

Rural-Urban Migration and Economic Growth in Developing Countries

Şirin Saracoğlu and Terry L. Roe¹

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Abstract

This essay extends the standard Ramsey-type growth model to include a capital market failure and households' endogenous residency decisions in a regional, multi-sectoral environment. In this environment, households decide to migrate, or not, from rural to urban region depending not only on the income differences across regions, but also on the cost-of-living differentials per unit of expenditure per household in each region. Income differentials arise due to the segmentation in labor and capital markets across regions, allowing for different rates of return on these factors of production, and cost-of-living differentials stem from the existence of non-tradeable goods in each region. We find that segmentation in rural and urban capital markets may help explain the uneven growth across regions and the rapid rates of migration in developing countries.

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Keywords: Internal Migration, Economic Growth, Capital Market Segmentation.

¹Instructor, Department of Economics, METU, Ankara, Turkey, and Professor, Department of Applied Economics, University of Minnesota, respectively. Correspondance can be directed to ssirin@metu.edu.tr, and all comments will be greatly appreciated.

1 Introduction

Rural-urban migration, or internal migration, is in essence a change in the spatial distribution of population in a given country over time. Migration and the change in population distribution are influenced by specific characteristics of the economic development process (Ammassari, 1994), and by various stages of development in a country (Tabuchi, et al., 2002). As Tables 1 and 2 show, developing countries have experienced relatively rapid rates of urban population growth or urbanization, and migration in the post-World War II period. In particular, migration of the labor force from rural to urban markets has been a major source of the growth in urbanization: Chen, et al. (1996) report that internal migration accounted for 40.3%, 44.1% and 54.3% of urban population growth in the developing world during the 1960's, 1970's and 1980's, respectively.

Urban population (% of total)						
<i>Countries</i>	1960-69	1970-79	1980-89	1990-99	2000	2001
World	34.97	37.60	40.96	44.71	46.75	47.15
Low income	18.31	21.48	25.11	28.56	30.44	30.83
Low & middle income	25.85	29.16	33.78	38.58	41.06	41.54
Lower middle income	27.06	29.46	34.67	41.34	44.96	45.64
Middle income	31.65	35.18	41.01	47.52	50.94	51.59
Upper middle income	52.54	61.36	69.10	74.50	76.76	77.17
High income	67.77	71.96	74.04	76.23	77.34	77.55

Source: World Development Indicators, World Bank, 2003.

Table 1: Urban population (% of total population)

Urban population growth (annual %)						
<i>Countries</i>	1961-69	1970-79	1980-89	1990-99	2000	2001
World	2.91	2.67	2.65	2.32	2.06	2.13
Low income	3.89	4.15	3.66	3.32	2.71	3.05
Low & middle income	3.63	3.50	3.48	2.84	2.45	2.54
Lower middle income	3.35	2.98	3.65	2.83	2.51	2.42
Middle income	3.51	3.19	3.38	2.59	2.31	2.25
Upper middle income	3.90	3.64	2.79	2.01	1.80	1.82
High income	1.92	1.31	0.94	1.01	0.96	0.96

Source: World Development Indicators, World Bank, 2003.

Table 2: Urban population growth (annual %)

Migration has been seen as a response of individuals to better economic and non-economic opportunities and an expectation of increased economic welfare in urban areas (Mazumdar, 1987). According to Mazumdar, factors that “push” individuals from rural areas into cities include the expectation

that the pressure of population in rural areas has nearly exhausted all margins of cultivation, thus pushing hopeless people towards a new life in the cities with a mere expectation of subsistence living. On the other hand, the “pull” hypothesis emphasizes the attractiveness of the urban life and the rural-urban wage gap. In particular, 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. Recent 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 (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.

As argued in Bell, differences in income earned across regions is a determining factor in the migration decision. However, the income structure in his model is rather simple², and his model does not consider the differences in income across regions arising due to regional heterogeneity in factors production, such as land and capital resources. On the other hand, Gupta (1997) recognizes the presence of dual capital markets which is especially prevalent in developing countries. His model focuses on the role of informal credit markets³ in financing the production in the rural and urban informal sectors. Additionally, the urban formal sector uses a different type of capital (specific to formal urban sector) borrowed from the formal, institutional credit market⁴. Nevertheless, Gupta stops short of considering the existence of dual capital markets and the resulting inequities across regions as an important source of regional income differences. In his setup, informal and formal capital markets clear independently from each other, but the owners or the suppliers of these different types of capital are not identified. In order to examine the variations in income across regions, one needs to specify the owners of different types of factors of production, such as formal and informal capital. Such differences in income may arise due to variations in physical capital holdings and/or

²In Bell (1991), an individual’s income consists of wages and net transfers, only.

³Informal credit markets consist of moneylenders, farmers, landlords, traders, commission agents, etc.

⁴Formal, institutional credit market borrowing and lending activities take place through a formal financial intermediary such as a bank or a savings and loan institution (Poulson, 1994).

due to differences in rates of return on capital across regions.

Duality in capital markets, or capital market segmentation, exists to a certain degree in many economies, but is particularly observable in developing countries. According to Poulson (1994), in perfectly efficient capital markets, information is conveyed costlessly to all borrowers and lenders, who remain anonymous, through an efficient price mechanism. In imperfect capital markets however, this price mechanism does not work for several reasons. In particular, this imperfection has been linked to asymmetry in information gathering and difficulty in enforcing contracts (Hoff, et al., 1993, Stiglitz et al., 1981, Stiglitz, 1993). On one hand, such an imperfection in capital markets limits the availability of capital to certain groups of a society, for example particularly in developing countries, those living and working in remote rural areas may lack access to formal credit institutions from which they can borrow (this limitation can be both geographical, or financial due to lack of collateral). On the other hand, formal lenders of capital may refrain from lending to potential borrowers in rural areas due to costly monitoring of the loans and riskiness. Furthermore, where transaction costs are high, formal financial institutions may find it highly unprofitable to provide services to poor rural households who usually demand small loans (World Bank, 2001).

Where formal institutions are absent or insufficient to provide reliable information and enforcement, informal institutions such as the informal credit markets emerge to substitute for formal institutions (World Bank, 2002). For example Gupta reports that in the pre-independence era in India, the share of informal credit in agriculture used to be more than 90% of all credit utilized in that sector. Similar evidence for rural informal capital markets in developing countries include the case of Chile in Conning (1996), the case of Phillipines in Floro (1996), and evidence for urban informal capital markets in India in Srivastava (1992) and for Taiwan in Besley, et al. (1994), among many others.

It has been argued in Bencivenga, et al. (1997) that in developing countries at least in the early stages of development, capital accumulation has been far more rapid in the urban formal sector than in the rural areas. This can be in part explained by the rural producers' limited access to capital and financial resources. This prompts a vicious cycle: having limited access to capital resources, rural producers have few opportunities for output growth, which in turn limit their earnings from sales of their output. Low levels of income imply that a large fraction of income is spent on food and subsistence living, thus leaving little or no resources for saving. Additionally, because of the malfunctioning capital market institutions, households may also be skeptical about investing their earnings, and thus engage in savings that do not contribute to capital accumulation, such as buying jewelry or saving under-the-pillow for consumption smoothing purposes, only. These factors contribute to the relatively lower accumulation of capital in rural areas, which eventually leads to uneven or unbalanced growth across regions. In fact, Bencivenga, et al. point out that as a result, urban wages rise faster relative to rural wages, pulling the labor force into the urban areas.

The focus of this study is centered around these very concepts: migration of the labor force from rural to urban areas, segmentation in rural and urban capital markets in developing countries, and the ensuing uneven regional growth. The objectives of this study are to fully identify the channels

through which segmentation in capital markets in developing countries induces migration from rural to urban regions, and to explain how uneven regional economic growth may emerge as a consequence of imperfections in capital markets.

To achieve these objectives, an economy in which households make migration decisions taking the cost-of-living in urban and rural regions into consideration is described. Two cases are examined: the economy with segmentation in its rural and urban capital markets, and the same economy where they are integrated. Unlike the models mentioned above (with the exception of Bencivenga, et al.), the model is dynamic and general equilibrium in nature. With the use of a dynamic general equilibrium model, one can capture the migration pattern as a response to changes in cost-of living, as well as to the evolution of real wage differentials as capital accumulates due to household savings and as the rural-urban production sectors respond to the Rybczynski-like effects of competition in factors of production. In particular, to best assess the impact of capital market segmentation on the economy as a whole and on specific macroeconomic variables, a policy experiment is conducted under the cases with and without capital market segmentation: when a policy “shock” is introduced, the economy’s performance, as well as migration patterns are examined when there is segmentation in capital markets, and when there is a perfect capital market. The policy experiment is conducted by lowering the labor tax rates levied on the employers in urban manufacturing sector, namely the urban formal sector. The labor tax rate is proxied by the rate of contributions of the employers towards social security premiums and unemployment insurance of the employees. The reasons why the taxes are levied only on this sector in the model are clear: in developing countries, the rural sector is generally a very large informal sector, employing a fairly small amount of recorded and insured labor, and the urban informal sector by its very nature employs unrecorded and uninsured labor.

The rest of the study is organized as follows. Section 2 describes the environment with capital market segmentation, introduces the production sectors and the households, defines a competitive equilibrium for the economy, and introduces a method for solving for the equilibrium. In Section 3, the equilibrium for the model with no capital market segmentation is briefly defined. Section 4 includes a numerical analysis and the calibration strategy. In Section 5, results from policy experiments are presented. Section 6 concludes.

2 The Model with Capital Market Segmentation

In this section, the environment with capital market segmentation, production technologies, and assumptions about the consumer behavior are introduced.

The small, open economy consists of two regions and is endowed with resources of capital, labor, and land. The amount of land in the economy is assumed to be fixed. In each region, there are two production sectors, a non-tradeable goods sector, and a tradeable goods sector. Each non-tradeable good is specific to its region, i.e. cannot be traded within the country, whereas the tradeable goods can be traded both inter-regionally and internationally. Households in each region consume three

goods: both of the tradeable goods, and the home-good specific to the region in which they reside and work. In order for the households in the Region- i , $i = 1, 2$, to consume some of the goods produced in Region- i^* , $i^* \neq i$, the Region- i^* must produce a surplus beyond its own consumption of its tradeable good. Households and producers take the prices of the traded goods as given in this small open economy.

Producers in each region have access to the capital and labor markets in their respective regions, only, implying that capital and labor markets are segmented across regions. That is, at a given point in time, capital and labor resources are non-mobile across regions. However across time, households make residency choices and may migrate from one region to the other. There is no mobility of labor and capital across nations, as well.

The model described is a dynamic general equilibrium model of Ramsey type with consumer optimization, extended to include multiple sectors and consumers in two regions, and segmentation in regional factor markets.

2.1 Production

In Region- i , $i = 1, 2$, production takes place in two sectors indexed j , $j = 1, 2$, using constant returns to scale technologies:

$$Y_{ij} = Y^{ij}(\mathbf{x})$$

where Y_{ij} indicates the aggregate output in sector j of Region- i , and $\mathbf{x}$ specifies a vector of inputs. More specifically, in Region-1, production takes place in agricultural (tradeable) and home-good (non-tradeable) sectors:

$$\begin{aligned} Y_{11} &= Y^{11}(L_{11}, K_{11}, T) \\ Y_{12} &= Y^{12}(L_{12}, K_{12}) \end{aligned}$$

where T is a fixed factor specific to agriculture (land). In Region-2, production occurs in manufacturing (tradeable) and home-good (non-tradeable) sectors:

$$\begin{aligned} Y_{21} &= Y^{21}(L_{21}, K_{21}) \\ Y_{22} &= Y^{22}(L_{22}, K_{22}) \end{aligned}$$

Agricultural firms in Region-1 hire labor and capital inputs from their respective markets in Region-1; they take the price of the labor input, w_1 and the rental price of capital, r_1 as given, and choose L_{11} and K_{11} to minimize their costs for all $t, t = 0, 1, 2, \dots$. Given the cost-minimizing values of L_{11}, K_{11} , fixed input T , and the world-price of agricultural good, p_{11} , agricultural firms maximize profits, i.e. for all t ,

$$\pi = \pi(w_1, r_1, p_{11}, T) = \max_{Y_{11}} \{ \{ p_{11}Y_{11} - w_1L_{11} - r_1K_{11} \} \mid T' \leq T \}$$

$Y^{11}(L_{11}, K_{11}, T)$ is homogenous of degree one, then $\pi(w_1, r_1, p_{11}, T)$ is linear in T :

$$\pi(w_1, r_1, p_{11}, T) = \pi^a(w_1, r_1, p_{11})T$$

where $\pi^a(w_1, r_1, p_{11})$ is interpreted as a shadow price of a unit of land. In fact, the profits from agriculture accrue as immediate rents to the landowner households.

Firms producing the home-good in Region-1 also have access to the labor and capital markets in their region only, and take the rental prices w_1 and r_1 as given. Unlike the agricultural firms, home-good producers make normal profits due to constant returns to labor and capital. Firms in Region-2 hire labor and capital inputs from the labor and capital markets in Region-2 with rental prices of w_2 and r_2 , respectively, and both types of firms earn normal profits. In Region-2, the firms in the tradeable goods sector are subject to government regulations, and pay labor taxes⁵. The labor taxes collected in this sector return as lump-sum transfers to the households in Region-2.

2.2 Households

Households in each region- $i, i = 1, 2$ are endowed with L_i units of labor, and K^i units of capital. In addition, households in Region-1 are endowed with T units of land, and households in Region-2 receive transfers Υ from the government. Given the competitive rental prices of capital and labor, r_i and w_i , a household in region- i derives income from renting labor and capital services to the firms in the region in which he/she resides. Land is rented only within the agricultural sector, and the profits from agriculture are rents to the household in Region-1. The total household income in Region- i is

$$\mathcal{I}_i = w_i L_i + r_i K^i + \phi_i \pi^a T + \xi_i \Upsilon$$

where

$$\begin{aligned} \phi_i &= 1 \text{ if } i = 1 \\ &= 0 \text{ otherwise} \end{aligned}$$

and

$$\begin{aligned} \xi_i &= 0 \text{ if } i = 1 \\ &= 1 \text{ otherwise} \end{aligned}$$

Households in both regions wish to maximize the present value of intertemporal utility and choose consumption and savings paths $\{(\mathbf{C}_i(t), K^i(t))_{t=0, \dots, \infty}\}$, $i = 1, 2$,

$$\max_{\mathbf{C}_i, K^i > 0} \int_0^{\infty} \frac{\mathbf{C}_i(t)^{1-\theta} - 1}{1-\theta} e^{-\rho t} dt$$

⁵In developing countries, the services in the urban areas belong to the informal sector, in general. For example in Turkey (based on 1997 values), the services sector employs about 73% of the informal non-agricultural labor (Statistical Yearbook of Turkey. SIS, 1998).

subject to their flow budget constraint

$$\dot{K}^i \leq \mathcal{I}_i - \mathbf{E}_i(\mathbf{C}_i, p_i)$$

an initial level of capital in their region

$$K^i(0) = K_0^i$$

and a transversality condition

$$\lim_{t \rightarrow \infty} K^i(t) e^{-\int_0^t r(\nu) d\nu} = 0$$

where $\mathbf{C}_i$ is an index of aggregate household consumption, p_i is a vector of output prices, and $\mathbf{E}_i(\mathbf{C}_i, p_i)$ is aggregate expenditures in Region- i , $1/\theta$ is the elasticity of intertemporal substitution, and ρ is the time discount factor. In addition to their inter-temporal choice between savings and aggregate consumption, households must also make intra-temporal decisions concerning the allocation of their expenditures between the consumption of different goods, given the output prices. At every point in time, each household consumes three types of goods, indexed $m = 1, 2, 3$: a tradeable good from Region-1, a tradeable good from Region-2, and a home-good in his/her respective region, respectively. The intra-temporal consumption composite in region- i , $i = 1, 2$, is

$$\mathbf{C}_i = B_i \prod_{m=1}^3 C_{im}^{\lambda_m}$$

where the parameters $\lambda_m > 0$ denote the share of expenditures on a type- m good, $B_i > 0$ is a scaling constant⁶, and $\sum_{m=1}^3 \lambda_m = 1$.

2.3 Competitive Equilibrium

In the definition below, and in the remainder of the essay, all variables will be defined in per capita terms, as given in Table 3.

Definition 1 *A competitive equilibrium for this economy is a list of sequences of*

output prices $\{(p_{11}, \hat{p}_{12}(t), p_{21}, \hat{p}_{22}(t))\}_{t=0, \dots, \infty}$,

consumption levels $\{(\hat{c}_{im}(t)_{m=1,2,3})\}_{t=0, \dots, \infty}$ for each household in Region- i , $i=1,2$,

wage rates $\{(\hat{w}_i(t)_{i=1,2})\}_{t=0, \dots, \infty}$, capital rental rates $\{(\hat{r}_i(t)_{i=1,2})\}_{t=0, \dots, \infty}$, land rental rates $\{\hat{\pi}^a(t)\}_{t=0, \dots, \infty}$,

production plans $\{(\hat{y}_{ij}(t), \hat{k}_{ij}(t), \hat{l}_{ij}(t))_{i=1,2; j=1,2}\}_{t=0, \dots, \infty}$, and

a household residency decision $\{\hat{\ell}_i(t)_{i=1,2}\}_{t=0, \dots, \infty}$

such that for every period t ,

i) for the household in each region i , $i = 1, 2$, given the prices

$\{(p_{11}, \hat{p}_{12}(t), p_{21}, \hat{p}_{22}(t)), \hat{w}_i(t), \hat{r}_i(t)\}$, $(\hat{c}_{im}(t)_{m=1,2,3})$ solves the utility maximization problem;

⁶For algebraic simplicity, we set $B_i \equiv \prod_{m=1}^3 \lambda_m^{-\lambda_m}$.

<i>Variable</i>	<i>Per capita</i>	<i>Symbol</i>
Fraction of households residing in Region- <i>i</i>	$\frac{L_i}{L}$	ℓ_i
Region- <i>i</i> , household expenditures	$\frac{E_i}{L}$	E_i
Region- <i>i</i> , Aggregate consumption	$\frac{C_i}{L}$	c_i
Region- <i>i</i> , consumption of good <i>m</i>	$\frac{C_{im}}{L}$	c_{im}
Output, Region- <i>i</i> , Sector <i>j</i>	$\frac{Y^{ij}}{L}$	y_{ij}
Aggregate Capital, Region- <i>i</i>	$\frac{K^i}{L}$	k^i
Sectoral Capital, Region- <i>i</i> , Sector <i>j</i>	$\frac{K_{ij}}{L}$	k_{ij}
Sectoral Labor, Region- <i>i</i> , Sector <i>j</i>	$\frac{L_{ij}}{L}$	l_{ij}
Land	$\frac{T}{L}$	τ
Region- <i>i</i> , international trade in good <i>j</i>	$\frac{X_{ij}}{L}$	x_{ij}
Transfers from government	$\frac{\gamma}{L}$	$\varkappa$

Table 3: Variables, in per capita terms

- ii) for each firm $j, j=1,2$, in region $i, i=1,2$, given the prices $\{(p_{11}, \hat{p}_{12}(t), p_{21}, \hat{p}_{22}(t)), \hat{w}_i(t), \hat{r}_i(t)\}$, $(\hat{y}_{ij}(t), \hat{k}_{ij}(t), \hat{l}_{ij}(t))$ solves the profit maximization problem;
- iii) home-good markets clear in both regions;
- vi) capital market clears in region $i, i=1,2$;
- v) labor market clears in region $i, i=1,2$;
- vi) the non-arbitrage condition holds across regions: cost of living per unit of expenditure per household across regions is equalized;
- vii) taxes collected in Region-2 are equal to transfers to households in Region-2; and
- vii) Walras' Law holds.

2.3.1 Profit maximization conditions

At each period in time, given w_i, r_i and p_{ij} , firm $j, j=1,2$, in region- $i, i=1,2$ maximize normal profits according to

$$MC_{ij}(w_i, r_i) = p_{ij} \quad (1)$$

where $MC_{ij}(w_i, r_i)$ denote the marginal cost of firm j in region i . Agricultural firms, on the other hand, make positive profits given as

$$\pi(w_1, r_1, p_{11}, T) = \pi^a(w_1, r_1, p_{11})T$$

2.3.2 Factor market clearing conditions

At every point in time, labor markets in Region-1 and in Region-2 clear independently from each other. Within a given period, firms in each region must hire labor amongst the resident households of

their respective regions. That is, demand for labor by firms in Region-1 must be equal to the fraction of households choosing to reside in Region-1, and demand for labor in Region-2 must be equal to the fraction of households choosing to reside in Region-2:

$$-\frac{\partial \pi^a(w_1, r_1, p_{11})}{\partial w_1} T + \frac{\partial MC_{12}(w_1, r_1)}{\partial w_1} y_{12} = \ell_1 \quad (2)$$

$$\frac{\partial MC_{21}(\tilde{w}_2, r_2)}{\partial \tilde{w}_2} y_{21} + \frac{\partial MC_{22}(w_2, r_2)}{\partial w_2} y_{22} = \ell_2 = 1 - \ell_1 \quad (3)$$

where $w_2 \equiv \tilde{w}_2(1 + \tau_f)$, and τ_f is the labor tax rate.

Similarly, at a given period in time, firms in region- i can have access to the capital markets in their region only, and households can rent capital only to the firms of the region in which they reside:

$$-\frac{\partial \pi^a(w_1, r_1, p_{11})}{\partial r_1} T + \frac{\partial MC_{12}(w_1, r_1)}{\partial r_1} y_{12} = k^1 \quad (4)$$

$$\frac{\partial MC_{21}(\tilde{w}_2, r_2)}{\partial r_2} y_{21} + \frac{\partial MC_{22}(w_2, r_2)}{\partial r_2} y_{22} = k^2 \quad (5)$$

2.3.3 Households' Residency Choice

The residency choice condition is an equilibrium condition where the cost of living per unit of expenditure per household in Region 1 and Region 2 are equalized, so that a typical household is indifferent between living in Region 1 or in Region 2. We can also call this the ‘migration equilibrium’ condition. What this condition implies is that whenever there are differences in the cost of living across regions, the households will be on the move from one region to the other. Then, migration is in fact a disequilibrium phenomenon. When the cost of living across regions are equalized, migration ceases to occur.

Note that ‘expenditure per household in Region 1’ is:

$$\frac{\mathbf{E}_1}{L_1} = \frac{L \times E_1}{L_1} = \frac{1}{\ell_1} E_1$$

and in Region 2:

$$\frac{\mathbf{E}_2}{L_2} = \frac{L \times E_2}{L_2} = \frac{1}{\ell_2} E_2 = \frac{1}{1 - \ell_1} E_2$$

Expenditure per household in each region can be written as

$$\begin{aligned} \frac{E_1}{\ell_1} &= p_{12}^{\lambda_3} \frac{c_1}{\ell_1} \\ \frac{E_2}{1 - \ell_1} &= p_{22}^{\lambda_3} \frac{c_2}{1 - \ell_1} \end{aligned}$$

where $p_{12}^{\lambda_3}$ and $p_{22}^{\lambda_3}$ are the price indices in each region, and $\frac{c_1}{\ell_1}$ and $\frac{c_2}{1-\ell_1}$ are the composite consumption per household in each region. Then, the cost of living per unit of household in each region is

$$\begin{aligned}\frac{p_{12}^{\lambda_3}}{\frac{E_1}{\ell_1}} &= \frac{1}{\frac{c_1}{\ell_1}} \\ \frac{p_{22}^{\lambda_3}}{\frac{E_2}{1-\ell_1}} &= \frac{1}{\frac{c_2}{1-\ell_1}}\end{aligned}$$

Then, equating cost of living per unit of expenditure per household in both regions, we obtain

$$\frac{p_{12}^{\lambda_3}}{\frac{E_1}{\ell_1}} = \frac{p_{22}^{\lambda_3}}{\frac{E_2}{1-\ell_1}}$$

or,

$$\ell_1 = \frac{p_{22}^{\lambda_3} E_1}{p_{22}^{\lambda_3} E_1 + p_{12}^{\lambda_3} E_2} \quad (6)$$

2.3.4 Households' saving and consumption choice in equilibrium

In order to solve the inter-temporal choice problem of the representative household in region- i , the present-value Hamiltonian of the problem is written as

$$\mathcal{H}_i(t) = \frac{c_i^{1-\theta} - 1}{1-\theta} e^{-\rho t} + \chi_i [w_i \ell_i + r_i k^i - \mu_i(p_i) c_i + \phi_i \pi^a T + \xi_i \mathcal{Z}]$$

where the expression in the brackets equal k^i , $\mu_i(p_i)$ is an index of prices in region- i , $\mu_i(p_i) c_i \equiv E_i$, $\phi_i = 1$ if $i = 1$, and $\phi_i = 0$ otherwise, and finally $\xi_i = 0$ if $i = 1$ and $\xi_i = 1$ otherwise. Then, the first order conditions for a maximum are

$$\frac{\partial \mathcal{H}_i}{\partial c_i} = 0 \implies \chi_i \mu_i(p_i) = c_i^{-\theta} e^{-\rho t} \quad (7)$$

$$\dot{\chi}_i = -\frac{\partial \mathcal{H}_i}{\partial k^i} \implies \dot{\chi}_i = -\chi_i r_i \quad (8)$$

Rearranging the first order conditions, we write the Euler equation for consumer maximization as follows

$$\underbrace{\frac{\dot{c}_i}{c_i} + \frac{\dot{\mu}_i}{\mu_i}}_{\frac{\dot{E}_i}{E_i}} = r_i - \rho \quad (9)$$

2.4 Solving for the Competitive Equilibrium

2.4.1 Steady state

In the long-run equilibrium in this economy, all endogenous variables are constant for all t , under the assumption that $\dot{k}^1 = \dot{k}^2 = 0$, in particular. Such an equilibrium is called the steady state equilibrium:

Definition 2 A steady state is an equilibrium such that it satisfies all equilibrium conditions above, and given p_{11}, p_{21} , and k_0^i , all endogenous variables $(p_{12}(t), p_{22}(t))$, $(c_{im}(t))_{i=1,2,m=1,2,3}$, $(\omega_i(t), r_i(t))_{i=1,2}$, $(y_{ij}(t), l_{ij}(t), k_{ij}(t))_{i=1,2;j=1,2,3}$ and $\ell_i(t)$ are constant for all periods of time, t .

From the Euler conditions (9), at the steady state

$$r_i^{ss} = \rho \quad (10)$$

must hold. From the profit maximization conditions, the value w_2^{ss} can be found directly, which allows us to find the value p_{22}^{ss} directly, as well. On the other hand, without knowing the steady state value of p_{12} , we cannot calculate the steady state value for w_1 . To find the steady state values of the remaining variables, we construct the system of 8 equations of 2 labor market clearing conditions, 2 capital market clearing conditions, 2 home-good market clearing conditions, and 2 budget constraints in 8 unknowns of $p_{12}, E_1, E_2, y_{12}, y_{21}, y_{22}, k^1$ and k^2 : from the residency choice condition,

$$\begin{aligned} \ell_1^{ss} &= \frac{(p_{22}^{ss})^{\lambda_3} E_1}{(p_{22}^{ss})^{\lambda_3} E_1 + (p_{12}^{ss})^{\lambda_3} E_2} \\ \ell_2^{ss} &= 1 - \frac{(p_{22}^{ss})^{\lambda_3} E_1}{(p_{22}^{ss})^{\lambda_3} E_1 + (p_{12}^{ss})^{\lambda_3} E_2} \end{aligned}$$

and the profit maximization condition for firm in sector-2 of Region-1,

$$w_1 = \mathbf{w}_1(r_1^{ss}, p_{12})$$

Then, the system of 8 equations in 8 unknowns is

$$-\frac{\partial \pi^a(w_1, r_1, p_{11})}{\partial w_1} T + \frac{\partial MC_{12}(w_1, r_1)}{\partial w_1} y_{12} - \ell_1 = 0 \quad (11)$$

$$\frac{\partial MC_{21}(w_2, r_2)}{\partial w_2} y_{21} + \frac{\partial MC_{22}(w_2, r_2)}{\partial w_2} y_{22} - \ell_2 = 0 \quad (12)$$

$$-\frac{\partial \pi^a(w_1, r_1, p_{11})}{\partial r_1} T + \frac{\partial MC_{12}(w_1, r_1)}{\partial r_1} y_{12} - k^1 = 0 \quad (13)$$

$$\frac{\partial MC_{21}(w_2, r_2)}{\partial r_2} y_{21} + \frac{\partial MC_{22}(w_2, r_2)}{\partial r_2} y_{22} - k^2 = 0 \quad (14)$$

$$\frac{p_{12} y_{12}}{\lambda_3} - E_1 = 0 \quad (15)$$

$$\frac{p_{22} y_{22}}{\lambda_3} - E_2 = 0 \quad (16)$$

$$w_1 \ell_1 + r_1 k^1 + \pi - E_1 = 0 \quad (17)$$

$$w_2 \ell_2 + r_2 k^2 - E_2 = 0 \quad (18)$$

which is solved for the steady state values of $p_{12}^{ss}, E_1^{ss}, E_2^{ss}, y_{12}^{ss}, y_{21}^{ss}, y_{22}^{ss}, k^{1,ss}$ and $k^{2,ss}$.

2.4.2 Transition path equilibrium

Given the steady state values and initial conditions, the Time-Elimination Method by Mulligan and Sala-i-Martin (1991) and by Barro and Sala-i-Martin (1995) is utilized to numerically solve for the transition path equilibrium using the system of differential equations:

$$\dot{k}^1(t) = f_1(w_1(t), w_2(t), p_{12}(t), k^1(t), E_2(t)) \quad (19)$$

$$\dot{k}^2(t) = f_2(w_1(t), w_2(t), p_{12}(t), k^1(t), k^2(t), E_2(t)) \quad (20)$$

$$\dot{E}_2(t) = f_3(w_2(t), E_2(t)) \quad (21)$$

$$\dot{p}_{12}(t) = f_4(w_1(t), w_2(t), p_{12}(t), k^1(t), k^2(t), E_2(t)) \quad (22)$$

$$\dot{w}_1(t) = f_5(w_1(t), w_2(t), p_{12}(t), k^1(t), k^2(t), E_2(t)) \quad (23)$$

$$\dot{w}_2(t) = f_6(w_1(t), w_2(t), p_{12}(t), k^1(t), k^2(t), E_2(t)) \quad (24)$$

Once the time-paths of these variables are derived, it is trivial to solve for the time-paths of the remaining endogenous variables.

3 The Model with No Capital Market Segmentation

In this economy, the environment without capital segmentation is identical to the environment introduced above, except that the capital markets are integrated. That is, given a capital rental rate r , households in all regions may rent their capital services to any firm regardless of its region, and firms in both regions may rent capital from a single capital market taking a uniform capital rental rate as given. Below, we define the equilibrium for this economy:

3.1 Competitive Equilibrium

Definition 3 *A competitive equilibrium for this economy is a list of sequences of output prices $\{(p_{11}, \hat{p}_{12}(t), p_{21}, \hat{p}_{22}(t))\}_{t=0, \dots, \infty}$, consumption levels $\{(\hat{c}_{im}(t))_{m=1,2,3}\}_{t=0, \dots, \infty}$ for each household in Region- i , $i=1,2$, wage rates $\{(\hat{w}_i(t))_{i=1,2}\}_{t=0, \dots, \infty}$, capital rental rates $\{\hat{r}(t)\}_{t=0, \dots, \infty}$, land rental rates $\{\hat{\pi}^a(t)\}_{t=0, \dots, \infty}$, production plans $\{(\hat{y}_{ij}(t), \hat{k}_{ij}(t), \hat{l}_{ij}(t))_{i=1,2; j=1,2}\}_{t=0, \dots, \infty}$, and a household residency decision $\{\hat{\ell}_i(t)_{i=1,2}\}_{t=0, \dots, \infty}$ such that for every period t ,*

- i) for the household in each region $i, i = 1, 2$, given the prices $\{(p_{11}, \hat{p}_{12}(t), p_{21}, \hat{p}_{22}(t)), \hat{w}_i(t), \hat{r}(t)\}$, $(\hat{c}_{im}(t))_{m=1,2,3}$ solves the utility maximization problem;*
- ii) for each firm $j, j=1,2$, in region $i, i = 1, 2$, given the prices $\{(p_{11}, \hat{p}_{12}(t), p_{21}, \hat{p}_{22}(t)), \hat{w}_i(t), \hat{r}(t)\}$, $(\hat{y}_{ij}(t), \hat{k}_{ij}(t), \hat{l}_{ij}(t))$ solves the profit maximization problem;*
- iii) home-good markets clear in both regions;*
- vi) capital market clears;*
- v) labor market clears in region $i, i=1,2$;*

- vi) the non-arbitrage condition holds across regions: cost of living per unit of expenditure per household across regions is equalized;
vii) taxes collected in urban areas equal transfers to households; and
viii) Walras' Law holds.

Notice that the capital market clearing condition in this environment is

$$\frac{\partial MC_{12}(w_1, r)}{\partial r} y_{12} - \frac{\partial \pi^a(w_1, r, p_{11})}{\partial r} T + \frac{\partial MC_{21}(w_2, r)}{\partial r} y_{21} + \frac{\partial MC_{22}(w_2, r)}{\partial r} y_{22} = k$$

where k is the aggregate capital per capita.

4 Numerical Analysis

4.1 Parameter Specification

To numerically solve the model presented above for equilibria, below we specify the parameters of the model economy in more detail. In particular, the production functions of the firms representing each sector in each region are of the constant-returns-to-scale, Cobb-Douglas type. In this model, no technological change and population growth are assumed. The agricultural firm in Region-1 is represented by

$$Y_{11} = b_{11} B_{11} L_{11}^{\beta_1} K_{11}^{\beta_2} T^{\beta_3}$$

where $b_{11}, B_{11} > 0$ are scaling constants⁷, $\beta_1, \beta_2, \beta_3 \in (0, 1)$, and $\beta_1 + \beta_2 + \beta_3 = 1$. However, note that since the land input T is held fixed, the returns to labor and capital are diminishing. The Cobb-Douglas production functions of the firms in the other sectors are

$$\begin{aligned} Y_{12} &= b_{12} B_{12} L_{12}^{\alpha} K_{12}^{1-\alpha} \\ Y_{21} &= b_{21} B_{21} L_{21}^{\delta} K_{21}^{1-\delta} \\ Y_{22} &= b_{22} B_{22} L_{22}^{\phi} K_{22}^{1-\phi} \end{aligned}$$

respectively. Similar to the agricultural production function, here, $b_{12}, b_{21}, b_{22}, B_{12}, B_{21}, B_{22} > 0$, are the scaling constants⁸ in the production functions above, and $\alpha, \delta, \phi \in (0, 1)$.

4.2 Model Calibration and the Base-run Equilibrium path

The numerical values of consumption and production parameters of the model are obtained from model calibration to the Turkish economy for the year 1997. The model is calibrated to fit precisely to the initial conditions of 1997, or the 'base-run equilibrium'. A simple Social Accounting Matrix (SAM)

⁷For simplification, the scaling parameter B_1 is set at $B_1 \equiv \alpha_1^{-\alpha_1} \alpha_2^{-\alpha_2} \alpha_3^{-\alpha_3}$.

⁸For simplification, the scaling parameters are set at $B_{12} \equiv \alpha^{-\alpha} (1 - \alpha)^{\alpha-1}$, $B_{21} \equiv \delta^{-\delta} (1 - \delta)^{\delta-1}$, $B_{22} = \phi^{-\phi} (1 - \phi)^{\phi-1}$.

for Turkey is constructed with the help of National Accounts, consumption and employment statistics (Statistical Yearbook of Turkey, SIS, 1998). In principle, the parameters of the model economy are calibrated so as to precisely reproduce the structure and the transactions observed in the simple SAM constructed.

The base-run equilibrium is characterized by the steady-state equilibrium conditions. The significance of this calibration method is that in the base-run, the dynamic model produces the same equilibrium values for the model variables in the initial period and in the long-run (steady state), which are in fact exactly the same values from the base-year SAM. That is, in the base-run, no (dynamic) transition path in the endogenous variables can be detected; however, a disturbance, or a “shock” to the base will induce a movement away from the base, and the transition effects of the “shock” to the base can be traced.

More specifically, in our case the base-run equilibrium from the segmented capital markets model and the base-run equilibrium from the non-segmented capital markets model will be exactly the same, since these two model economies approach to the same steady state in the long run. In particular, it is assumed that at the base year (1997),

$$\begin{aligned} r_1^{1997} &= r_2^{1997} = r^{1997} = \rho \\ \dot{k}^{1,1997} &= \dot{k}^{2,1997} = \dot{k}^{1997} = 0 \end{aligned}$$

that is, expenditure of the household in each region must be equal to his/her income, and that savings are equal to zero. In the base year, all output prices are normalized to unity,

$$p_{11}^{1997} = p_{12}^{1997} = p_{21}^{1997} = p_{22}^{1997} = 1$$

4.2.1 Consumption parameters

In this initial (base-run) equilibrium, we require that

$$\begin{aligned} c_{i1}^{1997} &= \lambda_1 E_i^{1997} \\ c_{i2}^{1997} &= \lambda_2 E_i^{1997} \\ p_{12}^{1997} \times y_{12}^{1997} &= c_{13}^{1997} = \lambda_3 E_1^{1997} \\ p_{22}^{1997} \times y_{22}^{1997} &= c_{23}^{1997} = \lambda_3 E_2^{1997} \end{aligned}$$

Knowing the values for E_1^{1997} , E_2^{1997} , y_{12}^{1997} and y_{22}^{1997} from the SAM, the consumption share parameter λ_3 value can be calculated. Without further information, a value for λ_2 is assumed, and finally λ_1 is calculated as $\lambda_1 = 1 - \lambda_2 - \lambda_3$. These parameters are then used to calculate the consumption of each good by each household in each region. Additionally, the household’s residency choice condition must hold in equilibrium. To assure that the condition holds, the share of rural population in Turkey in 1997, which is 42%, is equated to $\frac{(p_{22}^{1997})^{\lambda_3} E_1^{1997}}{(p_{22}^{1997})^{\lambda_3} E_1^{1997} + (p_{12}^{1997})^{\lambda_3} E_2^{1997}}$.

4.2.2 Production parameters

As for the production parameter values, we simply require data concerning worker compensation in each sector in each region to obtain factor elasticities as follows:

$$\begin{aligned}\beta_1 &= \frac{w_1 L_{11}}{Y_{11}} \\ \alpha &= \frac{w_1 L_{12}}{Y_{12}} \\ \delta &= \frac{w_2(1 + \tau_f)L_{21}}{Y_{21}} \\ \phi &= \frac{w_2 L_{22}}{Y_{22}}\end{aligned}$$

where in sector-1 of Region-2, the firms pay labor taxes at a rate τ_f . In the base-run, this rate is taken as 24.25%, which is the average labor tax to the employers in the form of contributions towards social security premiums and unemployment insurance of the employees in Turkey. In the agricultural sector, the value for land elasticity β_3 is assumed at 0.15, and the values for capital elasticities in each sector in both regions are calculated as residuals since we assume constant returns to scale in all sectors: $\beta_2 = 1 - \beta_1 - \beta_3$, $1 - \alpha$, $1 - \delta$ and $1 - \phi$.

4.2.3 Parameters of the model

Table 4 presents the parameter values from model calibration.

5 Simulation Results

After calibrating for the initial equilibrium for this economy, we proceed to obtain both the base-run equilibrium and the dynamic equilibrium after a shock to the base is introduced in both models, with capital market segmentation and without capital market segmentation. As mentioned in the introduction of this chapter, the experiment that we conduct is “lowering the labor taxes from 24.25% to 10% in the formal urban sector”, or the urban manufacturing sector. By conducting the same experiment in both model environments, the results can be compared and contrasted, and one can see the effects of integrating the capital markets on macroeconomic variables in the model economy.

In this section, the results from the experiments are presented. In both model environments, first, the initial period effects of the shock on the economy are examined, secondly the effects along the transition path are introduced. Finally, we compare the simulation results obtained from each model environment, and they are summarized in Tables 5 and 6.

Parameter	Symbol	Value
<i>Production</i>		
<i>Rural Region</i>		
Labor elasticity in Sector-1	β_1	0.72
Capital elasticity in Sector-1	β_2	0.13
Land elasticity in Sector-1	β_3	0.15
Labor Elasticity in Sector-2	α	0.36
Land	T	1
<i>Urban Region</i>		
Labor elasticity in Sector-1	δ	0.83
Labor elasticity in Sector-2	ϕ	0.35
Labor tax rate	τ_f	0.2425
<i>Consumption</i>		
<i>Rural household</i>		
Expenditure share of good-1	λ_{11}	0.27
Expenditure share of good-2	λ_{12}	0.1
Expenditure share of good-3	λ_{13}	0.62
<i>Urban household</i>		
Expenditure share of good-1	λ_{21}	0.26
Expenditure share of good-2	λ_{22}	0.18
Expenditure share of good-3	λ_{23}	0.55
Elasticity of intertemporal substitution	$1/\theta$	1
Time discount rate	ρ	0.042

Table 4: Parameter values

Segmented Capital Markets Model, Summary Tables				
	Base-run, tax=24.25%	Simulation, tax=10%		Change from base
		Initial value	Steady state	at steady state (%)
Capital Stock				
k1	119,876	90,813	104,151	-13.118
k2	159,506	159,506	185,985	16.601
Total	279,382	250,319	290,136	3.849
Residency choice (l1)	0.42000	0.35795	0.35445	-15.607
Labor demand, Rural				
Agriculture	0.22961	0.20654	0.19375	-15.616
Services	0.19044	0.15106	0.16070	-15.617
Labor demand, Urban				
Capital goods	0.35052	0.42346	0.40871	16.601
Services	0.22943	0.21860	0.23684	3.228
Capital demand, Rural				
Agriculture	12,628	10,697	10,971	-13.117
Services	107,249	80,117	93,180	-13.118
Capital demand, Urban				
Capital goods	26,685	293,533	31,115	16.601
Services	132,821	130,153	154,870	16.601
Output				
Rural region				
Y11	4,170,000	3,782,060	3,623,000	-13.118
Y12	7,004,360	5,345,660	6,022,510	-14.018
Urban region				
Y21	6,837,976	8,134,820	7,973,130	16.601
Y22	8,590,312	8,335,310	9,597,580	11.726
Consumption				
Rural household				
Composite	11,174,361	8,678,550	9,645,390	-13.683
Food	3,052,566	2,441,410	2,652,140	-13.118
Urban good	1,117,436	893,715	970,856	-13.118
Home-good	7,004,360	5,345,660	6,022,510	-14.018
Urban household				
Composite	15,428,288	15,566,900	17,566,800	13.861
Food	4,060,883	4,303,640	4,735,020	16.601
Urban good	2,777,091	2,943,110	3,238,110	16.601
Home-good	8,590,312	8,335,120	9,597,580	11.726
Expenditures				
Rural household	11,174,361	8,937,150	9,708,560	-13.118
Urban household	15,428,288	16,350,600	17,989,500	16.601
Home-good prices				
Rural (p12)	1.00	1.04796	1.01047	1.047
Urban (p22)	1.00	1.09223	1.04363	4.363
Wages				
Rural	13,127.30	13,236.10	13,516.00	2.961
Urban	13,127.30	14,601.80	14,827.90	12.955
Capital rental rates				
Rural	0.04200	0.04497	0.04200	0.000
Urban	0.04200	0.04542	0.04200	0.000

Table 5: Simulation Results, Segmented Capital Markets

Non-segmented Capital Markets Model, Summary Tables				
	Base-run,	Simulation, tax=10%		Change from base
	tax=24.25%	Initial value	Steady state	at steady state (%)
Capital Stock				
k	279,382	279,382	287,303	2.835
Residency choice (l1)	0.42000	0.42099	0.42123	0.293
Labor demand, Rural				
Agriculture	0.229607	0.227329	0.227795	-0.789
Services	0.190435	0.193664	0.193436	1.576
Labor demand, Urban				
Capital goods	0.350523	0.371575	0.368288	5.068
Services	0.229434	0.207432	0.210481	-8.261
Capital demand, Rural				
Agriculture	12,627.4	12,253.1	12,544.8	-0.654
Services	107,247	106,893.0	109,086.0	1.715
Capital demand, Urban				
Capital goods	26,684.9	27,650.1	28,037.2	5.068
Services	132,822.0	132,585.0	137,635.0	3.624
Output				
Rural region				
Y11	4,170,000	4,124,200	4,142,690	-0.655
Y12	7,004,360	6,971,930	7,120,890	1.664
Urban region				
Y21	6,837,976	7,221,680	7,184,570	5.069
Y22	8,590,312	8,282,440	8,529,490	-0.708
Consumption				
Rural household				
Composite	11,174,361	11,076,600	11,362,300	1.682
Food	3,052,566	3,048,470	3,104,860	1.713
Urban good	1,117,436	1,115,940	1,136,580	1.713
Home-good	7,004,360	6,971,930	7,120,890	1.664
Urban household				
Composite	15,428,288	15,234,100	15,611,800	1.189
Food	4,060,883	4,131,650	4,208,070	3.625
Urban good	2,777,091	2,825,480	2,877,750	3.625
Home-good	8,590,312	8,282,430	8,529,490	-0.708
Expenditures				
Rural household	11,174,361	11,159,400	11,365,800	1.713
Urban household	15,428,288	15,697,100	15,987,500	3.625
Home-good prices				
Rural (p12)	1.00	1.01195	1.0005	0.049
Urban (p22)	1.00	1.05525	1.0436	4.363
Wages				
Rural	13,127.30	13113.40	13,145	0.136
Urban	13,127.30	14772.60	14,828	12.955
Capital rental rate	0.0420	0.0428080	0.042	0.000

Table 6: Simulation Results, Non-segmented Capital Markets

5.1 Effects in the initial period-Segmented Capital Markets Model

When the labor tax rates in the urban manufacturing sector are reduced, *ceteris paribus*, the representative firm in the urban manufacturing sector reacts by increasing its demand for labor as the unit labor costs are now relatively lower. Since the regional labor markets are segmented, the firm in the urban manufacturing sector has to compete only with the representative firm in the urban services sector for labor resources. Wages in urban region increase as a result of the increased competition for labor resources. As wages increase, urban household incomes increase. Everything else constant, demand for home-goods in the urban region increases, pulling the home-good prices and the urban region price index upwards. As prices increase, expenditures in the urban region increase, as well. Then, due to these two effects, migration equilibrium holds at a lower ℓ_1 than before.

As ℓ_1 drops, the firms in the rural region must now compete for a smaller body of rural workforce, and they cannot substitute capital for labor in production as they are capital scarce, and as they cannot have access to the relatively abundant source of capital in the urban capital market due to the segmentation in rural and urban capital markets. Then, we can detect two forces that pull up the price of the home-goods in the rural region: first, the representative firm in the services sector of the rural region increases the relative price of the home-good to be able to compete in the rural labor market, which is now smaller, and to afford the labor hired, secondly, as the firm cannot substitute capital for labor fast enough, the output volume drops faster than the decrease in the demand volume as households move out of the rural region. It can be seen from the simulation results that despite the increase in the relative price of the home-good in the rural region, the actual expenditures of the rural household decreases. This can be attributed to the drastic drop in the output in the services sector: since the market clears in the home-good sector, i.e.

$$p_{12}y_{12} = \lambda_3 E_1$$

if y_{12} falls at a higher rate than does p_{12} , we can see a decrease in E_1 .

A decrease in E_1 and an increase in p_{12} have the effect of further decreasing the ℓ_1 in migration equilibrium. In fact, this drop in ℓ_1 and thus an immediate rise in $\ell_2 = 1 - \ell_1$ is just enough to accommodate the increased labor demand in the urban manufacturing sector.

The simulation results from the segmented markets model are depicted in Table 5 and Figures 1-7. At the initial period, the immediate effect of a cut in the labor tax burden on urban manufacturing firms is to increase labor demand in this sector and to attract households into the urban areas: about 36% of the households now reside in the urban areas as opposed to 42% in the base equilibrium. As the rural region firms cannot accomodate the loss of rural labor with increased use of capital, the output level in both sectors of this region drops: initially, agricultural output drops by about 9% and the services drops by 23% from the base. On the other hand, the capital abundant urban region further increases its overall output as it attracts labor from the rural areas: initially, urban manufacturing output increases by about 19%, whereas a slight drop of 3% in the services is observed. Since the urban capital is taken as the state variable in the model and is the same initially in the base and in the

simulations, we can conclude that the increase in urban output stems from the increase in urban labor. In the rural sector, as households move out, the aggregate capital available drops in the first period. Coupled with a drop in rural labor, overall rural output diminishes. The resulting effect is a 22% drop in aggregate consumption in the rural region, which is an indicator of the per period utility of the households. The consumption, or the per period utility per household in the rural areas drop as well: initial period consumption per rural household decreases about 9% from the base. In the urban areas, we observe an aggregate increase in aggregate consumption by 9% from the base-run equilibrium. As urban areas get more populated, however, the consumption per urban household actually decreases by about 9% from the base. Therefore, in the segmented capital markets model, the initial effects of lowering the labor taxes in the urban manufacturing sector are clear: labor migration out of the rural region; a negative effect on output in the rural region; a negative effect on rural household utility; a positive effect on urban manufacturing output; a positive effect on aggregate utility of the urban households, whereas a negative effect on per urban household utility.

5.2 Effects in the initial period-Non-Segmented Capital Markets Model

In the model with non-segmented, or integrated capital markets, the immediate effect of lowering labor taxes in the urban manufacturing sector is the same as in the segmented capital markets case: *ceteris paribus*, it increases the demand for labor in this sector as the cost per unit of labor is now lower. Again, the representative firm in this sector turns to the urban labor market to hire more workers, wages per unit of labor increase, and as a result, household incomes in urban region increase. Everything else constant, price of the home-good increases. An increase in the price index in urban region causes the expenditures in the urban region to increase. At first, as a result of the change in the relative price of the urban home-good and the subsequent change in the urban household expenditures, it would appear as if the fraction of households who choose to reside in the rural versus urban region (ℓ_1) would drop (i.e. migration equilibrium would hold at a lower ℓ_1). However, households choose to remain in the rural region since the relative home-good prices in the rural region do not rise as fast as they do in the urban region. First of all, there's not a large change in the rural household income that would affect the demand for rural home good that ultimately affects the price, and secondly, rural output keeps up with any changes in demand as the rural firms now have the ability to replace capital for labor as they have access to the integrated capital market.

Table 6 and Figures 8-14 present the simulation results. In the non-segmented capital markets model, after a change in the urban manufacturing labor tax rate, at the initial equilibrium, agricultural output drops only by 1.1% , and services output increases by about 0.4% compared to the base equilibrium. Urban manufacturing output, on the other hand, increases by 5.6%, and urban services output drops by 3.5% compared to the base equilibrium. Home-good prices in the rural region increase only by 1.2% compared to the base, whereas the home-good prices rise by 5.5% in the urban region compared to the base. Overall, the value of rural output increases by about 0.6% and the value of

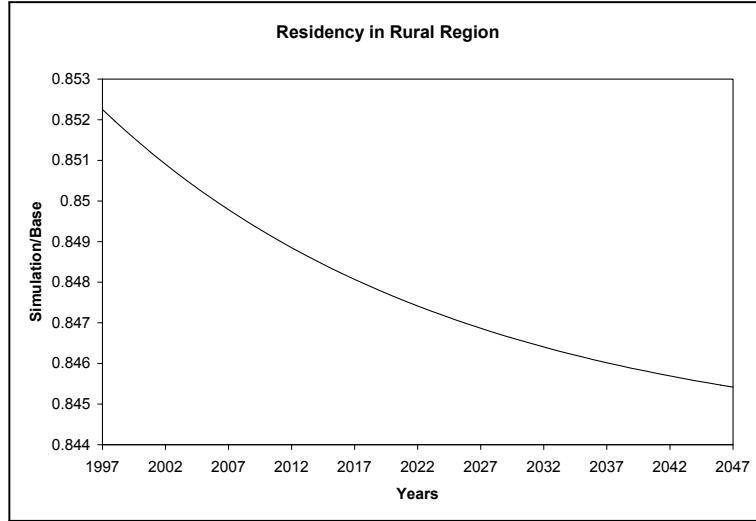


Figure 1: Residency in Rural Region

urban output increases by 3.5% compared to the base.

5.3 Effects along the Transition path-Segmented Capital Markets Model

As capital accumulates in the urban region, the productivity of the urban labor increases, and wages in the urban region increase by 12.96% from the base at the steady state equilibrium. Being the relatively labor intensive sector, urban manufacturing decreases its demand for labor along the transition path and accomodates by increasing its demand for capital. Compared to the base, however, the urban manufacturing sector increases its demand for labor and capital by 16.6% to experience an increase in output at the same rate.

Urban services sector, on the other hand, increases its demand for labor along the transition path to steady state equilibrium by 8.3%. From the base, its labor demand increases by 3.2%. Note that both of the urban sectors increase labor demand from the base, which means that the increased demand must be accompanied by a decrease in the labor use in the rural region, a drop of 15.6% from the base.

The Euler conditions of the two households give the clues to the saving and expenditure patterns of the households in each region. Since

$$\frac{\dot{E}_2}{E_2} > \frac{\dot{E}_1}{E_1}$$

we can infer that the rural household is saving at a slower rate than the urban household. In other words, the rural rate of return on capital is not conducive to savings by the rural household at a rate

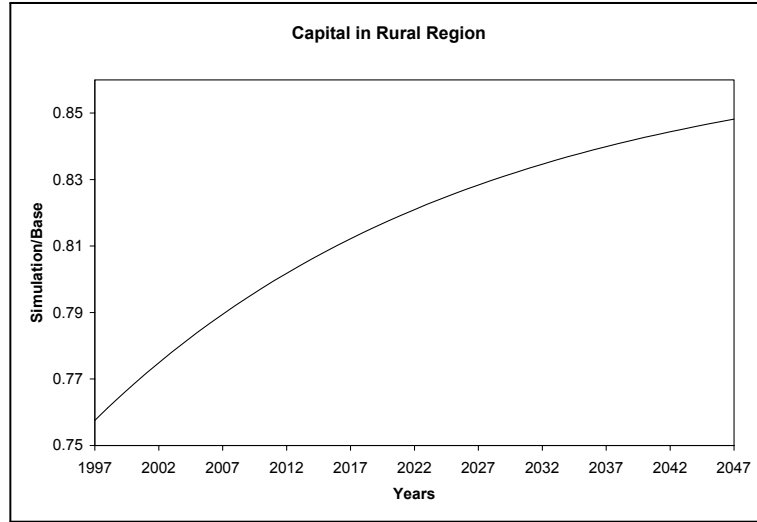


Figure 2: Capital Stock in Rural Region

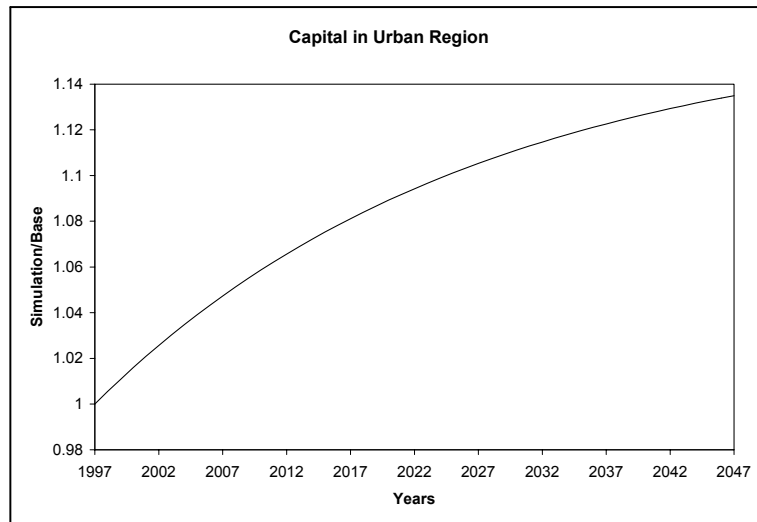


Figure 3: Capital Stock in Urban Region

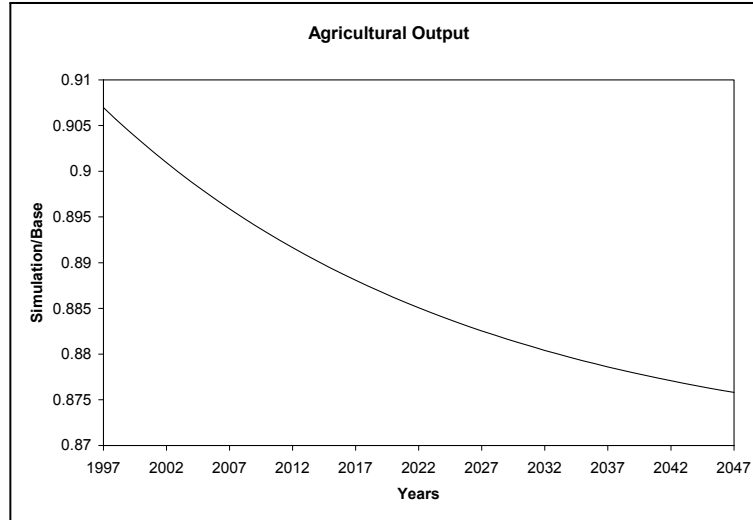


Figure 4: Agricultural output-Rural Region

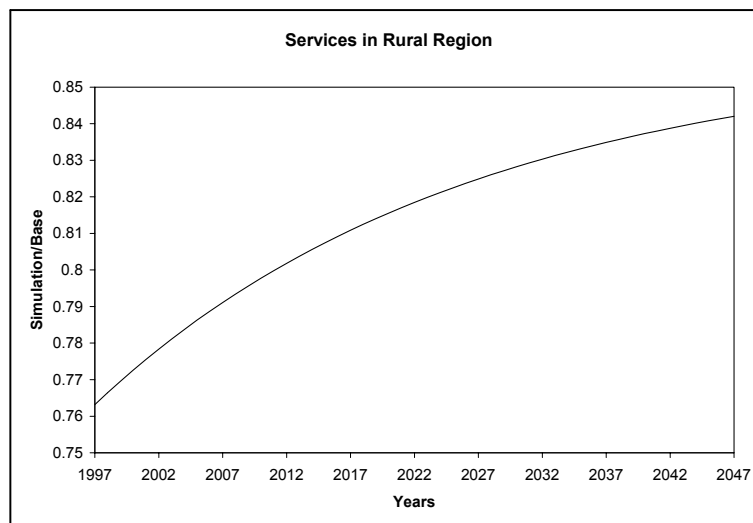


Figure 5: Services-Rural Region

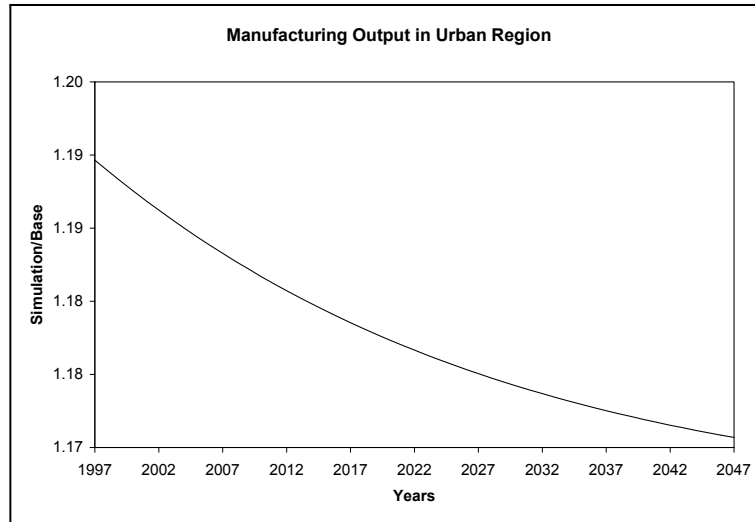


Figure 6: Manufacturing output-Urban Region

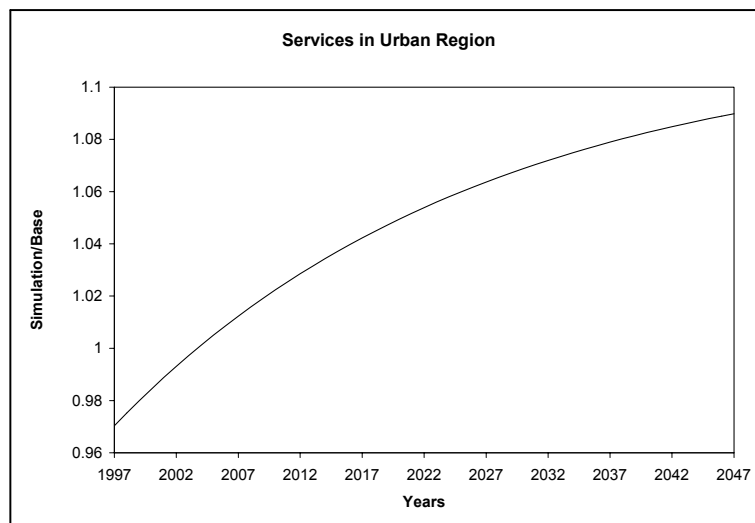


Figure 7: Services-Urban Region

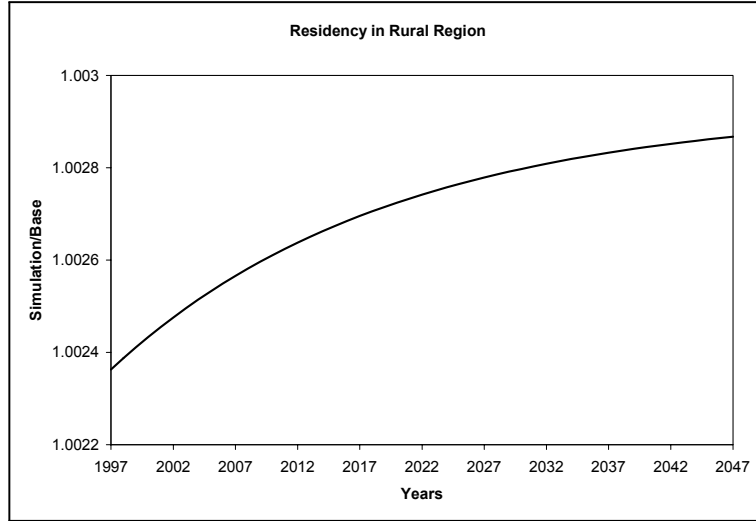


Figure 8: Residency in Rural Region

as fast as in the urban region. The relatively slow rate of accumulation in wealth in rural region is a contributing factor in the rural-to-urban migration that is observed over time.

As capital accumulates in the urban region at a faster rate than it does in the rural region, wages in urban region rise faster relative to rural wages. Additionally, we see along the transition path that home-good prices in the urban region fall faster than they do in the rural region. These two factors are also contributing factors in the rural-to-urban migration over time in the transition path.

5.4 Effects along the Transition path-Non-segmented Capital Markets Model

Wages in both regions rise, albeit at different rates⁹, as aggregate capital accumulates in the economy along the transition path to steady state. Labor demand in the urban manufacturing sector slightly drops by 0.88% along the path, even though it increases by 5.1% from its base-run equilibrium value. On the other hand, the urban services sector, which is relatively more capital intensive than the urban manufacturing sector, can afford to increase its labor demand by 1.5%. As capital accumulates and the cost of unit capital services decreases along the transition path, urban services sector hires more capital, increases its output by 3%, and is capable of hiring and affording more workers. Compared to the base equilibrium, however, the output of the urban services drops by 0.71%.

In the rural region, the agricultural sector is able to compete with the rural services for labor resources as the relative price of the agricultural good rises along the transition path, and as the

⁹In the non-segmented capital markets model, along the transition path, urban wages rise by 0.38%, rural wages rise by 0.14%.

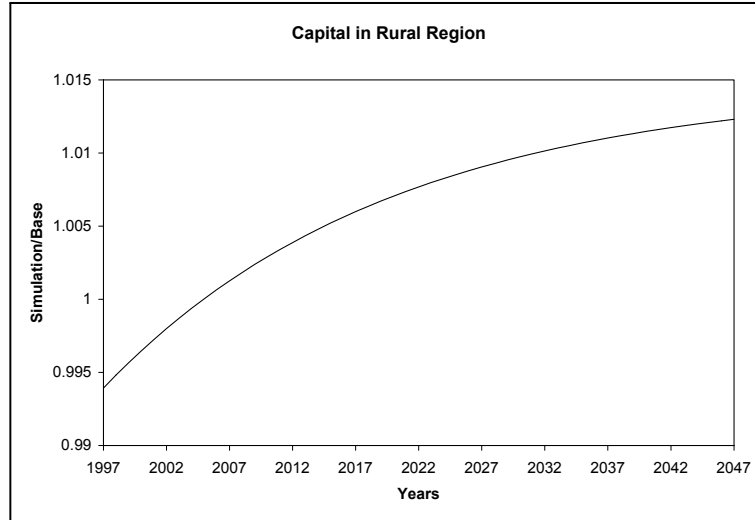


Figure 9: Capital Stock-Rural Region

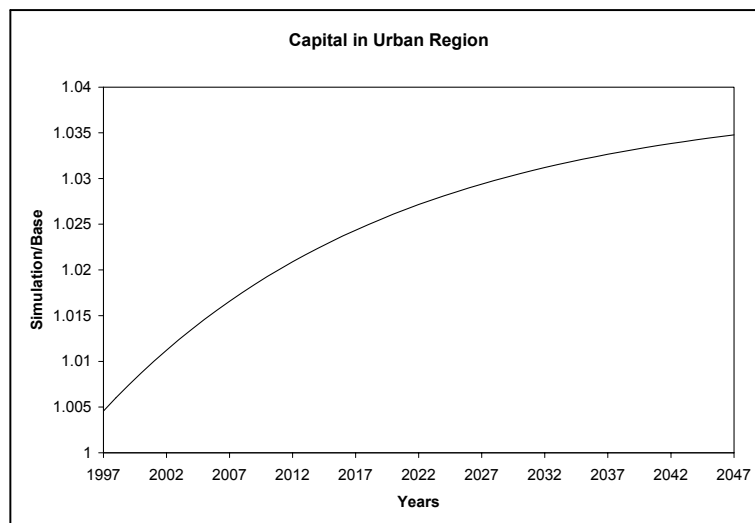


Figure 10: Capital Stock-Urban Region

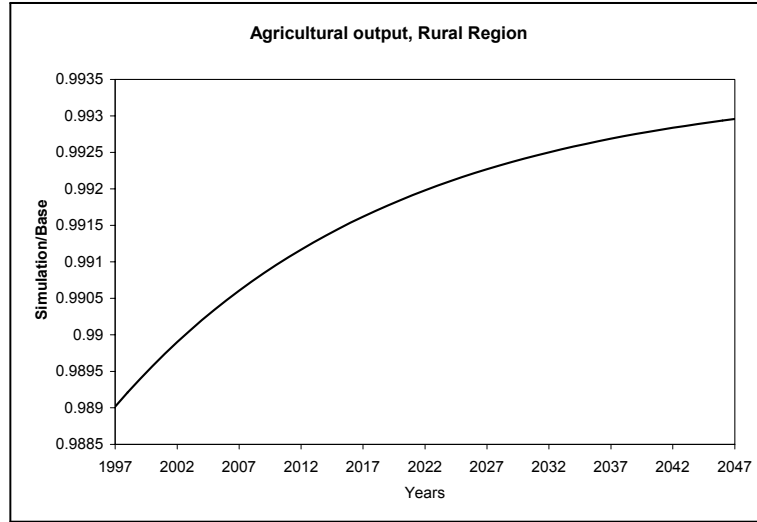


Figure 11: Agricultural output-Rural Region

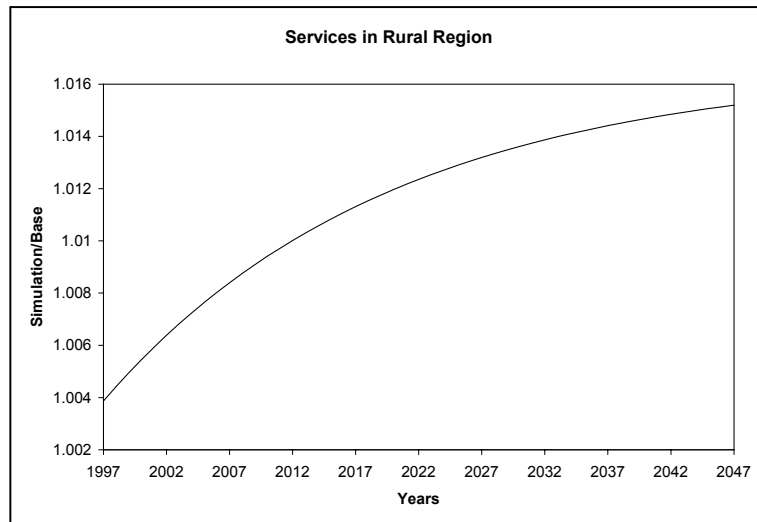


Figure 12: Services-Rural Region

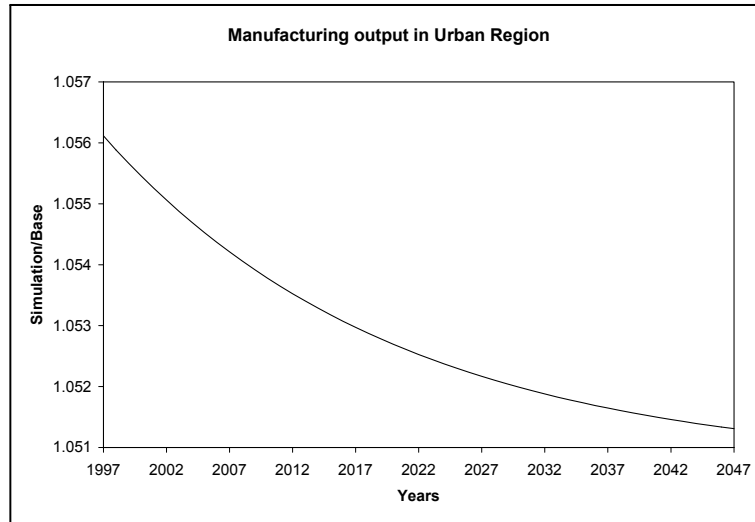


Figure 13: Manufacturing output-Urban Region

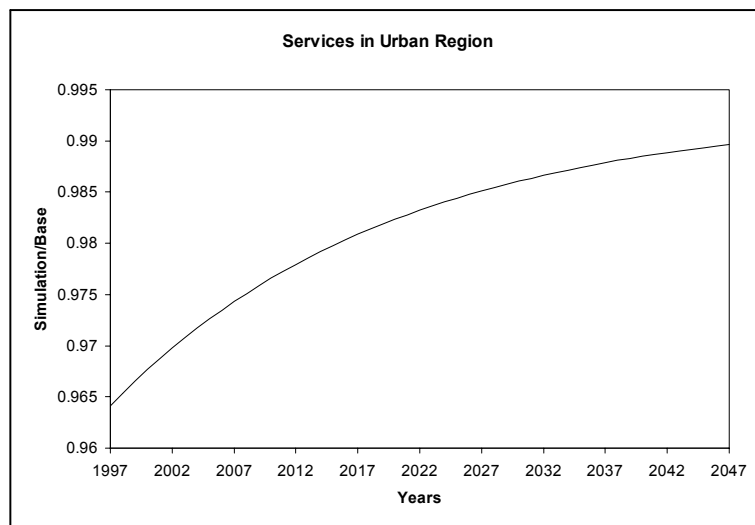


Figure 14: Services-Urban Region

agricultural sector is able to attract more workers. Compared to the base, the relative price of the agricultural good slightly drops, and the ability of this sector to afford workers decreases, hence labor demand diminishes by 0.8% at the steady state. The services sector accomodates the decrease in its labor demand by increasing its capital demand by 2% along the transition path, and by 1.7% from the base. The services sector can do so since it is relatively more capital intensive than the agricultural sector, and takes advantage of the falling capital rental rates along the transition path. Also, since the rural firms are able to rent capital from a uniform capital market, as capital accumulates, they have the same advantage in capital markets as the urban firms do.

Since there is a uniform capital market, all households in both regions earn the same rate of return on capital:

$$\frac{\dot{E}_1}{E_1} = \frac{\dot{E}_2}{E_2} = r - \rho$$

which implies that neither of the households in either region has an advantage in terms of wealth accumulation, both households save at the same rate and their expenditures grow at the same rate. It also implies that households can now rent their capital in the sector that they will receive the highest rate of return per unit of capital, they are not restricted to renting their capital within their region, only.

6 Concluding Remarks

The main focus of this essay has been to establish the linkages between segmentation in rural and urban capital markets, uneven regional economic growth, and rural urban migration in a developing country with a large rural population. We find that in an economy with a large rural population and segmentation in its capital markets, a policy change in the economy such as reducing the labor taxes imposed in the urban manufacturing sector induces migration from rural to urban areas, and this migration continues along the transition path to a new long run equilibrium. Large drops in output of the rural sectors are detected, whereas the outputs of the urban sectors grow. However, the same economy reacts to the same policy change much differently after this economy undergoes an institutional reform such as the integration of its capital markets. As the economy adjusts to a new equilibrium once a policy change is introduced, relative to the case with segmented capital markets, no large changes in the macroeconomic variables occur. In particular, in the integrated capital markets environment, even after a policy change that prompts the urban wages to increase, rural residents choose to remain in the rural region.

In terms of regional growth, after the policy change is introduced, initially, total output in urban region grows, and total output in rural region recedes in the segmented capital markets environment. In transition to a new long run equilibrium, we observe growth over time in both regions, but rural region output still remains below its base level. On the other hand, total output in both regions grows intially and in transition in the integrated capital markets model, though urban output grows more

rapidly. Nevertheless, the output growth gap between the urban and rural regions is not as large in the integrated capital markets environment as in the segmented capital markets environment.

The basic model introduced in this study can be extended to include transaction costs, both in terms of the movement of goods across regions, and the movement of labor across regions. Inclusion of both types of transaction costs are expected to affect the differences in cost of living across regions, thus have an effect on the migration decision of the households. Another possible extension for studying rural-urban migration would be to consider household's utility from migrating to urban areas, where the households take advantage, or derive utility from the urban amenities, or public goods.

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