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Technological Progress with Segmented Factor Markets and Welfare Implications for the Urban Poor

by

Soumyatanu Mukherjee and Sameen Zafar

Abstract

Motivated by a set of stylised facts based on provincial data for India, this paper investigates the incidence of urban poverty by modelling the impact of technological progress in the formal sectors of the economy on the urban informal wage in a four-sector general equilibrium framework with labour and capital market distortions. Uniform technological progress only in the capital intensive segment of the formal sectors affects the urban informal workers adversely, whereas productivity improvement only in the less capital intensive sector benefits them. The sensitivity analysis demonstrates that when both formal sectors undergo uniform technological progress at the same rate, informal wage may improve if the vertically integrated sector is less capital intensive (as capital flows to the informal sectors). This helps in understanding trends in urban poverty given the strong association between the urban informal wage and degree of urban poverty.

JEL Classification: E26; F11; F16; J46; I32; O17**.**

Keywords: Poverty; Technological Progress; Informal Wage; General Equilibrium.

Centre for Research in Economic Development and International Trade, University of Nottingham

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Outline

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1. Introduction:

It is well-known that in a developing economy the 'informal sector' hosts a substantial proportion of the workforce in unregistered activities, primarily characterised by the ease of entry and unregulated markets. As suggested by many authors (Agenor (1996), Schneider and Enste (2000) and the references therein) more than 70% of the workforce is engaged in the informal sector of a developing country (DC). In South Asian countries such as India, a significant proportion (about 85% in non-agricultural activities of India) of the working population are engaged in the informal sector. In 1995, the informal sector accounted for almost 92.5 per cent of India's workforce (Subrahmanya and Jhabvala, 2000).

Here we define 'informal' sector as the unregulated sector where minimum wage laws are not maintained. Such sectors are mainly engaged in producing non-traded items in the economy. These sectors comprise own-account enterprises as well as many subcontract firms producing various parts and semi-processed components for the parent formal sector firms. This definition allows us to focus on the economic conditions of the majority of the workforce in LDCs like India.

According to the International Labour Organisation (ILO) World Employment Report (ILO, 1998 p. 168), the informal sector is classified into three categories:

a) The *micro-enterprise sub-sector* is the most important part, typically connected to the formal sector through various types of sub-contracting arrangements.
b) The *household-based sub-sector*, where major activities are carried out by family members (mostly by the unpaid female labour force). Most households belong to the lower tail of the income-distribution and are unable to come out of the poverty-trap.
c) The *independent service sector*, comprises of domestic helpers, street-vendors, cleaners, street-barbers etc., as well as those referred to as casual labour. The skills required for these occupations are of the most basic nature in the informal skill hierarchy.

As shown in different papers (Chaudhuri, 2001; Koizumi and Kopecky, 1977, 1980; Findlay, 1980) liberalising a developing economy may result in technological progress as a peer-effect (such as an inflow of foreign capital usually leads to transfer of technology from the foreign producers to the destination sector of the recipient country). Such productivity improvements can lead to a rise in per capita income of the host country (Chaudhuri, 2005; Mukherjee, 2014). In fact, the most important determinant of the boom in Indian growth during the liberalised regime was primarily the productivity improvement in the organised sectors.

The informal sector mostly comprises of "wage hunters and gatherers" (Breman 1994), usually but not always uneducated, with little or no chance of a living wage and no security. A large part of such employment opportunities is generated in the urban or semi-urban areas where majority of the workforce is economically marginalised. The social consequence of such an overall rise in the growth rate must be reflected in the quality of life of the poor

people. There has also been evidence (such as Sethuraman, 1997) suggesting that urban poverty tends to decline with economic growth in Asia and Africa. Kapsos and Bourmpoula (2013) have shown that the share of the extremely poor (less than $US 1.25) has dropped from 43.3% in 1999 to 27% in 2011 whereas (as shown in Figures 1 and 2 below) India experienced a productivity boom in the organised sectors (primarily service sectors) over the ten-year period from 2000 to 2010 in almost all the states. The benefits of productivity growth in the formal sectors should have percolated to the bottom of the income group working in the urban informal sectors. While it is difficult to assess such an impact at the micro level and in terms of various indicators of poverty and human development, the informal wage and employment can be considered to be good indicators to link productivity improvement in the formal sectors and urban poverty, given that most of the urban workforce in a typical developing economy (such as India) is absorbed in this segment.

These workers look for what they can salvage on the margins of the industrial economy (this being literally the situation of the rag pickers and recyclers). These people mostly do not possess any assets. Only a small number of them find employment, often only temporary, and the larger proportion of these workers have no choice but to "go out hunting and gathering a wage" (Breman, 1996). They are not suffering from unemployment; their problem is the abysmal wages offered to them which they often find insufficient to meet their minimum daily needs. Survival takes precedence over everything else (Pathy, 1993). Therefore, as argued in Kar and Marjit (2009), Marjit and Kar (2009) and others, in the present context, informal wage can be considered as a reasonable benchmark to measure the living conditions of these poor people.

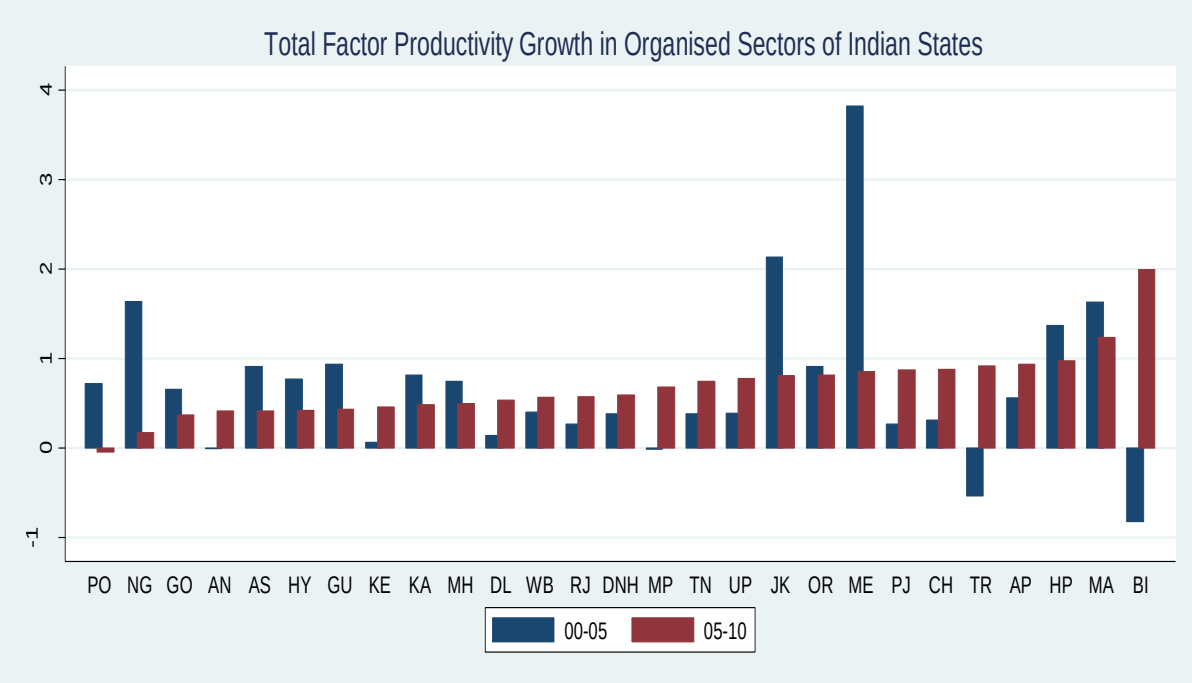
The principal objective of this research is to examine whether and to what extent the productivity growth in the formal sectors, producing tradable products, will affect the urban informal sector wages and employment. Section 2 provides some stylised facts from using provincial data of India during the liberalised regime in order to motivate our key research agenda. Section 3 provides a review of relevant literature and the major gaps in existing research. Section 4 discusses the theoretical model and the results. Finally section 5 concludes.

2. Stylised Facts

In this section we introduce and discuss the data and provide empirical evidence to motivate the theoretical analysis with examples from the liberalisation experience in India. We use the survey data on the registered manufacturing industries across 27 major Indian states available from the Annual Survey of Industries (ASI) to compute total factor productivity growth (TFPG) using the growth accounting method for the survey years 2000-01, 2005-06 and 2010-11.[1] It is easily observable from Figure 1 that almost all the states have experienced productivity boom from 2000 – 2005 and from 2005 – 2010.

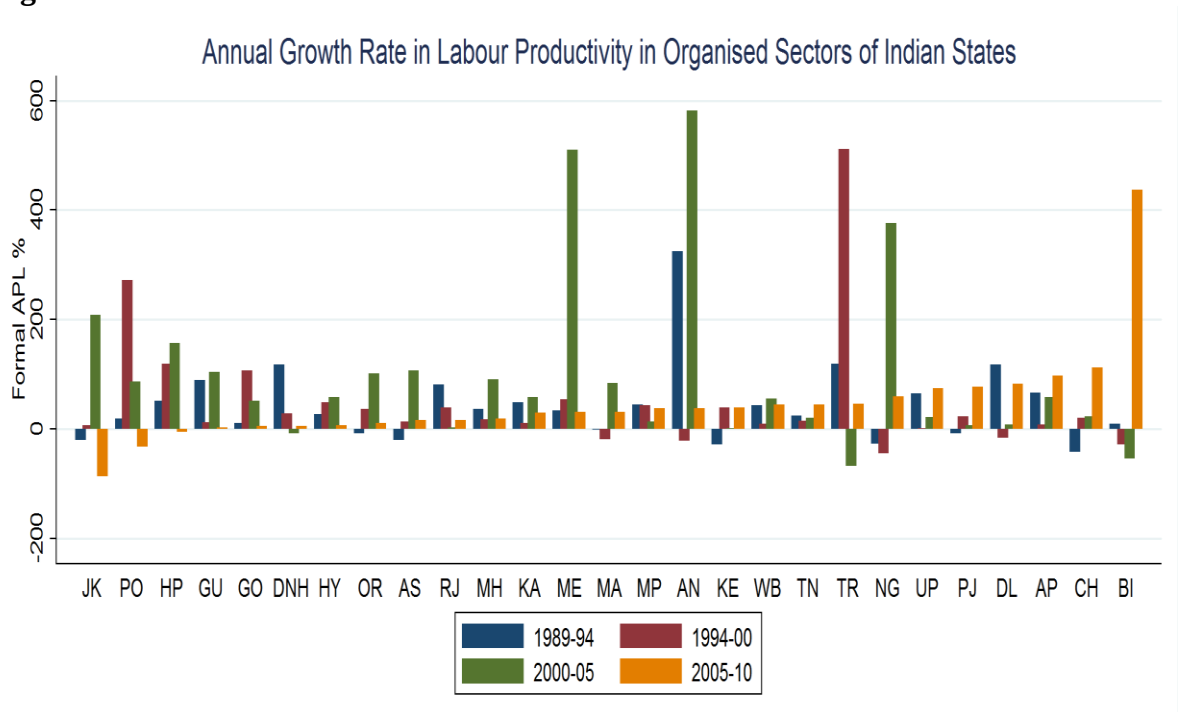
[1] See Appendix III for details on the construction of TFPG.

Figure 1



***NOTES*:** AN – Andaman & Nikober; AP – Andhra Pradesh; AS – Assam; BI – Bihar; CH – Chandigarh; DL – Delhi; DNH – Dadra-Nagar-Haveli; GO – Goa; GU – Gujrat; HP – Himachal Pradesh; HY – Haryana; JK – Jammu & Kashmir; KA – Karnataka; KE – Kerala; MA – Manipur; ME – Meghalaya; MH – Maharashtra; MP – Madhya Pradesh; NG – Nagaland; OR – Orissa; PJ – Punjab; PO – Pondicherry; RJ – Rajasthan; TN – Tamil Nadu; TR – Tripura; UP – Uttar Pradesh; WB – West Bengal.

Figure 2



Source: ASI surveys, various rounds.

Labour productivity in the organised sectors has increased fairly evenly across the provinces of India between 1989 and 2010 as revealed in Figure 2. Generally if stringent labour laws, constituting a rigid labour market, act as a constraint on formal sector activity (for which these restrictions are binding) in a particular industry, the production in that industry is at least partly made up by informal sector activity (which is not under the purview of such laws). The formal sector firms are generally farming out a part or whole of their production to the informal sector firms to avoid various regulations and associated costs. This is because the latter firms enjoy the advantage of cheaper labour supply. On the other hand, the informal firms are also dependent on formal firms for marketing their products and, in particular, for the supply of credit from the formal sector firms since the formal firms usually have an advantage over the informal firms in the credit market.

As reported in Sundaram et al. (2012), within the manufacturing sector, the share of informal sector employment increased over time from about 75 per cent in 1989 to around 81 per cent in 2000, while its share in value added has been stable (with minor fluctuations) at around 20 per cent. However, value added has been rising over time in both the informal and formal manufacturing sectors. On the other hand, employment in the formal sector has remained static or has even been slightly declining, while in the informal sector it has been rising steadily. Therefore, in case of value added, we get a percent-to-percent match in the growth of formal and informal manufacturing, which is indicative of some degree of complementarity between the two sectors, while the growth in population or labour force has mainly been absorbed by the informal manufacturing sector. Sundaram et al. (2012) found strong positive correlation between formal and informal sector activities (employment, output and value added) at the industry-province level, which supports significantly the inter-linkage between formal and informal sectors. Also the reliance of formal sectors on informal sectors is much higher where labour laws are more stringent and organised sectors are relatively capital (physical or human) intensive.

Following such a technological change in the formal sectors, organisation of production between the formal and informal segments would be affected, with a significant impact on informal activities, wages and employment. We have used data from various rounds of surveys conducted by 'National Sample Survey Organisation' (NSSO) of the Government of India for Non-Directory Manufacturing Establishments (NDMEs) in the urban sector (because of their strong inter-linkages with urban formal sectors) to construct measures of real informal wage and real fixed assets' formation for 1989-90, 1994-95, 2000-01, 2005-06 and 2010-11 across twenty-seven Indian provinces.[2]

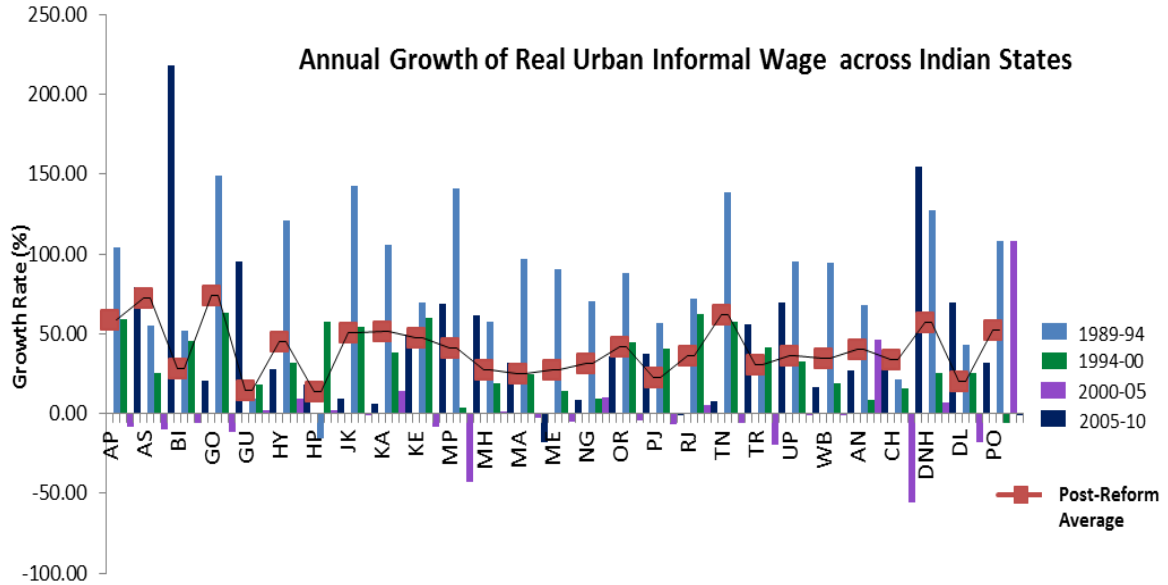
We also construct a broad measure of input purchases by the formal sectors from local informal firms. This variable captures the notion of vertical production linkages between urban formal and informal sectors or the formal sector subcontracting activity owing to which formal/registered firms farm out their production to the vertically integrated informal firms. This variable is the sum of: (a) Value of products sold by the registered factories in the same condition as purchased from the other local firms; (b) Cost of contract and commission work

[2] Detailed construction of variables from survey data is mentioned in Appendix II.

done by others on materials supplied by the factory; and (c) Total delivered value of all other materials (other than fuel), which have not been produced by the registered factories. The first two items together constitute a measure of subcontracting.[3]

During the liberalised regime, although more labour and capital have been reallocated to the urban informal sectors, we observe a positive trend in informal wage growth across the provinces of India in the post-reform period, as observed in Figure 3.

Figure 3



Source: NSS surveys, various rounds.

Figures 4 and 5 display the causal relationship between labour productivity and the intermediate input usage by the formal sector for the years 1994 and 2010 respectively. This causal relation is shown by producing a linear fit with 95% confidence interval for the twenty-six Indian states and one Union Territory (UT).[4] As can be seen, the relationship is weakly positive. We conclude that the increase in labour productivity in the urban formal sector leads to an increase in intermediate input usage by the formal producers.

[3] Ramaswami (1999) measured subcontracting intensity in formal sectors in a similar fashion. He used the ratio of the value of goods sold in the same condition as purchased to value-added as a measure, but this excludes other forms of subcontracting recorded as contract work performed on materials supplied.

[4] For the sake of brevity we are only presenting two years' graphs although the remaining years also exhibit the same pattern.

Figure 4: Intermediate Input Usage by Formal Sectors versus Formal Labour Productivity for 1994

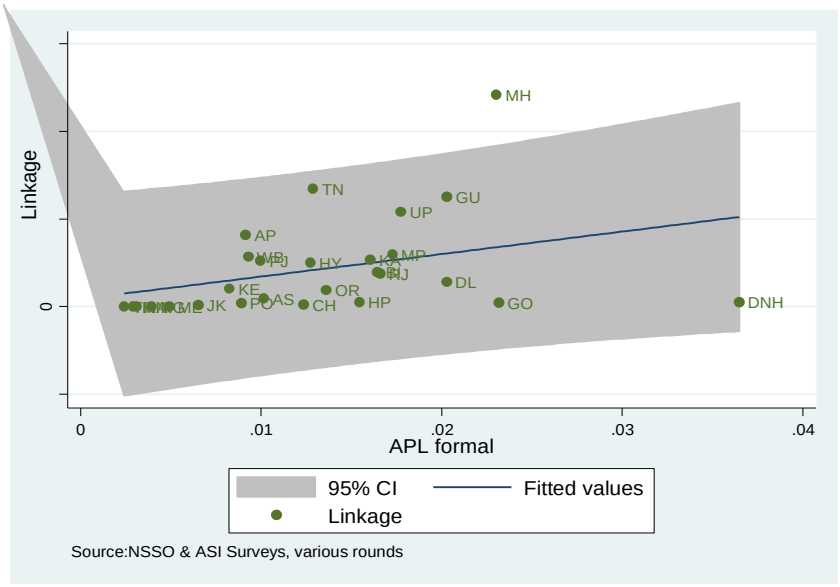


Figure 5: Intermediate Input Usage by Formal Sectors versus Formal Labour Productivity for 2010

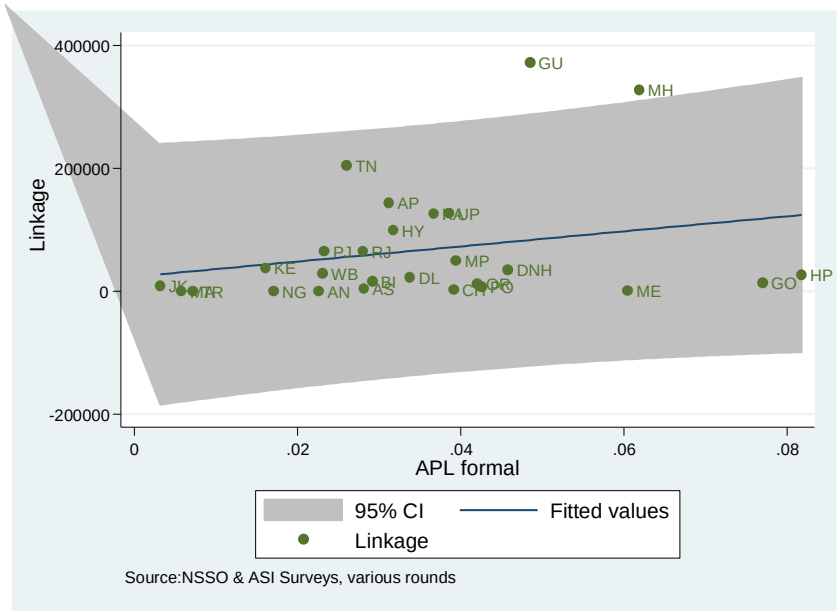
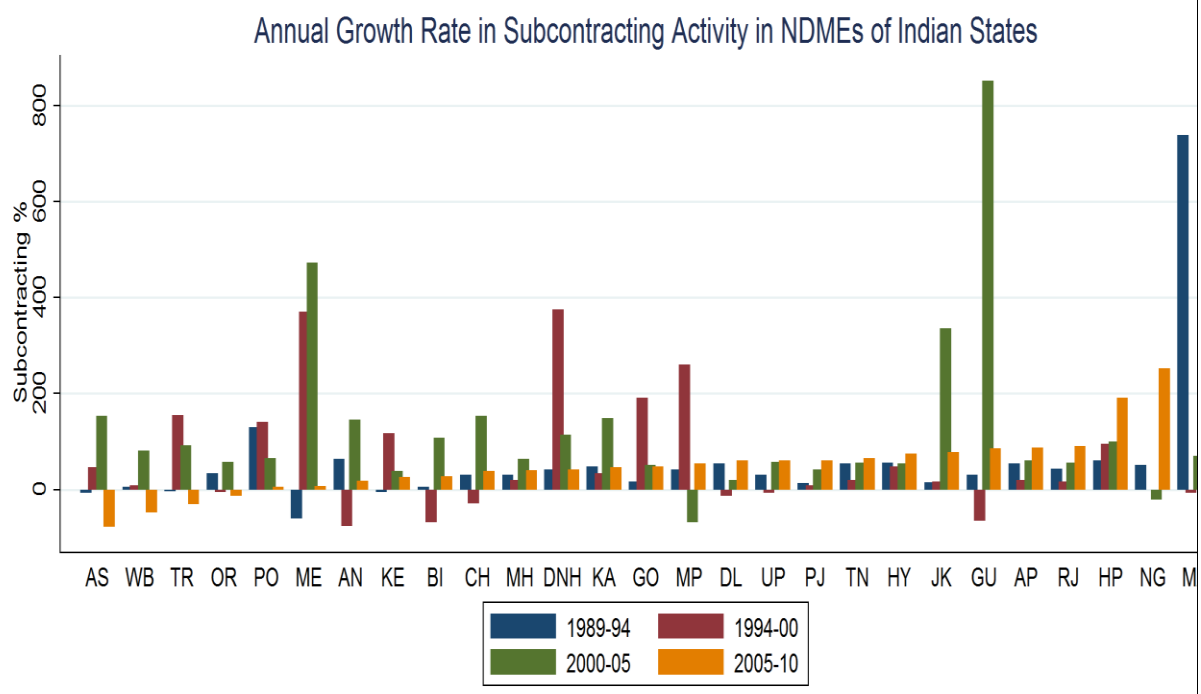


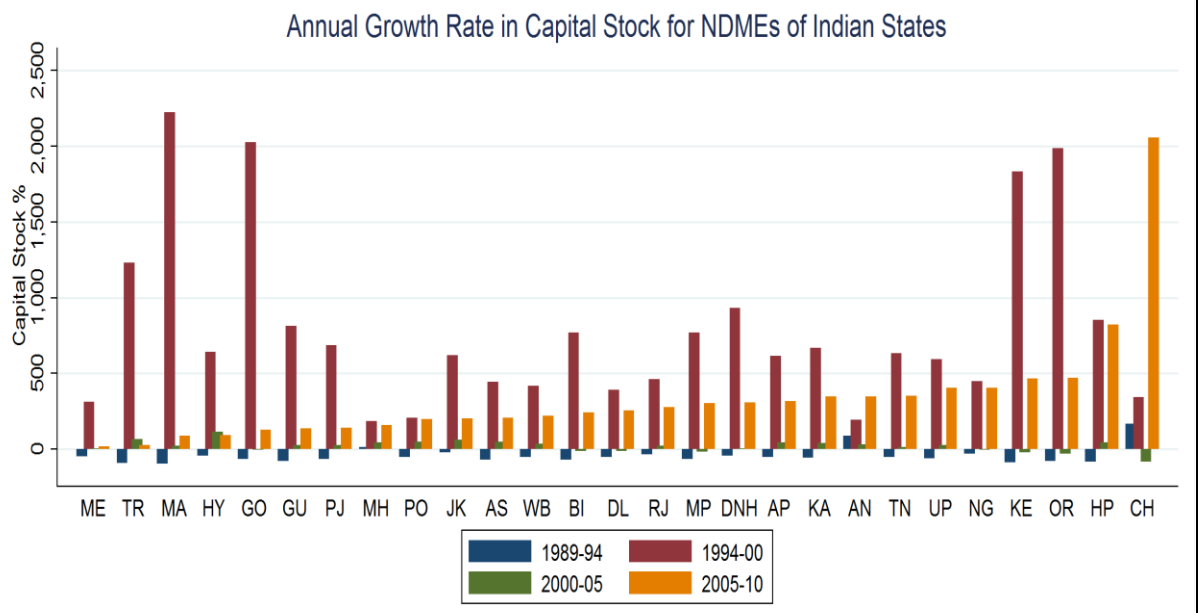
Figure 6 illustrates that the growth rate of the subcontracting activity has been fairly positive across the majority of the states during the liberalised regime. One can infer that productivity improvement in organised sectors has encouraged the producers in these sectors to demand more intermediate inputs and services provided by the urban informal sector. This has induced the informal sector producers to hire more workers, leading to the upswing in informal wages.

Figure 6



Source: ASI and NSS surveys, various rounds and own calculations.

Figure 7



Source: NSS surveys, various rounds.

We also observe a high rate of growth in real fixed assets in urban NDMEs, an approximation to capital accumulation in the urban informal sectors, across almost all the 27 provinces (Figure 7) during the liberalised regime.[5] We utilise all this information to assess how far the increase in the formal sector subcontracting activity and increased capital accumulation in the urban NDMEs have contributed to the rise in wages in the urban NDMEs during the liberalised regime across Indian provinces.[6]

Table 1: Empirical Results of Two-Way-Effects Model

	Pooled OLS	**Random Effects**	**Fixed Effects**
	Dependent Variable: Real Urban Informal Wage		
Fixed Assets	-0.001	0.002	0.002*
	(0.285)	(0.225)	(0.124)
Linkage	0.0003	0.004	0.005**
	(0.302)	(0.270)	(0.102)
R^2	0.481	0.513	0.581
N	135	135	135

Note: Standard Errors in Parentheses. Significance level: 1%***, 5%**, 10%*.

Given the significant time-effects, we estimate a two-way fixed effects model (FE), allowing for both province-specific fixed effects and time-effects:

$$w_{it} = \alpha_i + \gamma_t + \beta_1(Link)_{it} + \beta_2(FA)_{it} + e_{it}$$

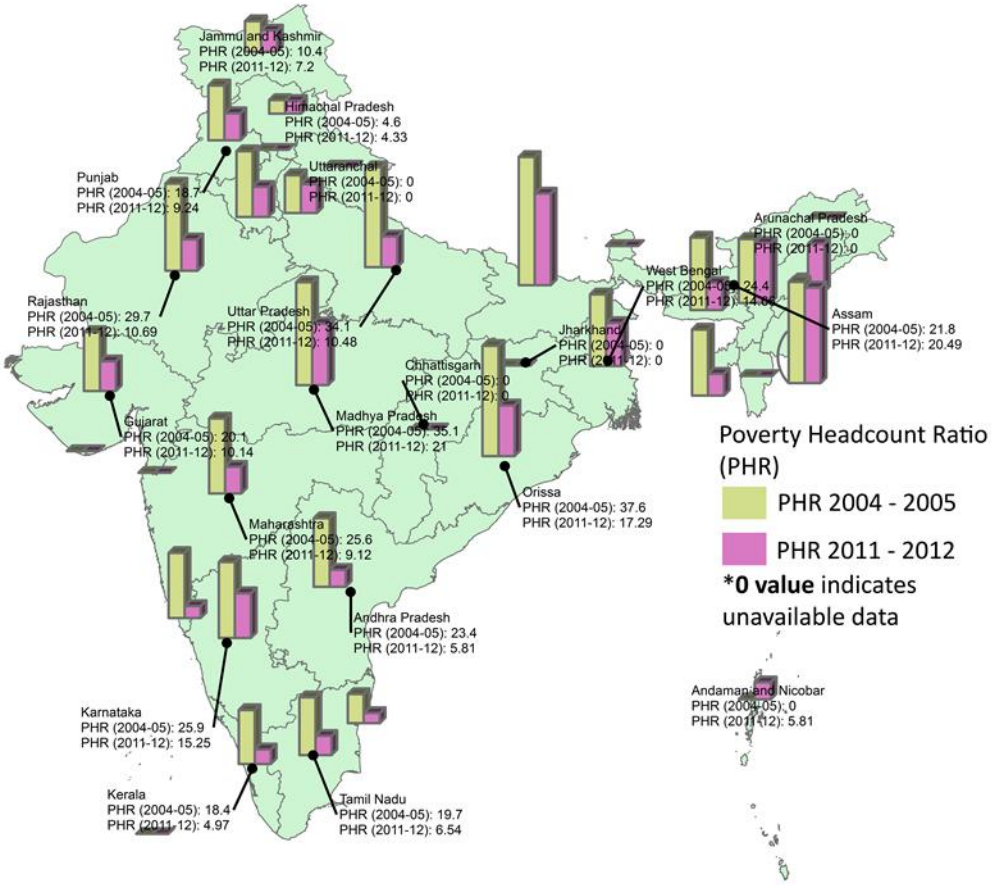
Where w is the real urban informal wage, α_i is the permanent effect associated with individual units and captures unobserved time-invariant individual heterogeneity that effects informal wage, γ_t captures the time-effects, FA is the real fixed assets formation in the urban NDMEs. Each i denotes one Indian state (or UT) and t denotes year. The error term is $e_{it} \sim N(0, \sigma_e^2)$. We estimate γ_t by including a set of year-dummies. Therefore, $\gamma_t = \sum_{s=1}^{T} \gamma_s D_t^s$ and for example, $D_t^s = 1$ if $t = 1989$ and zero otherwise.

[5] We have been unable to utilise other more appropriate variable, such as 'Working Capital' in the urban NDMEs to provide a proper notion of 'Capital' due to data-unavailability. However, the overwhelming fixed assets formation in the informal sectors definitely indicates that a large portion of the investments (previously in the formal sector) has flown into the informal segment. Kar and Marjit (2009) have also used this empirical approximation.

[6] Descriptive Statistics are given in Appendix III.

Results are in Table 1. The Breusch and Pagan Lagrangian Multiplier rejects the Pooled OLS model and the Hausman test supports the fixed effects (FE) model. Therefore, FE with year-fixed effects is the preferred model.[7] The slope coefficients of 'Fixed Assets' & 'Linkage' variables are positive and statistically significant in FE and RE models. An increase in both variables leads to an increase in real informal wage, ceteris paribus.[8]

Figure 8: Change in the Incidence of Poverty across Indian Provinces between 2004-05 and 2011-12



Source: Planning Commissions and NSSO data, various rounds and authors' calculations.

We next investigate the association between the urban informal wage and urban poverty at the provincial level to motivate our main research agenda. We calculate the poverty head count ratios in the urban areas of Indian provinces for the years 2004-05 and 2011-12. As demonstrated in Figure 8, the head count ratio has dropped across all the provinces except

[7] The p-value obtained from Breusch and Pagan Lagrangian Multiplier test is 0.04. For Hausman test to choose between FE and RE, a p-value of 0.025 is obtained, providing to reject the null hypothesis of the Hausman test is that individual (and time) effects are not correlated with the regressors (Cameron and Trivedi, 2010).

[8] The instrumental variable (IV) approach was also adopted because the linkage variable was expected to be endogenous in our model. Therefore, the linkage variable was instrumented using the formal value added (FVA) as FVA is expected to be uncorrelated with the informal wage. When the Hausman test was performed between OLS and IV, the test went in favour of OLS.

Nagaland. The increase in the urban informal wage between 2005 and 2010 (as shown in Figure 3) in these Indian states can plausibly be one reason for the decrease in urban poverty headcount ratio, given the fact that the majority of the urban poor in India are engaged in the non-agricultural urban informal sector.

The evidence documented above has motivated us to explore the general equilibrium implications of the productivity take-off in the tradeable organised sectors on urban informal wage and employment and to examine how far the consequences hinge on the nature of capital mobility between the formal and informal sectors of the urban economy. Given the concentration of informal workers in the urban economy and presence of urban poverty, the theoretical exercise will help us to obtain an overall view of the well-being of the poor as a consequence of productivity improvement in the organised sectors.

3. Existing Literature and Major Research Gap

The key hypothesis we want to analyse is how informal wage is affected following a productivity take-off in the formal/organised sectors of the economy. Goldberg and Pavcnik (2003) and Marjit, Ghosh and Biswas (2006) have explored the asymmetric impact of reform policies on the size of the informal sector. However, DCs like India are also plagued by capital market segmentation among the organised formal and non-organised informal sectors. It has been shown theoretically (Marjit 2003; Marjit and Kar 2004; Marjit, Kar and Acharyya 2007; Marjit, Kar and Beladi 2007; Marjit and Kar 2008 a, b; Marjit Kar and Maity 2008) that informal wage can change depending on various degrees of capital mobility between formal and informal sectors. These studies use simple general equilibrium structure to answer a critical question – how do exogenous policy changes in the formal sector affect the wage and employment conditions in the informal sector? Marjit and Kar (2009) assessed the implication of a tariff-cut in the organised formal sector on informal wages, explaining the notion of different degrees of capital mobility between informal and formal segments of the economy and how they affect the outcome on informal wage. However, while the paper by Marjit and Kar (2009) attempted to check trade policy induced relative price effects on real informal wage, this paper highlights the productivity issue explicitly.

It should be mentioned that Marjit and Kar (2008) explored the link between labour productivity growth and informal wage, emphasising the role of capital mobility between formal and informal segments of the economy. Moreover, it has been illustrated in different studies that informal sector firms are attached to the formal sector firms on a contractual basis. Thus, it would be unrealistic to assume (like Marjit and Kar 2008, 2009) that the informal sector produces internationally traded final goods, capital is sector-specific and that the informal and formal credit markets are completely disintegrated even in the short-run. This is because the informal sector money-lender borrows capital from the formal credit market for re-lending. Hence a part of the formal credit enters the informal credit market. Therefore the ‘zero mobility’ case in Marjit and Kar (2008, 2009) is unlikely in reality.

There has been a pertinent debate on the desirability of various types of technological progress among labour economists and trade-theorists (Jones 1996, 2003, 2006; Krugman 2000; Ethier 2005). Trade-theorists, emphasising the importance of relative factor intensities in different sectors (Jones 1965; Oladi and Beladi 2007; Beladi et al. 2008), argue that a labour-augmenting type technological change in the labour-intensive sector will push the wages up. This result is in contradiction to the usual predictions of labour economists. Findlay and Jones (2000) argued that trade and labour theory outcomes will be merged for a major modification of production structure consequent upon such a technological progress. The most recent attempt has been made by Beladi et al. (2012) in terms of a simple two-sector general equilibrium model with segmented labour markets to show that technological progress leads to opposite wage movements independent of relative factor-intensity ranking between organised (formal) and non-organised (informal) labour sectors.

The simple two-sector set-up in Beladi et al. (2012) is not sufficient to portray the conditions of urban informal sector in a developing economy. It would be more realistic to classify the urban informal sector as comprising of an industrial segment that uses labour and capital to provide an intermediate input such as leather and rubber products, electrical equipment etc. to the formal sector firm, with the urban informal firm being tied to the formal firm by the system of subcontracting. Another aspect of the informal service sector comprises producing non-traded services such as street-vendors with almost no use of capital. These possibilities have been considered in Kar and Marjit (2009). This paper has adopted the same set-up since we believe that production structure of Kar and Marjit (2009) is quite generic and plausible for mapping the urban informal sector of a poor developing economy. However, Kar and Marjit (2009) did not consider any dualism in the domestic capital market. The dominant feature of dualism in the capital market is the fragmented interest rate structure, featuring lower allocation of loanable capital to the informal sector at a higher relative rental rate. The informal producers do not have access to credit from formal institutions. Therefore, they have to depend on the informal credit market, where the rental cost of capital is exorbitantly high. We are going to incorporate this issue of dual capital market in our model and this serves as our point of departure from Kar and Marjit (2009).

4. The Model

Consider a static general equilibrium model for a small, open developing economy with four sectors: two urban formal sectors and two urban informal sectors. Among the two informal sectors, one is an informal service sector (sector 1) providing non-traded services by the unskilled (surplus) labour of the economy. Another sector (sector 2) is within the industrial set-up, producing a non-traded intermediate input using unskilled labour and capital for the formal export sector. Within the formal segment, the export sector (sector 3) uses skilled labour[9], capital and the intermediate input in the production process. Skilled wages are fixed

[9] Here by 'skilled' we do not mean only human capital. In fact, the labourers in the formal sectors are distinguished from the informal sector workers in terms of productivity. Thus 'skilled labour' refers to the combination of wage-earners, mangers, supervisors and clerical job-performers in the organised sector. 'Skilled

at a higher level by prior negotiations with labour unions. We do not explicitly model wage-fixation given the focus of our paper and we will treat skilled wages as institutionally given[10]. Sector 4 is the import-competing sector of the economy using skilled-labour, capital and an imported 'middle product' (M, price P_M^*) following Sanyal and Jones (1982) in its production process[11]. Countries such as India export primary agricultural products and also products requiring high level of skills such as computer software, while they are the net importers of relatively more capital-intensive but less skill-intensive manufacturing products. Therefore, we assume that sector 4 is the most capital-intensive sector in the economy. In the Heckscher-Ohlin-Subsystem (HOSS) formed by the two formal sectors, sector 4 is relatively capital-intensive compared to sector 3 in physical and value terms. Production functions follow constant returns to scale (CRS) technology.

The following notation is used:

W= competitive informal wage rate for unskilled labour ($\bar{L}$);

W_S^*= Institutionally given skilled wage rate in formal segment of the economy;

R =rate of interest in the informal credit market;

r =rate of interest in the formal credit market;

a_{ji}= amount of the j^{th} factor used to produce 1 unit of the i^{th} good ($j = L, S, K; i = 1,2,3,4$);

a_{23} = per-unit requirement of the non-traded intermediate input in the export sector;

a_{M4} = per-unit requirement of the imported middle product in the import-competing sector;

$\bar{K}$ = total stock of capital in the economy;

$\bar{S}$= stock of skilled labour in the economy;

K_1 = available capital in informal sector;

P_i = domestic prices of non-traded goods ($i = 1,2$);

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wage' here means the total wages and salaries paid to 'skilled labour', which includes the payments to the managers and supervisors.

[10] For a similar treatment of unionised wage in the organised sector, see Chaudhuri (2005) and Mukherjee (2012, 2014). Chaudhuri (2003) has provided an explanation regarding how the unionised wages can be determined through the collective bargaining process.

[11] It is well-known that there is a range of productive activities wherein productive resources and raw materials are transformed into final commodities ready for consumption, so that the role of international trade is to convert products available in early stages of production into a different set of products more useful as inputs to produce the final goods required by the consumers. That is, international trade takes place in the 'middle' of the production process. As illustrated in Sanyal and Jones (1982), the 'Input Tier' combines local resources to produce a set of 'middle products', which then get traded for other middle products, which, in turn, will be used as inputs in the 'Output Tier' of the economy, producing the final consumer goods. Let us assume here for simplicity that there is only one production activity in the Input Tier to produce a middle product E that gets exchanged in the world market for the middle product M, which is combined with skilled-labour and capital in the Output Tier (i.e. in import-competing formal industry sector 4) to produce the import-competing product commodity 4.

P_i^* = internationally given prices of traded goods ($i = 3,4$);

θ_{ji} = cost-share of factor j in the production of good i;

λ_{ji} = share of sector i in the total employment of factor j;

$\wedge$ = proportional change.

Price-unit cost equality in competitive product markets entail:

$$Wa_{L1} = P_1 \quad (1)$$

$$Wa_{L2} + Ra_{K2} = P_2 \quad (2)$$

$$W_S^* a_{S3} + ra_{K3} + P_2 a_{23} = P_3{}^* \quad (3)$$

$$W_S{}^* a_{S4} + ra_{K4} + a_{M4} P_M^* = P_4{}^* \quad (4)$$

We assume the following functional relationship between R and r:

$$R = \rho r;\ \rho > 1 \quad (5)$$

Here ρ denotes the degree of imperfection of the informal credit market; $\rho > 1$ implies that $R > r$. This is because the informal moneylenders generally borrow funds from the formal sector at the market rate of return r, re-lend it to the informal borrowers and in this way maximise the net interest income[12]. Therefore, it is realistic to assume that informal interest rate is positively related to and steeply higher than the formal interest rate. The lower the number of alternative sources of credit to the borrowers in the informal sector, the higher is the degree of imperfection in the informal credit market. And thereby, the higher is the power of the informal sector lenders to mark up interest rate in the informal credit market over the one in the formal capital market (i.e. the greater the value of ρ).

Using (5), Equation (2) can be written as

$$Wa_{L2} + \rho r a_{K2} = P_2 \quad (2.1)$$

Equations (1), (2.1), (3), (4) are the price-unit cost equality conditions for the informal service sector, intermediate input producing sector, the export (formal) sector and the import-competing manufacturing sector, which is relatively capital intensive compared to the vertically integrated export sector.

We also assume that the amount of credit allocated to the informal sector is a positive function of the return differential between the two capital markets. Therefore as long as $\rho > 1$, informal capital market exists and thus the dichotomy between the two credit markets exists.

[12] Thus r could also be interpreted as the opportunity cost of lending credit to the moneylender.

$$K_1 = K_1(R - r) = K_1\{r(\rho - 1)\}. \text{So when } (R - r) \geq 0, K_1'(.) \geq 0. \quad (6)$$

Thus, full utilisation of informal credit implies:

$$a_{K2}X_2 = K_1\{r(\rho - 1)\} \quad (7)$$

Note that Equation (7) is not an independent equation since it only states that part of the available credit is allocated to the informal credit market[13].

The two urban formal sectors use the formal credit. The equilibrium in the formal credit market ensures that[14]

$$a_{K3}X_3 + a_{K4}X_4 = \bar{K} - K_1\{r(\rho - 1)\} \quad (8)$$

The full employment of unskilled labour implies:

$$a_{L1}X_1 + a_{L2}X_2 = \bar{L} \quad (9)$$

The full employment condition for skilled labour implies

$$a_{S3}X_3 + a_{S4}X_4 = \bar{S} \quad (10)$$

The demand-supply equality condition for the non-traded input gives:

$$a_{23}X_3 = X_2 \quad (11)$$

We assume that

(i) Per-unit requirement of the intermediate input in sector 3 is constant.[15]
(ii) Per-unit requirement of the imported middle product, a_{M4}, is constant to rule out substitution possibilities between M and other factors of production in sector 4.

We have nine independent equations, namely Equations (1), (2.1), (3), (4), (6), (8)–(11) to solve for nine endogenous variables: $W, r, P_1, P_2, K_1, X_1, X_2, X_3$ and X_4; given the parameters: namely the world prices of commodities 3 and 4, W_S^*, t, ρ, $\bar{K}, \bar{L}$ and $\bar{S}$. The four price variables can be solved in the following way: r is determined from Equation (4) given the unionised skilled wage and exogenous price of the importable. Given r, one can determine P_2 from Equation (3) and given the policy-parameter ρ, substituting r and P_2 in Equation (2.1) one can obtain W. Finally from Equation (1) P_1 is found by substituting W. Once factor prices are known, factor-coefficients a_{ji}s are also known. Now using the value of r and given ρ, we can find $K_1(.)$ from Equation (6). Then simultaneously solving Equations

[13] For similar treatment see Chaudhuri (2003).
[14] The presence of foreign capital in the economy's capital endowment is assumed away in this framework.
[15] This rules out the possibility of substitution between the non-traded intermediary and other factors of production in sector 3. This is not an unrealistic assumption. For example, consider an automobile industry where the various parts (such as tyres) and semi-processed components are produced by the informal subcontracting firms. The automobile maker always uses four tyres produced by the informal firms for building and marketing a car. Hence, there remains a fixed proportion between the use of the intermediate input and the quantity of the final commodity produced and marketed by the formal sector. Gupta (1994), Chaudhuri (2005) and Chaudhuri et al. (2006) have used this same assumption.

(8) and (10) we get X_3 and X_4. Then X_2 is solved from Equation (11). Substituting X_2 in Equation (9), X_1 will be solved.

4.1. Comparative Static Exercises[16]

First let us assume the productivity parameters are such that only sector 4 (the import-competing and relatively capital-intensive segment of the formal zone) experiences 'uniform technological progress' at the same Hicksian rate $\alpha > 0$. Then the implication on informal workers can be summarised in the following proposition.

Proposition 1:

In the absence of any reform in the informal credit market, a productivity take-off in the relatively capital-intensive import-competing formal segment unambiguously reduces commodity prices and wages in both informal sectors. The informal sector producing intermediate input for the export sector is more likely to contract in terms of both output and employment; whereas the non-traded service sector is more likely to expand. However, if the government would intervene to undertake a reform policy which would reduce the mark-up power of the informal money-lenders, that could help the workers in intermediate input producing sector.

Intuitive Explanation: If the relatively capital-intensive import-competing formal segment (sector 4) undergoes technological progress (uniform or factor-specific) by $\alpha > 0$, it will raise only the rental to capital (given the fixed skilled wage and fixed price of the imported intermediate product). As the production functions in these two sectors are of variable-coefficient type, this will encourage a Rybczynski-type effect in the Heckscher-Ohlin Subsystem (HOSS) formed by the two zero-profit conditions for sector 3 and sector 4 following which the relatively capital-intensive sector 4 expands but the export sector (sector 3) contracts. Therefore, the demand for non-traded intermediate input falls given the supply. This will reduce the price of the intermediate input (P_2); whereas rental costs paid by the informal producers rise. As a result, from the zero-profit condition of sector 2 (the intermediate input producing sector), it is clear that competitive unskilled wage rate should fall. At the same time, since intermediate input is used in a fixed proportion in the export sector production, which cannot be supplemented by other factors of production in sector 3, this implies that sector 2 must shrink as well (complementary relationship between these two sectors). Hence sector 2 will release unskilled labour which will be absorbed in sector 1, but at a lower competitive wage than before. We call it the 'first round' effect.

However as r rises, $(R - r) = r(\rho - 1)$ goes up as well. This will lower the supply of capital to the formal capital market. This will induce a Rybczynski effect in the HOSS which would tend to expand sector 3 and sector 2 (by the complementarity assumption explained above)

[16] The detailed algebraic results are provided in Appendix I.

and we term it as the 'second round' effect. But this 'second round' effect is entirely the by-product of the 'first round' effect. Therefore the 'first round' effect is likely to dominate and both sector 3 and sector 2 are likely to contract as a consequence.

In fact, it can readily be seen from our framework that if government would intervene aiming to reduce the degree of imperfection in informal credit market and hence the informal rental return (by reducing ρ) in this scenario[17], that would tend to reduce the capital-cost of intermediate input producers and thus would help the workers in sector 2. But in the absence of any such reform, rental cost of intermediate input producers would always rise unambiguously following technological improvement in sector 4. As a result, some of the industries in sector 2 would shut down and the rest will try to survive using less capital-labour ratios in per-unit of production. This implies that only those unskilled workers who are relatively more productive will remain in sector 2 and the rest will join sector 1. This is welfare reducing from various points:

a) The downward pressure on wages of informal workers has a clear impact on aggravating poverty in the urban areas. This is because a large share of the urban poor in DCs (such as above 78% in India) work in the informal sector and any reduction in the wages of the informal workers may significantly increase the incidence of poverty.
b) Sector 2 contracts in terms of both output and employment. Hence workers are forced to leave the unregulated manufacturing firms and take up insecure non-traded service sector jobs with lower earnings and hence greater likelihood of poverty.

When only the export sector undergoes technological progress by $\alpha > 0$, the following proposition is imminent from our model.

Proposition 2:

If only the export sector experiences productivity improvement by $\alpha > 0$, ceteris paribus, product prices and competitive real wages of the informal workers will go up in both informal sectors. Also, the intermediate input producing sector would expand in terms of both

[17] Government intervention aiming to integrate the formal and informal credit institutions through appropriate linkages is the most feasible way to achieve this. Since credit is not directly accessible from formal sources, the focus should lie on the provision of microfinance and related services to informal sector enterprises, strengthening of the institutional framework in this area, creation of alternative sources of credit and developing alternative delivery mechanisms. Most of these interventions in different countries have focused on alleviating credit constraints for the rural poor, but some have also targeted the urban poor. Among these, the following are widely known: Grameen Bank in Bangladesh; Bank Rakyat Indonesia (BRI); and Prodem (*Fundacion para la Promoc´on y Desarrollo de la Microempresa*) in Bolivia (see Jackelen and Rhyne (1991) for details). Apart from governmental initiatives, self-help groups can also have a considerable role in alleviating the problem of obtaining credit. A self-employed women's association (SEWA) in Ahmedabad and the Working Women's Forum (WWF) in Madras (both in India) have created their own banks along the lines of cooperatives to cater to the credit needs of poor women; they follow mechanisms similar to those described above and reach well over half a million people.

output and employment. A government policy of capital-market reform in the informal sector would encourage this wage-improvement even more in this scenario.

Intuitive Argument: Since the return to capital in the formal sector, r, is already determined from the zero-profit condition for sector 4, technological progress in sector 3 would lead to an increase in price of the intermediate input. From the zero-profit condition of sector 2, the real informal wage increases. Producers in the intermediate input producing sector substitute capital for the costlier labour in production. Given the endowment of capital in the economy, this will create relative shortage in capital availability and therefore a subsequent Rybczynski effect in the HOSS. Under our reasonable assumption that sector 4 is relatively more capital-intensive than sector 3 in physical and value terms, sector 4 will contract while sector 3 will expand and given the complementary relationship between sector 3 and sector 2, sector 2 will expand as well. As a result, unskilled labourers will move from sector 1 to sector 2 and sector 2 will expand both in terms of output and employment.

If the government undertakes a policy to reform the informal credit market this would reduce R by reducing ρ. From the zero-profit condition for the intermediate input producing sector, it is clear that it will make the informal wage increase more pronounced.

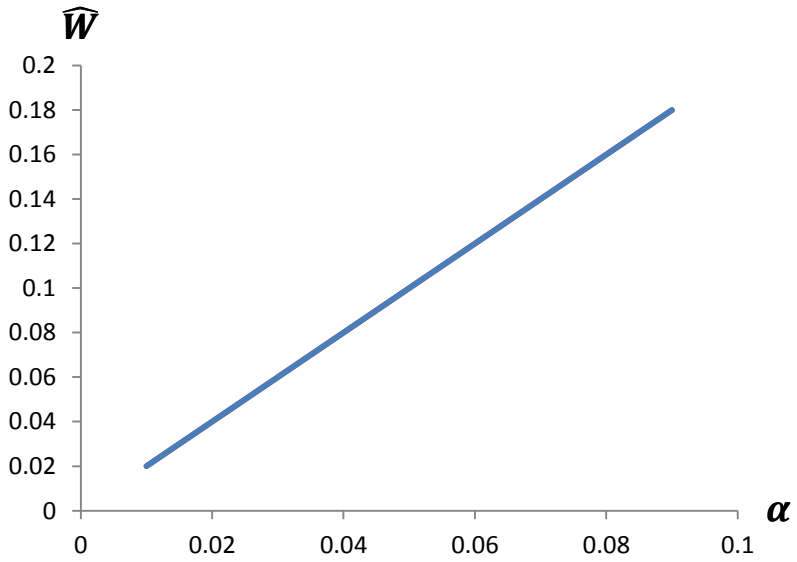
4.1.1. Uniform Technological Progress by $\alpha > 0$ in Both Formal Sectors and Informal Wage Response – A Sensitivity Analysis for India.

We examine here the implication of a uniform technological progress (at the same Hicksian rate $\alpha > 0$ in both export and import-competing formal sectors) on the informal wage, ceteris paribus. Therefore, each of the two formal sectors undergoes uniform technological improvement by α%. We will show this by using a sensitivity analysis for India. Totally differentiating Equations (1), (2.1), (3) and (4); applying envelope conditions and using Cramer's rule, allowing for both sectors 3 and 4 to undergo productivity take-offs by $\alpha > 0$, the key equation of change will become:

$$\widehat{W} = \frac{\alpha}{\theta_{23}\theta_{L2}}\left\{1 - \frac{(\theta_{K3} + \theta_{K2}\theta_{23})}{\theta_{K4}}\right\} = (\alpha/\theta_{23}\theta_{L2})\left\{\left(\theta_{K4} - \widetilde{\theta_{K3}}\right)/\theta_{K4}\right\} \qquad (12)$$

Where $\widetilde{\theta_{K3}} = \theta_{K3} + \theta_{23}\theta_{K2}$ represents the share of capital costs in sector 3 for both its direct and indirect use of capital. $|\theta| = \left(\theta_{K4}\theta_{S3} - \widetilde{\theta_{K3}}\theta_{S4}\right) > 0$ if the vertically integrated sector 3 is relatively less capital-intensive than sector 4 in value-terms.

Figure 9: Relationship between Growth in Informal Wage and Uniform Productivity Improvement in Formal Sectors (α)



We use Equation (12) to quantify the relationship between productivity change in the formal sectors and changes in informal wage. We assign the following parameter values for the initial equilibrium according to the assumptions in the model in a close approximation to the actual data for India:[18]

$\theta_{L2} = 0.7 = (1 - \theta_{K2})$; $\theta_{K3} = 0.4$; $\theta_{S3} = 0.5$; $\theta_{23} = 0.1$ (constant); $\theta_{S4} = 0.3$; $\theta_{K4} = 0.5$; $\theta_{M4} = 0.2$ (constant).

Note that the relationship between technological progress in the formal sectors and change in informal wage is positive. Thus, given the parameter values we have adopted for initial equilibrium, when the formal sector of the economy (i.e., both sectors 3 and 4 in our model) undergoes technological improvement by 5% and 8%, the model predicts that informal wage would increase by about 10% and 16% respectively.

This is because in our model when both formal sectors experience uniform technological progress by $\alpha>0$, the relatively capital-intensive sector 4 would demand more capital to expand which would push up the return to capital in both informal and formal sectors. This would lead to the 'first round effect' mentioned before. At the same time since the interest rate differential between the two credit markets rises, more capital flows to the informal sector (sector 2). This reduces capital-availability in the formal sectors, resulting in the expansion of the relatively capital un-intensive sector 3, by saving on capital cost and demanding more of the non-traded intermediary from sector 2. This will encourage sector 2 producers to hire more workers and consequently informal wage will increase. This positive

[18] See Table A1.1 in Appendix I for details on the source and range of parameter values.

impact on informal wage depends crucially on the relative factor-intensity rankings of the two formal sectors in the HOSS in value-terms (i.e. the sign of $|\theta|$).

Capital mobility between the formal and informal sectors should also be crucial for the upsurge in informal wage in response to uniform technological progress in all the formal sectors of the economy producing tradable goods (as has been documented in Section 2 using provincial data for liberalised India).

Table 2: Effect of $\alpha = 0.08$ under Parametric Assumptions

Simulation Rounds	$\theta_{K3} = 1 - \theta_{S3} - \theta_{23}$	$\theta_{K4} = 1 - \theta_{S4} - \theta_{M4}$	θ_{23}	θ_{M4}	$\widehat{W}$
Sim1 (Initial Equilibrium)	*0.4*	*0.5*	*0.1*	*0.2*	*0.16*
Sim 2	*0.37 (↓)*	*0.5*	*0.1*	*0.2*	*0.23 (↑)*
Sim 3	*0.4*	*0.55(↑)*	*0.1*	*0.2*	*0.25(↑)*

We use Table 2 to verify Equation (12) in response to changes in the parameters (except the cost share of intermediate input in the export sector, θ_{23}, which is held fixed). We use the value of $\alpha = 0.08$ in case of India (Kathuria et al. 2013). As expected, if the cost share of capital in the export sector goes down by just 7.5% from the initial equilibrium value, the informal wage rises by 23% whereas in initial equilibrium, the increase in informal wage was about 16%. If the cost share of capital in sector 4 goes up by 10%, then the subsequent Rybczynski-type effect in the HOSS will benefit the informal workers in terms of wages and employment.

5. Concluding Remarks

This paper has examined the implications of technological progress in the formal sectors of the economy on the wellbeing of the workers in urban informal sectors using a four-sector general equilibrium model with labour and capital market distortions. Our present research stems from the observation that recent growth in the Indian economy is fuelled primarily by an upsurge in productivity in the organised sectors which has been quite substantial over the recent years. Given the strong production inter-linkage between formal and informal sectors, the producers in the urban informal sectors have been encouraged to produce more of the intermediate inputs and to demand more hired workers, while the upswing in urban informal wage has been further aggravated by increased capital allocation to the urban informal sectors of Indian provinces during the liberalised regime. The calculated poverty head count ratios demonstrate that the incidence of urban poverty has declined for nearly all the states from 2004-05 to 2011-12, while urban informal wage has also increased for these states over the

2005-2010 period. Since the informal activities comprise the majority of the urban workforce, which is economically marginalised, we investigate the general equilibrium implications of technological progress in the traded sectors of the economy on the urban informal wage and employment conditions with segmentation in factor markets.

In our simple general equilibrium model, the urban formal sectors wages are pegged at a higher level than competitive wages by prior negotiations with labour unions; while dualism in the capital market is characterised by the fragmented interest rate structure, featuring lower allocation of loanable capital to the informal sector at a higher relative rental rate. We have provided a sensitivity analysis of our model using plausible ranges of parameter values for India. Our sensitivity analysis supports the fact that a uniform productivity take-off at the same Hicksian rate in all the formal/organised sectors could potentially help the informal workers if the vertically integrated export sector could save more on their capital cost of production. In other words, less capital will be allocated in the formal sectors of the economy vis-à-vis the informal sectors.

We have addressed a policy-question which is often the subject of intensive debate: whether and under what economic conditions could the benefits of productivity improvement in the formal sectors would trickle down to the marginalised workforce in the urban areas working in so-called 'informal sectors' (through the impact on their real wages and employment conditions). One possible extension of the present research will be empirically test the propositions of our theoretical model using longitudinal data that would help to narrow down the attention to specific industries in both formal and informal sectors.

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Appendix I

i. Proof of Proposition 1:

Totally differentiating Equations (1), (2.1), (3) and (4); applying 'envelope conditions'[19] and using Cramer's rule one can obtain:

$$\begin{pmatrix} \theta_{L1} & 0 & -1 & 0 \\ \theta_{L2} & \theta_{K2} & 0 & -1 \\ 0 & \theta_{K3} & 0 & \theta_{23} \\ 0 & \theta_{K4} & 0 & 0 \end{pmatrix} \begin{pmatrix} \widehat{W} \\ \hat{r} \\ \widehat{P_1} \\ \widehat{P_2} \end{pmatrix} = \begin{pmatrix} 0 \\ -\hat{\rho}\theta_{K2} \\ 0 \\ \alpha \end{pmatrix} \tag{A.1}$$

That is if sector 4 undergoes technological progress of $\alpha > 0$, ceteris paribus, and if government also undertakes a policy of capital market reform in the informal sector ($\hat{\rho} < 0$), we get

$$\widehat{W} = \left\{ \underbrace{-\alpha(\theta_{K3} + \theta_{23}\theta_{K2})/(\theta_{23}\theta_{L2}\theta_{K4})}_{<0} \right\} + \underbrace{(-\hat{\rho}\theta_{K2}/\theta_{L2})}_{>0} \tag{A.2}$$

So informal wage falls unambiguously; however in absence of any government policy of credit market reform (the latter is captured by second term in the RHS, which would have a positive impact on informal wage).

$$\hat{r} = (\alpha/\theta_{K4}) > 0 \tag{A.3}$$

$$\hat{P}_2 = -\alpha\theta_{K3}/(\theta_{23}\theta_{K4}) < 0 \tag{A.4}$$

Totally differentiating Equations (8) and (10) (not taking into account any reform policy in informal credit market) and assuming production functions in sectors 2, 3 and 4 are of Cobb-Douglas type and solving simultaneously by Cramer's rule for $\widehat{X_i}$ yields[20]

$$\widehat{X_3} = \hat{r}\{\Theta - \lambda_{S4}r(\rho - 1)\hat{r}\,K_1'(.)/\overline{K}\}/(\lambda_{K3}\lambda_{S4} - \lambda_{S3}\lambda_{K4}) \tag{A.8}$$

Or,

$$\widehat{X_3} = (\alpha/\theta_{K4})\{\Theta - \lambda_{S4}r(\rho - 1)\hat{r}\,K_1'(.)/\overline{K}\}/(\lambda_{K3}\lambda_{S4} - \lambda_{S3}\lambda_{K4}) \tag{A.9}$$

Since sector 4 is relatively capital-intensive vis-à-vis the vertically integrated export sector in physical and value-sense, $(\lambda_{K3}\lambda_{S4} - \lambda_{S3}\lambda_{K4}) < 0$. Also

$$\Theta = (\lambda_{S4}\lambda_{K3}\theta_{S3} + \lambda_{K4}\lambda_{S4}(1 + \theta_{S4}) + \lambda_{S3}\lambda_{K4}\theta_{K3}) > 0 \tag{A.9.1}$$

[19] This stems from the fact the competitive producers in each sector choose techniques of production in order to minimise unit costs of production. See Caves et al. (2002) for details.

[20] Detail derivations of these expressions will be available from the authors upon request.

The RHS of Equation (A.9) is negative under the sufficient condition $\Theta > \lambda_{S4}\frac{K_1'(.)}{\bar{K}}r(\rho-1)$ [i.e., the 'first-round effect' dominates the 'second-round effect']. So without any government policy of credit market reform in the informal sector, from Equation (A.9), it is evident that $\hat{X}_3$ is likely to be negative. Similarly one can show that it is likely $\hat{X}_4 > 0$ without any government policy of credit market reform in the informal sector.

It is also straightforward from Equation (11) that $\widehat{X_3} = \widehat{X_2}$ since $\lambda_{23} = \frac{a_{23}X_3}{X_2} = 1$. So sector 2 will also contract. Now totally differentiating Equation (9) and substituting $\widehat{X_2} = \widehat{X_3}$ from Equation (A.9) and using Equations (A.2) and (A.3); one can show that without any government policy of credit market reform in the informal sector, $\hat{X}_1 > 0$ iff $\Theta > \left[\lambda_{S4}\frac{K_1'(.)}{\bar{K}}r(\rho-1) + \left\{\left(\widetilde{\theta_{K3}}/\theta_{23}\theta_{L2}\right)+1\right\}(\lambda_{S3}\lambda_{K4} - \lambda_{K3}\lambda_{S4})\right]$ holds (where $\widetilde{\theta_{K3}} = \theta_{K3} + \theta_{23}\theta_{K2}$). Hence we have our proposition 1.

ii. Proof of Proposition 2:

If sector 3 undergoes technological progress of $\alpha > 0$, ceteris paribus, and if government also undertakes a policy of capital market reform in the informal sector ($\hat{\rho} < 0$),

$$\begin{pmatrix} \theta_{L1} & 0 & -1 & 0 \\ \theta_{L2} & \theta_{K2} & 0 & -1 \\ 0 & \theta_{K3} & 0 & \theta_{23} \\ 0 & \theta_{K4} & 0 & 0 \end{pmatrix}\begin{pmatrix} \widehat{W} \\ \hat{r} \\ \widehat{P_1} \\ \widehat{P_2} \end{pmatrix} = \begin{pmatrix} 0 \\ -\hat{\rho}\theta_{K2} \\ \alpha \\ 0 \end{pmatrix} \qquad \text{(A.10)}$$

Solving Equation (A.10) by Cramer's rule we get

$$\widehat{W} = \left\{\underbrace{\alpha\theta_{K4}/(\theta_{23}\theta_{L2})}_{>0}\right\} + (\underbrace{-\hat{\rho}\theta_{K2}/\theta_{L2}}_{>0}) \qquad \text{(A.11.1)}$$

Thus, informal wage will unambiguously increase even in the absence of any government policy of credit market reform ($\hat{\rho} < 0$). Moreover, following a government policy of credit market reform informal wage will also increase. However we shall not consider any government intervention in the informal credit market in our comparative static exercises. So ρ is parametrically given and we have

$$\widehat{W} = \alpha\theta_{K4}/(\theta_{23}\theta_{L2}) > 0 \qquad \text{(A.11.2)}$$

However now,

$$\hat{r} = 0;\ \hat{P}_2 = (\alpha/\theta_{23}) > 0 \qquad \text{(A.12)}$$

Since r and hence R are not changing given ρ, there is no change in credit allocation among the two domestic credit markets. So we can express the full utilisation condition for capital as

$$a_{K2}X_2 + a_{K3}X_3 + a_{K4}X_4 = \overline{K} \qquad \text{(A.13)}$$

Totally differentiating Equation (A.13) and utilising $\widehat{X_3} = \widehat{X_2}$ (given the complementary relationship between sectors 2 and 3, since $\lambda_{23} = \frac{a_{23}X_3}{X_2} = 1$) we have[21]

$$\widehat{X_3} = -\lambda_{K2}\theta_{L2}\lambda_{S4}\widehat{W}/|\lambda| \qquad \text{(A.16)}$$

Or substituting for $\widehat{W}$ from Equation (A.11.1),

$$\widehat{X_3} = -\alpha\theta_{K4}\lambda_{K2}\lambda_{S4}/(\theta_{23}|\lambda|) \qquad \text{(A.17)}$$

And

$$\widehat{X_4} = \alpha\theta_{K4}\lambda_{K2}\lambda_{S3}/(\theta_{23}|\lambda|) \qquad \text{(A.18)}$$

Where $|\lambda| = \left(\widetilde{\lambda_{K3}}\lambda_{S4} - \lambda_{K4}\lambda_{S3}\right) < 0$ if and only if the vertically integrated export sector is relatively less capital-intensive compared to the import-competing sector. Then we have from Equations (A.17) and (A.18) that $\widehat{X_3} > 0$ and $\widehat{X_4} < 0$. This is precisely what has been argued in proposition 2.

Table A1.1: Parameter Values

θ_{S3} = Cost-share of skilled-labour in the export sector = [0.5, 0.6] (Marjit et al. 2011).

θ_{23} = Cost-share of intermediate input in sector 3. To find an estimate of this parameter, we construct a measure of formal sector subcontracting using the ASI data, which is the sum of: purchase value of goods sold by the registered factories in the same condition as purchased from others; and cost of contract and commission work done by others on materials supplied by the registered factory. θ_{23} = Ratio of value-added by the subcontracting activity defined above to the value-added in organised sectors. This ratio remained almost the same over 1999 – 1996 at around 0.08, increased to 0.15 from 1996 to 1999, but again remained stagnant over 1999 – 2005 at around 0.14 and then it declined. Given the complementarity assumption between sector 2 and sector 3 (i.e. per-unit requirement of the intermediate input produced by sector 2 is fixed in sector 3); we can take it as constant ≅ 0.1.

θ_{K3} = Cost-share of capital in the export sector = $1 - \theta_{S3} - \theta_{23}$ = [0.3, 0.4].

θ_{S4} = Cost-share of skilled labour (managerial and supervisory employees) in capital-intensive import-competing sector ≅ [0.2, 0.3] (Abraham 2010; Berman et al. 2005; Marjit and Kar 2008).

[21] Note that for a given ρ, since r is not changing, we have $\widehat{a_{K3}} = \widehat{a_{K4}} = \widehat{a_{S3}} = \widehat{a_{S4}} = 0$.

θ_{M4} = Cost-share of middle products in sector 4. As in Seker and Rodriguez-Delgado (2011), we take average import intensity of the importing firms as 19%, computed as the share of total foreign input costs to total sales for each import-competing firm from ASI 2001-02 data, where roughly 19% of the firms participated in import activity during 2001-02 in India. Therefore, we take $\theta_{M4} = 0.19$.

$\theta_{K4} = 1 - \theta_{S4} - \theta_{M4} \cong [0.5, 0.6]$.

This is also consistent with our theoretical assumption that sector 4 is relatively capital-intensive vis-à-vis the vertically integrated sector 3 in value-sense, since we have $\theta_{K4}\theta_{S3} > \widetilde{\theta_{K3}}\theta_{S4}$. This trivially implies sector 4 is relatively capital-intensive in physical terms as well.

θ_{K2} = Cost-share of capital in the intermediate-input producing sector ≅ [0.3, 0.5] (Marjit et al. 2011).

θ_{L2} = Cost-share of labour in the intermediate-input producing sector= $1 - \theta_{K2} = [0.5, 0.7]$.

Appendix II

Derivation of TFPG in the organised sectors on provincial level:

First we have derived net value added (net VA) = gross value added – value addition by intermediate inputs – depreciation. Then we deflated this variable using WPI for 2001-02 base year. The TFPG = growth rate of net VA – weighted growth rates of capital and labour (when the weights are share of the factors in net value-added). So Divisia-Tornquist (D-T) approximation has been used for the calculation of TFPG. The TFPG under the D-T approximation is given by the following equation:

$$TFPG = (\ln Q_t - \ln Q_{t-1}) - \frac{1}{2}\left[\left(s_{L,t} - s_{L,t-1}\right)(\ln L_t - \ln L_{t-1}) + \left(s_{K,t} - s_{K,t-1}\right)(\ln K_t - \ln K_{t-1})\right] \quad \text{(A.19)}$$

Where Q = net VA, s_L= share of labour in net VA; s_K= share of capital in net VA. We consider the share of emoluments in net value added as s_L. Assuming CRS, $s_K = 1 - s_L$.

Data Description and Construction of Variables:

The informal sector real wages have been constructed by deflating the nominal wages in the urban NDMEs using 2001-02 Consumer Price Indices (CPI). And the informal real fixed assets (proxy for capital accumulation in the informal sector) have been formed by deflating the nominal figures using 2001-02 Wholesale Price Indices (WPI) for Machinery and Machine Products.

We have constructed the variable (termed as 'Linkage') capturing formal sector subcontracting activities as 'total inputs' minus 'fuel consumed' in the ASI survey data. Subsequently, this variable was deflated using 2001-02 WPI for Manufactured products.

All the price indices (CPI, WPI for Manufactured products and WPI for Machinery and Machine products) were available at the national level, thus price differences between states were adjusted using the ratio of state to national GDP deflator.

Appendix III:

Table A3.1: Descriptive Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Informal Wage 1989	27	90.10185	37.58973	47.32	180.01
Fixed Assets 1989	27	775.9122	441.5575	298.34	1937.68
Linkage 1989	27	15927.22	21047	1.93	92680.77
Informal Wage 1994	27	151.2089	35.65809	96.69	211.79
Fixed Assets 1994	27	441.3022	559.9268	46.83	2874.97
Linkage 1994	27	21081.6	28079.55	16.17	120840.9
Informal Wage 2000	27	197.2741	37.49708	117.8	264.97
Fixed Assets 2000	27	2617.223	2267.978	810.1	12748.86
Linkage 2000	27	25532.24	35163.41	14.84	144254.9
Informal Wage 2005	27	194.5222	52.57534	94.78	321.53
Fixed Assets 2005	27	2827.415	1623.554	1079.22	7698.67
Linkage 2005	27	43442.49	60077.58	25.11	236271.8
Informal Wage 2010	27	269.1952	75.94624	153.08	438.77
Fixed Assets 2010	27	12006.97	12035	1593.86	56504.33
Linkage 2010	27	66629.96	97603.66	79.41	372947.4

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