Where to Create Jobs to Reduce Poverty: Cities or Towns?*

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Abstract
Should job creation be targeted to big cities or to small towns, if the objective is to minimize national poverty? To answer this question, we develop an equilibrium model of migration from rural areas to two potential destinations, small town and big city. We develop sufficient statistics for policy decisions based on the parameters of the model. The empirical remit of the theoretical model is illustrated with long running panel data from Kagera, Tanzania. Further, we show that the structure of the sufficient statistics is maintained in the case where the model is generalized to introduce heterogeneous workers and jobs.

Key words: Secondary Towns versus Big Cities, Poverty Reduction, Poverty Gradient, Todaro Model, Migration Equilibrium, Equilibrium Income Distribution.

JEL Codes: O18, O41, I3, J61

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1. Introduction

Should job creation be targeted to big cities or to small towns, if the objective is to minimize national poverty? This perennial policy question has grown in importance as the debate on "megacities versus secondary towns" has intensified (Christiaensen and Kanbur, 2017). The relative permanency of building and urban infrastructure adds further impetus. A first cut response to this question might look at which location had greater poverty. If there is a declining poverty gradient from towns to cities, an initial answer might be to invest in secondary towns for poverty reduction.

But it should be clear that an answer to the question depends on at least three factors. First, what will be the first round impact of job creation in either location, on income distribution and poverty? Here the poverty gradient may give us an initial clue. Second, how will this first round impact change the attractiveness of migration to cities and towns from rural areas? And third, how will this migration in turn affect income distribution in cities and towns, and thence migration and distribution in subsequent rounds? The key point is that any job creation, through public investment for example, will induce a reallocation of population, and any assessment of the impact of public investment on national income distribution and thus national poverty will have to model the new migration equilibrium. Indeed, the poverty gradient will itself be an equilibrium phenomenon, taking into account migration responses to income differentials.

There are thus many moving parts in attempting to provide an answer to the basic question. One approach is to build complex general equilibrium models and calibrate them, taking into account numerous sectors and a multitude of effects. Such an approach is followed, for example, in Dorosh and Thurlow (2014). Our approach, instead, will be to use the framework of a simple model that captures key economic forces while remaining tractable enough to produce closed form solutions. This helps better illuminate the intuition behind the outcomes of the interacting forces.

In particular, the focus will be on population reallocation, migration equilibrium and the national income distribution, for a given efficiency of public investment in creating jobs in big cities versus small towns. It builds on existing traditions in the literature. Migration equilibrium has of course been a staple of development theory since the seminal papers of Todaro (1969) and Harris and Todaro (1970). In these papers there are two sectors: "rural", naturally thought of as the location of origin in migration, and "urban", thought of as the destination. In the urban sector the migrant has a probability of getting a high-paid modern sector job, or otherwise ending up in unemployment or the low paid informal sector. Location choice is determined by (expected) economic prospects in the two sectors and equilibrium is attained when there are no private incentives to migrate from one location to another in a population of identical, risk neutral agents.

The basic model has endured as a platform for analysis and debate despite its simplified nature. From this base, one strand of the literature has progressively complicated the urban prospects, for example by introducing different features of an informal sector including endogeneity of income (e.g. Fields, 1989). Further complications like skill acquisition while waiting for a modern sector job, which brings into play dynamic considerations (e.g. Bosch and

Maloney, 2005), and heterogeneity of individual abilities (Fiess et. al, 2016), have also been introduced. A recent example of this line of development which incorporates all of these features, and which also has references to previous work in this tradition, is Basu et al. (2019). Another strand of the literature made the formal wage and employment endogenous (e.g. Moene, 1988; Bencivenga and Smith, 1997; Satchi and Temple, 2009; Albrecht, Navarro and Vroman, 2009). Yet another departure has introduced risk aversion among agents (e.g. Katz and Stark, 1986). Finally, papers have also considered the rural wage itself as responsive to migration (e.g. Hnatkovska and Lahiri, 2015; Zhu and Luo, 2010). The general issue of endogenous prices is tackled also in economy-wide Computable General Equilibrium (CGE) models (e.g. Dorosh and Thurlow, 2014).

The literature comprising of these different lines of enquiry is therefore huge. The main point, however, is that each such relaxation has a focus and a purpose. For example, relaxing risk neutrality may lead to a focus on whether patterns of risk aversion may explain wealth related patterns of out migration. Or introducing a downward sloping demand curve for labor may lead to a modification of the shadow cost of labor in project evaluation. Or introducing a more complex structure of urban informal markets, as in the work of Gary Fields and others, invites a more detailed look at waiting and skill formation in what might otherwise be dismissed simply as "unemployment." For each question asked, a different type of extension is pursued.

How about the question of income distribution? With the basic set up, income distribution is determined by the migration equilibrium, which gives the share of population at each of the three income levels—rural, modern employment and unemployment/informal. Comparative statics on this income distribution have also been a staple in the literature. For example, in an early contribution, Anand and Kanbur (1985) trace out the implications of increasing the urban modern wage or the number of urban modern jobs. More recently, papers such as those by Temple (2005) and Temple and Ying (2014) continue this tradition of tracing out the evolution of income distribution in a two-sector model of population reallocation between agriculture and non-agriculture under different economic environments. In these papers, extensions such as risk aversion or an endogenous rural wage are not attempted since the focus is on getting insights into the distributional implications of population reallocations across the two sectors.

There is thus already a strong tradition of analyzing migration equilibrium and income distribution in the setting of two-sector models—typically a rural and an urban sector. This provides a powerful platform to build on to address the question posed at the start of the paper, by splitting the urban sector into two sectors (towns and cities), i.e. by incorporating a third sector. The migration equilibrium will then have to encompass population allocation in three locations—one rural and two urban. And the national income distribution will now be more complex, taking into account income and respective population shares at each of the income levels in the three locations.

Multiple destinations have also been a staple of the rural-urban migration literature. For example, Fafchamps and Shilpi (2013) is only one of the recent additions to the literature, looking at the choice of migration destination in Nepal using two rounds of the Living Standards Survey. But, like that paper, as well as the paper by Gibson et al. (2017), nearly all of this strand of the literature is empirical and econometric in nature, and there is no focus on the distributional implications of a multiple destinations model. The missing piece of the puzzle, then, is indeed a model of migration equilibrium and income distribution with multiple destinations.

To add perspective, globally, a larger share of the population lives closer to secondary towns than to cities. While 16.0 percent live within 1-3 hours from a secondary town (defined as ≤ 500,000 inhabitants), 9.8 percent live within 1-3 hours from a city (> 500,000 inhabitants); another 15.6 percent live in the rural hinterlands (at more than 3 hours from an urban center) (FAO, 2017).[1] In Sub-Saharan Africa, which houses about half of the world's extreme poor (World Bank, 2016), 22.1 percent of the population live within 1-3 hours from a secondary town, compared with 8.4 percent living within 1-3 hours from a city. More than 1/3 of the rural population (36 percent) lives in the rural hinterland at more than 3 hours from an urban center (FAO, 2017). With 82 percent of Africa's poor living in rural areas (Beegle et al., 2016) and many of these closer to towns than to Africa's cities, it becomes important for global poverty reduction to understand how distance and migration costs interact in practice with the difference in income gaps between formal and informal jobs in those towns and cities.

The paper proceeds as follows. It first develops a simple model of migration equilibrium and income distribution where rural migrants face two urban destinations—a big city and a secondary town, each with its own stylized prospects (Section 2). Section 3 examines the properties of such an equilibrium focusing on the nature of the distributional differences between the three locations—specifically on whether there is a "poverty gradient" from rural to towns to cities, as has been found in the empirical literature. Section 4 turns to the motivating question of this paper—should job creation be targeted to towns or cities, if the objective is poverty reduction? This is analyzed in terms of the overall poverty impact of an equal amount of jobs generated either in the town or in the city. Conditions under which one or the other policy stance dominates are then derived. Section 5 then explores the empirical remit of the approach with long running panel data from Kagera, Tanzania. Section 6 finally extends the simple, identical agents model of the previous sections to the case where agents are heterogeneous. It is shown that heterogeneity complicates the picture somewhat, but the basic economic forces identified in the previous analyses still hold sway. Section 7 concludes.

2. Model and Equilibrium

Consider a setting where there are two potential destinations for out-migration from the rural area – a small town and a city. Rural, small town and city are identified by subscripts r, s and c, respectively. In each destination the migrant faces a prospect of getting a high paying modern sector job with wage w (w_s, w_c), or ending up unemployed with a low paying informal sector income w_o (w_{os}, w_{oc}). The probability of securing a modern sector job is e (e_s, e_c). There is a single rural sector wage which is certain, and denoted w_r. All wages in the model are exogenously given.

[1] Globally, 33.9 percent live within less than one hour from (or in) a secondary town and 24.8 percent within less than one hour from (or in) a city. For Sub-Saharan Africa, these shares correspond to 19 and 14.4 percent respectively.

Total population is $\overline{N}$, and the populations of the three sectors are denoted N_r, N_s and N_c. Modern sector employment (i.e. the number of high paying formal sector jobs) is denoted by E (E_s, E_c) and informal sector employment (or unemployment) is denoted U (U_s, U_c). Throughout we treat the words "unemployment" and "informal employment" as synonymous. Thus

$$\overline{N} = N_r + N_s + N_c \quad (1)$$
$$N_s = E_s + U_s \quad (2)$$
$$N_c = E_c + U_c\,. \quad (3)$$

Further, as in the classic Todaro (1969) formulation, the total population $\overline{N}$, and the number of modern sector jobs in the town (E_s) and city (E_c) are given exogenously.[2] The probability of getting a modern sector job in a destination (e_s, e_c) is identified with the modern sector employment rate in that destination:

$$e_s = E_s / N_s \quad (4)$$
$$e_c = E_c / N_c\,. \quad (5)$$

The "unemployment rate" is then the fraction of the population in the informal sector:

$$u_s = 1 - e_s \quad (6)$$
$$u_c = 1 - e_c\,. \quad (7)$$

We come now to the migration decisions and migration equilibrium in this model with a single origin and two destinations (i.e. the number of people in the rural area ($\overline{N}$- N_s- N_c), the town (N_s) and city (N_c)). The agent in the rural sector faces the choice of staying in the rural sector with income w_r, migrating to the small town for a prospect of w_s with probability e_s and w_{os} with probability $1 - e_s$, or migrating to the city for a prospect of w_c with probability e_c, and w_{oc} with probability $1 - e_c$.[3]

In addition, we suppose that there is a "migration cost" for each destination, denoted t_s^* and t_c^*. These can be transportation costs to, and settlement and job search costs in, each of the destinations. These migration costs are typically also closely related to distance. The critical role of migration costs and distance in understanding migration patterns has long been recognized in the literature (see for example Sjaastad (1962) for an early discussion), though they have typically not been modeled explicitly in the two-sector migration models. Yet, as they are a

[2] By holding the number of formal or high paying jobs (E_c, E_s) fixed in each location, and thus independent of urban size (N_c, N_s), we abstract from the potential of agglomeration economies, and thus faster economic growth and potentially larger formal employment generation, induced by rural-urban migration. If these effects are larger for cities than for towns, cities may in equilibrium attract more migrants than towns, which could affect the income distribution. While the evidence for the developed world clearly indicates that larger urban centers (by population size) also enjoy faster economic growth (Duranton, 2015), such a relationship has not been empirically established for urban centers in the developing world. In fact, if anything, the relationship may be negative (Frick and Rodriguez-Pose, 2016).

[3] Of course, in keeping with the Todaro (1969) tradition of modelling, rural areas are the only source of migrants. Empirically we see inter-urban migration as well, as in China or in India. About 10 percent of China's cities have shrunk, with de facto population less than de jure population, even while there has been a massive ongoing urbanization and this is due to the urban-urban moves.

crucial feature of the difference between towns and cities from the rural migrant's perspective, they are explicitly incorporated here. The incorporation of migration costs also makes the model more consistent with empirical reality—(real) informal and formal wages (in towns and cities alike) are often both above rural wages, as demonstrated further in the empirical section, suggesting an empty country side, which is contrary to what is observed. We assume that $t_c^* > t_s^*$.[4]

In a two-period framework we assume that the costs of migration are paid in the first period and the benefits come in the second period.[5] Let the discount factor be δ. We make the assumption that workers are risk-neutral so the migration decision depends on the comparison

$$w_r + \delta w_r \gtreqless w_r - t_s^* + \delta\, [e_s\, w_s + (1 - e_s)\, w_{os}]$$

for the secondary town and the corresponding comparison for the city. Rearranging terms, the comparison becomes:

$$w_r + t_s^*/\delta \;\gtreqless\; [e_s\, w_s + (1 - e_s)\, w_{os}]\,.$$

Let

$$t_s = t_s^*/\delta$$

be the discounted migration cost and let the corresponding term for city be

$$t_c = t_c^*/\delta\,.$$

Then all of the relevant comparisons can be written as follows:

$$w_r \;\gtreqless\; e_s\, w_s + (1 - e_s)\, w_{os} - t_s \qquad (8)$$

$$w_r \;\gtreqless\; e_c\, w_c + (1 - e_c)\, w_{oc} - t_c \qquad (9)$$

$$e_s\, w_s + (1 - e_s)\, w_{os} - t_s \;\gtreqless\; e_c\, w_c + (1 - e_c)\, w_{oc} - t_c\,. \qquad (10)$$

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[4] Transport costs are often only a fraction of the annual income gain that could be obtained from moving. Among migrants in Kagera, in northern Tanzania, for example, transport costs to towns were 23,346 TSH and to cities 47,140 TSH, representing only 5% and 6% of the average annual income gain obtained by a migrant (Christiaensen, De Weerdt and Kanbur, 2019). Schwartz (1973) alerted us to this already early on. In her paper, "Interpreting the effect of distance on migration", she shows that the adverse effect of distance on migration follows especially from diminishing-information (i.e. rising jobs search costs), and less likely from actual transport (or psychological costs). Migration costs, t_i^*, thus reflect both transport costs to, as well as settlement and jobs search costs in the destinations. This makes it also more likely that the interior equilibrium migration conditions hold empirically (see equations (18) and (19)).

[5] Once time is introduced the question arises of the accuracy of expectations on which decisions are based. Although we do not address this question here, there is a literature on migration and expectations (see for example, McKenzie, Gibson and Stillman, 2013).

It should be clear that we will not get an interior solution to population allocation if any of the inequalities hold strictly – one or two of the three locations will have zero population in that case. For an interior equilibrium, we thus require the core conditions:

$$w_r \;=\; e_s\, w_s + (1 - e_s)\, w_{os} - t_s \;=\; e_c\, w_c + (1 - e_c)\, w_{oc} - t_c\,, \tag{11}$$

or

$$w_r + t_c \;=\; e_c\, w_c + (1 - e_c)\, w_{oc} \tag{12}$$

$$w_r + t_s \;=\; e_s\, w_s + (1 - e_s)\, w_{os}\,. \tag{13}$$

Recall that, as in the basic Todaro model, we take w_r, w_s, w_{os}, t_s, E_s, w_c, w_{oc}, t_c, E_c to be exogenous. The variables e_s and e_c adjust to satisfy the equilibrium conditions (12) and (13). These together with (1) – (7) determine population allocation across the different locations and income levels. The endogenous variables are thus e_s, e_c, N_r, N_s, N_c, U_s and U_c. In other words, the full equilibrium income distribution in the current period can now be specified.

Solving (12) and (13), in conjunction with (1) – (7), gives us the following equilibrium values:

$$e_s = \frac{w_r + t_s - w_{os}}{w_s - w_{os}} \;; \quad u_s = \frac{w_s - w_r - t_s}{w_s - w_{os}} \tag{14}$$

$$N_s = \left[\frac{w_s - w_{os}}{w_r + t_s - w_{os}}\right] E_s \;;\; U_s = \left[\frac{w_s - w_r - t_s}{w_r + t_s - w_{os}}\right] E_s \tag{15}$$

$$e_c = \frac{w_r + t_c - w_{oc}}{w_c - w_{oc}} \;;\; u_c = \frac{w_c - w_r - t_c}{w_c - w_{oc}} \tag{16}$$

$$N_c = \left[\frac{w_c - w_{oc}}{w_r + t_c - w_{oc}}\right] E_c \;;\; U_c = \left[\frac{w_c - w_r - t_c}{w_r + t_c - w_{oc}}\right] E_c\,. \tag{17}$$

The equilibrium rural population is then given by using (15) and (17) in (1).

The equilibrium values in (14) – (17) are thus determined by the exogenous parameters. However, the two employment rates clearly need to lie between zero and one, and this restricts the range of parameter values:

$$1 > e_s > 0 \quad \Longleftrightarrow \quad w_s > w_r + t_s > w_{os} \tag{18}$$

$$1 > e_c > 0 \quad \Longleftrightarrow \quad w_c > w_r + t_c > w_{oc}\,. \tag{19}$$

The full equilibrium and its income distribution are now pinned down.[6] What are its properties?

[6] It has been suggested to us to consider the generalization where the rural wage is endogenous. We have attempted this, but even with the simplest case of a linear demand curve for labor the equilibrium rural wage is the solution to a cubic equation. The intractability does not permit closed form solutions which are at the heart of our approach.

3. Poverty Gradients

The equilibrium income distribution in this model consists of five incomes and their associated populations:

$$(w_r, N_r); (w_s, E_s); (w_{os}, U_s); (w_c, E_c); (w_{oc}, U_c) . \quad (20)$$

N_r, U_s and U_c are endogenous equilibrium variables derived from equations (1), (15) and (17). The population shares are simply (N_c / $\overline{N}$), (E_s / $\overline{N}$), (U_s / $\overline{N}$), (E_c / $\overline{N}$) and (U_c / $\overline{N}$). We can now investigate the properties of the equilibrium income distribution.

Consider first the observed mean incomes in the secondary town and city, μ_s and μ_r respectively. It is easy to see that

$$\mu_c \gtreqless \mu_s \iff t_c \gtreqless t_s . \quad (21)$$

Thus the basic stylized fact, observed almost universally, that mean income in the city exceeds mean income in town, requires that the cost of migration to the city is greater than the cost of migration to the town. From now on we will assume that this is the case.

What about the poverty comparison between rural, town and city? Is there a poverty gradient? This depends on where exactly the poverty line lies relative to the five incomes and how the five incomes lie relative to each other. We assume that the ranking of the five incomes is as follows:

$$w_r < w_{os} < w_{oc} < w_s < w_c . \quad (22)$$

In other words, the lowest income is in the rural area and the highest is in the city modern sector. The modern sector income in the secondary town is less than modern sector income in the city, but it is greater than informal income in the city. Informal income in the city is greater than informal income in the secondary town, which is in turn greater than rural income. We can now consider different cases as the poverty line is increased progressively to cover a larger and larger share of the national population.

We focus on poverty as measured by the FGT class of poverty indices P_α. Denote the poverty line by z. Then if incomes are w_i for i = 1, 2, 3 …, n individuals in the society,

$$P_\alpha = \frac{1}{n} \sum_{\substack{i \\ s.t.\ z>w_i}} \left[\frac{z - w_i}{z}\right]^\alpha .$$

As is well known, α is the degree of poverty aversion. When $\alpha = 0$, we recover the standard poverty head count ratio (P_0). When $\alpha = 1$, we have the poverty gap measure (P_1). As α increases beyond 1, the index gives more and more weight to the poorest of the poor.

We now consider poverty across the different groups for progressively higher poverty lines. The first case is where

$$w_r < z < w_{os} < w_{oc} < w_s < w_c \, . \tag{24}$$

In this case there is poverty in the rural sector but not in either of the two urban locations. There is thus a rural-urban poverty gradient but no such gradient between town and city. So consider the second case, where

$$w_r < w_{os} < z < w_{oc} < w_s < w_c \, . \tag{25}$$

Poverty in the three locations – r, s and c, – is given by

$$P_{\alpha,r} = \left[\frac{z - w_r}{z}\right]^{\alpha} \tag{26}$$

$$P_{\alpha,s} = \left[\frac{w_s - w_r - t_s}{w_s - w_{os}}\right] \left[\frac{z - w_{os}}{z}\right]^{\alpha} \tag{27}$$

$$P_{\alpha,c} = 0 \, . \tag{28}$$

Let us compare $P_{\alpha,r}$ and $P_{\alpha,s}$. When $\alpha = 0$, the head count ratio is 100% in the rural sector but less than 100% in the secondary town, and it is zero in the city. Thus, there is a clear declining poverty gradient in the equilibrium, as has been found empirically by Ferré, Ferreira and Lanjouw (2012). The same holds true for $\alpha = 1$ because not only are a small proportion of the secondary town's population in poverty, the depth of their poverty is smaller. For this same reason, $P_{\alpha,s}$ is lower than $P_{\alpha,r}$ for all α. There is thus a clear poverty gradient from r, to s, to c.

Now consider a third case where both the urban informal sectors are in poverty:

$$w_r < w_{os} < w_{oc} < z < w_s < w_c \, . \tag{29}$$

In this case:

$$P_{\alpha,r} = \left[\frac{z - w_r}{z}\right]^{\alpha} \tag{30}$$

$$P_{\alpha,s} = \left[\frac{w_s - w_r - t_s}{w_s - w_{os}}\right] \left[\frac{z - w_{os}}{z}\right]^{\alpha} \tag{31}$$

$$P_{\alpha,c} = \left[\frac{w_c - w_r - t_c}{w_c - w_{oc}}\right] \left[\frac{z - w_{0c}}{z}\right]^{\alpha} . \tag{32}$$

When $\alpha = 0$, the highest poverty is once again in the rural sector. The comparison between $P_{\alpha,s}$ and $P_{\alpha,c}$ essentially comes down to which location has the higher unemployment rate (or fraction of population in informality) since given the poverty line this is in fact the poverty rate.

This is a priori not clear and depends on the relative value of the wages in and transport costs to the different locations. Particularly, an examination of (14) and (16) shows that unemployment goes down with: (i) higher migration costs (transport, search and settlement), (ii) higher rural wages, (iii) lower informal urban wages, and (iv) lower formal wages. The latter can be seen by considering that the derivative

$$\frac{\partial u_c}{\partial w_c} = \frac{(w_r + t_c - w_{oc})}{(w_c - w_{oc})^2} > 0 \,,$$

given (19).

Thus, a falling P_0 poverty gradient for rural to town to city then becomes more likely when cities have higher migration costs and lower informal and formal wages, which all discourage city migration, in turn leading to lower city unemployment and poverty. And if the gradient holds for P_0 it will also hold for P_1 and for all α greater than 1, given that $(z - w_{os}) > (z - w_{oc})$. Hence, under certain conditions there will again be a general poverty gradient from rural, through secondary town, to big city.

We come to the final case, where only the city modern sector wage is above the poverty line:

$$w_r < w_{os} < w_{oc} < w_s < z < w_c \,. \tag{33}$$

Now poverty in the different locations is given by:

$$P_{\alpha,r} = \left[\frac{z - w_r}{z}\right]^{\alpha} \tag{34}$$

$$P_{\alpha,s} = \left[\frac{z - w_{os}}{z}\right]^{\alpha} \tag{35}$$

$$P_{\alpha,c} = \left[\frac{w_c - w_r - t_c}{w_c - w_{oc}}\right]\left[\frac{z - w_{0c}}{z}\right]^{\alpha} . \tag{36}$$

The poverty gradient for P_0 is decreasing from rural to town to city ($P_{0,r} = P_{0,s} > P_{0,c}$), and even more pronouncedly so for P_1 ($P_{1,r} > P_{1,s} > P_{1,c}$ as $w_r < w_{os} < w_{oc}$), and for all α greater than 1.

4. Job Creation and Poverty Reduction

Consider now the motivating policy question of whether the government should create jobs in small towns or big cities. We specify this in the context of our model as a policy of increasing formal sector jobs in either of the two locations. If the objective is to reduce national poverty, will the impact be greater with an increase of E_s or an increase of E_c? Of course the final answer to the policy question will depend on the costs of creating a job in the town versus the city. That is not the focus of this paper, but the answers we provide can be used to benchmark the cost differential which will flip the targeting of public investment in one direction or the other.

Let us start again, with scenario (24), where the poverty line is so low that the only poverty is in rural areas. Then national poverty is simply

$$P_\alpha = \frac{1}{\bar{N}}\left[\bar{N} - \frac{E_s}{e_s} - \frac{E_c}{e_c}\right]\left[\frac{z - w_r}{z}\right]^\alpha . \qquad (37)$$

Differentiating (37), we get

$$\frac{dP_\alpha}{dE_s} \lesseqgtr \frac{dP_\alpha}{dE_c}$$

$$\Longleftrightarrow$$

$$1/e_s \gtreqless 1/e_c$$

$$\Longleftrightarrow$$

$$\frac{w_s - w_{os}}{w_r + t_s - w_{os}} \gtreqless \frac{w_c - w_{oc}}{w_r + t_c - w_{oc}} . \qquad (38)$$

Thus, poverty reduction is greatest ($\frac{dP_\alpha}{dE_s}$ is more negative) where the employment rate is smallest or the informality rate is largest ($1/e_s$ is largest). The intuition behind this is as follows. Each new job of course attracts a migrant. But it also attracts, in equilibrium, additional migrants drawn by the higher probability of getting a job. At the margin, the number of additional migrants attracted is inversely proportional to the employment rate in the location—the lower the employment rate, the more additional migrants are attracted (from (15) and (17): $dN_i/dE_i=1/e_i$). Even if the additional migrants end up in the informal sector, in the scenario depicted in (24), they are still above the poverty line.

With migration costs to towns typically substantially lower than to cities ($t_s<<t_c$), favoring migration to towns, the formal employment rate is likely to be lower in towns (unless offset by much higher wage differentials in the cities compared to the towns), as can be seen from

comparing (14) and (16). Under such a scenario, poverty reduction from employment generation in towns would be larger than from employment generation in the city.

Scenario (25), where only the rural income and small town informal income are below the poverty line, is a relatively straightforward case where the inherent advantage of the city drives the results. In this case there is no poverty in the city. Any migration induced to the city informal sector from job creation in the city modern sector will reduce P_0. But the same is not true for the small town, since its informal sector income is below the poverty line. Thus job creation in the city will always dominate for poverty reduction as measured by change in P_0. The same holds true for P_1 since w_{os} is less than z.

Let us now turn to scenario (29) where rural income and both of the urban informal incomes are below the poverty line. In this case:

$$P_\alpha = \left[\frac{z - w_r}{z}\right]^\alpha - \left(\frac{E_s}{\bar{N}}\right)\left[\frac{z - w_r}{z}\right]^\alpha - \left(\frac{E_c}{\bar{N}}\right)\left[\frac{z - w_r}{z}\right]^\alpha$$

$$- \left(\frac{U_s}{\bar{N}}\right)\left\{\left[\frac{z - w_r}{z}\right]^\alpha - \left[\frac{z - w_{0s}}{z}\right]^\alpha\right\} - \left(\frac{U_c}{\bar{N}}\right)\left\{\left[\frac{z - w_r}{z}\right]^\alpha - \left[\frac{z - w_{0c}}{z}\right]^\alpha\right\}. \quad (39)$$

This seemingly complicated expression simplifies when $\alpha = 0$, to

$$P_0 = 1 - \left[\frac{E_s}{\bar{N}}\right] - \left[\frac{E_c}{\bar{N}}\right] . \quad (40)$$

Thus

$$\frac{dP_0}{dE_s} = \frac{dP_0}{dE_c} = -\left[\frac{1}{\bar{N}}\right]. \quad (41)$$

This should be clear intuitively as well. This is a scenario where the only incomes above the poverty line are the modern sector incomes in the two urban locations. Job creation either in the city or in town reduces poverty one for one. There are migration consequences, of course, from rural areas to the informal sectors of the two destination locations. But all of these moves are below the poverty line. Since the index of poverty is the incidence or head count of poverty, these moves below the poverty line do not affect poverty at all. What is left is the effect of a new job in the modern sectors of the two locations, whose consequence for the numbers in poverty is identical. The choice thus depends only on the relative cost of creating jobs in either of the two locations, not on its poverty consequences.

When $\alpha = 1$ the complicated expression in (39) also simplifies, giving us:

$$P_1 = \left[\frac{1}{z\,\bar{N}}\right]\{(z - w_r)\bar{N} - X_s E_s - X_c E_c\}$$

$$X_s = \frac{(w_{0s} - w_r)(w_s - z) + t_s(z - w_{0s})}{w_r + t_s - w_{0s}}$$

$$X_c = \frac{(w_{0c} - w_r)(w_c - z) + t_c(z - w_{oc})}{w_r + t_c - w_{0c}} \quad . \tag{42}$$

Job creation in both towns and cities reduces poverty, but the impact depends on the relative magnitudes of the various income levels and the poverty line:

$$\frac{dP_1}{dE_i} = -\left[\frac{1}{z\,\bar{N}}\right] X_i \quad ; \quad i = s, c\,. \tag{43}$$

Thus, whether to invest in city or town depends on the relative magnitudes of X_s and X_c –these are the sufficient statistics for whether to create the marginal job in city or town.

The intuition behind expressions (42) and (43) is as follows. Creating a modern sector job in the city, say, reduces the poverty gap of a rural person by ($z - w_r$). But this job creation also moves a number of people from the rural area to the urban informal sector. For each person so moved, the reduction in poverty gap is given by ($w_{oc} - w_r$). The total number of persons moved to the city informal sector by creating one job in the modern city sector is given from (17) by ($w_c - w_r - t_c$)/($w_r + t_c - w_{oc}$). The reduction in poverty gap from moves to the informal sector is thus given by the product of these two expressions. The total reduction in poverty gap, from moves to the modern and the informal sector in the city as the result of creating one modern sector job, is then ($z - w_r$) + [($w_c - w_r - t_c$) /($w_r + t_c - w_{oc}$)] ($w_{oc} - w_r$), which is the expression X_c in (42). An analogous argument establishes the intuition for X_s.

The decline in poverty will be greater for modern job generation in the town if $X_s > X_c$, i.e. if

$$\frac{w_s - (w_r + t_s)}{(w_r + t_s) - w_{os}}(w_{os} - w_r) > \frac{w_c - (w_r + t_c)}{(w_r + t_c) - w_{oc}}(w_{oc} - w_r) \quad , \tag{44}$$

which is more likely if secondary town job generation induces more migration and the larger is the reduction in their poverty gap, i.e. the larger are w_{os} and w_s[7] and the smaller is t_s , compared to t_c ($dX_s/dt_s<0$).

To complete the analysis, consider the range where the poverty line is such that only the city wage is above the poverty line as in (33). In this case we add secondary town modern sector poverty to (39) to give us

$$P_\alpha = \left[\frac{z - w_r}{z}\right]^\alpha - \left(\frac{E_s}{\bar{N}}\right)\left[\frac{z - w_r}{z}\right]^\alpha - \left(\frac{E_c}{\bar{N}}\right)\left[\frac{z - w_r}{z}\right]^\alpha$$
$$- \left(\frac{U_s}{\bar{N}}\right)\left\{\left[\frac{z - w_r}{z}\right]^\alpha - \left[\frac{z - w_{0s}}{z}\right]^\alpha\right\} - \left(\frac{U_c}{\bar{N}}\right)\left\{\left[\frac{z - w_r}{z}\right]^\alpha - \left[\frac{z - w_{0c}}{z}\right]^\alpha\right\}$$

[7] Or the smaller the difference with w_{oc} and w_c respectively (recall from (22): $w_r < w_{os} < w_{oc} < w_s < w_c$).

$$+ \quad (\frac{E_s}{\bar{N}}) \left[\frac{z - w_s}{z}\right]^{\alpha}. \tag{45}$$

The expressions corresponding to (40), (41), (42) and (43) are now

$$P_0 = 1 - \left[\frac{E_c}{\bar{N}}\right]. \tag{46}$$

Thus

$$\frac{dP_0}{dE_c} = -\left[\frac{1}{\bar{N}}\right]$$

$$\frac{dP_0}{dE_s} = 0 \tag{47}$$

$$P_1 = \left[\frac{1}{z\bar{N}}\right]\{(z - w_r)\bar{N} - Y_s E_s - Y_c E_c\}$$

$$Y_s = X_s + (z - w_s)$$

$$Y_c = X_c \tag{48}$$

$$\frac{dP_1}{dE_i} = -\left[\frac{1}{z\bar{N}}\right] Y_i\,;\, i = s, c\,. \tag{49}$$

and once again job creation in both towns and cities reduces poverty, but the impact depends on the relative magnitudes of the various income levels and the poverty line.

We thus have a precise set of conditions under which job creation in one sector or the other will reduce poverty, for different poverty lines falling in the different ranges given by the configuration of rural and urban incomes. One might ask whether the same sort of exercise can be done for the Gini coefficient, or indeed for the Lorenz curve as a whole. Under what conditions would the Gini coefficient of income fall, or the Lorenz curve move inwards uniformly, as the result of job creation in one sector or the other? But the Lorenz curve in our model is a piece-wise linear curve with six points defined by the origin and the five urban incomes. The analysis of how the Gini coefficient or the whole Lorenz curve moves after job creation and the new migration equilibrium, proves to be intractable.

However, even if we cannot characterize results on the Gini coefficient or the Lorenz Curve when jobs are created, we may be able to say something about a *stochastic dominance relation* between the post-intervention and pre-intervention distributions. Notice that we have characterized the conditions under which poverty will rise or fall for the entire range of poverty lines from the lowest to the highest. Foster and Shorrocks (1988) show that if the P_0 measure for a distribution *F* is less than that for a distribution *G* for *all* poverty lines *z*, ranging from the lowest income to the highest income, then (and only then) *F* first order dominates *G.* And an implication of first order dominance is that all social welfare functions which are increasing in incomes will prefer *F* to *G*. Further, they also show that if the P_1 measure for *F* is less than that for *G* for all poverty lines *z*, then (and only then) *F* second order dominates *G*. And an implication of second order dominance is that all social welfare functions which are increasing and concave (in other words, egalitarian) in incomes will prefer *F* to *G*.

Finally, even though we are not able to characterize the movement of the Lorenz curve itself after job creation, our analysis can also be shown to be linked to the behavior of the *Generalized Lorenz Curve* (GLC) post intervention. Shorrocks (1983) defines the GLC as being "constructed by scaling up the ordinary Lorenz curve by the mean of the distribution". Thus although the starting point of the GLC is still the origin (0, 0), its end point is not (1, 1) as in the standard Lorenz curve, but (1, μ) where μ is the mean of the distribution. In general, interventions such as job creation will change not only the income distribution but also its mean, and the GLC keeps track of both movements. Shorrocks (1983) and Foster and Shorrocks (1988) show that comparing two income distributions *F* and *G*, the GLC of *F* is higher than the GLC of *G* if (and only if) P_1 measure for F is less than that for G for all poverty lines z.

Thus not only have we set out the conditions under which poverty will or will not be reduced after job creation in one or other sector, we have also, in effect, set out the conditions under which stochastic dominance and GLC dominance in the income distribution will or will not occur as a result of the intervention.

In conclusion, even though the model, with two destinations and explicitly accounting for migration costs, remains relatively simple, it is clear that to assess whether to invest in cities or towns for poverty reduction, we need to take into account many interactions. Especially, the migration response to job generation as a result of the investment is key. The poverty outcome depends further intimately on where the poverty line falls in relation to the income levels in cities and towns. Finally, the poverty index chosen to evaluate the poverty effects can also matter.

For an empirically plausible income gradient scenario ($w_r < w_{os} < w_{oc} < w_s < w_c$) and all different locations of the poverty line within this gradient, we have also derived exact conditions under which one or the other policy will dominate. For convenience, Table 1 summarizes the findings, together with the associated poverty gradient. Given the importance of the migration response in determining the empirical outcome, migration costs and thus the proximity of the poor to towns versus cities, which is closely related to the migration cost they face (Schwarz, 1973), will play an important role (as will the difference in the income gaps between formal and informal employment across towns and cities).

Table 1: Poverty gradient and poverty reduction from modern job generation under different positions of the poverty line in the income gradient

Position of the poverty line in the income gradient	Poverty gradient	Poverty reduction from modern job generation in town is greater (i.e. change in poverty is more negative) (equal, smaller) than from modern job generation in the city ($\frac{dP_\alpha}{dE_s} \lesseqgtr \frac{dP_\alpha}{dE_c}$)
(24): $w_r < z < w_{os} < w_{oc} < w_s < w_c$	Rural-Urban: $P_{\alpha,r} > P_{\alpha,s} = P_{\alpha,c}$	if the modern sector employment rate in the town is smaller $\frac{1}{e_s} \gtreqless \frac{1}{e_c} \Leftrightarrow \frac{w_s - w_{os}}{w_r + t_s - w_{os}} \gtreqless \frac{w_c - w_{oc}}{w_r + t_c - w_{oc}}$
(25): $w_r < w_{os} < z < w_{oc} < w_s < w_c$	Rural-Town-City: $P_{\alpha,r} > P_{\alpha,s} > P_{\alpha,c}$	always greater in the city
(29): $w_r < w_{os} < w_{oc} < z < w_s < w_c$	Rural-Town-City: $P_{\alpha,r} > [P_{\alpha,s} > P_{\alpha,c}]$ if $u_s < u_c \Leftrightarrow \frac{w_s - w_r - t_s}{w_s - w_{os}} < \frac{w_c - w_r - t_c}{w_c - w_{oc}}$	$\alpha = 0$: no difference $\alpha = 1$: if $\frac{w_s - (w_r + t_s)}{(w_r + t_s) - w_{os}}(w_{os} - w_r) \gtreqless \frac{w_c - (w_r + t_c)}{(w_r + t_c) - w_{oc}}(w_{oc} - w_r)$
(33) : $w_r < w_{os} < w_{oc} < w_s < z < w_c$	Rural-Town-City: $\alpha = 0$: $P_{0,r} = P_{0,s} > P_{0,c}$ $\alpha \geq 1$: $P_{1,r} > P_{\alpha,s} > P_{\alpha,c}$	$\alpha = 0$: $\frac{dP_0}{dE_s} = 0 > \frac{dP_0}{dE_c} = -\left[\frac{1}{\bar{N}}\right]$: always greater in the city $\alpha = 1$: if $Y_s \gtreqless Y_c$

5. An empirical illustration

The Kagera Health and Development Survey (KHDS) provides an ideal opportunity to explore the empirical remit of the model. Under the KHDS 915 households, sampled to be representative of (rural and urban) Kagera, a region in the north-western part of Tanzania, were first interviewed up to four times during 1991-1994. Over time the original sample respondents and their household members spread across Tanzania's rural areas, towns and cities. In 2010, KDHS attempted to trace and reinterview all 6,353 original household members, even if they had migrated or split off from the original household. In total, 68 percent (4,336) of the original household members were interviewed, 20 percent had died (1,275) and 12 percent were untraced (739). Out of the 4,336 respondents, comparable consumption data are available for 4,323. With at least one person contacted in 92 percent of the initial households and only 12 percent of individuals not found, survey attrition rates were extremely low, especially considering the long time period of 20 years.[8] This renders it is one of the longest and rather unique panel data sets of individuals in Africa.

From the sample of 4,323 individuals we drop 313 who were already living in an urban area in 1991/94, leaving 4,010 individuals who originate from rural Kagera. Out of those 1,899 migrated out of their original villages. Twenty years later, in 2010, we find 315 of these individuals had migrated to a city, 557 individuals to a town and 1,027 individuals to another rural area.[9] Of the 2,111 individuals who did not move, 331 live in an area that was reclassified from rural to urban and we drop them from our analysis to avoid confusion. Virtually everyone in the rural areas is in the informal sector (only 3.5 percent rely on a formal wage job), so this group corresponds closely to the rural population we have in mind in the model. In the towns, 18.9 percent lives in a household that relies on formal wage employment. This rises to 22.2 percent in the cities.[10]

The 2010 income distribution of these individuals could essentially be thought of as the migration equilibrium outcome of the rural population of Kagera in 1991 across the three destinations, the rural area (i.e. no migration or another rural area), the secondary towns and the cities and across the informal and formal sectors within the last two destinations. It provides an

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[8] While attrition is low, it is not random. We know, for example, from De Weerdt et al. (2012) that attrition is lower among the oldest cohorts, presumably because they are less mobile. *A priori* there is no particular direction in which we should expect attrition to impact our result..

[9] We distinguish between urban and rural centers using the 2002 census classification. Urban centers with more than 500,000 inhabitants are considered cities, the others are towns. Using this definition, the cities are Dar es Salaam (the economic capital of Tanzania with an estimated 4.36 million people according to the 2012 census) and Mwanza (with an estimated 700,000 inhabitants)

[10] Of the formally wage employed, 70 and 80 percent work in the private sector in towns and cities, respectively. In towns, 21 percent work in the public sector, while that share is 11 percent in the cities. The remaining 7 percent work for NGOs or religious organizations, in both the towns and the city.

ideal backdrop to give empirical content to the findings of the model under the different scenarios considered (summarized in Table 1).

We begin by examining the income gradient observed in the data across the five different income groups considered in the model (informal rural employment, informal town employment, informal city employment, formal town employment, formal city employment). Given the difficulties in obtaining reliable income data in African settings, consumption per capita[11], spatially deflated and expressed in 2010 Tanzanian Shilling (TSH), is taken as proxy for income.[12]

Figure 1: Cumulative density function of income (2010), by income groups

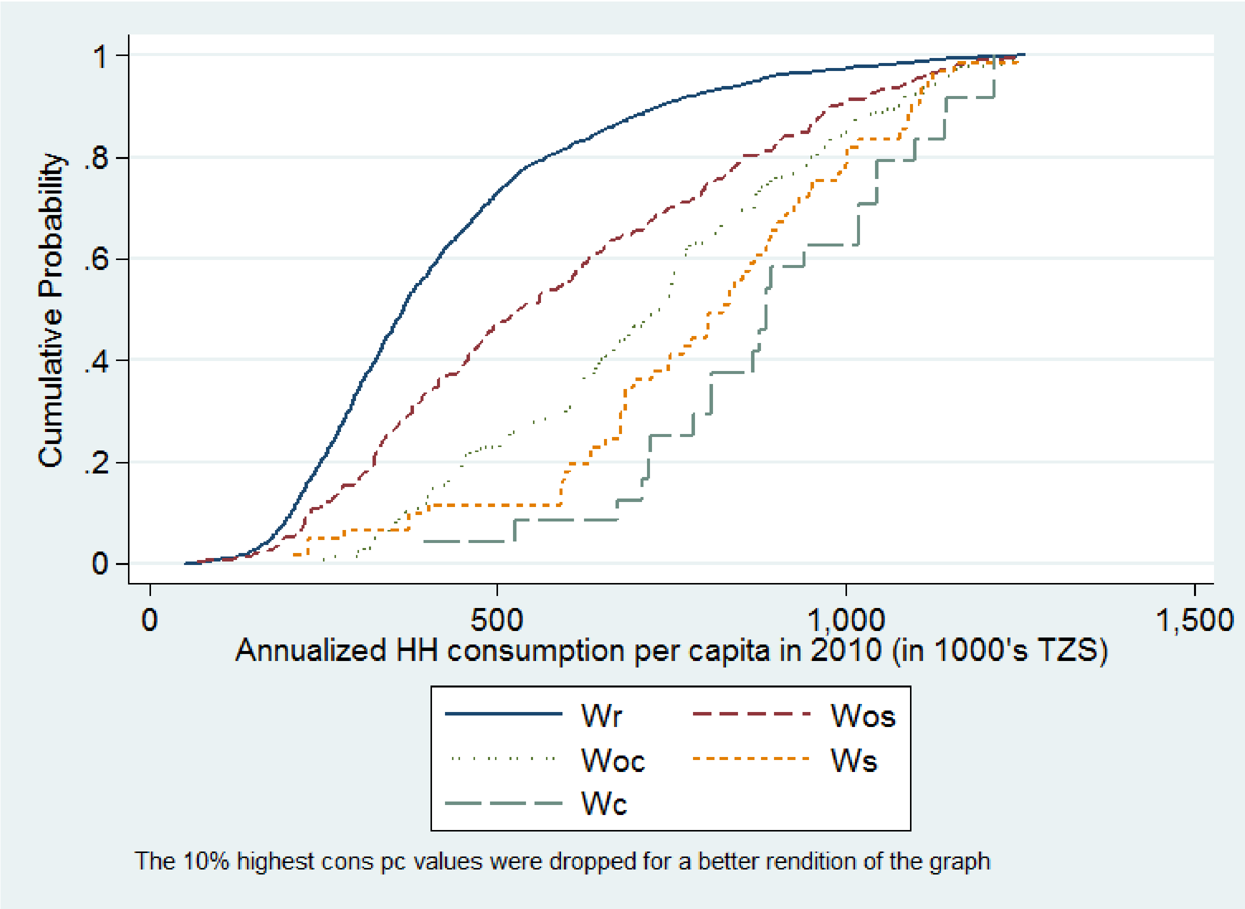

Table 2, panel A (see further below) shows that the median incomes (in '000 TSH) of each group conform with the income gradient assumed in the model ($w_r < w_{os} < w_{oc} < w_s < w_c$).[13] Figure 1 overlays the cumulative density functions (cdf) for each of the five incomes of interest and clearly shows a similar dominance pattern across the different distributions. For the

[11] Similar results are obtained when using consumption per adult equivalent.
[12] For a detailed description of the data and the consumption variable construction, see De Weerdt et al. (2012).
[13] A similar gradient is observed when taking average incomes, which are more sensitive to outliers: w_r= 495 < w_{os}= 766 < w_{oc} = 1,064 < w_s = 1,325 < w_c = 1,605.

largest part, the income distributions first order dominate each other in the expected manner, with perhaps the only exception W_s crossing W_{oc} in the left and right tail of the distribution.[14]

While the poverty line can be set at different levels (Ravallion, 2016), one natural anchor point, adopted as benchmark by the international community in the Sustainable Development Goals, is the international $1.9-day poverty line (in 2011 prices). This line basically corresponds to the national poverty line of the poorest nations, corrected for 2011 differences in purchasing power (Ferreira et al., 2016). Converted in ‘000TSH, this yields z=406 for our 2010 Kagera population. It puts us in scenario (24) in Table 1 ($w_r < z < w_{os} < w_{oc} < w_s < w_c$).

The observed poverty headcount gradient across our population is: $P_{0,r}$= 0.56 > $P_{0,s}$= 0.25 > $P_{0,c}$= 0.08. For the poverty gap, we find: $P_{1,r}$= 0.17, and $P_{1,s}$= 0.07, and $P_{1,c}$=0.01. This suggests a clear poverty gradient declining from rural to town to city.[15] Finally, according to (38), the creation of an additional formal wage job in town would be more poverty reducing than the creation of an additional formal job in the city if $1/e_s > 1/e_c$ or if $e_c>e_s$. With e_c=0.222 and e_s=0.189, the model would favor formal wage job creation in the towns. While overall 5.3 more poor people would be lifted out of poverty with one additional formal wage job in town, according to the model, 4.5 more poor people would be lifted out of poverty for an additional formal wage job in the city. This is because formal job generation in town induces a larger migrant flow out of the rural areas than job generation in the city, which the model links to 1) differences in migration costs; and 2) differences in the informal-formal wage gap in towns and cities.

The difference between formal employment rates in towns versus cities is not very big. One reason for this is that we are including Mwanza as a city, while it is 6 times smaller than Dar. Raising the threshold and considering only Dar as a city reinforces the notion that job generation in towns could be more poverty reducing in Tanzania’s current context. Based on the model’s findings (and thus abstracting from differences in the costs of employment generation and spillover effects), one additional formal wage job in Dar would lift 3.36 poor people out of poverty (e_c=0.296), though 5.74 poor people (e_s=0.174) when created in the town (including Mwanza in this case).

While there is no direct information on migration costs, reported one-way transport costs are on average twice as high to the city as to the towns (47,140 TSH vs 23,346 TSH respectively) and migrants to towns are 8 percentage point more likely to have found work before moving than migrants to the city, illustrating differences in search costs. Reliance on friends and family for the first residence was also much more important for city migrants (56 percent) than for town migrants (30 percent) who were more likely to own a dwelling (32 percent versus 16 percent in cities) or have housing provided by the employer (8 percent, versus 2 percent in cities). In each case about 30 percent rented a dwelling. Overall, this suggests higher settlement barriers for city migrants, and a greater role of family and friends to overcome them. As distance reduces the

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[14] Intersecting lines in the very extremes of these cumulative distribution can be due to measurement errors.

[15] The slight deviation from the model’s prediction, whereby poverty levels in town and city are equal ($P_{\alpha,r} > P_{\alpha,s} = P_{\alpha,c}$) follows from the fact that the income distribution in the respective destinations contains in practice more than two income profiles (formal and informal), contrary to what is assumed in the model.

likelihood of a first mover, and thus the likelihood of having family and friends far away, migration costs to cities are bound to increase, or poorer households may simply be locked out (McKenzie, Gibson and Stillman, 2010; Beegle, De Weerdt and Dercon, 2011; Bryan, Chowdhury and Mobarak, 2014; Ingelaere et al. 2018; De Weerdt, Christiaensen and Kanbur, 2019).

While these calculations abstract from other consideration such as differences in the cost of formal job creation and further spillover effects, they illustrate the empirical remit of the model. Different poverty lines and urban definitions could further be taken.

6. Heterogeneous Migrants and Jobs

The previous sections assume that the migrants are identical. But the empirical example already alludes to the fact that there is bound to be heterogeneity and a major strand in the migration literature has relaxed this assumption and considered the consequences, for example, when agents in the rural area differ by wealth or by education. How would such a complication affect the analysis of poverty gradients and job creation and poverty reduction? We show below that although the results are further complicated, they maintain their basic structure and economic intuition.

Let us consider the situation where migrants and jobs are segmented by education or skill level. The distinction is indicated by superscript "*a*" for advanced education and superscript "*b*" for basic education. There are separate labor markets and migration streams for each type of labor. Total population is now

$$\overline{N} = [N_r^a + N_s^a + N_c^a] + [N_r^b + N_s^b + N_c^b]\,. \tag{50}$$

But the migration streams of *a* and *b* types are segmented and follow their own logic, comparing the costs and benefits of migration to small towns and cities.

The returns and costs to migration are now superscripted by *a* and *b* to distinguish between the two types of labor. We assume that the pattern of wages set out in (18), (19) and (22) holds for each type of labor – in other words with superscripts *a* and *b* respectively for advanced and basic education. Further, we assume that each wage for advanced exceeds the corresponding wage for basic and that the migration costs of *a* are less than the migration costs of *b*. With this specification, the equilibrium conditions set out in (12) and (13) are simply replicated with superscripts *a* and *b*. Thus the equilibrium values (14) – (17) are also replicated with superscripts *a* and *b*.

Since we assume that each wage for type *a* exceeds each corresponding wage for type *b*, poverty within group *a* will never be higher than poverty within group *b*:

$$P_\alpha^a \leq P_\alpha^b\,. \tag{51}$$

Overall poverty P_α is simply a population weighted sum of poverty among *a* and *b* types:

$$P_\alpha = \left[\frac{\overline{N}^a}{\overline{\overline{N}}}\right] P_\alpha^a + \left[\frac{\overline{N}^b}{\overline{\overline{N}}}\right] P_\alpha^b . \qquad (52)$$

The poverty gradients for ($P_{\alpha,r}^a$, $P_{\alpha,s}^a$, $P_{\alpha,c}^a$) and ($P_{\alpha,r}^b$, $P_{\alpha,s}^b$, $P_{\alpha,c}^b$) are determined by the same arguments as used for comparing (26), (27) and (28) when wages for each type *a* and *b* rank as in (25). In this case there is a poverty gradient for each type, with poverty decreasing from rural to secondary town to city. When wages in relation to the poverty line are given by (29) for each type, the gradient depends on the relative values of (30), (31) and (32) for each type. If the unemployment (or informality) rate for each type is lower in the city than in the town, then we will again have a declining poverty gradient from rural to town to city. Of course, if each type *a* and *b* has a declining poverty gradient, then overall poverty will also show this gradient.

Turning to job creation, note from (52) that job creation for education type a (b) will only affect poverty through poverty among workers of type a (b). But the logic of poverty impacts within each type is the same as that for poverty impacts for the homogeneous population case. Thus, for scenario (24), we can compare the poverty impact of modern sector job creation for type a or b in location c or s analogously to (38)

$$\frac{dP_\propto}{dE_s^a} \lesseqgtr \frac{dP_\propto}{dE_c^a} \quad \text{and} \quad \frac{dP_\propto}{dE_s^b} \lesseqgtr \frac{dP_\propto}{dE_c^b}$$

$$\Leftrightarrow \qquad\qquad \Leftrightarrow$$

$$e_s^a \lesseqgtr e_c^a \qquad\qquad e_s^b \lesseqgtr e_c^b . \qquad (53)$$

The relative poverty impact of modern job creation is determined by the relative modern employment rate in that sector.

For scenario (29), the equivalent expression to (43) can be written as

$$\frac{dP_1}{dE_s^a} \lesseqgtr \frac{dP_1}{dE_c^a} \quad \text{and} \quad \frac{dP_1}{dE_s^b} \lesseqgtr \frac{dP_1}{dE_c^b}$$

$$\Leftrightarrow \qquad\qquad \Leftrightarrow$$

$$X_s^a \gtreqless X_c^a \qquad\qquad X_s^b \gtreqless X_c^b . \qquad (54)$$

Thus, the efficacy of job creation by location and education level is captured by the four sufficient statistics X_i^j, analogously to the two sufficient statistics in (43). The basic structure of the policy rule is maintained in this more complicated setting with heterogeneous migrants and jobs. Similar correspondence can be shown for the other scenarios laid out in Table 1.

Let us now look at the empirical remit of the extension of the approach. Panels B and C of Table 2 show the income gradients for the advanced and basic groups. We classify the population who has completed at least lower secondary education as advanced (about 10% of the population). In the Tanzanian education system this means 4 years of post-primary education and comes with a recognized O level certificate. A few things emerge. First, those with higher education are much more likely to have migrated to urban areas (by a factor 2.8)[16] and when they do, they are much more likely to end up in the formal/modern sector.

Second, the table shows that the wage distributions basically follow the wage patterns set out in (22) (with the exception of w_{sb}, which is marginally lower than w_{ocb}) and that the advanced wage is always higher than the basic wage. If we maintain the international poverty line, (z=406), then there is no poverty in the advanced group and the poverty reduction through job creation will depend entirely on what happens to the basic group. For the basic group we are in scenario (24), so that (38) will tell us where job creation will reduce poverty most. Formal employment rates for the basic group are 0.10 and 0.12 for towns and cities respectively, so employment generation in towns will give the largest poverty reduction effect.

What happens if we raise the poverty line to, say, 750, so that the advanced rural population is also classified as poor? From Table 2 we can see that among the advanced group formal employment in secondary towns *exceeds* that in cites, which means that this group would benefit more from jobs created in the city. And with the poverty line at this level, the basic group would fall under assumption (25) in Table 1 and also benefit most from city job creation.

In other words, raising the poverty line from 406 to 750 changes the basic policy prescription in this context from one favoring job creation in secondary towns to one favoring job creation in cities. With economic activity in secondary towns often closely linked with agriculture, this also resonates with the broader empirical regularity reported in the literature that the advantage of growth in agriculture to reduce poverty declines when the poverty line increases and countries grow richer (Christiaensen, Demery and Kuhl, 2011; Christiaensen and Martin, 2018).

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[16] From Table 2, 57 percent (=217/384*100) of those with higher education migrated to towns or cities, compared with 20 percent (655/3295*100) of those in the basic group.

Table 2: Income gradients

Location/Occupation by education level	Median income	N
PANEL A: ALL		
Rural (W_r)	372	2807
Town informal (W_{os})	614	452
City informal (W_{oc})	872	245
Town modern sector (W_s)	1,089	105
City modern sector (W_c)	1,475	70
PANEL B: Advanced Education		
Rural (W_{ra})	722	167
Town informal (W_{osa})	1,080	52
City informal (W_{oca})	1,112	57
Town modern sector (W_{sa})	1,325	63
City modern sector (W_{ca})	1,540	45
PANEL C: Basic Education		
Rural (W_{rb})	366	2640
Town informal (W_{osb})	571	400
City informal (W_{ocb})	834	188
Town modern sector (W_{sb})	830	42
City modern sector (W_{cb})	1,334	25

Notes: panel A gives median incomes for all 3679 respondents. Panel B does the same for the 384 respondents who have completed at least lower secondary education (O level). Panel C is for those who did not complete lower secondary. The international extreme poverty line z=406 TSH/day (2011 purchasing power parity prices).

7. Conclusion

In this paper we first extended a basic model of rural-urban migration to the case of migration from rural areas to two potential destinations, secondary town and big city, characterized the income distribution in migration equilibrium, and derived conditions under which a poverty gradient from rural to town to city will exist as an equilibrium phenomenon. We then addressed the motivating question: Should job creation be targeted to big cities or to small towns, if the objective is to minimize national poverty?

The paper which comes closest to ours in the literature in terms of question asked is that by Dorosh and Thurlow (2014). Theirs is a full blown recursive dynamic computable general equilibrium model. They also have three regions—rural, cities and towns, but each of the three regions "contains up to 60 different sectors and has its own production technologies and endowments" and "Labor markets are segmented into skilled (e.g. managers), semiskilled (e.g. technicians, and unskilled workers (e.g. farmers)" (Dorosh and Thurlow, 2014, p 115). The model is developed to incorporate “sub-national growth linkages, food imports, internal migration, and agglomeration and congestion effects” (p. 120).

These economy-wide models are useful for their purposes but at this level of complexity cannot provide tractable closed form solutions whose structures can be examined in detail. Their final conclusion, that “investing in cities is unlikely to adequately address national poverty concerns” (p. 120) comports with ours, but our approach is focused on theoretical modelling in a simple framework which highlights the different forces in play and presents an alternative analytical perspective on the question.

We have shown that the answer to the question “Where best to create jobs (in towns or cities) to minimize national poverty” is not self-evident and depends on the migration response (which in turn depends on the migration cost and the difference in the informal-formal wage gaps between the town and the city), where the poverty line lies relative to incomes in the three locations, and at times also the chosen poverty index. We developed sufficient statistics for the policy decisions based on these economic parameters and illustrated the empirical remit of this model with an example of a long panel from rural Kagera, Tanzania. The latter represents a natural migration equilibrium, and thus an ideal platform to explore the insights of the model empirically. Further, we showed that the structure of the sufficient statistics is maintained in the case where the model is generalized to introduce heterogeneous workers and jobs.

In conclusion, the common consideration of urban areas in the aggregate foregoes key dimensions of these urban areas, which can have an important bearing on the poverty outcomes of urban investment for job creation. More analysis of the distributional effects of urban investment which explicitly incorporates such disaggregation is called for. This paper has taken one step in that direction.

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