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UNSKILLED IMMIGRATION, TECHNICAL PROGRESS, AND WAGES — *ROLE OF THE HOUSEHOLD SECTOR*

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UNSKILLED IMMIGRATION, TECHNICAL PROGRESS, AND WAGES — *ROLE OF THE HOUSEHOLD SECTOR*

Sugata Marjit[*], Manoj Pant[†], Sugandha Huria[‡]

ABSTRACT:

This paper revisits a query regarding the relationship between unskilled immigration and skilled wage. In the recent episode of BREXIT, there is a perception that while people of London, which has a much greater proportion of immigrants' inflow voted against BREXIT, regions which do not experience substantial inflows have voted in favour. Our simple general equilibrium model introduces a household sector where unskilled people are employed by skilled workers. Without the household sector, immigration of unskilled workers depresses skilled wage. But when we include the household sector, effective skilled wage may increase with a greater inflow of migrant workers. This is also a novel outcome in the theory of trade and factor flows. Our model also argues that though technical progress in a skill/human-capital intensive sector raises wage inequality, it no longer displaces traditional jobs. In fact, the usual negative impact of unskilled immigration on the traditional sector is mitigated by raising the returns to the unskilled workforce.

JEL Codes: F11, F20

Key Words: Immigration, Skilled wage rate, Unskilled wage rate, Household sector, Technical progress

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UNSKILLED IMMIGRATION, TECHNICAL PROGRESS, AND WAGES — *ROLE OF THE HOUSEHOLD SECTOR*

1. Introduction

Immigration policy in the USA and Europe has been under scanner for some time especially after the United Kingdom voted out of the European Union and Mr. Trump became president of the United States. There is a general presumption that immigration of unskilled workers has adversely affected the livelihood of the locals in similar professions and has induced them to vote in favour of BREXIT or favour Mr. Trump. This shows that the pattern of votes clearly speaks of the support of the Londoners against BREXIT. From a different angle, one could argue that intellectuals and white collared professionals tend to be much more liberal and progressive relative to the so-called less educated workers. Apart from human rights activists, there is a large body of economists who favour liberal migration policies.[4]

The purpose of this paper is to ask the following question - How will the greater immigration of unskilled population affect the real income of skilled workers? In other words, we try to assess how such inflows are likely to affect the wages and salaries of white collared professionals and, hence, the economic incentive of the white collared liberals to support such policies.

This is a non-trivial theoretical question apart from having a political-economic content. In any standard neo-classical text book type model such as the specific-factor model of *Jones* (1971) and its application in terms of factor flows, such as *Jones* and *Dei* **(**1983), *Marjit* and *Kar* (2005, 2018), *Jones* (2018), etc., a secular inflow of unskilled workers, ceteris paribus, is bound to hurt local skilled wage by increasing returns to capital, which flows between skilled and unskilled sectors. This means that corporates and capitalists, in general, should vote in favour of open immigration policies as their profits increase with lower wages. But, as per the standard economic logic, skilled workers should vote against it along with the unskilled workers if immigration of the unskilled/family workers is the policy of the government.

[4] Winters (2018, December)

We propose a simple extension of the standard framework where unskilled workers and the family labour/undocumented immigrants are hired to perform household jobs that are essential such as cleaning, gardening, childcare, etc. This is a universal phenomenon where maid service and different varieties of domestic maintenance jobs are needed by households where earning members are quite busy with their own work. While some of these services undoubtedly require special skills, they are not considered as white collared jobs. Such activities determine 'net' skilled wage, i.e., net of expenses incurred by white collared workers for employing other workers to perform household jobs.

A greater inflow of unskilled immigrants lowers unskilled wage and increases returns to capital depressing skilled wage also. But the cost of running household or domestic maintenance activities also goes down for skilled workers. At the same time, they are able to free up their labour and work in the production sector to earn more income. These effects tend to offset each other and thus, may even raise the net income of skilled workers under certain conditions.

Another important issue in the context of world trade relates to rising income inequality (or wage inequality, more specifically) in both developed and developing countries. In general, theoretical literature on this subject argues that factors such as greater inward foreign direct investment, technology bias in favour of skilled labour or domestic factors such as labour productivity are responsible for rising wage inequality and not trade per se (See for e.g., *Wood* (1997), *Beladi and Batra* (2004), *Barua and Pant* (2014), etc.). Our paper is an attempt to provide an alternative explanation to this question, which does not depend on the standard arguments. Whether skilled wage rate rises or falls, an increase in unskilled immigration increases the rate of change in wage inequality, under certain condition. This also explains the "*extreme right*" electoral responses to immigration in the EU, USA and many other parts of the globe.

A third issue relates to the impact of technical progress on wage inequality, particularly in the context of the *information technology revolution*. According to the standard arguments, any improvement in the state of technology in a skill/human-capital intensive sector raises the skilled wage rate at the expense of the unskilled wage rate by displacing unskilled jobs. Our model, however, shows that, in the presence of the so-called *household* sector, technical progress mitigates the impact of unskilled immigration by raising the returns to unskilled labour within the small open economy though wage inequality increases.

The next section develops the model framework and details the results, and the last section concludes.

2. Model and Result

Our small open economy is characterised by two sectors - X and Y and three factors of production viz. skilled labour (S), unskilled labour (L) and capital (K). While capital is used in both the sectors and is freely mobile across the two, skilled labour is specific to sector X and unskilled labour to Y. Product and factor markets are competitive in nature and production functions are linearly homogenous and concave.

There is another factor 't' representing the *improved* state of technology in sector X. In line with *Batra and Ramachandran* (1980) and *Batra* (1986), 't' could also be construed as entrepreneurship or something like a specific factor that raises the quality/efficiency of the factors employed in sector X. In addition, the nature of this factor is such that its production involves incurring a sunk cost (F), but there exist zero or negligible marginal cost for its use in the production process. Thus, 't' is like Leibenstein's X-efficiency factor.[5]

The production functions in the two sectors are given by:

$$X = X(K_X, S_X, t) \tag{1}$$

$$Y = Y(K_Y, L_Y) \tag{2}$$

Competitive equilibrium in the product market implies

$$X = X_S S_X + X_K K_X + X_t t \tag{3}$$

$$Y = Y_L L_Y + Y_K K_Y \tag{4}$$

Alternatively (3) and (4) can be written as:

$$w_S a_{SX} + r a_{KX} = p_X \tag{3'}$$

$$w a_{LY} + r a_{KY} = p_Y \tag{4'}$$

Symbols have usual interpretation.

There is another activity, which requires $0 < h_i < 1$ $(i = S, L)$ unit of labour for household maintenance and doing routine jobs such as sleeping, cooking, gardening, childcare, etc. This is essential for everyone and also entails cost in terms of 'own' time not utilised in doing production work.

[5] For details on how introduction of this specific factor still retains the perfectly competitive nature of product markets, see *Batra and Ramachandran* (*op. cit.*) or *Huria and Pant* (2018). Moreover, it is worth noting that since skilled labour is specific to sector X while capital is not, any improvement in 't' will always be accompanied by an increase in the returns to the former.

Let 'a' out of 'h' represent the minimum time a person must devote to personal activities like sleeping, eating, etc.[6] And, (h-a) represent the time (apart from production work) devoted to other 'irksome' household activities, which can be outsourced. In particular, there are two options available to each of the two types of workers – one is to hire from the group of unskilled workers, and the other is to outsource the work to the pool of family labour and/or immigrants (illegal or undocumented) who cannot work in the formal production sectors X or Y. In our model, we assume that the skilled workers have higher quality requirements because of the nature of their household work relative to the unskilled. Hence, they prefer to hire legal, unskilled workers for their household chores and pay them a wage rate equal to what these workers earn by working in sector Y (i.e., w). The unskilled, however, outsource the work to non-production workers/immigrants, for which they are not willing to pay an amount that exceeds their opportunity cost of not working in sector Y.[7]

Accordingly, we assume that for any worker, the cost of household maintenance is given by

$$w_i a + w(h_i - a) = c_i \tag{5}$$

Since, $w < w_S$, it is always rational for the skilled workers to hire the unskilled labour for their household activities to minimise c_S, and, therefore,

$$c_L = wh_L \text{ and } c_S = wh_S \tag{6}$$

For both skilled and unskilled workers, this outsourcing allows them additional income earning time spent on productive activity. This treatment of h as a proxy for time in models of trade is novel. The use of outsourcing of time on the production side of such models is also seen in the work of *Marjit* (2007) and *Kikuchi and Marjit* (2011). In our model, this motivation comes from the demand side - we assume that household work is 'irksome' and creates disutility for both skilled and unskilled workers. Thus, lower h creates greater disutility. It is also clear that h is an endogenous variable and it can be easily shown that h, an outcome of utility maximizing behaviour of skilled and unskilled workers, is higher for skilled than for unskilled workers.[8]

Accordingly, we assume that

$$h_i = f(h_0, w_i - w), \qquad i = S, L$$

where, $h_0 > 0$ represents the minimum level of labour units required for household maintenance. Also, h_i varies positively with *net income* of an individual, where net income is nothing but the difference between

[6] Note that 'a' is assumed to be same for both sets of workers. It is easy to show that this does not make any difference to the results.

[7] It is important to note that this outsourcing of time is limited by the pool of family labour/immigrants and also by population trends especially in the developed countries where populations are either stagnant or declining.

[8] See Appendix 1.

what an individual can earn by working in the production sector (X or Y) and cost of hiring one unit of household labour, which is 'w' for both skilled and unskilled individuals. In particular, we assume that

$$\widehat{h_L} = \widehat{h_0} + \lambda(\widehat{w} - \widehat{w}) = \widehat{h_0} = 0 \tag{7}$$

$$\widehat{h_S} = \widehat{h_0} + \lambda(\widehat{w_S} - \widehat{w}) = \lambda(\widehat{w_S} - \widehat{w})\ ;\ 0 \leq \lambda < 1 \tag{8}$$

where hat (^) denotes proportional change. Equation (8) implies that 'h_S' is not fixed and any change in $\widehat{h_S}$ is driven by the gap between $\widehat{w_S}$ and $\widehat{w}$ in the proportion 'λ' (given that $\lambda > 0$, otherwise h will become exogenous). On the contrary, since the per unit cost of household maintenance exactly equals the per unit earnings of unskilled workers from the production work, therefore, for them, our specification assumes that 'h_L' remains fixed.

The net wage to both the groups is given by

$$\widetilde{w} = w - c_L \tag{9}$$

$$\widetilde{w}_S = w_S - c_S \tag{10}$$

From (5), (6), (9) and (10), it is clear that

$$\widetilde{w} = w(1 - h_L) \tag{11}$$

$$\widetilde{w}_S = w_S - w h_S \tag{12}$$

Full employment condition for unskilled labour is given by

$$a_{Ly}Y = L(1 - h_L) - h_S S \tag{13}$$

It is important to note that $h_L L$ and $h_S S$ cannot be used to produce Y directly and, the full employment conditions for skilled workers and capital are, thus, represented as follows:

$$a_{SX}X = S \tag{14}$$

$$a_{KX}X + a_{KY}Y = K \tag{15}$$

Thus, we have 8 equations - $(3), (4), (8), (11) - (15)$ that determine $w_S, r, w, \widetilde{w}_S, \widetilde{w}, \widehat{h_S}, X$ and Y.

Our setup follows the standard specific-factor model of *Jones* (1971), which has also been employed in various recent related works by *Chaudhuri and Mukhopadhyay* (2014), *Beladi, Marjit and Oladi* (2018), *Jones* (2018), *Marjit and Kar* (2018), *Marjit and Yu* (2018), *Long* (2018).

2.1 Wages & Immigration[9]

Let $\hat{L} > 0$ indicate immigration of unskilled workers. From the standard results, it is quite well known that,[10]

$$\hat{w} = -\alpha_L \hat{L} \quad ; \quad \alpha_L > 0 \tag{16}$$

$$\hat{w}_s = -\beta_L \hat{L} \quad ; \quad \beta_L > 0 \tag{17}$$

$$\hat{r} = \gamma_L \hat{L} \quad ; \quad \gamma_L > 0 \tag{18}$$

So, an increase in L, increases r as Y expands and draws capital away from X, thus, lowering w_s. However, in our model, equations (16) - (18) hold if $\frac{K_Y}{L_Y} > \frac{K_X}{S_X}$. In the absence of factor intensity reversal, this also implies that the share of capital in value of output in unskilled sector is higher in comparison to its share in the skilled sector. At a glance, it seems unreasonable as to how the capital intensity of the unskilled sector (in physical or value terms) can be greater than for the skilled sector. But if X represents a human capital-intensive sector i.e., where physical-capital/machine usage is less compared to human capital such as in the information technology sector or high-end service sectors such as banking and insurance, $\frac{K_X}{S_X}$ will be low compared to $\frac{K_Y}{L_Y}$. In fact, in all the results that follow, we continue to assume that sector Y is capital intensive vis-à-vis sector X.

From (8) and (12),

$$\widehat{\widetilde{w_S}} = \frac{\widehat{w_S} w_S}{\widetilde{w_S}} \left[1 - \lambda\, h_S \frac{w}{w_S}\right] - \frac{w \hat{w} h_S}{\widetilde{w_S}} [1 - \lambda]$$

Let $\eta_1 = \frac{\widetilde{w_S}}{w_s} > 0$, so that

$$\eta_1 \widehat{\widetilde{w_S}} = \left[1 - \lambda\, h_S \frac{w}{w_S}\right] \widehat{w_S} - \frac{w h_S}{w_S} [1 - \lambda] \hat{w} \tag{19}$$

Since $\left[1 - \lambda\, h_S \frac{w}{w_S}\right] > \frac{w h_S}{w_S} [1 - \lambda]$, equation (19) implies that change in net skilled wage rate can be positive if and only if $|\hat{w}| > |\widehat{w_S}|$ or,

$$\frac{X_{SK} Y_{KL}}{w_S} < \frac{Y_{LL} X_{KK}}{w}$$

[9] While assessing the impact of unskilled immigration, we continue to assume that $\hat{t} = 0$, i.e., the state of technology is fixed.

[10] For derivations, refer Appendix 2.

Or, $\frac{\theta_{KY}}{\theta_{LY}} > \frac{\theta_{KX}}{\theta_{SX}}$ (20)

And, this holds whenever $\frac{K_Y}{L_Y} > \frac{K_X}{S_X}$.

Proposition 1: Unskilled immigration will increase $\tilde{w}_s$ if and only if capital intensity of the unskilled sector is more than that of the skilled sector.

Proof: From (19) and (20). QED.

The result is almost self – explanatory.

If the wage of domestic help and maintenance support workers go down more relative to w_s , $\tilde{w}_s$ will rise. Note that this is independent of the statement that globalisation helps skilled labour because of skill-biased technological change such as through information technology revolution and automation.

If we look at (19) and (20) closely, certain observations will be in order. If $\frac{\theta_{KX}}{\theta_{SX}} > \frac{\theta_{KY}}{\theta_{LY}}$, i.e., the impact of a rising r is greater on w_S than on w, then, $\widehat{\widetilde{w_S}} \ngtr 0$. Therefore, it is necessary that $\frac{\theta_{KX}}{\theta_{SX}} < \frac{\theta_{KY}}{\theta_{LY}}$, which fits our definitions of sectors X and Y. In fact, recent papers such as *Furceri* and *Laungani* (2018) and others talk about declining income share of unskilled labour. That makes $\frac{\theta_{KY}}{\theta_{LY}}$ assume a higher value compared to $\frac{\theta_{KX}}{\theta_{SX}}$**,** and our result is more likely.

With constant $\hat{h}_L$, however, $\hat{\tilde{w}}$ changes in the same proportion as $\hat{w}$ and this leads us to derive our next proposition.

Proposition 2: Given that sector Y is more capital intensive vis-à-vis sector X, an increase in unskilled immigration necessarily worsens wage inequality regardless of whether skilled wage rate rises or falls.

Given that $0 < \lambda$, $h_S, \frac{w}{w_S} < 1$, using (11) and (19), we find

$$\eta_1\left(\widehat{\widetilde{w_S}} - \hat{w}\right) = \left[1 - \lambda\, h_S \frac{w}{w_S}\right] [\widehat{w_S} - \hat{w}] > 0 \text{ whenever } |\hat{w}| > |\widehat{w_S}| \qquad (21)$$

As is well known now, the issue of global rise in wage inequality is not new and in fact, several studies have been conducted in the past to examine its association with rising trade between different economies in the world market. The relatively more recent theoretical works such as those by Beladi and Batra (*op. cit.*), Xiang (2007), Barua and Pant (*op. cit.*), etc. have put forward various reasons as to why trade cannot be held responsible for worsening wage inequality within developed and developing countries. More or less, these relate to the presence of non-traded goods, differences in the productivity of skilled-unskilled labour, technology bias against unskilled labour, etc. In our case, however, this happens because of the presence of the so-called household sector or the time that a labourer needs to spend on domestic maintenance. Even though initially skilled wage rate tends to fall with an increase in immigrants' inflow into the small open economy due to a fall in capital in the skill-intensive sector, but at the same time, greater inflow of unskilled workers depresses unskilled wage rate too. These two forces work together to ensure that wage inequality necessarily rises due to immigration.

It is noteworthy that as capital flows out, the standard condition for rising inequality in a similar model (*Marjit* and *Kar* (2005)) is also given by $\frac{\theta_{KY}}{\theta_{LY}} > \frac{\theta_{KX}}{\theta_{SX}}$, i.e., the unskilled sector is hurt relatively more as r goes up. Our condition is related to such an outcome.

A very well-known empirical reality that echoes our result relates to childcare and female labour force participation. As evidenced by *Barone and Mocetti* (2011), *Forlani, Lodigiani, and Mendolicchio* (2015), *Furtado* (2015) amongst others, and explained in detail in the World Bank's report on *Global migration and labour markets* (*World Bank*, 2018), an increase in immigrants' inflow, specifically low-skilled female immigrants, in a region reduces the cost of childcare and hence, the time that women (especially the high-skilled) spend on household chores.

2.2 Wages & Technical Progress[11]

As quoted in the recent *World Trade Report* (*WTO*, 2017), throughout history, technological change has often been a source of anxiety for many workers, particularly for the traditional or unskilled workers. This is so because it is generally assumed that skill-biased technical progress negatively affects the unskilled wage rate. However, this result ceases to hold when we consider the role of the so-called *household* sector.

Let $\hat{t} > 0$ indicate technical progress in sector X and therefore,[12]

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[11] In this subsection, we assume that $\hat{L} = 0$, i.e., no unskilled immigration takes place.

[12] For derivations, refer Appendix 2.

$$\hat{w} = \alpha_t \hat{t} \; ; \qquad \alpha_t > 0 \tag{22}$$

$$\hat{w}_s = \beta_t \hat{t} \; ; \qquad \beta_t > 0 \tag{23}$$

$$\hat{r} = \gamma_t \hat{t} \; ; \qquad \gamma_t > 0 \tag{24}$$

Thus, unlike the standard results, technical progress leads to an increase in the unskilled wage rate, whenever $\frac{K_Y}{L_Y} > \frac{K_X}{S_X}$. In fact, as regards the net skilled wage rate, we observe that

$$\eta_1 \widehat{\widetilde{w_S}} = \left[1 - \lambda \, h_S \frac{w}{w_S}\right] \widehat{w_S} - \frac{w h_S}{w_S} [1 - \lambda] \hat{w}$$

And, $\widehat{\widetilde{w_S}} > 0$ whenever $\hat{w}_s > \hat{w}$.

Proposition 3: Technical Progress in a human-capital intensive sector leads to a rise in both net-skilled and unskilled wage rates but wage inequality increases.

Knowing that $\left[1 - \lambda \, h_S \frac{w}{w_S}\right] > \frac{w h_S}{w_S} [1 - \lambda]$ and $\frac{K_Y}{L_Y} > \frac{K_X}{S_X}$, if $\hat{w}_s > \hat{w}$, then net skilled wage rate will unambiguously increase. On the contrary, one of the necessary conditions under which it may decrease, requires $\hat{w}_s$ to fall short of $\hat{w}$. Given that sector Y is more capital intensive vis-à-vis X, the latter condition never holds true, and therefore, technical progress leads to an unambiguous rise in net skilled wage rate in the presence of the household sector.

Intuitively, this happens because any improvement in the state of technology in sector X raises the efficiency and hence, demand for both its factors of production. Since skilled labour is already fully employed, this leads to an unambiguous increase in its return while dragging more of capital from sector Y to X. Consequently, unskilled wage rate tends to fall because $Y_{LK} > 0$, thereby raising the gap between the skilled and unskilled wage rates. This, in turn, raises the demand for household labour by the skilled workers or h_S and hence, impacts their return positively in contrast to when there is no household sector.

The next logical question is to find out if technical progress, in such a case, would lead to a fall or rise in wage inequality. Using equations (8), (11) and (12), we find

$$\eta_1 (\widehat{\widetilde{w_S}} - \hat{w}) = \left[1 - \lambda \, h_S \frac{w}{w_S}\right] [\widehat{w_S} - \hat{w}] \tag{25}$$

Given that $< 0 \left[1 - \lambda\, h_S \frac{w}{w_S}\right] < 1$, technical progress will worsen wage inequality in our small open economy provided $\frac{K_Y}{L_Y} > \frac{K_X}{S_X}$.

Though it seems that our model also supports the usual argument about the negative impact of technical progress on intra-country wage inequality as has been observed in the standard literature, there is a difference. Studies such as those by *Lawrence et al.* (1993), *Berman, Bound and Griliches* (1994) or a relatively recent research by *Autor and Salomons* (2018) argue that technical progress (specifically skill-biased technical improvement or say, automation) raises the skilled wage rate at the expense of the unskilled wage rate by displacing unskilled jobs and thus, wage inequality also rises. Our model, however, establishes that even though wage inequality still rises with an improvement in the state of technology in sector X because skilled wage rate rises more than the unskilled wage rate, however, it no longer displaces unskilled jobs. And, this is only because of the presence of the so-called household sector. Therefore, in our case, rather than displacing, technical progress creates new jobs in the new segment because skilled wage rate and hence, the incentive to outsource more of h or h_S rises.

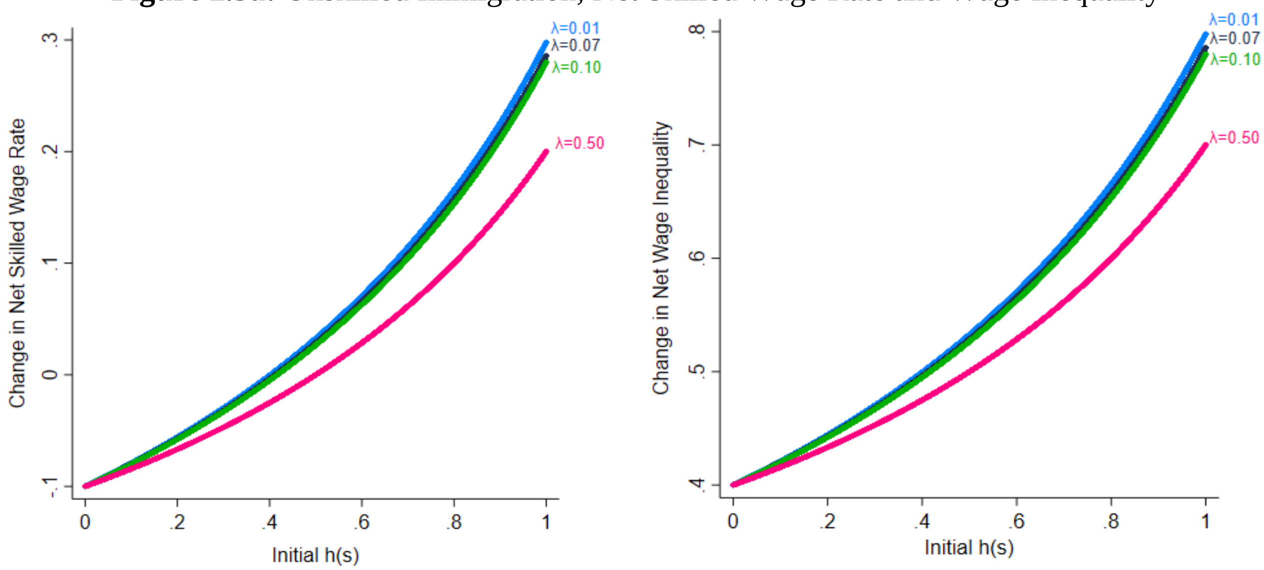
Two more related conclusions can be drawn from our analysis. One, our result can be utilised to explain the relative well-being issue (or the falling inter-country wage inequality) between the richer countries, or the North, and the South. Higher w_S in the former but choice of low h_S due to high w reduces their real skilled-income and hence, the inter-country real income gap between the North and the South. This is what has been observed in the data as well – while *within-country* wage inequality seems to have risen in the past few decades, suggestive evidence for various countries show that wage inequality *between countries* has fallen over time (*Darvas* (2016), *Milanovi* (2016)).

Moreover, using results from sections 2.1 and 2.2, we can also argue that in the presence of technical progress, wage inequality rises more in countries that allow for unskilled immigration vis-à-vis those which do not. And, thus our model frames a solution as to why some countries such as the UK suffer from higher levels of wage inequality vis-à-vis others, for instance, India.

2.3 Sensitivity Analysis

Our simple model can also be quite easily solved numerically to find out how sensitive are the results to different values of initial h_S and λ. Given w and w_S, we know that a higher value of h_S is associated with higher net skilled wage rate and so, with higher (net) wage inequality. On the contrary, given the capital-labour intensities, higher the value of λ i.e. more responsive are the skilled households to change in the gap between skilled and unskilled wage rates, lesser is the impact of unskilled immigration/technical progress on net skilled wage rate and wage inequality. Figures 2.3a and 2.3b establish these points graphically.

Figure 2.3a: Unskilled Immigration, Net Skilled Wage Rate and Wage Inequality

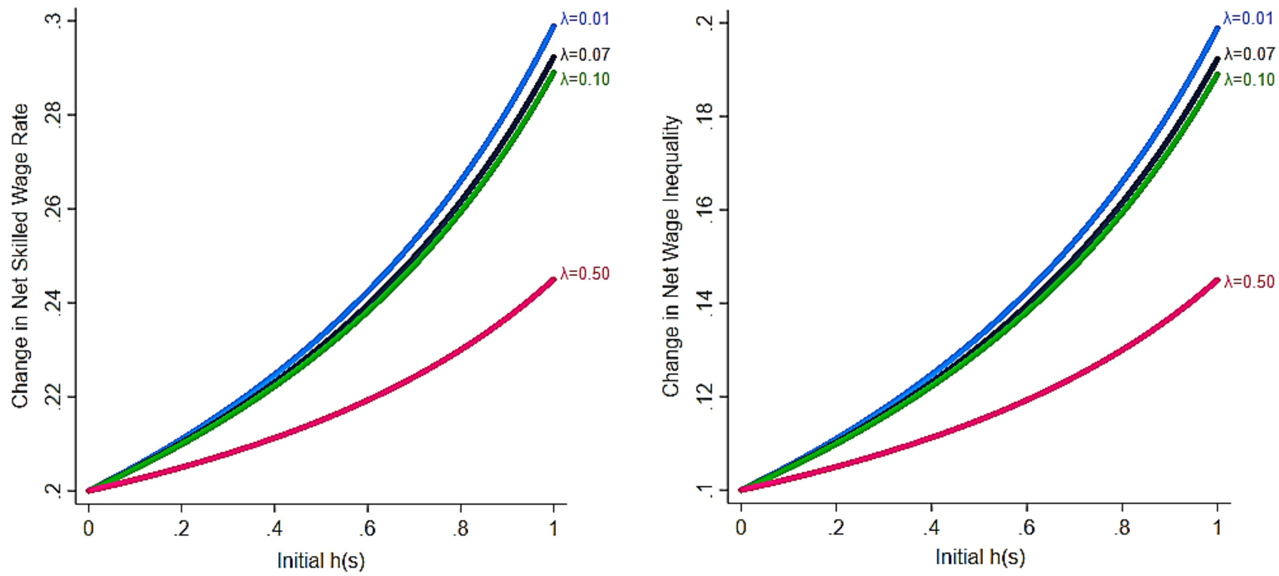


Source: Authors' Input.

Note: In accordance with the theoretical results observed in section 2.1, the simulation exercise assumes that initial $w = 500$, $w_S = 1000$, $\widehat{w} = -0.50$, $\widehat{w_S} = -0.10$ and is based on series of 10,000 random observations for initial h_S (at equilibrium). Since our model only establishes a necessary condition for skilled wage rate to rise with greater immigrants' inflow, we also observe that change in net skilled wage rate is negative for a few initial values of h_S. We also find that a *cubic relation* best explains the association between initial values of h_S and change in net skilled wage rate/wage inequality.[13]

[13] Stata 15 is used to run the simulations.

Figure 2.3b: Technical Progress, Net Skilled Wage Rate and Wage Inequality.



Source: Authors' Input.

Note: In accordance with the theoretical results observed in section 2.1, the simulation exercise assumes that initial $w = 500$, $w_S = 1000$, $\hat{w} = 0.10$, $\widehat{w_S} = 0.20$ and is based on series of 10,000 random observations for initial h_S (at equilibrium). We also find that a cubic relation best explains the association between initial values of h_S and change in net skilled wage rate/wage inequality.

Thus, with greater inflow of immigrants or technical progress in sector X, net skilled wage rate rises more, the higher the initial value of h_S. This is because in each of the two cases, $\widehat{h_S} > 0$, which leads to a further rise in the value of h_S thereby raising the net skilled wage rate and thus, the (net) skilled-unskilled wage gap. And, the result also holds in the presence of exogenous h_S or when $\lambda = 0$. This means that if there would have been no response of the household sector, then, the entire burden of a rise in unskilled immigration would have fallen on sector Y – given full employment, the sector would have to absorb the entire increase in L, leading to capital reallocation from X to Y thereby depressing the skilled wage rate along with the greater fall in unskilled wage rate. $\lambda \neq 0$ reduces this negative impact to some extent. Similarly, in the case of technical progress, a relatively higher rise in skilled wage rate vis-à-vis unskilled wage rate, increases the demand for household labour by the skilled workers, which, in turn, puts an upward pressure on unskilled wage rate (given full employment) and thus, net skilled wage rate or wage inequality rises less in comparison to when $\lambda = 0$ or when it is low.

3. Conclusion

While analysing votes in favour of BREXIT, various sources including the media, have demonstrated the willingness of Londoners to remain in the European Union. It seems that crowding in immigrants in large cities may not cause much of social tension as in suburbs or remote places where such flows are usually of much lower magnitude. What we show here is that benefactors of such inflows stay in cities in the form of more affluent people who use *cheaper labour for household work*. The labour affected by declining wage, even if not in geographical contact with the immigrants may oppose such flows because of the rise in wage inequality. Our result also introduces a novel outcome in the theory of trade and factor flows. The conventional wisdom is that if international mobility of a specific factor hurts the specific factor, it must hurt all specific factors as capital becomes more expensive. We alter that result. Greater inflows of a specific factor may actually increase the net income of the specific factor.

More so, the conventionally established outcome regarding the negative impact of technical progress in a skill-intensive sector on unskilled wage rate ceases to hold in the presence of the so-called *household* sector. Though wage inequality may still increase, our paper also shows how the introduction of this new segment mitigates the negative impact of technical improvement on relative wages.

We also address the relative well-being issue between the North and the South and show why, in the presence of technical progress, countries with greater immigration suffer from higher wage inequality.

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Appendix 1

Optimal 'h' for the skilled and unskilled workers

To explain the nature of h, let's assume that the utility function of an individual 'i' is given by:

$$U_i = U_i(D_X, D_Y, h_i) \qquad \forall i \in \{S, L\} \qquad (i)$$

where D_X, D_Y represent consumption of goods produced in sectors X and Y and h_i represents the extent of household job that can be outsourced to others such that $U_i'(h_i) > 0$. As outlined in the main text, each i ends up paying a wage rate equal to w for hiring household labour, and therefore, maximises (i) subject to the following budget constraint –

$$pD_X + D_Y = w_i - h_i w$$

We can, thus, rewrite the utility function as:

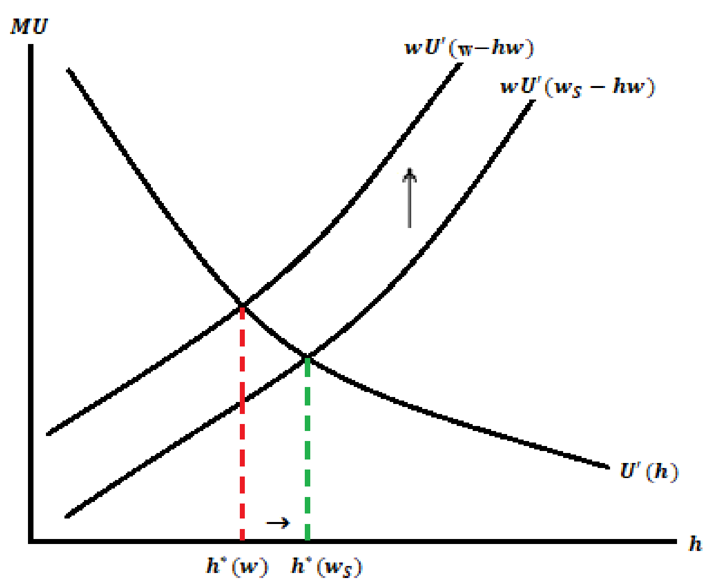
$$U_i = U_i(w_i - h_i w, h_i)$$

and, the marginal first order conditions imply

$$wU_i'(w_i - h_i w) = U_i'(h_i)$$

This shows that h_i is now endogenously determined and its optimal level is determined by the intersection of 'w' times the marginal utility from consumption and marginal utility from a higher 'h_i' as shown in figure A2.1.

Figure A2.1: Choice of 'h'



For the richer individuals (or skilled workers), consumption will be higher and thus, $U_S'(w_S - h_S w) < U_L'(w - h_L w)$. As a consequence, in equilibrium, $h^*(w_S) > h^*(w)$ or, $h_S > h_L$. Higher w, on the other hand, will reduce h^* for both.

Appendix 2

Since factors are paid according to their value of marginal productivity and capital is freely mobile across the two sectors, (assuming $p = 1$):

$$r = X_K(K_X, S_X) = Y_K(K_Y, L_Y) \tag{ii}$$

$$w = Y_L(K_Y, L_Y) \text{ and } w_S = X_S(K_X, S_X) \tag{iii}$$

Totally differentiating equations (ii) and (iii) and making necessary substitutions, we find,[14]

$$\hat{w} = \frac{Y_{LL}X_{KK}L_Y}{w(X_{KK}+Y_{KK})}\widehat{L_Y} + \left[\frac{Y_{LK}X_{Kt}}{w(X_{KK}+Y_{KK})}\right]t\hat{t} \tag{iv}$$

$$\widehat{w_S} = \frac{X_{SK}Y_{KL}L_Y}{w_S(X_{KK}+Y_{KK})}\widehat{L_Y} - \left[\frac{X_{SK}X_{Kt} - X_{St}(X_{KK}+Y_{KK})}{w_S(X_{KK}+Y_{KK})}\right]t\hat{t} \tag{v}$$

$$\hat{r} = \frac{Y_{KL}X_{KK}L_Y}{r(X_{KK}+Y_{KK})}\widehat{L_Y} + \left[\frac{Y_{KK}X_{Kt}}{r(X_{KK}+Y_{KK})}\right]t\hat{t} \tag{vi}$$

From equation (13) in the main text,

$$\left[\frac{L_Y}{L} + \lambda h_S \frac{S}{L}\left[\frac{X_{SK}Y_{KL}L_Y}{w_S(X_{KK}+Y_{KK})} - \frac{Y_{LL}X_{KK}L_Y}{w(X_{KK}+Y_{KK})}\right]\right]\widehat{L_Y} = [1 - h_L]\hat{L} +$$

$$h_S\frac{S}{L}\left[\frac{X_{SK}X_{Kt} - X_{St}(X_{KK}+Y_{KK})}{w_S(X_{KK}+Y_{KK})} + \frac{Y_{LK}X_{Kt}}{w(X_{KK}+Y_{KK})}\right]t\hat{t} \tag{vii}$$

where, $\left[\frac{L_Y}{L} + \lambda h_S \frac{S}{L}\left[\frac{X_{SK}Y_{KL}L_Y}{w_S(X_{KK}+Y_{KK})} - \frac{Y_{LL}X_{KK}L_Y}{w(X_{KK}+Y_{KK})}\right]\right] > 0$ whenever $\frac{K_Y}{L_Y} > \frac{K_X}{S_X}$.

Assuming $\hat{t} = 0$ and using $(iv) - (vii)$, we find equations $(16) - (18)$ of the main text and assuming $\hat{L} = 0$ yields equations $(21) - (23)$ of the main text.

[14] Linear Homogeneity implies that $[Y_{LL}Y_{KK} - (Y_{LK})^2] = 0$ and $[X_{SS}X_{KK} - (X_{SK})^2] > 0$

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