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Internal Migration, Structural Change, and Economic Growth

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Abstract

Structural change or the change in the sectoral composition of output is a common component in the growth process in developing economies. Not recognized in previous models of this process is the households' choice of urban - rural residency which not only alters the demand for regionally specific goods (e.g., housing, education, health), and hence the cost of living, but also the stock of rural - urban labor and the rate of growth and structural change. We investigate the relationship between GDP growth, regional imbalances, and rural-urban migration using a neoclassical multi-region-sector growth model. The household decision for migration is dependent on the cost-of living differentials implied by the relative changes in regional home goods prices across regions as capital deepening occurs and the capital stock within each region evolves. Results show that allowing for residency choice provides a much richer explanation of the forces of structural change and growth.

Keywords: Rural-urban migration; structural transformation; growth; residency choice; multi-sector modeling; general equilibrium

JEL Codes: O41; R13; R23; C61

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1. Introduction

Growth in developing countries' share of households in urban areas involves the transformation of a rural-agrarian economy to an industrial-service based economy, as labor is released from agriculture, capital deepening occurs and labor saving technologies are introduced (Henderson, 2003). This reallocation process, or structural change, has been well documented, especially by Kuznets (1957), recently by Herrendorf et al. (2013), and by other early development economists as Johnston's (1970) review of this literature documents. The sectoral composition of production and the nature of consumer preferences are common themes in this literature. Syrquin (1988) associates the change in sectoral composition of GDP and income growth with changes in demand patterns, trade and factor use. Acemoglu (2009) focuses, analytically, on rural urban migration, from a dual economy perspective motivated by the early work of Lewis (1954), and on a model of agriculture, manufacturing and services developed by Kongsamut et al. (2001). This framework permits consideration of both preference-related ('demand-side') and technology-related ('supply-side') reasons why an economy may experience structural transformation as it gets richer. The preference-related ('demand-side') reasons for transformation are linked to the Engel's law, and Stone-Geary preferences are employed to capture the expenditure share features of Engel's law on food relative to other consumption goods. [1] Technology-related ('supply-side') reasons for structural change may simply be originating from technological changes and/or advances in different sectors[2], and/or changes in factor distribution and factor use across sectors owing to Rybczynski-like effects of capital deepening.

The contribution of this paper is to show that an urban-rural economy of the balanced growth variety can give rise to rural to urban migration of households (as opposed to labor alone) due to competitive urban and rural market forces without appeal to a dual economy structure or the presence of externalities. According to Henderson (2005), urban growth and economic growth are closely connected as urbanization generates agglomoration benefits from technological externalities, such as knowledge spillovers. While externalities and factors other than competitive market forces are surely involved in explaining the transition of households from rural to urban in real economies, isolating the effects of market forces alone reveal how they induce migration and stimulate economic growth. In our framework, households make a

[1] Other related work includes Laitner (2000), Echevarria (1997), and Dekle and Vandenbroucke (2012), notwithstanding using different preference schedules, but with similar outcomes satisfying Engel's Law.
[2] For example, Baumol (1967) states that different sectors might be growing at different rates, hence changing the sectoral composition of GDP, simply because they have different rates of technological progress.

residency choice decision at each instant in time based on a no-arbitrage condition derived from maximizing their discounted present value of felicity. Movement from rural to urban (or urban to rural) requires a representative household to ‘carry’ not only their labor resources from one location to the other, but also their preference structure. Not recognized in previous models of this structural transformation process is the households’ choice, inter-temporally, of urban - rural residency which not only alters the demand for regionally specific goods (e.g., housing, education, health), and hence the cost of living, but also the stock of urban-rural labor which affects the competition for resources within and between the urban-rural economies, and hence the rate of growth and structural change.

In this paper, we investigate the relationship between GDP growth, regional imbalances, and ongoing rural-urban household migration over time using a neoclassical two region-multi-sector growth model of a stylized small and open economy. The theoretical foundation of the model is based on the Ramsey single sector economic growth framework (Ramsey, 1928; Barro and Sala-i-Martin, 2004). This framework is extended to include four final-good production sectors, manufacturing and services for the urban region and agriculture and services for the rural region, with household mobility across regions. Services are a home good in each region, and factors of production in all sectors are labor, capital, and land for the case of agriculture.

Within the scope of this model, we are able to trace the evolution of each region's output and factors of production (labor and capital) along the path of transition with migration, as well as the interregional disparities in income and output. The household decision for migration is dependent on the cost-of living and utility differentials implied by the relative changes in regional home good prices across regions as capital deepening occurs and the capital stock within each region evolves. We also capture the Engel's Law effects of changes in income of rural and urban household via Stone-Geary preferences, which, in the long-run, yields same preference patterns across both types of households, but varying preferences at the initial equilibrium and during transition.

The model economy’s equilibrium path is obtained empirically. To represent a typical developing economy, data on Turkish GDP, production, expenditure, savings, and rural-urban allocation are used. Results show that allowing for residency choice provides a much deeper explanation of the forces of structural transformation and growth. In our model, the change in sectoral composition of GDP occurs from both changes in demand due to residency choice and changes in factor allocation across sectors. Migration to urban areas lessens the competition between urban based manufacturing (a traded good) and service (a home good) for labor. Or, put another way, the competition for labor between urban based manufacturing and services provides an incentive for rural to urban migration, which tends to be dampened by the rising cost of consuming urban services. Migration increases urban purchasing power and the demand for urban services. The rural sector suffers a loss of purchasing power for rural services and experiences an upward pressure on rural wages as the rural workforce declines. This upward pressure induces a substitution of capital for rural labor. We construct a counter-example to show empirically the extent to which residency choice affects structural transformation and economic growth. Hence, as in real economies, we see the combined impact of both demand-side and supply-side factors on structural transformation. During transition towards the steady state, these two factors play out together, and their combined effect is enhanced by the inclusion of household migration across regions. Previous models which do not consider household migration may be underestimating the effect of labor reallocation on structural transformation. We believe that accounting for this effect is one of the main contributions of our study.

In the next section, we present the Literature Review. In section 3, the theoretical model is introduced together with the model's equilibrium. In section 4, model's data description and numerical solution are presented, and we discuss the results from the numerical solution, including the growth accounting results. Section 5 concludes the study.

2. Related Literature

Internal migration in essence is a change in the spatial distribution of population in a given country over time, and is a transitionary process. Change in the spatial distribution of population is highly correlated with the various stages of development in a country (Tabuchi and Thisse, 2002). While the share of urban population in total population has increased in virtually all regions of the world over the last 50 years, there has been little change in urbanization rates among the developed countries since the late 1970's; in fact, in upper middle income ranges, countries become "fully" urbanized with about 60 to 90 percent urban population on average (Henderson, 2005). Table 1 shows that developing countries have experienced relatively rapid rates of urban population growth or urbanization in the post-World War II period. But how much does the internal, or, rural-urban net migration contribute to the rapid increase in urban population in the developing countries? According to Lucas

(1997), there are three main factors contributing to the change in urban population: natural population increase among urban dwellers; net migration into the urban areas; and reclassification of areas as urban zones. In particular, Chen et al. (1996) report that internal migration accounted for 40.3 percent, 44.1 percent and 54.3 percent of urban population growth in the developing world during the 1960's, 1970's and 1980's, respectively. Similarly, Becker and Morrison (1999) estimate that for the 1980-1993 period, contribution of rural-urban migration to urban population growth in low income countries was about 53 percent, while in East Asian countries, including China, was about 55 percent.

<Table 1> here

2.1. Internal Migration and Economic Growth

An examination of the share of rural population versus GDP per capita among 149 countries for the 1980-2010 averages shows that the share of urban population rapidly increases with increased income (Figure 1). From a careful examination of this graph, one can infer that economies with the highest GDP per capita have more than 70 percent urbanized population, while the countries with the lowest GDP per capita have about 25 percent urbanized population on average. However one striking feature of this figure is that as countries move from a low income to a lower middle or middle income category, share of urban population rises sharply, indicating that rapid urbanization is taking place along with economic growth. Based on cross-country data from 1991, Kojima (1996) divides the rate of urbanization across countries to four levels: rates below 20 percent, from 20 percent to 50 percent, from 50 percent to 70 percent, and rates above 70 percent. According to Kojima, genuine economic development in most of the countries with less than 20 percent urban population share has not yet begun. However in these countries, such as those in Africa and in the Middle East, the pace of urbanization is nevertheless very high, indicating that urbanization is taking place without industrialization. For the countries in East Asia, on the other hand, Kojima argues that for the most part urbanization has been progressing along with industrialization.

<Figure 1> here

As can be inferred from the figure above, there is a positive correlation between the economic development (as measured by GDP per capita) of the country and its urbanization rate. In fact, as mentioned above, the change in the urban population can be decomposed into three factors, one of which is rural to urban, or internal migration. We can approximate the growth in urban population due to internal migration by growth in the ratio of the urban population L_u to the growth in total population L as

$$\frac{\dot{u}}{u} = \frac{\dot{L}_u}{L_u} - \frac{\dot{L}}{L}$$

Then we pose the question whether there is a correlation between the change in urban population share, approximated by internal migration rate, and rate of economic growth. That is, assuming that the natural change in urban population due to births net of deaths is the same as the general population, and assuming away the effect of reclassification of areas from rural to urban zones, $\frac{\dot{u}}{u}$ gives an approximation of the rate of internal migration.

Figure 2 depicts a slightly positive relationship between the change in the 1980-2010 average urban population share and 1980-2010 average annual GDP per capita growth for a sample of 144 countries. The positive slope of the trend line implies that countries with higher internal migration rates have a tendency to grow at a faster rate. Next, we exclude from the sample the high income countries, which are considered to be fully urbanized (and thus experience little or no change in urban population share), city states such as Singapore and Monaco and Sub-Saharan African countries which have very rapid change in urban population share without industrialization[3], and small island states which already have very small populations with little or no movement in population. Then, we find a stronger relationship between internal migration rate and economic growth rate (Figure 3). For the sample of 67 developing countries, this finding indicates that the countries on the transition path with relatively higher rates of internal migration experience higher growth in GDP per capita.

<Figure 2> here

<Figure 3> here

[3] According to Hardoy and Satterthwaite (1989), many sub-Saharan African countries experience rapid growth in urbanization simply because they had a relatively small urban base to start with in the early 1960s, when most of these countries gained political independence from colonial powers. The development of national government departments and ministries, judiciaries, armed forces, city and municipal governments, universities medical fcilities and other city-centric organizations help to induce rapid urbanization since independence, even though national economies have not grown as rapidly. Sommers (2003), on the other hand, emphasizes the impact of civil wars in rapid growth in urban populations all across sub-Saharan African countries: from Angola to Sudan and the Democratic Republic of Congo to Sierra Lione, people displaced by civil wars have taken refuge in capital cities.

Breaking down the overall GDP into its main sectors, we see even a stronger relationship between the change in urban population share and the growth in manufacturing value added as well as the growth in services value added. This finding can be expected as both manufacturing and services are considered to be relatively more urban activities.

The interrelationship between internal migration and economic growth in a multi-sector economy with factor productivity differences across sectors is complex, and the causality between internal migration and economic growth may run in both ways (Yap, 1976). Surplus labor models as by Lewis (1954) and by Ranis and Fei (1961) focused on the transfer of labor from low-productivity agriculture to (presumably) high-productivity manufacturing, creating efficiency gains by the reallocation of labor. From the point of view of these surplus labor models, urbanization unambigously leads to positive changes in national output (Morrison and Guo, 1996). Alhough the literature on internal migration has for the most part concentrated on the determinants of the individual household's motivation to migrate (e.g. Greenwood, 1997), relatively much less work exists on the consequences of migration, except for some of the studies on the link between urbanization and economic growth.

Urbanization can be seen as a consequence of labor moving out of labor-intensive agricultural production to manufacturing and services, which are predominantly located in urban areas because of agglomeration economies (Krugman, 1991; Fu, 2004; Henderson, 2005). According to Henderson (2005), benefits from agglomeration, such as localized information and knowledge spillovers (Lucas, 1988), may be enhanced through urbanization, and thus efficient urbanization may induce economic growth. In fact, Gallup et al. (1999) suggest that urbanization may cause economic growth and argue that positive effects of migratory movements on economic growth are closely linked to the geographic position of the country or the region: in coastal areas where the transportation costs are low and division of labor is high, a rising population (represented by an increase in population density) may be linked to stable or even rising per capita incomes through increasing returns to scale in labor, whereas in the hinterland, output is predominantly characterized by decreasing returns to labor with limited supplies of land. Henderson (2003), on the other hand, suggests that increases in productivity growth are not necessarily due to urbanization per se, but rather to the degree of urban concentration.

Although there are not many theoretical as well as empirical studies on the impact of internal migration on economic growth, Yap (1976) builds a theoretical model and uses simulation techniques to quantify the impact of internal migration on the growth of Brazilian GDP for the period 1950-1965. Simulations with and without migration show that internal migration has had a strong positive effect on Brazilian growth. Using non-stationary panel data techniques, McCoskey and Kao (1998) find a long-run relationship between the change in urbanization levels and growth in output per worker for 30 developing countries and 22 developed countries for the period 1965-1989. However, they note that the impact of urbanization on economic growth varies across countries. For the case of Lima, Peru for the period 1988-1993, Morrison and Guo (1996) estimate that net in-migration had the largest impact on output of the commerce and services sectors, which absorbed about 74 percent of all migrants to this city. In a growth accounting exercise for the period 1978-2003, Dekle and Vandenbroucke (2010) find that 26 percent of the labor productivity growth in China can be attributed to the reallocation of labor from agriculture to non-agricultural sectors, which can be regarded as representing rural-urban migration.

2.2. Cost of Living Differentials and Internal Migration

In formulating the behavior of rural-urban migration, much of the earlier literature focuses on the rural-urban labor response to the simple rural-urban wage gap (for example Lewis; 1954, Ranis and Fei, 1961; for the Brazilian case, Yap, 1976), or rural-urban differentials in expected incomes (Todaro, 1969; Harris and Todaro, 1970). In Todaro (1969) and Harris-Todaro (1970)-type probabilistic models, migrants are attracted to the cities with the expectation of a higher wage than they receive in agriculture, and are willing to accept the probability of urban unemployment, or lower wages and “underemployment” in the urban informal (traditional) sector. According to Todaro, the migrant is willing to accept urban unemployment or lower wages in the urban informal sector as long as he expects to “graduate” to the urban modern sector in the future. Extensions of these probabilistic migration models include Gupta (1988, 1993, 1997), Basu (2000), Chaudhuri (2000), and Bhattacharya (2002).

However, focusing solely on the rural-urban wage differentials, the Harris-Todaro-type migration models fail to take the cost-of-living differences across rural and urban regions into consideration in migration decision. Bell (1991) points out that in the presence of spatially non-mobile regional factors of production, there will be differences in regional household incomes. Further regional heterogeneity may arise due to the existence of regional non-traded goods, which exacerbates the differences in cost of living across regions. Along the lines of Heady (1981, 1988), Bell emphasizes that for an individual to be in equilibrium (i.e. no migration), it must be the case that his expected utility derived from staying in the rural region is equal to the expected utility derived by moving to the urban region. Since the household's income and consumer prices in a region directly affect the consumption decision, they also affect the household's expected utility from staying or migrating. In Michaels et al. (2012), in a model linking urbanization, population density, and structural transformation away from agriculture, workers choose residency by maximizing their discounted stream of utility, and the choice implies equating the real income across all locations. In Michaels, et al., real income depends on identical prices across locations (due to costless trade) but varying regional rental rates on land, as in Bell.

Several empirical studies consider the role of regional cost-of living differentials in internal migration decision of households. For the United States, Renas and Kumar (1978) show that higher cost of living discourages in-migration and induces out-migration. They also show that a rapid rate of change in the cost of living in an area also discourages in-migration. However, this result is not as statistically significant as is the level of the cost of living parameter. Nevertheless, excluding the rate of change in cost of living in migration regression leads to a misspecification problem. Liu (1975) considers the cost of living as a component in living conditions as part of quality of life index and finds that living conditions constitute the most important factor in non-whites' migration decision in the United States between 1960-1970. In an empirical study on Spain, Antolin and Bover (1997) approximate the regional cost of living differentials with house price differentials, and find that individuals have a higher probability of moving if they live in a region with a higher than average house prices. Cebula (1980, 1993, 2005), in empirical studies for the United States, finds that in-migrants prefer areas where living costs are lower. Giannetti (2003) on the other hand, in an overlapping generations model, shows how heterogeneity in skill levels of the migrants and cost of living differentials across areas may explain some of the puzzles in internal migration and regional development. He finds the shortage of unskilled workers in high-technology areas such as Silicon Valley can be explained by the existence of skill complementarities that increase not only aggregate productivity but also the prices of non-traded goods (such as housing). As a result, workers who gain less from skill premia leave these areas. Giannetti's results also provide evidence to the regional divergences as mobility of labor may generate poverty traps in regions.

Around these concepts, we investigate households' motivation to migrate and the impact of migration on economic growth. To this end, in the next section we construct a two region, multi-sector model of an economy in which regional wage disparities as well as differences in regional prices, which lead to regional cost of living differentials, play a role in the migration decision.

3. Methodology and the Model Environment

We now introduce the theoretical set up and the model environment. The small open economy consists of two regions and is endowed with resources of labor, capital and land. The amount of land is assumed to be fixed. Households are the owners of factors of production in each respective region. Each region produces two goods, its own home good and a traded good. Traded goods are traded both internationally and across regions. Households in each region consume three goods: both of the two tradable goods from each respective region, and the home-good specific to the region in which they reside and work.

For simplicity, there is a single economy-wide capital market, and a single market clearing interest rate; however labor markets are segmented across regions. In each region labor markets clear separately at different wages at each instant in time. The two regional labor markets are 'connected' in a sense that households are allowed to move from one region to another so as to equate the indirect utility gained from consumption in each region, i.e. households can choose residency and move across regions over time. In so doing, they carry their labor as well as their demand for service from their original location, and augment the labor supply and demand for services in their destination location.

3.1. Production

In region *i*, *i=1* (rural), and *i=2* (urban), production takes place in two sectors indexed *j*, *j=1* (a traded good), and *j=2* (a non-traded home good), utilizing neoclassical constant returns to scale production technologies to produce outputs Y_{ij}. More specifically, we specify Cobb-Douglas production technologies in each sector as follows:

$$Y_{11} = A_{11} L_{11}^{\beta_1} K_{11}^{\beta_2} T^{\beta_3} \quad (1)$$
$$Y_{12} = A_{12} L_{12}^{\alpha} K_{12}^{1-\alpha} \quad (2)$$
$$Y_{21} = A_{21} L_{21}^{\delta} K_{21}^{1-\delta} \quad (3)$$
$$Y_{22} = A_{22} L_{22}^{\phi} K_{22}^{1-\phi} \quad (4)$$

Here, L_{ij} and K_{ij} represent the labor and capital employed in sector *j* of region *i*, respectively, and *T* is the amount of land in agricultural production in region 1. Let Y_{11} denote agricultural output (a traded good) in the rural region, and Y_{12} denote rural region output of the home-good (non-traded good). For the urban region, Y_{21} is the manufacturing output (traded good) and Y_{22} is the home-good output (non-traded good).

Agricultural firms in rural region hire labor from rural region's labor market, and capital from the economy-wide capital market, choosing the combinations of labor L_{11} and capital K_{11} to maximize profits given factor prices, ω_1 and r, respectively, the given world price p_{11} of the agricultural good, and the fixed amount of land[4] T, to yield in each period t

$$\pi(\omega_1, r, p_{11})T = (a_{11}p_{11})^{\frac{1}{\beta_3}} \omega_1^{-\frac{\beta_1}{\beta_3}} r^{-\frac{\beta_3}{\beta_3}} T \equiv \max_{Y_{11}} \left\{ (p_{11}Y_{11} - \omega_1 L_{11} - rK_{11}) \middle| T' \leq T \right\} \tag{5}$$

Given (1), the value added by land is linear in T and $\pi(\omega_1, r, p_{11})$ can be interpreted as the rental rate that causes the land rental market to clear in a perfectly competitive rental market.

Firm behavior in the remaining sectors (rural region and urban region home good, and urban region manufacturing) is characterized by minimizing cost subject to their respective technologies, (2), (3), and (4). All firms have access to labor in their respective regional labor markets which clear at regional wages ω_i, and to capital in the economywide capital market at rate r. The profit maximization conditions for these firms are given as

$$MC_{ij}(\omega_i, r) - p_{ij} = 0, \; i = 1,2; \; j = 1,2 \tag{6}$$

where $MC_{ij}(\omega_i, r)$ denotes the marginal cost of the firm in sector j of region i. The region $i=2$ price p_{21} of the traded manufactured good is treated as the numeraire, and therefore is suppresed in the remaining analysis. The prices of the region-specific home goods are p_{12}, and p_{22} for the rural and urban regions, respectively.

3.2. Households

Households in each region i, $i=1,2$, are endowed with L_i units of labor, and K_i units of capital, which evolve regionally over time as residence changes. Household in region i derives

[4] We assume below that land T is evenly distributed to all households, both urban and rural, with the number of workers equal to the number of households.

income from renting labor services to firms in the region of residence while rents to capital accrue from the national capital market. For simplicity, we assume that land is evenly distributed on a per household basis with $\tau = T/L$, and hence, both regions receive proportionally distributed rents from land. Under these assumptions, the aggregate household income in region *i* is given by

$$\mathrm{I}_i = \omega_i L_i + rK_i + \pi L_i \tau$$

Households in both regions choose saving and consumption paths through time to

$$\max_{(Q_i, K_i)>0} \int_0^\infty \frac{Q_i(t)^{1-\theta} - 1}{1-\theta} e^{-\rho t} dt$$

Subject to the intertemporal budget constraint,

$$\dot{K}_i \leq \omega_i L_i + rK_i + \pi L_i \tau - \mathrm{E}_i(Q_i, p_{11}, p_{21}, p_{i2})$$

the transversality constraint,

$$\lim_{t\to\infty} K_i(t) e^{-\int_0^\upsilon r(\upsilon) d\upsilon} = 0$$

and the non-negativity constraints for capital and consumption

$$Q_i(t) \geq 0 \text{ for all } t$$
$$K_i(0) \leq K_{i,0}$$

Above, Q_i is an index of aggregate consumption in region *i*, p_{i2} is the price of home-good in region *i*. The coefficient, $1/\theta$, is the intertemporal elasticity of substitution, ρ is the time preference rate, and $\mathrm{E}_i(Q_i, p_{11}, p_{21}, p_{i2})$ is the aggregate expenditure on consumption in each region *i*.

In addition to the intertemporal decision of savings and composite consumption, households also make an intra-temporal decision concerning the allocation of expenditures among consumption of three different goods at each point in time, given their prices. At each point in time, households consume three types of goods, C_{in} each for region *i*, indexed *n*, *n=1* (agricultural), 2 (manufacturing), 3 (region-specific home-good). The intra-temporal consumption composite Q_i[5] in region *i*, is assumed to be of the Stone-Geary form

$$Q_i = \mathrm{B}_i (C_{i1} - \Gamma)^{\lambda_1} C_{i2}{}^{\lambda_2} C_{i3}^{\lambda_3}$$

where the parameter $0 < \lambda_n < 1$ denotes the expenditure share of consumption on good *n* in total expenditures. The subsistence parameter Γ is associated with the consumption of the agricultural good[6], C_{i1} in order to account for differences in income across households in each of the two regions. Households in both regions devote a smaller fraction of their incomes on agricultural good as their incomes increase over time; effectively, the income elasticities of demand for the agricultural good is less than unity in both regions. The corresponding expenditure function in region *i*, with the price of manufactures p_{21} as numeraire, is

$$\mathrm{E}_i = p_{11}\Gamma + p_{11}{}^{\lambda_1} p_{21}{}^{\lambda_2} p_{i2}{}^{\lambda_3} Q_i$$

Aggregate expenditure E_i is composed of two components, one of which is aggregate spending on subsistence $p_{11}\Gamma$, and this is the same across regions. The second component is referred to as supernumerary expenditures, which we denote as

$$\mathrm{M}_i = p_{11}{}^{\lambda_1} p_{21}{}^{\lambda_2} p_{i2}{}^{\lambda_3} Q_i$$

which varies by region.

With the total number of workers *L* unchanging and normalized to 1, we can express the households' problem in per capita terms, and hence we write the Hamiltonian of the utility maximization problem of household in region *i* as

$$\mathrm{H}_i(t) = \frac{q_i^{1-\theta} - 1}{1-\theta} e^{-\rho t} + \chi_i \left[\omega_i \ell_i + r k_i + \pi \ell_i \tau - \varepsilon_i(q_i, p_{11}, p_{21}, p_{i2})\right]$$

where $\varepsilon_i(q_i, p_{11}, p_{21}, p_{i2}) = p_{11}\gamma + p_{11}{}^{\lambda_1} p_{21}{}^{\lambda_2} p_{i2}{}^{\lambda_3} q_i = p_{11}\gamma + \mu_i$

[5] In other words, Q_i is the intra-temporal felicity of households from consumption in region *i*.

[6] Since we assume same preferences, aggregate subsistence Γ, as well as subsistence per economy-wide household (or, labor) γ is the same across regions, although the subsistence consumption parameters "per regional labor" may be different, due to differences in populations.

with $\ell_i = \frac{L_i}{L}, k_i = \frac{K_i}{L}, q_i = \frac{Q_i}{L} \gamma = \frac{\Gamma}{L}$, and $\mu_i = \frac{M_i}{L}$

Since the traded goods prices p_{11} and p_{21} are given and assumed unchanging, household optimization leads to the Euler equation

$$\frac{\dot{q}_i}{q_i} = \frac{1}{\theta}\left[r - \rho - \lambda_3 \frac{\dot{p}_{i2}}{p_{i2}}\right]$$

Total differentiating the supernumerary expenditures μ_i with respect to time we get

$$\dot{\mu}_i = \lambda_3 \frac{\dot{p}_{i2}}{p_{i2}} \mu_i + \mu_i \frac{\dot{q}_i}{q_i}$$

We substitute for $\frac{\dot{q}_i}{q_i}$ and we obtain

$$\frac{\dot{\mu}_i}{\mu_i} = \frac{1}{\theta}\left[r - \rho - (1-\theta)\lambda_3 \frac{\dot{p}_{i2}}{p_{i2}}\right]$$

For $\theta = 1$, we obtain the more familiar result

$$\frac{\dot{\mu}_i}{\mu_i} = r - \rho$$

This important result indicates that, per economy-wide labor, *L*, supernumerary expenditures of households in each region grows at the same rate, $r(t) - \rho$, during transition and at the steady-state i.e., they remain proportional at some constant rate $\bar{a} > 0$ for all *t*,

$$\frac{\mu_1(t)}{\mu_2(t)} = \frac{\mu_1(0)e^{[r-\rho]t}}{\mu_2(0)e^{[r-\rho]t}} = \frac{\mu_1(0)}{\mu_2(0)} = \bar{a}$$

3.3. Households' Residency Choice

The residency choice condition is an equilibrium condition where the representative household's instantaneous utility (intra-temporal felicity from consumption) in rural region and the instantaneous utility in urban region are equalized for each *t*. That is, the household is indifferent between residing in rural region or in urban region at any given point in time. We can also call this the "migration equilibrium" condition. What this condition implies is that whenever there are discrepancies between the utility gained in regions, the household has an incentive to migrate from one region to the other. Then, migration in fact is a disequilibrium phenomenon. When the instantaneous utility across regions is equalized, migration ceases to occur.

Note that if we represent the instantaneous utility of the representative household in region i as $\bar{q}_i$, then we require $\bar{q}_1 = \bar{q}_2$. Since $q_i L = Q_i = \bar{q}_i L_i$, we can write $\bar{q}_i = q_i \frac{L}{L_i} = \frac{q_i}{\ell_i}$. Let $\ell_1 = \ell$ for ease of notation. Since $\ell_1 + \ell_2 = 1$, we can express $\ell_2 = 1 - \ell$. The migration equilibrium condition is now equivalent to $\frac{q_1}{\ell} = \frac{q_2}{1-\ell}$, or more usefully, $\ell = \frac{q_1}{q_1 + q_2}$.

Next, we seek to replace the q_i terms with supernumerary income to reveal how home good prices affect the migration decision. From household's intra-temporal solution we have

$q_1 = \frac{\mu_1}{p_{12}^{\lambda_3}}; q_2 = \frac{\mu_2}{p_{22}^{\lambda_3}}$. Then, the share of labor force ℓ in region 1 can be written as

$$\ell = \frac{\mu_1 p_{22}^{\lambda_3}}{\mu_1 p_{22}^{\lambda_3} + \mu_2 p_{12}^{\lambda_3}}$$

Initially at *t=0*, with $p_{12} = p_{22} = 1$, and given that $\mu_1 / \mu_2 = \bar{a}$,

$$\ell(0) = \frac{\bar{a}}{1+\bar{a}} \tag{7}$$

In transition, using $\mu_1 / \mu_2 = \bar{a}$, and substituting for p_{12} and p_{22} as functions of factor prices in each respective region from profit maximization conditions for firms as given in (6), the residency decision can be seen as a function of factor prices, “mapped” through home-good prices as follows:

$$\ell(\omega_1, r) = \frac{\bar{a} p_{22}(r)^{\lambda_3}}{\bar{a} p_{22}(r)^{\lambda_3} + p_{12}(\omega_1, r)^{\lambda_3}}$$

Note further form the migration equilibrium condition, $\frac{q_1}{\ell} = \frac{q_2}{1-\ell}$, we have

$$\ell = (1-\ell)\frac{q_1}{q_2} = (1-\ell)\frac{\mu_1 / p_{12}^{\lambda_3}}{\mu_2 / p_{22}^{\lambda_3}} = (1-\ell)\bar{a}\left(\frac{p_{22}}{p_{12}}\right)^{\lambda_3}$$

Time differentiating the log of the terms on both sides of this equation yields

$$\begin{aligned}\frac{\dot{\ell}}{\ell} &= \frac{-\dot{\ell}}{1-\ell} + \lambda_3\frac{\dot{p}_{22}}{p_{22}} - \lambda_3\frac{\dot{p}_{12}}{p_{12}} \\ &= (1-\ell)\lambda_3\left(\frac{\dot{p}_{22}}{p_{22}} - \frac{\dot{p}_{12}}{p_{12}}\right)\end{aligned}$$

From the perspective of the change in wages, we have[7]

$$\frac{\dot{\ell}}{\ell} = (1-\ell)\lambda_3 \underbrace{\frac{1}{\varepsilon_{p_{12}}^{\omega_1}}}_{(+)}\left(\underbrace{\frac{\varepsilon_{p_{12}}^{\omega_1} + \varepsilon_{p_{22}}^{\omega_1}}{\varepsilon_{p_{22}}^{\omega_1}}}_{\in(0,1]}\frac{\dot{\omega}_2}{\omega_2} - \frac{\dot{\omega}_1}{\omega_1}\right) \tag{8}$$

with

$$\frac{\varepsilon_{p_{12}}^{\omega_1} + \varepsilon_{p_{22}}^{\omega_1}}{\varepsilon_{p_{22}}^{\omega_1}} = \frac{\frac{\phi}{\alpha} - \delta}{1-\delta}$$

where $\varepsilon_{p_{i2}}^{\omega_i}$ is the wage elasticity in region *i* associated with the home good price in region *i*.

Note from technologies (2) and (4), that for the case $\alpha \geq \phi$, i.e., when the rural home good production is relatively more labor intensive than the urban home good production,

$$\frac{\varepsilon_{p_{12}}^{\omega_1} + \varepsilon_{p_{22}}^{\omega_1}}{\varepsilon_{p_{22}}^{\omega_1}} = \frac{\frac{\phi}{\alpha} - \delta}{1-\delta} \leq 1$$

We thus obtain the counter intuitive result that as long as the rural wages grow at a faster rate than urban wages, i.e. $\frac{\dot{\omega}_2}{\omega_2} \leq \frac{\dot{\omega}_1}{\omega_1}$, migration out of the rural region, $\dot{\ell}/\ell < 0$ is implied. The counter intuitive result is explained by focusing on the cause of the rise in relative wage rates. What is crucial in determining the direction of migration is the relative changes in the home good prices, which in equilibrium are jointly determined with wages, i.e., these prices

[7] Details of the derivation are available from the authors upon request.

are directly affected by changes in wages, a cost factor in production. Hence as long as rural wages rise at a faster rate than urban wages, then the model predicts that rural home good prices rise at a faster rate than urban home good prices, affecting the equilibrium utility of the household, and thus determining the direction of migration.

We do not empirically test this prediction. However, casual observation of the relationship between the migration of rural Turkish labor and the regional home good (health, education, housing and utilities) price changes show that areas with higher price changes have higher rates of out-mirgation, and areas with relatively lower rates of price changes have net in-migration, while others in this cateorgy have lower rates of net out-migration.[8]

3.4. Equilibrium

Definition. A competitive equilibrium for this economy is a list of sequences of output prices, regional consumption levels, factor prices, and production plans for each sector in all regions such that

(i) Given output and factor prices in each region *i*, households in each region maximize the present value of their discounted intertemporal utility;
(ii) Given output and factor prices in each region *i*, representative firms in all sectors in each region maximize profits;
(iii) Market clears in the non-tradable (services) sector in each region *i*;
(iv) Labor market clears in each region *i*;
(v) Economy-wide capital market clears;
(vi) Households choose residency in such a way that utility from consumption per regional labor in both regions are equalized.

4. Quantitative Analysis

To fit our stylized model to data, we chose Turkey as representative of an environment where net rural to urban migration remains in transition. The model is fit to data from the Turkish economy (obtained from TurkSTAT) and, as explained below, some assumed parameter values. We systematize the data by constructing a two-region Social Accounting Matrix (SAM) and benchmark the model's initial equilibrium to the year 2006. In 2006, 34 percent of total labor in Turkey was allocated in rural regions. Using the initial rural labor share of 34 percent and equation (7), we find the constant ratio of supernumerary expenditures, $\bar{a} = \mu_1 / \mu_2 = 0.51$. The ratios of rural and urban expenditures in economywide expenditures are 36.5 percent and 63.5 percent, respectively. The economywide saving rate in 2006 is 16.6

[8] This observation is based on TURKSTAT data on 26 NUTS Level 2 regions of Turkey, 2007-2010.

percent. Approximately 32 percent of GDP is due to rural production (agriculture and rural services), and the remaining 68 percent to urban production (manufacturing and urban services).

To estimate the value of the subsistence consumption parameter γ, we first estimate the expenditure shares λ_i that would prevail in the steady-state when expenditure on subsistence consumption is negligible in total expenditures, i.e., when the preferences converge to Cobb-Douglas preferences. To estimate these values, we assume that Turkish consumers in the long-run hold preferences equivalent to current consumers in developed countries. We thus take the (average) expenditure shares of developed economies, which are assumed to be at or near their respective steady states. Given λ_1, λ_2 and λ_3, and using the base year information on year 2006 for initial consumption shares in expenditure, we estimate the subsistence parameter γ (common for households in both regions on per capita basis):

$$\frac{\lambda_1(\varepsilon_{i,0} - p_{11}\gamma) + p_{11}\gamma}{\varepsilon_{i,0}} = \frac{p_{11}c_{i1,0}}{\varepsilon_{i,0}}$$

$$\frac{\lambda_2(\varepsilon_{i,0} - p_{11}\gamma)}{\varepsilon_{i,0}} = \frac{p_{21}c_{i2,0}}{\varepsilon_{i,0}}$$

$$\frac{\lambda_3(\varepsilon_{i,0} - p_{11}\gamma)}{\varepsilon_{i,0}} = \frac{p_{i2}c_{i2,0}}{\varepsilon_{i,0}}$$

<Table 2a> here

As for the factor elasticities of technologies, we use the labor, capital and land shares in each sector to match the predictions of the model for rural to urban migration as given in Table 2b. Notice that the urban manufacturing sector is relatively more capital intensive than both rural and urban services sector, and rural services sector is relatively more labor intensive than the urban services sector. The data suggest that agriculture is the least labor intensive sector (i.e. with the lowest share of labor payments in total factor payments among all sectors).

<Table 2b> here

4.1. Model Results

To facilitate our exposition of model behavior, we specify and fit to data two models that only differ in that one does not allow for migration. Table 3 reports initial conditions, as given by the data (column 1), the steady state values given by the migration model (column 2) and the corresponding steady-state values given by the model in which migration is not permitted (column 3). Our interpretation of these results are facilitated by drawing upon the Rybczynski and Stopler-Samuelson theorems of static trade theory.

<Table 3> here

It is useful to first outline the general economic forces of the transition-growth process. In transition, households are motivated to save as long as the returns to saving remains above the time preference rate, $r(t) > \rho$. This saving behavior allows for capital deepening, albeit at a decreasing rate. As capital deepening occurs, Rybczynski-like effects cause rural traded good supply (whose production is most capital intensive) to increase, all else constant. Holding all else constant, including the regional migration, the Rybczynski Theorem predicts that rural labor will be pulled into the rural traded good sector as capital deepening raises its marginal product of labor relative the marginal product of labor in the home good sector, and consequently, rural home good output will tend to decline. However, as incomes increase due to the rise in rural region wages and capital rental income, rural household demand for both rural goods increases. Since the home good market must clear, the price of home good must increase in order for this market to clear. The resulting increase in rural wages is a Stopler-Samuelson-like effect. Since the rural home good is relatively more labor intensive, a rise in the home good price induces a rise in the wage rate and thus dampens the demand for labor employed in rural traded good production.

Similarly, in the urban region, as capital accumulates, with manufacturing production being relatively more capital intensive than urban services production, manufacturing output tends to expand as capital deepening occurs, all else constant, including the regional migration of labor. Consequently, urban home good output contracts. But as urban incomes rise, household demand for the home good rises, causing the price of the urban home good to rise in order for this market to clear, which in turn, dampens the demand for labor employed in the urban regions production of its traded good. In both regions, the rise in home good prices dampen the otherwise growth in traded good firms' demand for labor and capital.

The evolution of these basic economic forces provide an incentive to migrate, as can be seen from equation (8). As we show below in Figure 4, labor migrates from rural to urban. Relative to the case with no migration, in migration causes the urban region to experience an increase in demand for services. The increase in supply of urban labor benefits, through Rybczynski-like effects, production of the urban services, a relatively labor intensive sector (relative to urban manufacturing). While production of the rural sector traded good increases, its increase is less than the case of no migration. Out migration also lowers the production of the rural home good relative to the no migration case. Urban sector production becomes a larger share of economywide GDP compared to the no migration case.

<Figure 4> here

In the urban region, in migration causes the share of the workforce employed in manufacturing to decline (but not to the degree it would decline under no-migration) while the share employed in the production of the urban service good increases (to a degree greater than in the no-migration case). This implies that urban service firms not only pull labor from the rural region, they also pull labor from the manufacturing sector as capital deepening occurs. Importantly, this is the mechanism by which labor migration increases the urban production of traded and home goods. The decline in the share of manufacturing labor would have been much more significant if no inter-regional migration were allowed. Hence we can conclude that allowing migration across regions helps slow down the pulling of labor out of manufacturing to urban services. If migration across regions was not allowed, labor to support the increase in the urban services production must be pulled from manufacturing alone, even though total urban home good demand would have been marginally less. Allowing migration slows down and lessens the reallocation of labor from manufacturing to urban services, in spite of the growth in demand for urban services due to migration. Migration induces a corresponding decline in the share of labor employed in agriculture and share of workers in rural service production while the share of workers in production of the urban service goods expands. These results provide insight and support for the production measures of structural transformation discussed by Herrendorf et al.

Figures 5.a and 5.b present the evolution of sectoral output shares in GDP with and without migration. Results from both models show that over time, the contribution of the urban and rural services production to GDP increase, while that of manufacturing decreases, although the level of manufacturing output is higher with migration. In the model with migration, there is a distinctive decrease in the level and share of agricultural production in GDP. In contrast, the model with no migration, the share of agriculture in GDP experiences a modest increasing share. The sectoral effects of migration tend to pull labor from agriculture due to the more rapid rise in rural wages, and a “faster” substitution of capital for labor relative to the manufacturing sector. Nevertheless, this substitution is not sufficient to sustain the level of agricultural production in contrast to the no-migration model. What must be noted in comparing the results from the two models is that the fall in the share of manufacturing is much more pronounced in the no-migration model than in the migration model. In the migration model, part of the labor to support the increase in the urban services comes from the rural region, thus the pressure on the manufacturing sector to reallocate labor to the urban services sector is dampened. In the model where no migration is allowed, labor needed to support the increase in urban service production over time must be through a reallocation from the manufacturing sector. As manufacturing releases labor to the urban service production, its share in total production (but not level) decreases. Put another way, the migration of labor from the rural sector has increased the demand for urban services, but at the same time, has allowed the manufacturing sector to employ more resources than under the no-migration model. In spite of fewer rural households, agricultural production increases from initial levels with the migration of labor out of the region as does the level of production of rural services. However, both levels are higher in the no-migration model.

<Figure 5.a> here

<Figure 5.b> here

When we examine the income of the rural household with and without migration, we observe that the level of income per rural household is higher in the case with migration than in the case without migration. First of all, in the case without migration, rural wages rise at a slower rate than the case with migration. Also as can be seen from Figure 6, the utility of the rural household is less than what it would be with migration. On the other hand, the urban household is worse off with migration compared to the case without migration. Note that under the migration case, the utility per rural household and the utility per urban household are identical to allow for the migration equilibrium. Basically, rural household benefits from migration in terms of relatively higher wages in rural region and higher utility at household level.

4.2. Contributions to growth in real GDP per worker

In our model, the growth accounting identity for real GDP per capita, denoted y, can be formulated as[9]

[9] Full derivations are available upon request from authors.

$$\frac{\dot{y}}{y}=\frac{\dot{y}_{11}}{y_{11}}\frac{\widetilde{Y}_{11}}{Y}+\frac{\dot{y}_{12}}{y_{12}}\frac{Y_{12}}{Y}+\frac{\dot{y}_{21}}{y_{21}}\frac{\widetilde{Y}_{21}}{Y}+\frac{\dot{y}_{22}}{y_{22}}\frac{Y_{22}}{Y}$$
$$+\dot{\ell}_{2}\left(\frac{y_{21}-y_{12}}{y}\right)+\dot{\ell}_{11}\left(\frac{y_{11}-y_{12}}{y}\right)+\dot{\ell}_{22}\left(\frac{y_{22}-y_{21}}{y}\right)$$

where $Y=\widetilde{Y}_{11}+Y_{12}+\widetilde{Y}_{21}+Y_{22}$, $\widetilde{Y}_{i1}=\frac{Y_{i1}}{p_{i2}}$, with $y=\frac{Y}{L}; y_{ij}=\frac{Y_{ij}}{L_{ij}}; \ell_{ij}=\frac{L_{ij}}{L}; \ell_{2}=\ell_{21}+\ell_{22}$

According to this expression, the growth in aggregate output per economywide labor, $\dot{y}/y$, can be decomposed into: contributions of each sector weighted by their sectoral shares in aggregate output; the reallocation of labor from rural to urban region; the reallocation of labor within rural region, and the reallocation of labor within the urban region. We note that the reallocation of labor from rural to urban, $\dot{\ell}_{2}>0$, is weighted by the change in productivity from rural services to manufacturing; the reallocation of labor within rural region, $\dot{\ell}_{11}$ is weighted by the change in productivity from agriculture to services, and similarly the rellocation of labor within urban region, $\dot{\ell}_{22}$ is weighted by the change in productivity from manufacturing to services. In the following subsections, we elaborate on the evolution of contribution of each sector and labor reallocation within and across regions.

4.2.1. Contributions of sectoral output

The evolution of percentage contributions of each sector's output to real GDP in the model with migration and without migration are depicted in Figures 7.a and 7.b. What is similar in both cases is that the contribution of urban services output to growth in real GDP is the highest, increasing from 30 percent contribution to growth of real GDP up to about 60 percent. What is strikingly different beween the two models is the behavior of the contribution of the manufacturing output. The contribution of manufacturing output to real GDP growth in decreases from 45 percent to 27 percent in the migration model, and to 16 percent in the no-migration model. This result shows that in the urban region, since the urban services contribution remains more or less the same, the migration of rural labor to urban region benefits the manufacturing sector; without migration, the contribution of manufacturing to the overall economy becomes less important, as manufacturing sector loses labor to the services sector. Another striking difference between the model with migration and without migration is the behavior of the contribution of agricultural output to the growth of real GDP. In the model with migration, we see a distinct decrease in the contribution of agriculture as labor exits this sector, thus, all else constant, placing downward pressure on its marginal product of capital. This effect is loosely referred to as the "loss competitiveness" to the rural and urban services sectors in attracting capital. However in the model without migration, there is not a significant movement of labor within the rural region between agricultural and rural servives sectors. In this case, the agricultural sector competes "more favorably" with the rural services sector for capital, which helps sustain its share in GDP and its contribution to real GDP growth compared to the model with migration. Similarly for the rural services, since there is little reallocation of labor across sectors within the rural region, the contribution of the rural services output to real GDP growth remains roughly unchanged throughout transition.

<Figure 7.a> here

<Figure 7.b> here

4.2.2. Contributions of labor realloation

In the migration model, the contribution of the reallocation of labor from the rural region to the urban region is represented by the term which is the change in urban labor $\dot{\ell}_2$ multiplied by the change in labor productivity from rural to urban region relative to total productivity. Initially the contribution of labor reallocation from rural to urban is 12 percent of total real GDP growth, and over time it drops to 9.5 percent, and it remains a positive contribution throughout the transition (Figure 7.c). Since $\dot{\ell}_2$ is positive with rural labor moving to the urban region, we can deduce that $\left(\frac{y_{21}-y_{12}}{y}\right)$ is also positive throughout the transition. Basically, there is a gain in labor productivity as it is a positive contributor to overall real GDP growth in labor migration, but this contribution slightly declines towards the steady state, as the productivity gain cannot keep up with the movement of labor from rural to urban region.

<Figure 7.c> here

When we look at the contributions of labor reallocation within the regions, we see a different pattern. All else constant, labor reallocation across sectors within both regions contribute negatively to overall real GDP growth. In the rural region, within region labor reallocation contribution is represented by the term $\dot{\ell}_{11}\left(\frac{y_{11}-y_{12}}{y}\right)$ and in the urban region it is $\dot{\ell}_{22}\left(\frac{y_{22}-y_{21}}{y}\right)$. In both regions, throughout transition,

$$\dot{\ell}_{11}\left(\frac{y_{11}-y_{12}}{y}\right)<0;\ \dot{\ell}_{22}\left(\frac{y_{22}-y_{21}}{y}\right)<0$$

Since $\dot{\ell}_{11}<0$, the negative contribution of the rural region labor reallocation is due to the actual movement of labor from agriculture to rural services. In the urban region, $\dot{\ell}_{22}>0$, hence the negative contribution is due to the decrease in labor productivity as labor moves from manufacturing to urban services. In spite of the negative contribution, reallocation of labor within both regions is detrimental to overall real GDP growth, while reallocation of labor across regions is beneficial for real GDP growth. Effectively, these are the trade-offs in order for the positive effects of inter-regional migration to be achieved.

When we examine the case without migration, and consider only the contributions of labor reallocation within the regions, we still see that contributions to real GDP growth are negative; but in this case, since there is not a very significant movement of labor within the rural region, the negative contribution remains roughly unchanged throughout the transition. For the urban region, on the other hand, we see an even larger within region movement of labor compared to the migration case, and as labor continues to move from manufacturing sector to urban services sector, the loss of productivity increases further, leading to an increasingly negative contribution of urban labor reallocation over time.

5. Conclusion and Discussion

The contribution of this paper is to show the effects on economic growth from competitive market forces that incentivize households to migrate from a rural to an urban region. We construct a model of a stylized small, open and competitive two-region economy in which households maximize their dynastic utility subject to a flow budget constraint. Each region produces two goods, one of which is traded, and one which is a non-traded home good, for a total of four goods. The savings behavior of households causes capital deepening, and growth in real income per worker. Unique to the model is household, as opposed to worker, migration between regions. As income per worker grows differentially in the two regions, migration proceeds causing the sectoral composition of GDP to change due to both change in regional traded good and home good demand, and change in regional labor supply and hence allocation to sectors within regions. Hence, as in real economies, we see the combined impact of both demand-side and supply-side factors on structural transformation. During transition, these two factors play out together. Previous models which do not consider household migration across regions may be underestimating the effect of labor reallocation on structural transformation. We believe that accounting for this effect is one of the main contributions of our model.

To strengthen the insights provided by the analytical analysis, we fit the model to data, and solve to obtain transition equilibria. We also present results from a model that precludes migration, and is otherwise identical to the migration model. The effect on growth of household migration is the incremental increase in consumption of the home good in the in-migration region and incremental decline in consumption of the home good in the out-migration region. Since income per regional worker is increasing in both regions, the total consumption of home goods per regional worker, grows in both regions. This causes both regional home good markets over time to clear at rising home good prices, which, due to capital deepening and their relative labor intensity, contributes to the rise, albeit differentially, in regional wage rates. While the migration of households to the urban region increases urban home good demand, it also increases urban labor supply, which tends to increase the marginal product of capital in production of both urban goods. This effect allows the production of the manufactured good in the urban region to increase[10] due to, loosely speaking, a lessening of competition for labor among firms in the urban manufacturing and home good region. During the transition towards the steady state, the direct contribution of rural to urban migration of labor to overall real GDP growth accounts for from 12 percent initially to 9.5 percent near the steady state.

One of the most significant results from our model appear when we contrast the sectoral output contributions to growth in GDP per economy worker for the case with and without the rural-urban migration. In both cases, we see a distinctive increase in the share of services and a decline in the share of manufacturing. We observe a distinctive decrease in the share of agriculture in the model with migration, and a slight increase in the share of agriculture in the model with no migration. We also find the fall in the share of manufacturing is much more pronounced in the no-migration model than in the migration model. In the migration model, part of the labor to support the increase in the urban services comes from the rural region, thus the pressure on the manufacturing sector to reallocate labor to the urban services sector is dampened. This result can be interpreted as the rural sector's contribution to growth of the economy which becomes more urban based. When migration is not allowed, all labor needed

[10] However, as a share of GDP, manufacturing declines but maintains a higher share than in the no-migration case.

to support the increase in the urban services sector must be through reallocation from the manufacturing sector. We conclude from these results that rural-urban migration of labor works to support urban manufacturing, and without rural-urban migration of labor, the share of manufacturing in total GDP would be reduced.

Another notable result arises when we compare the felicity of rural and urban households with and without migration. Felicity per (remaining) rural household is higher with migration than without migration. However, the felicity per urban household is higher without migration than with migration. In the model with migration, time to double to real GDP is 58.0 periods, and the half-life of adjustment to the steady state equilibrium is 28.0 periods, while in the model with no migration, 64.2 periods and 28.6 periods, respectively. This difference indicates that the transition to the steady state in the model with no migration is slower than that in the model with migration. This result should be expected if we view the no migration model as a structural impediment to transition growth.

The model developed here is stylistic; it omits the more realistic case that rural households consume some non-traded urban goods (including amenities) at unit costs higher than urban households, while urban households consume rural non-traded goods at unit costs higher than rural households. We also ignore costs associated with a change of residency, and omit consideration of externalities. We also preclude manufacturing firms from locating to rural areas. Nevertheless, in spite of the stylistic nature the model, it provides compelling support for capturing the effects of household migration on economic growth.

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TABLES

Table 1: Urban population share and annual growth

	1960-69	1970-79	1980-89	1990-99	2000-09
Urban population (% of total)					
World	34.5	37.2	40.8	44.6	48.5
High income	63.3	68.1	71.2	74.0	76.3
Upper middle income	50.1	57.9	64.4	69.4	73.3
Middle income	27.1	30.4	35.3	40.5	45.7
Lower middle income	20.3	22.6	27.0	32.6	38.3
Low & middle income	25.5	28.9	33.5	38.3	43.0
Low income	13.9	16.8	20.5	23.5	26.9
Urban population growth (% annual)					
World	3.0	2.7	2.7	2.3	2.1
High income	1.9	1.5	1.1	1.1	1.0
Upper middle income	3.7	3.2	2.7	1.8	1.5
Middle income	3.6	3.4	3.5	2.8	2.3
Lower middle income	3.5	3.6	4.0	3.4	2.8
Low & middle income	3.7	3.5	3.5	2.9	2.5
Low income	5.7	5.0	4.3	3.8	3.7

Table 2a: Model's household parameters

Parameter		Value
Rural household		
Initial expenditure share on agricultural good		0.32
Initial expenditure share on subsistence consumption		0.22
Initial expenditure share on manufactured good		0.14
Initial expenditure share on services		0.54
Urban household		
Initial expenditure share on agricultural good		0.23
Initial expenditure share on subsistence consumption		0.13
Initial expenditure share on manufactured good		0.16
Initial expenditure share on services		0.61
Common parameters		
Long-run expenditure share on agricultural good	λ_1	0.12
Long-run expenditure share on manufactured good	λ_2	0.18
Long-run expenditure share on services	λ_3	0.70
Elasticity of intertemporal substitution	$1/\theta$	1
Time preference rate	ρ	0.042

Table 2b: Factor elasticities in production

Factor shares	Labor	Capital	Land
Rural region			
Agriculture	0.25	0.60	0.15
Services	0.75	0.25	
Urban region			
Manufacturing	0.55	0.45	
Services	0.6	0.4	

Table 3: Steady-state results from migration and no-migration models

	Initial value	Steady-state value	
		With migration	No migration
Interest rate (%)	9.0	4.2	4.2
Urban to rural wage ratio	1.23	0.55	0.75
Rural prices	1.00	2.44	1.91
Urban prices	1.00	1.07	1.07
GDP (bill. TL)	576.3	1 305.6	1 287.8
Rural GDP share (%)	32	35	44
Urban GDP share (%)	68	65	56
Agricultural output share in GDP (%)	15	13	22
Rural services share in GDP (%)	17	22	22
Manufacturing output share in GDP (%)	36	21	12
Urban services share in GDP (%)	32	44	43
Rural residency (%)	34	22	34
Agricultural labor share (%)	8	4	9
Rural services labor share (%)	26	19	25
Manufacturing labor share (%)	33	24	13
Urban services labor share (%)	33	54	53
Rural capital share (%)	31	33	46
Urban capital share (%)	69	67	54

FIGURES

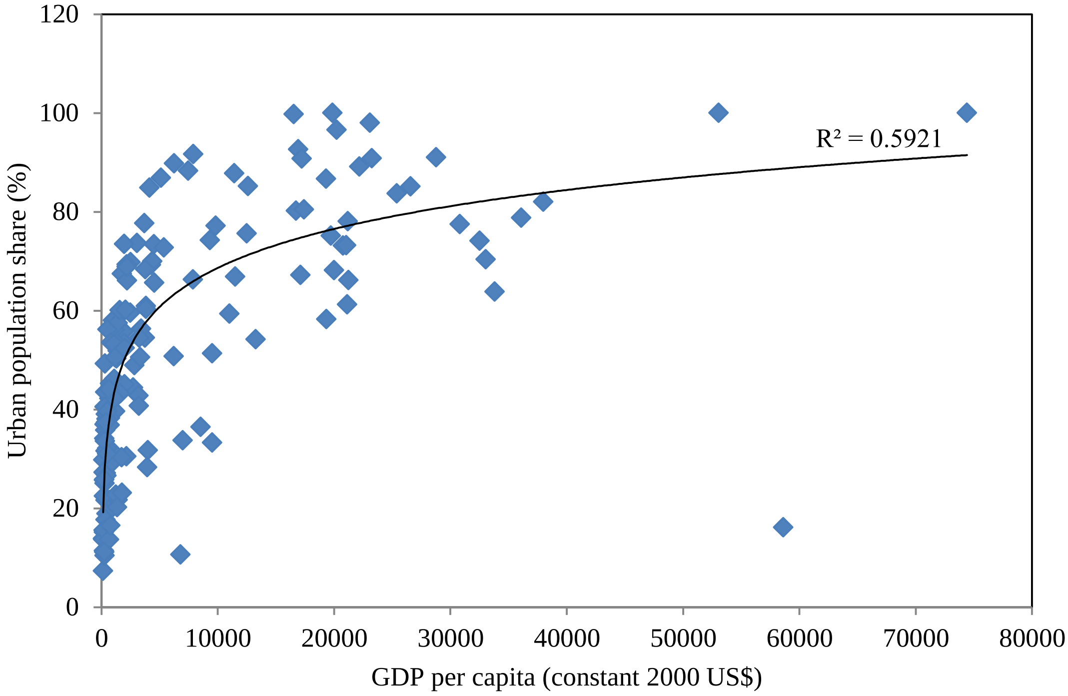

Figure 1: Urban population share and GDP per capita (Source: World Bank, WDI)

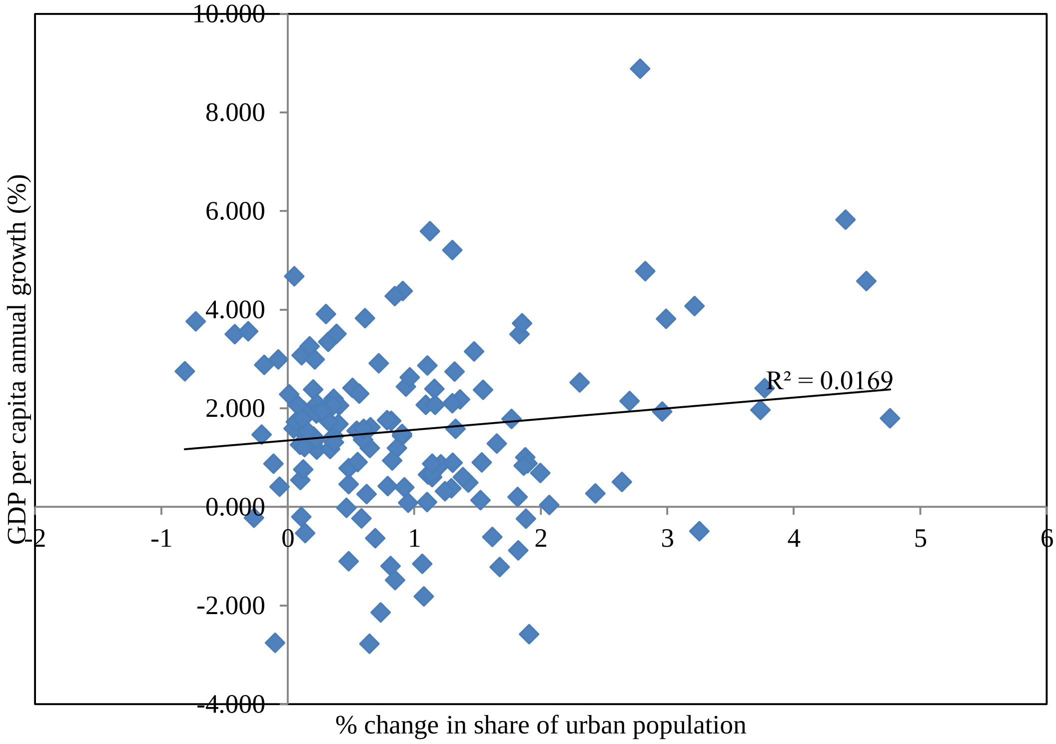

Figure 2: Change in urban population share and GDP per capita growth, 1980-2010 averages (Source: World Bank, WDI)

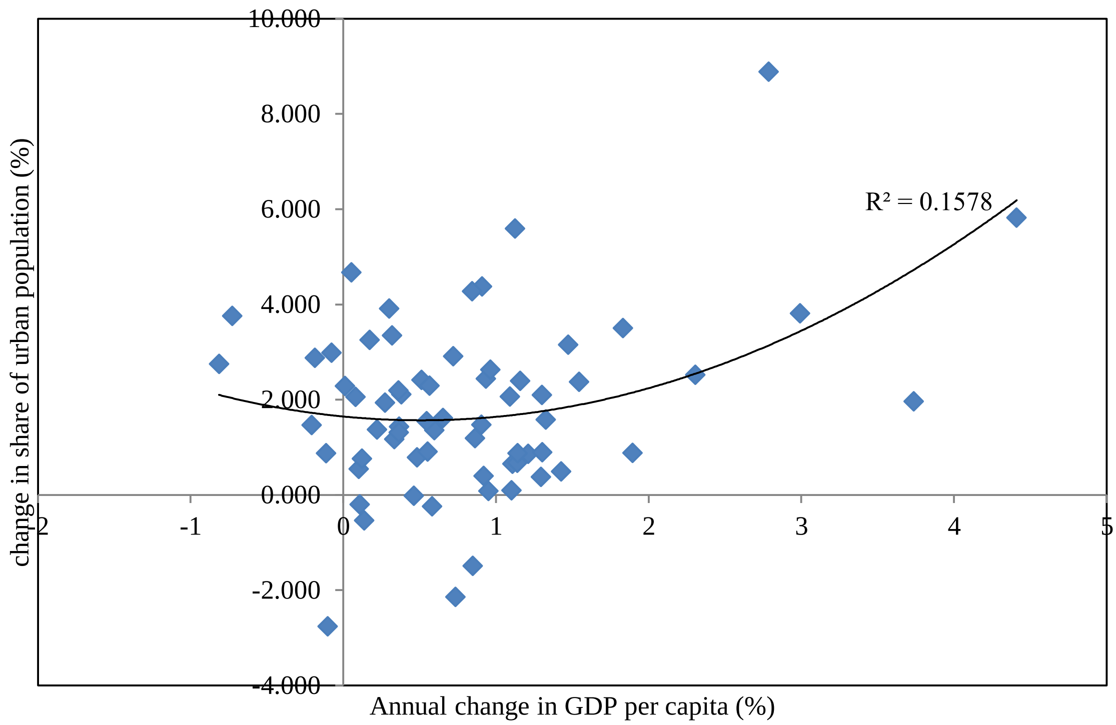

Figure 3: Change in urban population share and GDP per capita growth, developing countries excluding SSA and small island states, 1980-2010 averages (Source: World Bank, WDI)

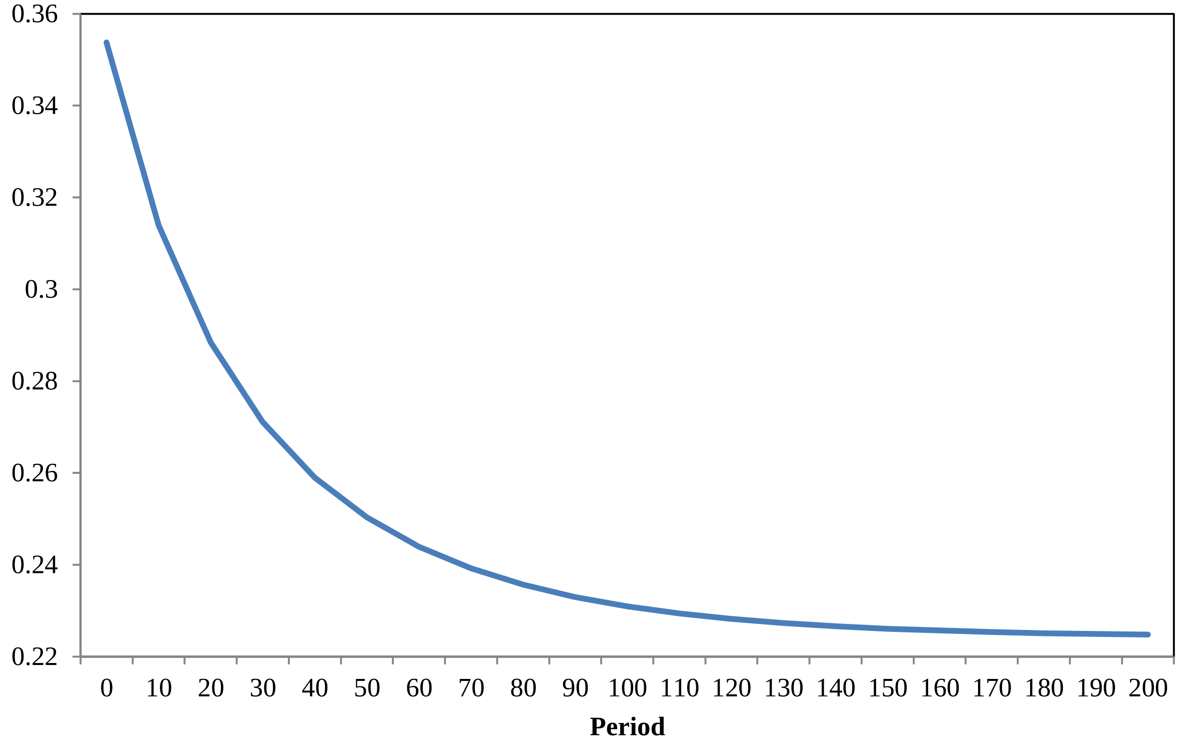

Figure 4: Residency choice of rural workers

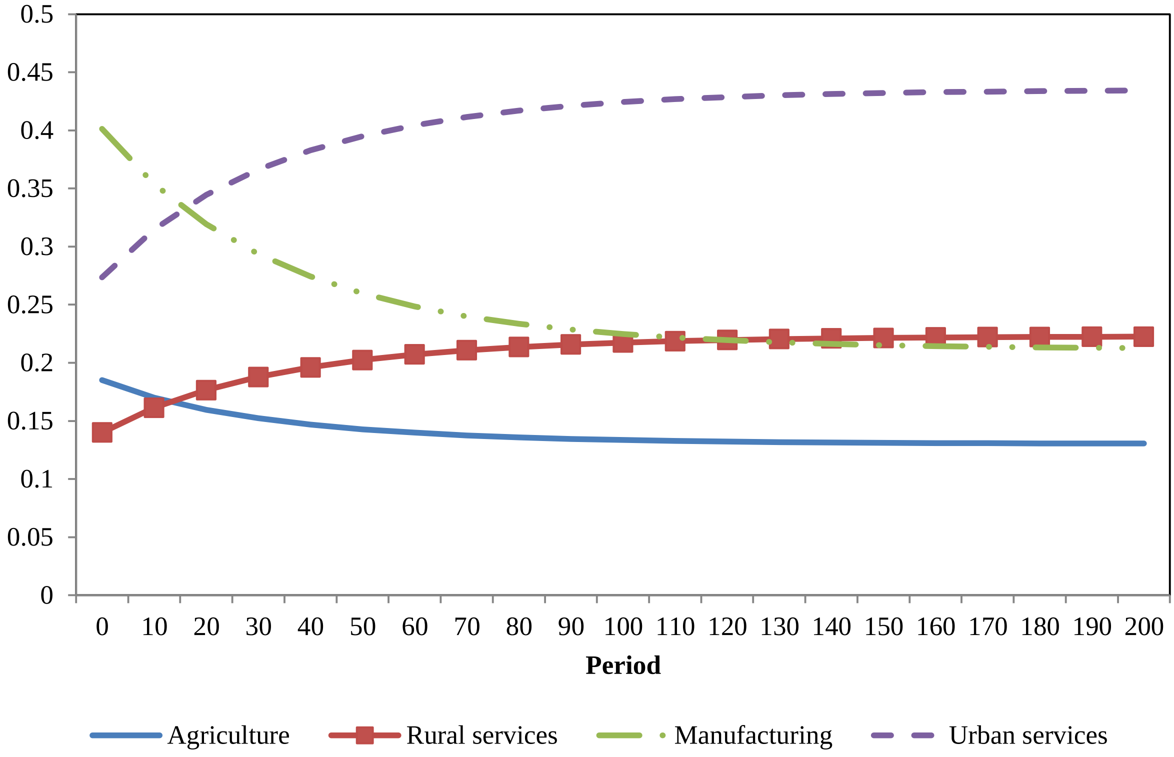

Figure 5.a: Sectoral output shares, migration model

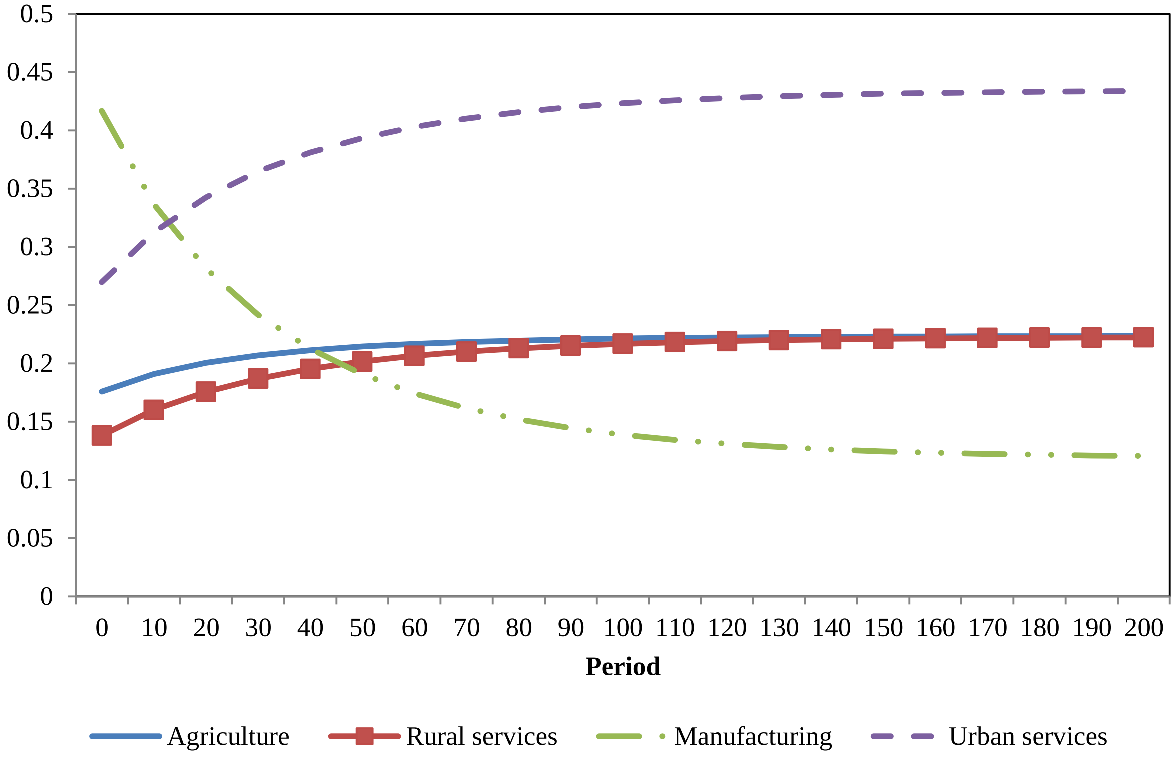

Figure 5.b: Sectoral output shares, no-migration model

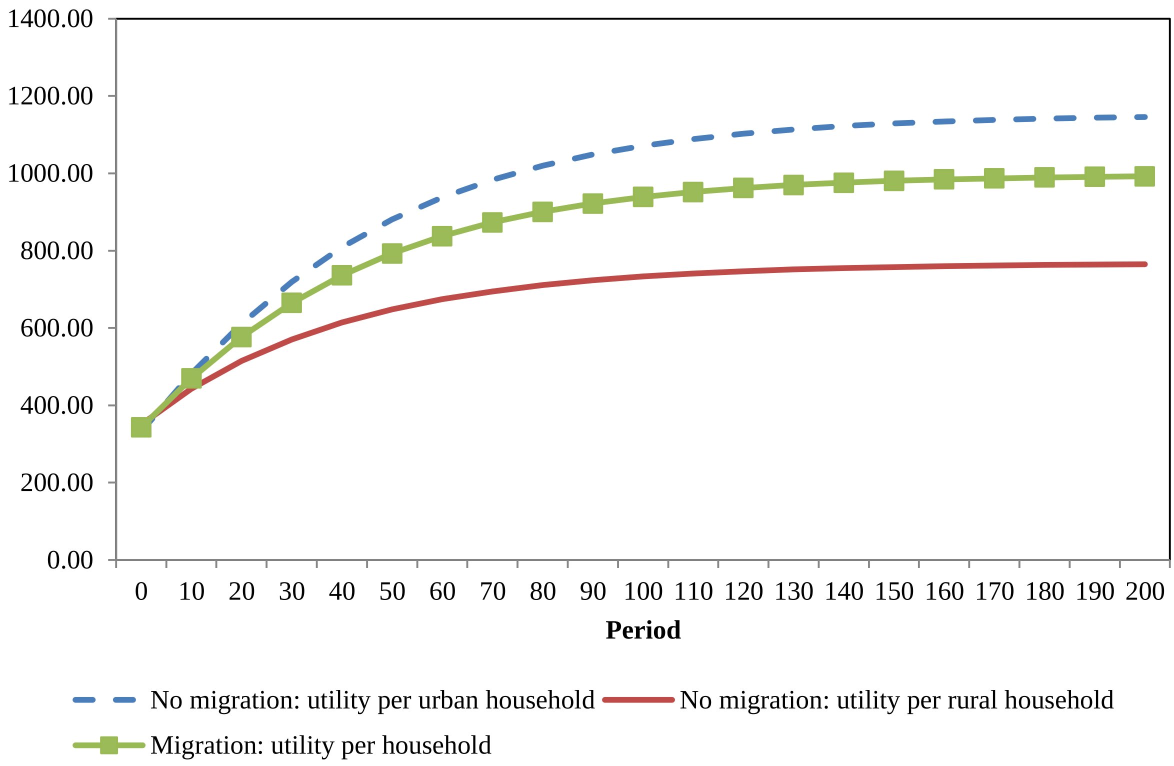

Figure 6: Utility per household, with and without migration

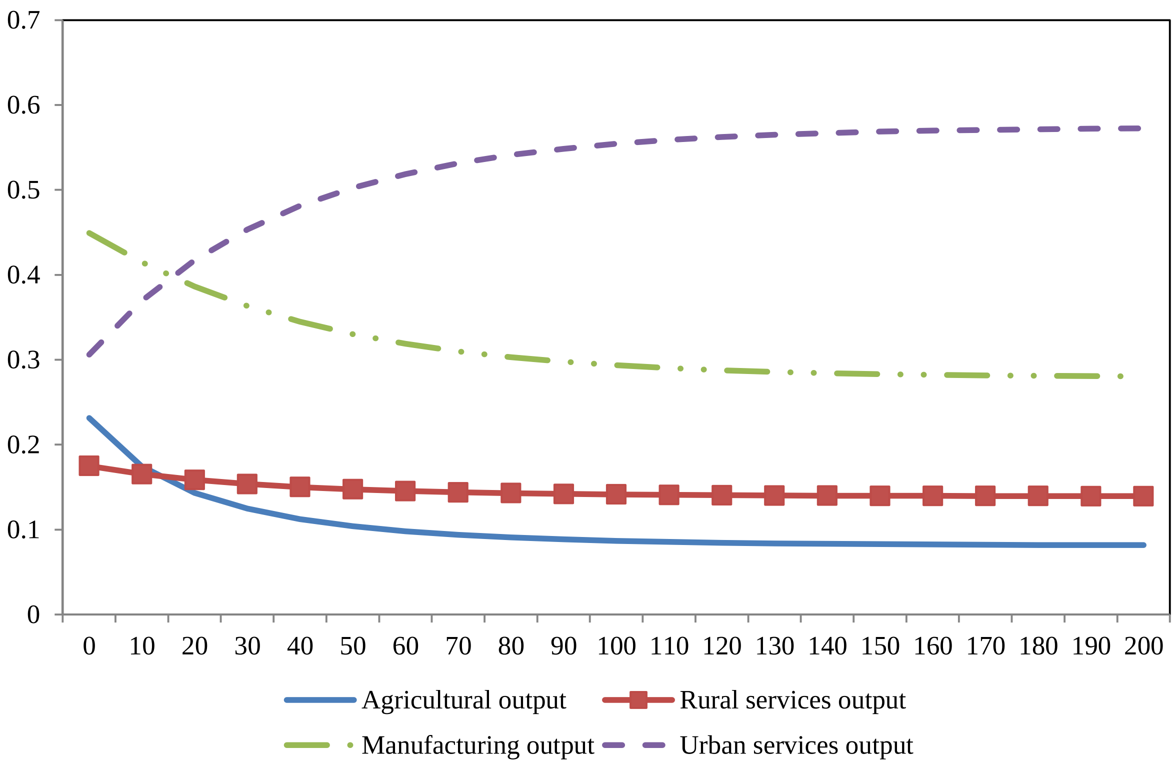

Figure 7.a: Percentage contributions to real GDP growth, migration model

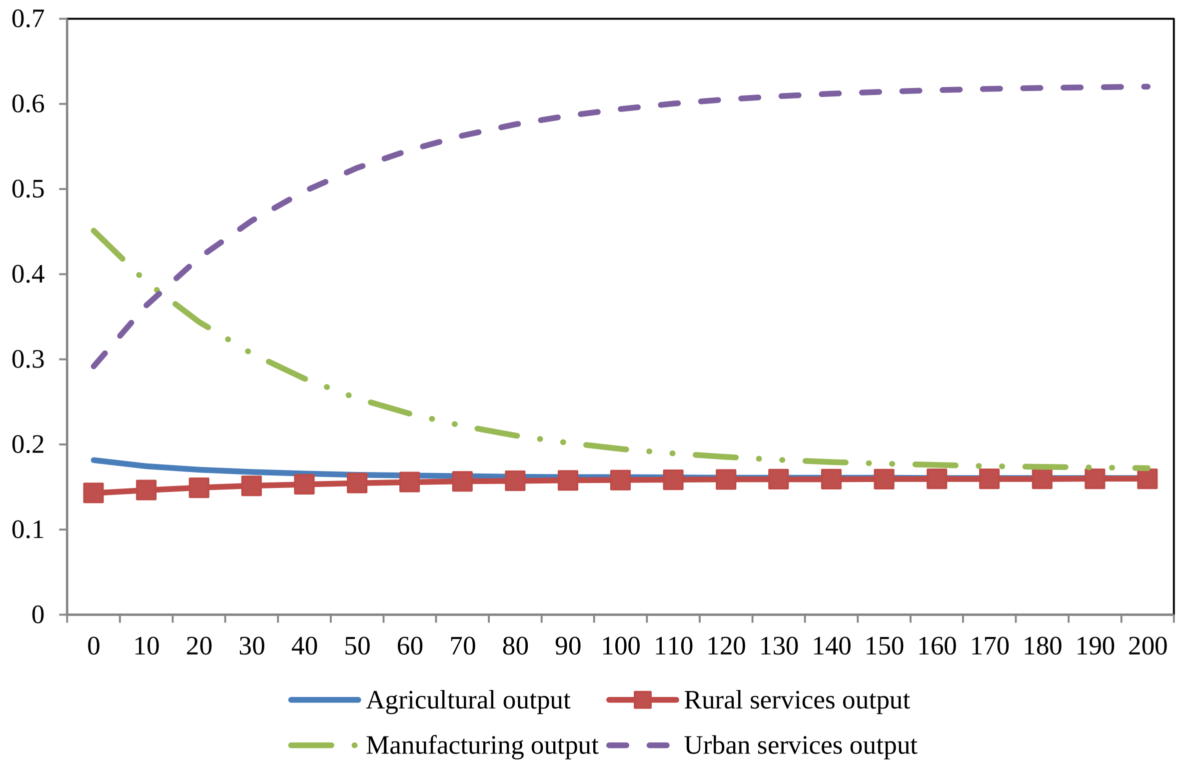

Figure 7.b: Percentage contributions to real GDP growth, no-migration model

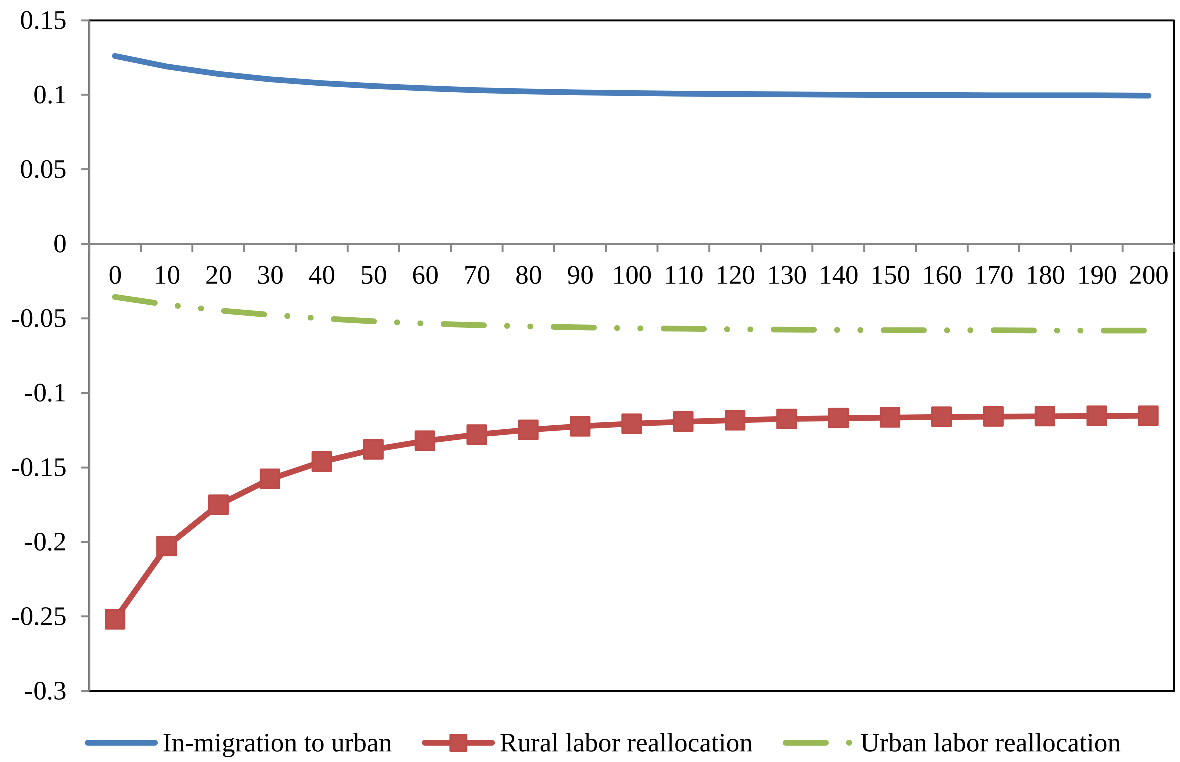

Figure 7.c: Percentage contributions to real GDP growth, migration model