workers, increase labour market efficiency, decrease unemployment, and boost job creation.

In such a context, this study sets out the possibility that a labour market reform that lowers the hiring-firing costs may not necessarily lead to an increase in the employment of unskilled labour. Within the standard neo-classical general equilibrium framework, it explains how labour market reform can paradoxically result in a larger unemployment of unskilled labour through shutting down of some import-competing sectors if workers laid off from there cannot be absorbed in other expanding sectors of the economy. Furthermore, it also explores whether a global demand shock for a skill-based exports can lead to an expansion of employment of unskilled workers through a similar finite change contrary to the general apprehension of an employment contraction.

The dominant theory explaining the employment effects of minimum wage is the neo-classical wage approach, which asserts that increasing the minimum wage raises employer costs, reducing employment. Several Studies (see, for example, Holtemoller and Pohle (2020), Clemens (2015), Neumark and Wascher (2000), among others) concur with the neoclassical view that increasing minimum wage can lead to negative employment effects. However, contrary to this view, observations by Card (1992) and Card and Krueger (1994) triggered a debate on the effects of minimum wage on employment. The study of Card (1992) on California for the period 1987-89 suggests that a higher minimum wage increased low-paid workers' incomes, but it had little effect on the number of teenagers employed in the retail trade sector. Card and Krueger (1994), on the other hand, compared employment growth at fast-food outlets in New Jersey and Pennsylvania, and their findings suggest no evidence of reduced employment due to a rise in minimum wages; instead, it led to a rise in employment contrary to the conventional belief. Subsequently, Neumark and Wascher (2000) used payroll data, as opposed to telephone survey data used by Card and Krueger (1994), to re-investigate the impact of minimum wage on employment and found contradictory results, pointing to a decline in employment in fast food outlets in New Jersey relative to Pennsylvania. Ropponen (2011) reconciled the results of Card and Krueger with those of Neumark and Wascher and concluded that the differences in results could be explained by differences in sample used (i.e., small restaurants vs large fast-food chains) in these studies. All these have rekindled interest in re-evaluating the relationship between minimum wage and employment, generating varied empirical findings (eg., Giupponi et al.(2024), Garcia-

Louzao & Tarasonis (2023), Manning(2021), Cengiz et al. (2019), Meer & West (2016), Dube et al. (2010)).

Motivated by such contrasting empirical observations, theoretical works of Marjit et al (2020), Brecher and Gross (2018), Ahn and Arcidiacono (2004), and Bai et al. (2018) have re-examined the employment effect of minimum wage. For instance, Marjit et al. (2020) have established the Card-Kruger type result that a higher minimum wage can raise aggregate employment in a standard general equilibrium model with a non-traded good. Similar in spirit, our theoretical analysis in this paper offers another plausible explanation for the seemingly unconventional result, highlighting that labour market reforms that lower the institutional costs of hiring workers may actually lower the employment of unskilled labour. And the channel through which it occurs here, which is also the main point of departure of the present analysis from Marjit et al. (2020), is labour-market reform causing a *finite change* whereby one of the import-competing sectors shut down as it fails to cope up with the import competition. The concept of finite change has already been used in the literature in other contexts (see Marjit and Gupta (2023); Marjit and Mandal (2014), Dutta et al (2013), Beladi et al (2013), Jones (1996) and Findlay and Jones (2000), among others). We use it to explain the unconventional employment responses to policy reforms.

Starting point of our analysis is a situation in a small open economy where a manufactured import-competing good (produced by unskilled labour, skilled labour and capital) need to be tariff-protected for its survival due to institutionally given high hiring (and firing) cost of unskilled labour. The economy also has another import-competing sector producing an agro-based good (using unskilled labour and capital); and an export sector producing a skill-based manufactured good or IT-enabled services. In such a context, a labour-market reform that lowers the effective cost of hiring unskilled workers, leads to a rise in the return to capital and a decrease in the wages of skilled workers engaged in production of the export good. But, with unchanged import-tariff, the higher capital cost may compel firms producing the import-competing manufactured good to offer lower wage of a larger magnitude to their skilled workers. If that be the case, skilled workers expecting a larger wage-cut moves out of this sector and move in to the skilled-based export sector where the wage-cut is smaller, causing the import-competing manufactured sector to shut down completely. Such a finite change may raise the level of unemployment if the agro-based import-competing sector does not expand; or even when it expands, it cannot absorb all the unskilled workers laid off from the vanishing sector. We set out the exact conditions underlying this paradoxical employment

contraction following a labour-market reform. However, as we show, subsequent reforms will unambiguously increase employment of unskilled workers. Thus, employment responses to gradual labour-market reforms may be non-monotonic with the short run and long run changes being contrary to each other.

We also show that similar unconventional employment changes may arise due to a finite change caused by a world-demand-driven rise in the price of the skill-based exports. This point of analysis assumes relevance since there has been a secular rise in the global demand for certain skill-based goods including IT-enabled services, particularly after the COVID-19 pandemic. The general apprehension one may have in this context is that the resultant world-price shocks and corresponding expansion of skill-based exports in a country may lower employment of unskilled workers as the other commonly used scarce resources are attracted into this sector from the rest of the economy.

Thus, the key contribution of this paper is the demonstration that labour market reforms and global shocks do not always produce uniform, predictable outcomes. It adds to the growing body of literature that challenges conventional wisdom about labour market flexibility and its favourable impact on employment. It also emphasizes the need for policymakers to carefully consider the broader economic context and potential sectoral shifts when designing labour market reforms.

The rest of the paper is organized as follows. The structure of the model is outlined in Section 2. Section 3 discusses the impact of labour market reform on the employment of unskilled workers through a finite change. Section 4 highlights contrasting effects of a drastic or big-bang labour-market reform and a gradual reform with minor changes in each phase. It also discusses employment effects of labour-market reforms under some alternative conditions. The possibility of an employment expansion when a world price shock of skill-based export good causes the finite change is explored in Section 5. The role of the finite change as the driving force for the unconventional impacts of both these policy and demand shocks are discussed in Section 6. Finally, Section 7 provides some concluding remarks.

2. The analytical structure and the general equilibrium

To begin with, consider a standard neo-classical general equilibrium framework of a small open economy producing three goods using three factors of production. X is an import-competing sector that produces an agro-based product using unskilled labour (L) and capital (K); Y is another import competing sector that produces a manufactured good using skilled

labour (S) along with L and K; and Z is a skill-intensive service exporting sector, which uses S and K for its production. Production functions display constant returns to scale technology with diminishing marginal productivities. Factor markets for skilled labour and capital are perfectly competitive and fully flexible prices of these two factors of production ensure their full employment. On the other hand, minimum wage laws require firms in sectors X and Y to pay unskilled workers a fixed minimum wage (\bar{w}). In addition to this minimum wage, firms also incur some other institutional costs per worker due to labour market inflexibilities. Such costs may reflect, for example, hiring and firing costs of workers. We assume that such costs are proportional to the minimum wage. Denoting this proportion by h which is larger more institutionally inflexible the labour market is, the *effective unskilled wage* borne by each firm is $(1+h)\bar{w}$. Alternatively, this effective wage can be interpreted as an institutionally fixed wage indexed to a wage floor \bar{w} .

Note that due to this institutionally given effective wage-cost per unskilled workers (or indexed money wage paid to each worker), both Y and Z sectors that use skilled labour cannot survive without the firms producing good Y being protected from import competition through a tariff. Further, the rate of tariff must be adjusted with any change in h to ensure their survival. This is evident from the following set of zero-profit conditions:

$$P_X^W = a_{LX}(1+h)\bar{w} + a_{KX}r \quad (1)$$

$$(1+t_Y)P_Y^W = a_{LY}(1+h)\bar{w} + a_{KY}r + a_{SY}w_S \quad (2)$$

$$P_Z^W = a_{KZ}r + a_{SZ}w_S \quad (3)$$

where, P_j^W , $j=X, Y, Z$ are the exogenously given commodity prices; $t_Y \in [0,1]$ is the ad valorem tariff rate imposed on the import of Y sectors; r is the rate of return to capital; w_S is the skilled wage; and a_{ij} ($i=L, K, S$; $j=X, Y, Z$) denote the per unit requirement of input i in production of the relevant good j , which depends on the relevant factor price ratios:

$$a_{ij} = a_{ij}(\bar{w}/r), i=L, K, j=X, Y; a_{iZ} = a_{iZ}(w_S/r), i=S, K \quad (4)$$

To explain how Y producers can survive only under tariff protection under the institutionally fixed wage, note that if there had been no minimum wage law (and no labour market inflexibility either), and the unskilled wage could adjust fully to market conditions like r and w_S , the three zero-profit conditions (even without any import tariff) would have determined

the three factor prices. But for a higher institutionally given unskilled money wage $(1+h)\bar{w}$, the rate of return to capital will be lower and w_s paid to the skilled workers in Z-sector would be higher as are evident from the zero-profit conditions (1) and (3). Producers of Y then must also offer this higher wage to the skilled workers working there. Otherwise they all will migrate to sector Z. But, paying the same higher skilled wage as the Z-sector pays may not be feasible for them, even when capital cost share is larger than the unskilled-labour cost share so that the total unit cost on account of hiring unskilled workers and capital is lower (than under a flexible unskilled money wage). That is, if they pay the same w_s as paid in sector-Z, they may make losses since they cannot raise the price of the Y they produce above P_Y^W in face of import competition. In such case, a tariff on imports of Y will enable domestic producers to survive by enabling them to pay the same wage to skilled workers as paid by producers of Z.¹ Suppose, the tariff on import of Y that ensure that the firms break-even and the Y sector survive, supports output triplet $\{X^0, Y^0, Z^0\}$ that fully employs the stock of capital and the pool of skilled workers, and generates L_0 level employment for the unskilled. If this L_0 number of workers employed in X and Y sectors are less than the total unskilled workforce, an unemployment emerges. *This is the initial scenario we start with.* For plausibility of such a less-than-full-employment equilibrium under an import tariff that enables sector Y to survive, note that if L_0 was the total workforce in the economy, the output triplet $\{X^0, Y^0, Z^0\}$ would have been consistent with the following full employment conditions:

$$\bar{S} = a_{SY}Y^0 + a_{SZ}Z^0 \quad (5)$$

$$\bar{K} = a_{KX}X^0 + a_{KY}Y^0 + a_{KZ}Z^0 \quad (6)$$

$$L_0 = a_{LX}X^0 + a_{LY}Y^0 \quad (7)$$

Now, consider an exogenous growth in the unskilled workforce. But these additional workers cannot be employed as long as the import tariff is kept unchanged since neither can the scale of production nor can the technique of production change in either of the sectors X and Y as long as the world prices are not impacted and the unskilled money wage is given

¹ Alternative parametric configurations may allow firms in sector Y to pay a higher skilled-wage than firm in the sector Z, thereby potentially attracting all skilled workers into this sector and thus a potential shut down of the export-sector Z. To ensure survival of this export sector and avoid problem of trade balance, the government must adjust tariff on Y again, but now by lowering it and thereby forcing firms in sector Y to pay the same wage as paid by firms in sector Z. We will later specify the exact conditions under which either sector Y or sector Z or both survive.

exogenously. That is, even though all the three sectors may co-exist under a tariff-protection, not all unskilled workers may be employed. We start with this initial situation of unemployment of unskilled workers for an initial configuration of exogenous and policy variables $\{P^{w0}, t_Y^0, h^0, \bar{w}\}$, where P^{w0} is the vector of world prices of the three goods.

3. Labour market reform, Finite change and Unskilled employment

Consider a minor labour market reform that marginally lowers the institutional costs for hiring (and firing) unskilled workers h . Given the world price of X, from the zero-profit or break-even condition it follows that lower effective wage raises the rate of return to capital to the following extent:

$$\hat{r} = -\tilde{h} \frac{\theta_{LX}}{\theta_{KX}} \hat{h} \quad (8)$$

where, $\tilde{h} = h/(1+h) > 0$; θ_{ij} is the cost share of input i in per unit price of producing commodity/service j ; and $\hat{h} \equiv \frac{dh}{h} < 0$ denotes the infinitesimal small reduction in h .

Lower wage-rental ratio induces producers of X to use more labour-intensive production techniques, which raises the demand for unskilled labour and correspondingly its employment even at the initial level of production. At initial output levels of Y and Z (and corresponding allocation of capital to these sectors), there will be some scale expansion of X as well as due to capital being in excess as a consequence of firms adopting relatively more labour intensive techniques. This will raise employment in sector X further. Algebraically, such employment expansion is of the following magnitude:

$$\hat{L}_X = -\tilde{h} \frac{\sigma_X}{\theta_{KX}} \hat{h} \quad (9)$$

Ceteris paribus, if there is no change in the rest of the economy, the aggregate employment thus increases unambiguously due to the labour market reform. This replicates the standard argument for a labour-market reform in a partial equilibrium (with only X being produced).

But, adjustments do take place in rest of the economy, and as we discuss below, such adjustments may be quite unfavourable to the unskilled workers by reducing overall employment despite the initial (or, ceteris paribus) employment expansion sector X. This

happens when the other sector Y that employs unskilled workers, which was operating under a tariff protection, cannot survive any more without the tariff on import of Y being raised.

Note that the higher capital cost forces producers of Z to reduce their production levels, given P_Z^W , and offer a lower wage to the skilled workers to break even to the following extent:

$$\hat{w}_S = \tilde{h} \frac{\theta_{KZ}}{\theta_{SZ}} \frac{\theta_{LX}}{\theta_{KX}} \hat{h} < 0 \quad (10)$$

On the other hand, if production of Y uses more capital but less labour per unit of output relative to production of X, $\frac{\theta_{LX}}{\theta_{KX}} > \frac{\theta_{LY}}{\theta_{KY}}$, labour market reform (that lowers h) would raise the sum of average labour and capital costs. Hence, to withstand import competition, the producers of Y must also offer a lower wage to skilled workers employed there (see appendix). But, if such a wage is even lower than what Z producers pay (as specified in (10) above), all skilled workers will eventually leave sector Y causing it to vanish. That is, sector Y may not survive in face of import competition, and we have a *finite change* with only production in the (X, Z) nugget remaining. As shown in the appendix, this would happen under the following condition:

$$\frac{\theta_{KZ}}{\theta_{SZ}} \frac{\theta_{LX}}{\theta_{KX}} < \frac{\theta_{KY}}{\theta_{SY}} \left[\frac{\theta_{LX}}{\theta_{KX}} - \frac{\theta_{LY}}{\theta_{KY}} \right] \quad (11)$$

In rest of this section, we assume that this condition holds – along with $\frac{\theta_{LX}}{\theta_{KX}} > \frac{\theta_{LY}}{\theta_{KY}}$ – so that sector-Y shuts down following the labour-market reform. In the next section we will discuss implications of these conditions not being satisfied.

After this finite change, the level of employment of unskilled labour (L_e) comes only from X sector since production of Z does not require unskilled labour. Overall, the change in the level of employment in sector X depends on how the technique and scale of production change there:

$$\hat{L}_X = \hat{a}_{LX} + \hat{X} \quad (12)$$

Increase in employment due to producers of X using more labour-intensive techniques ($\hat{a}_{LX} > 0$) has already been discussed. But, now at the post-reform general equilibrium with all adjustments in rest of the economy being taken into account, the scale of production of X may decline thereby lowering aggregate employment. Even when sector X expands, its expansion may not be sufficiently large to generate additional employment for those

unskilled workers who were earlier employed in sector Y and are now jobless. In this context, note that due to shut down of sector Y, additional unskilled workers, capital and skilled workers who were earlier engaged in this sector now are available for production of X and Z. All skilled workers can be absorbed in sector Z through scale expansion, whereas at least some excess capital, if not all, can be absorbed there. So, the magnitude of output expansion of X, *if at all*, is restricted by the difference between the additional capital available and the amount of capital being absorbed in the expanding Z sector.

Let \hat{L} , \hat{K} and \hat{S} are the additional unskilled labour, capital and skilled workers respectively available for the economy after sector Y shuts down. Thus, the expansion of the production of X can be worked out as (see appendix):

$$\hat{X} = \frac{\hat{K} - \lambda_{KZ}\hat{S}}{\lambda_{KX}} - \tilde{h} \frac{\theta_{LX}}{\theta_{KX}} \left[\sigma_X + \sigma_Z \frac{\lambda_{KZ}}{\lambda_{KX}} \frac{1}{\theta_{SZ}} \right] \hat{h} \quad (13)$$

where, λ_{Kj} and σ_j are respectively the employment share of capital in sector-j and the elasticity of factor substitution in production of good-j ($j = X, Z$).

Hence, substitution of (13) and $\hat{a}_{LX} = -\tilde{h}\sigma_X\hat{h}$ in (12) yields the change in aggregate employment of unskilled workers due to the finite change:

$$\hat{L}_e = \hat{L}_X - \hat{L} = \left[\frac{\hat{K} - \lambda_{KZ}\hat{S}}{\lambda_{KX}} \right] - \frac{\tilde{h}}{\theta_{KX}} \left[\sigma_X + \sigma_Z \frac{\lambda_{KZ}}{\lambda_{KX}} \frac{\theta_{LX}}{\theta_{SZ}} \right] \hat{h} - \hat{L}$$

Finally, note that the magnitudes of excess supplies of L, K and S due to shut down of sector Y are the products of respective employment shares in sector Y and the magnitude of its fall under the finite change. Since, finite change means $\hat{Y} = -1$, so $\hat{L} = \lambda_{LY}$, $\hat{K} = \lambda_{KY}$ and $\hat{S} = \lambda_{SY}$. Using these values, the above expression for employment change boils down to:

$$\hat{L}_e = -\lambda_{LY} + \left[\frac{\lambda_{KY} - \lambda_{KZ}\lambda_{SY}}{\lambda_{KX}} - \frac{\sigma_Z\tilde{h}}{\theta_{KX}} \frac{\lambda_{KZ}}{\lambda_{KX}} \frac{\theta_{LX}}{\theta_{SZ}} \hat{h} \right] - \frac{\sigma_X\tilde{h}}{\theta_{KX}} \hat{h} \quad (14)$$

The first term in (14) is the rate of fall in employment due to shut down of Y; the terms in the parenthesis together capture the rate of change in employment due to change in output of X, as a consequence of reallocation of capital and skilled labour that are released from sector Y, which may be positive or negative; and the last term is the rate of increase in employment due to more labour-intensive technique of production used in sector X (and corresponding output expansion that it induces).

Thus, a minor labour market reform that lowers h marginally will lower aggregate employment ($\hat{L}_e < 0$) if:

$$\lambda_{LY} + \frac{\lambda_{KZ}\lambda_{SY}}{\lambda_{KX}} > \frac{\lambda_{KY}}{\lambda_{KX}} - \frac{\tilde{h}}{\theta_{KX}} \left[\sigma_X + \sigma_Z \frac{\lambda_{KZ}}{\lambda_{KX}} \frac{\theta_{LX}}{\theta_{SZ}} \right] \hat{h} \quad (15)$$

This condition holds for sufficiently small values of the factor-substitution elasticity in the two sectors X and Z that survive after the labour-market reform. This brings out the importance of a finite change for labour market reforms leading to unconventional and paradoxical impacts on the level of aggregate employment.

Subsequent reforms, *after the new equilibrium is attained through the finite change*, however, will unambiguously raise aggregate employment. Further fall in h and corresponding rise in the rate of return to capital will cause firms producing X to employ more unskilled-labour intensive techniques, which will raise employment at the initial scale of production of X. On the other hand, more skilled intensive techniques adopted by firms in Z sector will cause a contraction of scale of production of Z since all the skilled workers are fully employed there. This will release some capital from there, the extent of which is given by σ_Z , which in turn will raise the scale of production of X. Employment of unskilled worker will rise on that account as well. Thus, after an initial adverse employment shock under the condition (15), the pre-reform level of aggregate employment of unskilled workers can be achieved over time through successive reforms. The speed with which the level of employment can adjust in each successive rounds of minor labour-market reforms, however, will depend on the values of factor substitution elasticities. In sum, aggregate employment of unskilled workers may respond to labour market reforms non-monotonically, and in J-curve fashion.

We summarize our results in Proposition 1 below:

Proposition 1:

- (a) A labour market reform that lowers the hiring-and-firing cost of unskilled labour lowers unemployment at the initial output levels of Y and Z through larger employment in sector X.
- (b) Adjustments in the rest of the economy that causes sector Y to shut down under condition (11), may lower aggregate employment at the new equilibrium after minor labour-market reform. This adverse outcome arises under condition (15).

(c) Subsequent minor reforms will unambiguously raise aggregate employment. Thus, overall, employment of unskilled workers may respond to sequential minor reforms in a J-curve fashion.

Proof:

(a) From (13) it follows that at initial (pre-reform) output levels of Y and

Z, $\hat{X} = -\sigma_X \tilde{h} \frac{\theta_{LX}}{\theta_{KX}} \hat{h}$. Hence, using $\hat{a}_{LX} = -\tilde{h} \sigma_X \hat{h}$ and (12) we get,

$$\hat{L}_X = -\tilde{h} \sigma_X \hat{h} - \sigma_X \tilde{h} \frac{\theta_{LX}}{\theta_{KX}} \hat{h} = -\frac{\sigma_X \tilde{h}}{\theta_{KX}} \hat{h} > 0. \text{ Note, this is the last term in (14).}$$

(b) Given that $\sigma_j \in [0, \infty]$, $j = X, Z$, consider the lowest possible extreme values of these

elasticities (which essentially corresponds to fixed-coefficient production functions):

$\sigma_X = 0, \sigma_Z = 0$. Only the scale effects in sector X and Z due to release of labour,

capital and skilled labour then determine the employment change. Thus, from (15) it

follows that aggregate employment falls if $\lambda_{LY} + \frac{\lambda_{KZ} \lambda_{SY}}{\lambda_{KX}} > \frac{\lambda_{KY}}{\lambda_{KX}}$. As it can be seen from

(13), for these extreme values of σ_X and σ_Z , $\hat{X} < 0$ if $\frac{\lambda_{KZ} \lambda_{SY}}{\lambda_{KX}} > \frac{\lambda_{KY}}{\lambda_{KX}}$ in which case

the expanding sector Z necessitates more capital than is released by shutting down of sector Y to accommodate all jobless skilled workers. The aggregate employment thus

falls. For, $\frac{\lambda_{KZ} \lambda_{SY}}{\lambda_{KX}} < \frac{\lambda_{KY}}{\lambda_{KX}}$, on the other hand, though $\hat{X} > 0$ due to these pure scale

effects, employment that it generates is not sufficient to absorb all those who have lost

job if $\lambda_{LY} + \frac{\lambda_{KZ} \lambda_{SY}}{\lambda_{KX}} > \frac{\lambda_{KY}}{\lambda_{KX}}$. Now, raise both σ_X and σ_Z . Employment will increase

monotonically through the production-technique effects as explained above, and for

some critically large values of σ_X and σ_Z , such employment expansion will exactly

wash out the adverse employment effect due to change in scale of production. This

proves the feasibility of condition (15) for sufficiently small values of σ_X and σ_Z ,

when the reform is minor leading to a marginal fall in h .

(c) Further fall in h after the new equilibrium is attained, employment changes only

through the relevant factor-substitutions. With less capital intensive techniques being

used in both X and Z sectors, there will be unambiguous scale expansion of X. This,

together with more labour used per unit of output of X, raises overall employment

unambiguously at the rate
$$-\frac{\tilde{h}}{\theta_{KX}} \left[\sigma_X + \sigma_Z \frac{\lambda_{KZ}}{\lambda_{KX}} \frac{\theta_{LX}}{\theta_{SZ}} \right] \hat{h}. \quad \square$$

The first part of Proposition 1 reflects the standard argument in partial equilibrium justifying labour-market reforms increasing aggregate employment. The second part brings out the relevance of a general equilibrium analysis to assess the effect of a labour market reforms on aggregate employment. And, this general equilibrium effect *may* be quite on the contrary when labour market reforms shut down some import-competing sectors causing significant job losses. Intuitively, a small value of σ_X means smaller additional demand for labour not only because of a marginal change in the production technique, but also because of marginal increase in output of X as a consequence. On the other hand, a small value of σ_Z means only a marginal substitution of capital by skilled labour per unit of output of Z, and accordingly a larger requirement of capital to accommodate all skilled workers that are now jobless due to shut down of Y.

4. Some alternative assumptions and further policy issues

The results stated in Proposition 1(b) are conditional upon several parametric restrictions. In this section we briefly discuss what implications we would have if such restrictions were relaxed (or reversed).

4.1 Large labour-market reform

If instead of the small labour-market reform that lowers h marginally, had it been a large dose of reform causing a significantly large fall in h , it could have raised aggregate employment even after the finite change and for small (but, strictly positive) values of σ_X and σ_Z . The critical degree of a large reform (as measured by the magnitude of fall in h) for which there would have been neither a job loss nor a gain can be obtained from (14) for $\hat{L}_e = 0$. Thus, an even *larger* labour market reform would ensure overall employment increases even after the induced finite change. The required extent of reduction in h , however, varies inversely with σ_X and σ_Z . With $h \geq 0$, scope of such large reform may be limited (or may not exist) if σ_X and σ_Z are quite small and initial value of h was not significantly large.

With such caveats for the scope of such a large reform, the policy lesson that follows is that under condition (15), a big bang approach may work better than a gradualist approach with minor reforms in each phase.

4.2 Protecting Sector Y in face of labour-market reform

Even for minor reforms lowering h marginally, the job losses arising under condition (15) due to sector Y shutting down can be avoided if the government raises the tariff on imports of Y (t_Y). A higher tariff that enables firms producing Y to match the smaller wage cut offered by producers of Z, and thus allowing sector Y to survive after the labour-market reform, is given by (see appendix):

$$\hat{t}_Y = \frac{\theta_{SY} \tilde{h}}{\gamma} \left[\frac{\theta_{KZ}}{\theta_{SZ}} \frac{\theta_{LX}}{\theta_{KX}} - \frac{\theta_{KY}}{\theta_{SY}} \left(\frac{\theta_{LX}}{\theta_{KX}} - \frac{\theta_{LY}}{\theta_{KY}} \right) \right] \hat{h} \quad (16)$$

where, $\gamma \equiv \frac{t_Y}{1+t_Y}$.

Note, by (11), $\hat{t}_Y > 0$. In this case, with all three sectors surviving at the new policy configuration of lower h and commensurate higher t_Y as per (16), overall employment decline is less likely. To see this, note that under (11), sector Y will definitely contract after the labour-market reform. But since it now survives under a higher tariff, labour displacement from this sector will not be as large as before. At the same time, more employment per unit of output will increase, which could not be realized when this sector shut down. Thus, the overall employment loss arising from contraction of the output of Y would be much less. Furthermore, since the skilled workers released from sector Y would be much less than if it had shut down, the scale expansion in Sector Z on this account would be much less as well, thereby eating up lesser proportion of excess capital (due to adoption of more labour-intensive techniques in X and Y, and a scale contraction of Y). This will enable sector X to expand (or, at best, to contract marginally).

Overall, we can expect a fall in aggregate employment, if at all, to occur under much stringent condition than (15).

4.3 Possibility of shutting down of the export sector

The possibility of an adverse employment effect of a (minor) labour market reform, without any commensurate increase in the tariff on imports of Y, arises primarily due to shut down of

sector Y under condition (11) given that $\frac{\theta_{LX}}{\theta_{KX}} > \frac{\theta_{LY}}{\theta_{KY}}$. But, if $\frac{\theta_{LX}}{\theta_{KX}} < \frac{\theta_{LY}}{\theta_{KY}}$, it is easy to check

that lower h and corresponding higher r would lower the sum of unskilled-labour and capital costs per unit of output in sector Y. Accordingly, the skilled-wage there should *rise*. With firms producing Z forced to offer a lower wage to the skilled workers there, now survival of

this sector is at stake. Similar possibility arises when for $\frac{\theta_{LX}}{\theta_{KX}} > \frac{\theta_{LY}}{\theta_{KY}}$, condition (11) does not

hold. Now, producers of Y also offer a lower wage to the skilled workers but the wage cut there is smaller than the wage cut that producers of Z are compelled to offer.

But, good Z being the sole export good, such a possibility of vanishing export sector would create BoP problem for this small open economy. Thus, further policy intervention is needed, now in the form of lowering the tariff rate on import of Y just enough to induce the producers of Y to offer the same larger wage cut as the producers of Z. Note that by (16), now $\hat{t}_Y < 0$ since reverse ranking than in (11) holds in this case. Thus, again all three sectors survive and the employment implications will be similar to that discussed in section 4.2.

5. World demand shock, finite change and employment

So far we have assumed that the world prices of the three traded goods remain unchanged. This seems reasonable since our home country being small in the world markets, its policy shocks should not affect the world commodity prices through changes in trade volumes. But, in recent times one can observe growing world demand for certain kinds of skill-based commodities, including IT-enabled services, that we have considered here as good/services Z. Thus, we can expect increases in P_Z^W driven by such global demand shocks. One would apprehend that the consequent scale expansion of the domestic Z sector may lower aggregate employment of unskilled workers since it will attract required capital and skilled labour used in other sectors that also employ unskilled workers, thereby causing their contraction. In the context of our small open economy here, this apprehension however may be unfounded. All depends on at what point the world-demand-driven price rise occurs: at the less-than-full-

employment equilibrium with the production of Y sustained by an import-tariff *before* any labour-market reform; or at an equilibrium *after* a labour-market reform has induced a finite change.

In the former case, the rise in P_Z^w itself can cause the finite change, exactly similar to the one caused by a labour market reform as discussed earlier, and consequently *may* in fact cause an expansion of aggregate employment of unskilled conditions contrary to the usual apprehension. Of course, a more stringent (and somewhat opposite) condition may be required now, but the crux of the matter is that such an employment expansion cannot be ruled out altogether. In what follows, we explore the plausibility of this unconventional result.

With the rate of return to capital pegged to its initial value for any given set of parameters P_X^w , t_X , \bar{w} , h , and the state of technology, a ceteris paribus global-demand shock that increases P_Z^w raises the skilled wage more than proportionately as the firms expand their production levels:

$$\hat{w}_s = \frac{\hat{P}_Z^w}{\theta_{sz}} \quad (17)$$

But, if the import-tariff is kept unchanged by the government, producers of Y cannot commensurately offer a higher wage to the skilled workers working there. If they do, their average cost of producing Y will rise above the tariff-inclusive domestic price of imported Y and they will be driven out of the market by cheaper imports. On the other hand, if they do not offer a higher skilled-wage, all skilled workers will move out of Y and migrate in to Z sector. Either way, sector Y shuts down. That is, a rise in P_Z^w leads to a similar finite change as does a labour-market reform. The point to note, however, is that now sector Y shuts down *unambiguously* unlike the case under a labour-market reform where it was conditional. Since this sector uses unskilled workers as well, this seems to support the general apprehension of an employment decline.

But, as the other import-competing sector X also employs unskilled workers, overall, the state of employment of unskilled labour will depend on the magnitude of scale expansion (if at all) of this sector. Just as in the case of the labour market reform discussed earlier, scale expansion will be driven by what amount of the capital released from the shut-down of sector

Y is available to X after some of it being absorbed in the expanding Z sector. Note that there would now be no change in the technique of production in this sector due to the institutionally given unskilled wage tying down the rate of return to capital for any given P_X^W . Thus, proceeding as before, the output and employment change in the X sector can be obtained as:

$$\hat{L}_X = \hat{X} = \left[\frac{\lambda_{KY} - \lambda_{KZ} \lambda_{SY}}{\lambda_{KX}} \right] - \sigma_Z \frac{\lambda_{KZ}}{\lambda_{KX}} \frac{1}{\theta_{SZ}} \hat{P}_Z^W \quad (18)$$

Thus, for zero or sufficiently small value of σ_Z , the scale of production of X increases, and with it the employment there, for the same condition as under a labour-market reform: $\lambda_{KY} > \lambda_{KZ} \lambda_{SY}$. So overall the aggregate employment can rise if

$$\left(\lambda_{LY} + \frac{\lambda_{KZ} \lambda_{SY}}{\lambda_{KX}} \right) + \sigma_Z \frac{\lambda_{KZ}}{\lambda_{KX}} \frac{1}{\theta_{SZ}} \hat{P}_Z^W < \frac{\lambda_{KY}}{\lambda_{KX}} \quad (19)$$

which is almost the reversal of condition (15). The reversal of the underlying condition is understandable because now the unconventional or paradoxical result occurs when aggregate employment expands in contrast to the aggregate employment declining in case of a labour-market reform. At the same time, it means that the unconventional result under a labour-market reform may rule out the unconventional result under a world-demand-driven rise in P_Z^W , and vice versa.

A further rise in P_Z^W , after all these finite change-driven adjustments is complete with the economy producing only X and Z, will unambiguously lower the output of X and correspondingly employment of unskilled workers consistent with the general apprehension. Algebraically,

$$\hat{L}_e = \hat{X} = -\sigma_Z \frac{\lambda_{KZ}}{\lambda_{KX}} \frac{1}{\theta_{SZ}} \hat{P}_Z^W < 0 \quad (20)$$

Thus, to summarise,

Proposition 2: *A world-demand-driven hike in the world price of skill-based exports may raise the level of employment of unskilled labour through a finite change for zero or sufficiently small value of σ_Z , if $\lambda_{KY} > \lambda_{KZ} \lambda_{SY} + \lambda_{KX} \lambda_{LY}$. Further price hike post finite change will however unambiguously decrease unskilled employment.*

Proof: Follows from (19) and (20).

6. Role of finite Change

The above arguments suggest that if the world-demand-driven hike in P_Z^w occurs after a labour market reform has already caused the finite change by shutting down the domestic Y sector, unemployment of unskilled workers will unambiguously increase as is popularly apprehended. Similarly, if a labour market reform is undertaken *after* a world-demand-driven hike in P_Z^w has already led to the finite change, the aggregate employment of unskilled labour will unambiguously improve in response to such policy reforms. These highlight the importance of a finite change. When an exogenous shock induces a finite change of the sort that we consider here, one can observe paradoxical impacts of the shock on some of the macroeconomic variables or indicators of the economy. In case of labour market reform inducing a finite change, it is a decline in the aggregate employment, though subsequent reforms will lead to the employment expansions. For a world-demand-driven hike in the world price of the skill-based export good inducing a finite change, it is an increase in the aggregate employment of unskilled workers contrary to apprehensions; the subsequent shocks, however, lowering aggregate employment. Of course, the underlying conditions will exactly be the opposite, but that does not take away the central message of our paper that finite changes may cause paradoxical or unconventional results.

7. Concluding Remarks

In a three-sector general equilibrium model of a small open economy we have highlighted in this paper the critical role that demand-shock and policy-shock induced finite changes play for the unconventional employment consequences of such shocks. Under a reasonable set of conditions, a small or minor labour market reform that lowers the institutional costs of hiring workers for the firms in traditional import-competing sectors, is shown to lower aggregate employment of unskilled workers due to a finite change whereby one of the import-competing sectors shut down as it fails to cope up with the import competition. Subsequent reforms however raise aggregate employment. Thus, we may have a non-monotonic or J-curve like employment response to gradual and sequential labour market reforms. A big-bang approach to policy reform may work better by avoiding such an initial adverse employment effect. We have also defined the critical dose of such a large policy reform. These results add to the growing body of literature that challenges conventional wisdom about favourable impact of labour market flexibility on employment. They also emphasizes the need for

policymakers to carefully consider the broader economic context and potential sectoral shifts when designing labour market reforms.

On the other hand, contrary to apprehensions, we have shown that global-demand-driven hike in the world price of the skill-based export goods may initially raise aggregate employment of unskilled workers due to a similar finite change.

Post finite changes, however, policy reforms and/or world demand shocks generate the usual and conventional employment effects. This brings out the role of finite changes causing paradoxical or unconventional employment effects.

The key contribution of this paper is the demonstration that labour market reforms and global shocks do not always produce uniform, predictable outcomes.

References

- Ahn, T. and Arcidiacono, P. (2004), Minimum wages and positive employment effects in general equilibrium. Department of Economics, Duke University, Durham, NC.
- Bai, X., Chatterjee, A., Krishna, K. and Ma, H. (2018), Trade and minimum wages in general equilibrium: Theory and evidence. NBER Working Paper No. 24456. Cambridge, MA: National Bureau of Economic Research.
- Bassanini, A. and R. Duval (2006), Employment Patterns in OECD Countries: Reassessing the Role of Policies and Institutions, OECD Economics Department Working Paper, No. 486, June, and OECD Social, Employment and Migration Working Paper, No. 35.
- Beladi, H. S., Marjit, and S. Kar (2013). Emigration, finite changes and wage inequality. *Economics and Politics*, 25 (1), pp. 61–71.
- Betcherman, G. (2012), Labor Market Institutions: A Review of the Literature, World Bank Policy Research Working Paper 6276.
- Blanchard, O. and Wolfers, J. (2000). The Role of Shocks and Institutions in the Rise of European Unemployment: The Aggregate Evidence, *Economic Journal*, 110 : C1–C33
- Brecher, R.A. and Gross, T. (2018). A minimum wage model of unemployment and growth: The case of a backward-bending demand curve for labor. *International Journal of Economic Theory*, 15(3), 297–309.
- Card, D. (1992), Do Minimum Wages Reduce Employment? A Case Study of California, 1987–1989, *Industrial and Labor Relation Review*, 46(1): 38–54.
- Card, D. and Krueger, A.B. (1994). Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania. *American Economic Review*, 84(4): 772–93.
- Cengiz, D., Dube, A., Lindner, A. and Zipperer, B. (2019). The Effect of Minimum Wages on Low-Wage Jobs, *The Quarterly Journal of Economics*, 134(3): 1405–1454,
- Clemens, J. (2015). The minimum wage and the great recession: Evidence from the Current Population Survey, National Bureau of Economic research, Working paper No. 21830.
- Dube, A., T. W. Lester, and M. Reich (2010). Minimum wage effects across state borders: Estimates using contiguous counties, *The review of economics and statistics*, 92, 945–964.
- Dutta, M., Kar, S. and Marjit, S. (2013), Product variety, finite changes and wage inequality, *Economic Modelling*, 35:610-613.
- Elmeskov, J. Martin, J.P. and Scarpetta, S. (1998). Key Lessons for Labour Market Reforms: Evidence from OECD Countries' Experiences. *Swedish Economic Policy Review*, 5: 205-252.
- Findlay, R. and Jones, R.W. (2000), Factor bias and technical progress. *Economics Letters* 68, 303–308.
- Garcia-Louzao, J. and Tarasonis, L. (2023). Wage and Employment Impact of Minimum Wage: Evidence from Lithuania, *Journal of Comparative Economics*, 51(2) : 592-609.

Giupponi, G., Joyce, R., Lindner, A., Waters, T. , Wernham, T. and Xu, X.(2024). The Employment and Distributional Impacts of Nationwide Minimum Wage Changes, *Journal of Labor Economics*, University of Chicago Press, 42(S1): 293-333.

Holtemoller, O. and Pohle, F. (2020), Employment effects of introducing a minimum wage: The case of Germany, *Economic Modelling*, 89 : 108-121.

Jones, R.W. (1965). The Structure of Simple General Equilibrium Models. *Journal of Political Economy* 73, 557-72.

Jones, R.W. (1996). International trade, real wages and technical progress: the specific factors model. *International Review of Economics and Finance* 5, 113–124.

Jones, R.W. (1971). A Three Factor Model in Trade, Theory and History. In: J.N. Bhagwati et al. (Eds.): *Trade, Balance of Payments and Growth*. North Holland, Amsterdam.

Layard, R., S. Nickell and R. Jackman (1991), *Unemployment: Macroeconomic Performance and the Labour Market*, Oxford University Press, Oxford.

Manning, A. (2021). The Elusive Employment Effect of the Minimum Wage. *Journal of Economic Perspectives*, 35(1):3–26.

Marjit, S. and B. Mandal (2014). Finite Change- Implication for Trade Theory, Policy and Development in P.G. Babu and M. Dev (eds) –*Development in India*- Springer-Nature

Marjit, S and K. Gupta (2023). Inward –looking policy, finite change and employment-The capital reallocation effect - *International Journal of Economic Theory*, The International Society for Economic Theory, 19(1): 62-76.

Marjit S, Ganguly S, and Acharyya, R.(2020). Minimum wage, trade and unemployment in general equilibrium, *International Journal of Economic Theory*, 1–14.

Meer, J. and West, J. (2016). Effects of the Minimum Wage on Employment Dynamics. *Journal of Human Resources*, 51(2):500–522.

Nickell, S.J. (1997). Unemployment and Labor Market Rigidities: Europe versus North America. *Journal of Economic Perspectives*, (3):55—73.

Neumark, D., and Wascher, W. (2000). Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania: Comment. *American Economic Review*, 90 (5): 1362–1396.

Ropponen, O.T (2011). Reconciling the Evidence of Card and Krueger (1994) and Neumark and Wascher (2000). *Journal of Applied Econometrics*, 26 : 1051–1057.

Appendix

A.1 Factor price changes driven by labour market reform and lowering of h .

Total differentiation of zero profit condition of X in the text gives us the proportionate change in rate of return to capital as:

$$\begin{aligned} P_X^W dt_X + t_X dP_X^W &= a_{LX} (1+h) d\bar{w} + a_{LX} \bar{w} dh + a_{KX} dr \\ \Rightarrow 0 &= \frac{dh}{h} \frac{h}{(1+h)} \frac{a_{LX} \bar{w} (1+h)}{P_X^W} + \frac{ra_{KX}}{P_X^W} \frac{dr}{r} \Rightarrow 0 = \theta_{LX} \tilde{h} \hat{h} + \theta_{KX} \hat{r} \Rightarrow \hat{r} = -\frac{\theta_{LX}}{\theta_{KX}} \tilde{h} \hat{h} \end{aligned} \quad (A.1)$$

where, $\tilde{h} \equiv \frac{h}{1+h}$.

Similarly, from the zero-profit condition in Y sector and substituting \hat{r} from (A.1) gives the extent of wage-cut that the skilled workers working there has to bear as for firms producing Y to break-even:

$$\begin{aligned} P_Y^W dt_Y + (1+t_Y) dP_Y^W &= a_{LY} (1+h) d\bar{w} + a_{LY} \bar{w} dh + a_{KY} dr + a_{SY} dw_S \\ \Rightarrow \hat{\gamma}_Y &= \tilde{h} \theta_{LY} \hat{h} + \theta_{KY} \hat{r} + \theta_{SY} \hat{w}_S^Y \\ \Rightarrow 0 &= \tilde{h} \theta_{LY} \hat{h} - \tilde{h} \theta_{KY} \frac{\theta_{LX}}{\theta_{KX}} \hat{h} + \theta_{SY} \hat{w}_S^Y \\ \Rightarrow \hat{w}_S^Y &= \frac{\gamma}{\theta_{SY}} \hat{t}_Y + \tilde{h} \frac{\theta_{KY}}{\theta_{SY}} \left[\frac{\theta_{LX}}{\theta_{KX}} - \frac{\theta_{LY}}{\theta_{KY}} \right] \hat{h} \end{aligned} \quad (A.2)$$

Thus, for no change in the rate of tariff on Y ($\hat{t}_Y = 0$), $\hat{w}_S^Y < 0$ if $\frac{\theta_{LY}}{\theta_{KY}} < \frac{\theta_{LX}}{\theta_{KX}}$ as mentioned in the text.

Totally differentiating the zero-profit condition in Z sector and substituting \hat{r} from (A.1) gives us wage cut that will be offered to the skilled workers in sector Z to break-even:

$$\begin{aligned} dP_Z^W &= a_{KZ} dr + a_{SZ} dw_S \\ \Rightarrow 0 &= \theta_{KZ} \hat{r} + \theta_{SZ} \hat{w}_S \Rightarrow \hat{w}_S^Z = \left\{ \frac{\theta_{KZ} \theta_{LX}}{\theta_{SZ} \theta_{KX}} \right\} \tilde{h} \hat{h} \end{aligned} \quad (A.3)$$

So, the break-even wage cut in sector Y is lower than the break-even wage cut in Z if:

$$\frac{\theta_{KZ}}{\theta_{SZ}} \frac{\theta_{LX}}{\theta_{KX}} < \frac{\theta_{KY}}{\theta_{SY}} \left[\frac{\theta_{LX}}{\theta_{KX}} - \frac{\theta_{LY}}{\theta_{KY}} \right] \quad (A.4)$$

This is the condition (11) in the text for which sector Y will shut down.

A.2 Employment change due to labour market reform

Totally differentiating the full employment condition for capital (after the finite change, i.e., shutting down of sector Y), $K = a_{KX}X + a_{KZ}Z$, we get:

$$dK = a_{KX}dX + Xda_{KX} + a_{KZ}dZ + Zda_{KZ}$$

$$\Rightarrow \hat{K} = \lambda_{KX}(\hat{X} + \hat{a}_{KX}) + \lambda_{KZ}(\hat{Z} + \hat{a}_{KZ})$$

The change in output of Z is given by additional skilled labour available due to shut down of Y less the higher skill-intensity of production due to the fall in the skilled wage: $\hat{Z} = \hat{S} - \hat{a}_{SZ}$.

Using this, the above condition boils down to:

$$\hat{K} = \lambda_{KX}(\hat{X} + \hat{a}_{KX}) + \lambda_{KZ}(\hat{S} + \hat{a}_{KZ} - \hat{a}_{SZ}) \quad (\text{A.5})$$

Using the definition of factor-substitution elasticity and the least-cost condition in sector X and Z, $\theta_{KX}\hat{a}_{KX} + \theta_{LX}\hat{a}_{LX} = 0$ and $\theta_{KZ}\hat{a}_{KZ} + \theta_{SZ}\hat{a}_{SZ} = 0$, we can write the following expressions (see Jones 1965, 1971):

$$(\hat{a}_{KZ} - \hat{a}_{SZ}) = \sigma_Z(\hat{w}_S - \hat{r}) \quad (\text{A.6})$$

$$\hat{a}_{KX} = \theta_{LX}(\hat{a}_{KX} - \hat{a}_{LX}) = \theta_{LX}\sigma_X(\hat{\tilde{w}} - \hat{r}) \quad (\text{A.7})$$

$$\hat{a}_{LX} = \theta_{KX}(\hat{a}_{LX} - \hat{a}_{KX}) = \theta_{KX}\sigma_X(\hat{r} - \hat{\tilde{w}}) \quad (\text{A.8})$$

where, $\hat{\tilde{w}} \equiv (1+h)\bar{\hat{w}}$ and $\hat{\tilde{w}} = \tilde{h}\hat{h}$.

So using (A.1) and (A.6)-(A.8), we can rewrite (A.5) as:

$$\hat{K} = \lambda_{KZ}\left[\tilde{h}\sigma_Z\frac{\theta_{LX}}{\theta_{KX}}\frac{1}{\theta_{SZ}}\hat{h} + \hat{S}\right] + \lambda_{KX}\left[\tilde{h}\sigma_X\frac{\theta_{LX}}{\theta_{KX}}\hat{h} + \hat{X}\right] \quad (\text{A.9})$$

Rearranging we get the change in output of X as specified in (13) in the text:

$$\hat{X} = \frac{\hat{K} - \lambda_{KZ}\hat{S}}{\lambda_{KX}} - \tilde{h}\frac{\theta_{LX}}{\theta_{KX}}\left[\sigma_X + \sigma_Z\frac{\lambda_{KZ}}{\lambda_{KX}}\frac{1}{\theta_{SZ}}\right]\hat{h}$$

A.3 Change in tariff on Y for survival of sector Y (or sector Z)

Both sectors Y and Z survive if the tariff rate is adjusted in a way to enable both sectors to pay the same lower skilled-wage after the labour-market reform. Such a change in tariff rate can be obtained from (A.2) and (A.3) as:

$$\begin{aligned}
\tilde{h} \frac{\theta_{KZ}}{\theta_{SZ}} \frac{\theta_{LX}}{\theta_{KX}} \hat{h} &= \frac{\gamma}{\theta_{SY}} \hat{t}_Y + \tilde{h} \frac{\theta_{KY}}{\theta_{SY}} \left[\frac{\theta_{LX}}{\theta_{KX}} - \frac{\theta_{LY}}{\theta_{KY}} \right] \hat{h} \\
\Rightarrow \hat{t}_Y &= \frac{\tilde{h} \theta_{SY}}{\gamma} \left[\frac{\theta_{KZ}}{\theta_{SZ}} \frac{\theta_{LX}}{\theta_{KX}} - \frac{\theta_{KY}}{\theta_{SY}} \left(\frac{\theta_{LX}}{\theta_{KX}} - \frac{\theta_{LY}}{\theta_{KY}} \right) \right] \hat{h}
\end{aligned} \tag{A.10}$$

Note, $\hat{t}_Y > 0$ under (A.4), or (11) in the text.

A.4 Effect of world price shock of Z export on Unskilled Employment

Substituting $\hat{\tilde{w}} = \tilde{h} \hat{h} = 0$, $\hat{r} = 0$, and $\hat{w}_s = \frac{\hat{P}_Z^w}{\theta_{SZ}}$, (A.9) can be re-written to obtain \hat{X} as:

$$\begin{aligned}
\hat{K} &= \lambda_{KZ} \hat{S} + \sigma_Z \lambda_{KZ} \frac{1}{\theta_{SZ}} \hat{P}_Z^w + \lambda_{KX} \hat{X} \\
\Rightarrow \hat{X} &= \frac{\hat{K} - \lambda_{KZ} \hat{S}}{\lambda_{KX}} - \sigma_Z \frac{\lambda_{KZ}}{\lambda_{KX}} \frac{1}{\theta_{SZ}} \hat{P}_Z^w
\end{aligned} \tag{A.11}$$