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A DEMOECONOMIC MODEL OF INTERREGIONAL GROWTH RATE DIFFERENCES

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PREFACE

Interest in human settlement systems and policies has been a critical part of urban-related work at IIASA since its inception. Recently this interest has given rise to a concentrated research effort focusing on migration dynamics and settlement patterns. Four subtasks form the core of this research effort:

- I. The study of spatial population dynamics;
- II. The definition and elaboration of a new research area called <u>demometrics</u> and its application to migration analysis and spatial population forecasting;
- III. The analysis and design of migration and settlement policy;
 - IV. A <u>comparative study</u> of national migration and settlement patterns and policies.

Consistent demoeconomic modeling of multiregional systems is an important component of demometrics. It requires the determination of labor force participation, migration and unemployment rates simultaneously and endogenously in the model. This paper presents an important contribution to regional modeling. Jacques Ledent and Peter Gordon elaborate on a recently published model of interregional growth and show how the demometric approach alleviates several problems inherent in conventional modeling.

> F. Willekens Leader Migration and Settlement Task

October 1978

ABSTRACT

This paper sets forth a *demoeconomic* approach to interregional development along non-neoclassical lines. This objective is carried out by elaborating on a recently published model of interregional growth rate differences (Dixon and Thirlwall, 1975).

First, a critical review of this model suggests the implausibility of its main result, i.e., the possibility of steady growth by a pair of regions over the long run. It is shown that

- a) the omission of migration which would eventually dampen the implied income divergence, and
- b) the linear structure of the model

cause such a result.

Thus, an extension of this model is proposed which includes migration as well as other demographic aspects of development (labor force participation and unemployment), endogenously and simultaneously determined. Interestingly enough, the nature of these variables provides an impetus for reconsidering linearity; the proper modeling of demoeconomic effects necessarily introduces nonlinearities.

Non-static long-term rates of change are shown to emerge from the simulation of this extended model: as a consequence of population shifts due to migration, there appear regional cycles accompanied by cycles of divergence and convergence of income.

A Demoeconomic Model of Interregional Growth Rate Differences

One of the most interesting models of interregional growth is that of Dixon and Thirlwall (1975)--hereafter referred to as DT. They attempt to formalize Kaldor's thoughts on development along non-neoclassical lines. Their formal model includes a price mark-up equation, in place of a marginal cost determined competitive price, as well as a positive feedback between the region's rate of technical innovation and regional economic growth rates (the Verdoorn effect). Competition between a pair of regions is taken care of by a relationship between relative regional prices and export demand.

The DT model is useful for studying the possibilities of income divergence or convergence between regions over the long term. Yet, the cited model is linear in the rates of change of all included variables and, not at all surprisingly, yields an outcome of stable growth rates in the long run. The authors cite this as an example of equilibrium characterized by an absence of divergence or convergence. Their conclusion is faulty for several reasons. First, the literature on regional convergence and divergence looks at long term income trends and not growth rate trends. Thus, stable growth rates for a pair of regions can easily be associated with an ever widening divergence of incomes. We can hardly expect this to be a longterm equilibrium. Given enough of an income gap, people will move from the poor to the rich region. This brings us to the second point which has to do with the secondary equilibrating and disequilibrating effects of migration. Simple models of factor price equalization cite the migration response as an equilibrating force which puts a brake on interregional income divergence. Yet, over shorter time spans, migration may well have an agglomerative effect (for example, only the most skilled and non risk averse may migrate) which accelerates income divergence. Thus, we claim that the stable growth equilibrium which DT cite is not only due to the linearity of their model but is also due to the omission of a demographic sector.

In order to put this assertion into focus, we will suggest the following: first, a truly interesting model of interregional development ought to be demoeconomic, i.e., to cover both economic and demographic aspects of development; second, such a demoeconomic model cannot be totally linear in the rates of change; and third, non-static long-term rates of change should automatically emerge from the simulation of such a model. This means that, as a consequence of population shifts due to migration, there should appear regional cycles accompanied by cycles of divergence and convergence of incomes.

To recapitulate,

- DT should not be surprised that their *linear* model leads to constant growth rates in the long run;
- they should not confuse steady growth with an absence of divergence or convergence of incomes;
- 3) the implausibility of the DT result (steady growth by a pair of regions over the long term) evokes the absence of migration and calls for a demoeconomic approach;
- 4) the migration response would eventually dampen the implied income divergence, and
- 5) the proper modeling of demoeconomic effects introduces non-linearities.

Our objective in this paper is to demonstrate these points with the help of an interregional demoeconomic model built on the DT model, which constitutes a useful reference point from which interregional demoeconomics can proceed along the nonneoclassical path.

Beyond the specific model that is developed in the following pages, we also hope to indicate the methodological gains that are suggested by the demoeconomic approach. Because economic and demographic variables interact, regional models that are either purely economic <u>or</u> demographic in nature are unsatisfactory. Yet, the demoeconomic synthesis is not trivial. Looking at the labor market in spatial terms, we treat the decision to migrate as endogenous. This extends the notion of job search

(Miron, 1978). The central idea is that labor force participation, migration and unemployment rates are endogeneous and simultaneously determined. Yet, it has been shown by Ledent (1978) that any model including variables of this sort is likely to generate preposterous unemployment and/or labor force participation rates without a proper modeling of the relationship between comparable variables of the economic and demographic sides: employment and labor force respectively. This is referred to as the consistency problem which is particularly acute if unemployment and labor force participation rates are defined as residu-Also, when these variables are dependent variables, a linals. ear model eventually develops population and labor force dimensions which imply unrealistic unemployment and labor force par-This suggests that a demoeconomic model will ticipation rates. have to be non linear.

In the next section, we present an augmented DT model, along demoeconomic lines. We then specify reasonable parameter values for the two-region case and suggest that the results of a longterm simulation of the expanded model are much more plausible than the growth equilibrium of DT. Finally, we comment on the costs and benefits of following the demoeconomic approach to regional analysis.

FORMULATION OF THE MODEL

In what follows, we present a two-region model which extends the DT model by allowing migration between the two regions.

- It consists of three blocks which describe successively:
- the impact of demographic forces on regional income growth rates,
- ii) the impact of economic forces on regional population growth rates, and
- iii) the relationships linking employment and labor force variables, ensuring the consistency between the economic and demographic sides of the model.

The first equation of the first block relates a two-element vector of regional income growth rates to the growth in the region's exports as well as in the region's population and labor force. The export-base approach was suggested by DT. We add the other elements to bring in the impact of demographic factors on growth, emphasizing the role of households as consumers as well as of suppliers of labor. Thus,

$$(g_t) = \Gamma(x_t) + \phi^1(n_t) + \phi^2(1_t + n_t)$$
 (1)

where, (g_t) is the vector of regional growth rates, (x_t) is the vector of export growth rates, (1_t) is the vector of labor force participation rate changes (n_t) is the vector of population growth rates, Γ, φ¹ and φ² are diagonal matrices of coefficients*.

The second relationship expresses the growth of exports in

terms of changes in relative prices and world demand. We have,

$$(\mathbf{x}_{t}) = \underbrace{\eta}_{u}(\mathbf{p}_{t}) + \mathbf{z}_{\tilde{u}}(\mathbf{i})$$
(2)

^{*}Because all the variables are expressed in their growth rates, the coefficients are elasticities.

where, (p_{+}) is the vector of regional export price changes,

(i) is the two-element vector of ones, and

z is the change in world demand.

Note that ε is a diagonal matrix of coefficients, unlike η whose off-diagonal elements represent the impact of a region's price change on the growth of the other region's exports.

Prices are explained by a cost mark-up equation, just as in the DT paper, so that we have:

$$(p_t) = (w_t) - (r_t) + (\tau)$$
 (3)

where, (w_{+}) is the vector of regional wage rate changes,

- (τ) is the exogeneous vector of regional rates of change of cost mark-up.

The next equation explains regional technical innovation in terms of an endogenous and an exogenous element,

$$(r_t) = (\bar{r}) + \lambda_{\tilde{c}}(g_t)$$
(4)

where, (\bar{r}) is the vector of the exogenous elements and

 λ is a diagonal matrix of coefficients. Just as in the DT paper, the second term represents the Verdoorn effect.

At this point, it may be noted that substituting (4) into (3) and the result into (2) reveals a particular impact of one region's growth on the other region's export growth. This reflects a competitive effect in that growth in region i diminishes the export demand growth of region j through an impact on relative export prices. Another growth effect on export demand growth could be included with a positive impact via the traditional income-consumption linkage. Clearly, the two effects work in opposite directions and are of different magnitudes. In the former case we emphasize competition between regions and in the

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latter case we would emphasize trade. The two cases are probably differentiable in terms of the sizes of the regions vis-a-vis rest-of-the-world demand.

We retain the (implicit) small-but-competitive region example of the DT model. We do this for the sake of continuity and simplicity. Also, we wish to highlight the demoeconomic effects and it makes no difference which case is studied to make that point.

The next equation concerns the wage rate which, unlike DT, we chose to make partially endogenous. Thus,

$$(\mathbf{w}_{t}) = (\overline{\mathbf{w}}) + \psi_{t}(\mathbf{l}_{t}) .$$
 (5)

A time subscript is attached to the diagonal matrix ψ_t because its elements, representing each region's wage elasticity with respect to labor force participation rate (LFPR) are not taken as constants. It is hypothesized that the absolute value of each element ψ_{it} , which by the way has a negative sign, increases with the value of the beginning-of-the-period LFPR. Thus, supposing in addition that each region's labor force participation rate can take on values within a range of $(\rho^1, \dot{\rho}^r)$ where ρ^1 is a low enough LFPR so as to have no impact on wage rate change and ρ^r is a high enough LFPR so as to have an infinite impact on wage rate change, we have:

$$\psi_{it} = d_i \frac{\rho_{it} - \rho^1}{\rho_{it} - \rho^r}; \quad \forall i = 1, 2 \quad (6)$$

or, in compact form,

$$\psi_{t} = \sum_{\alpha} \left(\rho_{t} - \rho^{1} I \right) \left(\rho_{t} - \rho^{r} I \right)^{-1}$$
(6')

where ρ_{t} is a diagonal matrix of the beginning-of-the period LFPR

- I is the two by two identity matrix
- D is a diagonal matrix of coefficients.

The last equation of the first block relates a region's rate of income growth to its rate of change in employment level.

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$$(e_{t}) = \mu(g_{t}) \tag{7}$$

where (e_t) is the vector of regional employment growth rates, μ is a diagonal matrix of coefficients.

Note, that the rationale for this equation is the **av**ailability of an economic variable directly comparable with a variable from the demographic side (labor force) to ensure the aforementioned consistency.

The next block of the model describes the impact of economic forces on population growth through migration. The demographic model underlying this block is the so-called components-of-change model of population growth and distribution (Rogers, 1968). Thus, we have:

$$N_{i,t+1} = N_{it} + b_i N_{it} - m_{it} N_{it} + m_{jt} N_{it}; \forall i = 1,2$$
 (8)

where N_{it} is population in region i at time t,

b_i is region i's exogenous rate of natural increase
m_{it} is the migraton rate from region i to the other
region in period (t,t + 1).

Rewritten, this relationship yields,

$$n_{it} = \frac{N_{i,t+1} - N_{it}}{N_{it}} = b_{i} - m_{ij} + m_{ji} \frac{N_{jt}}{N_{it}}; \forall i = 1, 2 \quad (8)$$

as, in a more compact form:

$$(n_t) = (b) - N_t - \frac{1}{2} PN_{t}(m_t)$$
 (8'')

where (n_t) is the vector of regional population growth rates P_{\sim} is the matrix $\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$

(b), and $\underset{\sim t}{\tt N}$ are vector or matrix equivalents of previously defined variables.

To assure a demoeconomic model, it is necessary to specify the way in which economic forces cause migration rates to change. We suggest that,

$$m_{it} = \alpha_{i} \frac{N_{it}}{N_{it}+N_{jt}} \left[1 + \beta_{i} \left(\frac{e_{jt}}{u_{jt}} - \frac{e_{it}}{u_{it}} \right) \right]; \forall i, j = 1, 2 \quad (9)$$

That is, the migration rate out of each region is proportional to the attractiveness of the other region--measured by the part of the total population living in this region--and is related to the difference in the economic opportunities offered by the two regions. Note, that the index of regional economic opportunities used here is a slight variation of Todaro's probability that a migrant finds a job (Todaro, 1976): it is the ratio of employment growth rate e_{it} to the beginning-of-the-period unemployment rate u_{it}. (The latter is defined below).

Equation (9) can be rewritten in a more compact form as:

$$(\mathbf{m}_{t}) = \frac{1}{N_{\cdot t}} \underset{\sim}{\overset{\alpha N}{}} t \left[(\mathbf{i}) - \underset{\sim}{\overset{\beta p N}{}} \underset{t}{\overset{-1}{}} (\mathbf{e}_{t}) \right]$$
(9)

where N_{•t} is the total population of the system at time t, α and β are diagonal matrices of coefficients,

 u_{+} is the matrix of regional unemployment rates at time t.

The last block of the model defines the labor force and unemployment variables. The first equation of this block posits a behavioral basis for the change in the LFPR

$$(1_{t}) = \gamma_{t} (I_{t} - u_{t})^{-1} \left[(u_{t+1}) - (u_{t}) \right]$$
(10)

in which γ_{t} is a diagonal matrix introducing further non-linearity into the model. It is hypothesized that the value of each element γ_{it} , which, by the way, has a negative sign, is smaller when the unemployment rate takes on extreme values, either low or high, and much larger for unemployment rate values intermediate between those extremes. We have,

$$\gamma_{it} = a_i(u_{it} - u^1)(u_{it} - u^r); \quad \forall i = 1,2$$
 (11)

where u^{1} and u^{r} are the extreme values of the range in which u_{i+} falls, and, in more compact form,

$$\gamma_{t} = A \left(\bigcup_{t} - u^{1} \prod_{t} \right) \left(\bigcup_{t} - u^{r} \prod_{t} \right)$$
(11')

where A is a diagonal matrix of coefficients.

The last equation of this block is the following relationship:

$$(e_t) = (l_t) - (l_t - U_t)^{-1} \left[(u_{t+1}) - (u_t) \right] + (n_t)$$
 (12)

obtained by differentiating (logarithmically) the identity relating employment levels (E_+) and population levels (N_t),

$$(\mathbf{E}_{t}) = \rho_{t} (\mathbf{I} - \mathbf{U}_{t}) (\mathbf{N}_{t})$$
(13)

As shown in Appendix 2, various substitutions permit one to reduce each of the three blocks of the system to a single equation in three variables (e_t) [or (g_t)], (l_t) and (n_t) . This leads to a simple model of three equations in three unknowns that can be analytically solved in spite of the nonlinearities introduced into the model. As also shown in Appendix 2, the derivation of the reduced form equations of the model is tractable because the coefficients of the endogenous variables are known variables (either constant or depending on lagged variables).

It is clear, from these reduced form equations, that the introduction of the equations of population change have added difference equations which make the model much more dynamic than the DT model. Also, a radical departure from linearity has been introduced in the process. We note again that non-linearity is almost implicit in the demoeconomic approach.

SIMULATION OF THE MODEL

From the three reduced form equations concerning (e_t) , (l_t) and (n_t) , it is easy to develop a simulation of the time paths of these variables and then of all the other variables. So as to be of maximal policy interest, the simulation was conducted for an hypothetical pair of regions where the one is economically advanced and the other is developing. As already mentioned, these are competing regions, whose primary trade is with the rest of the world.

It will be seen that the time paths of growth rate changes that result fluctuate over patterns of convergence and divergence. As suggested at the outset, since non-linearities and a migration response have been added to the DT model we would not expect anything like steady state growth rates and the associated diverging regional income levels. Though our results simply indicate a simulation result, we have based the simulation on reasonable assumptions and parameter choices. In defending this sort of approach to model building, Nelson and Winter (1977) assert that,

Simulation... can be a useful adjunct to an analytical approach. It can establish, with the same finality as a theorem, the logical consistency of the model's assumptions with a set of proportions about its behavior. And while it offers a way around the tractability constraints of analytic methods, it imposes its own constructive discipline of modeling dynamic systems: the program must contain a complete specification of how the system at t + 1 depends on that at t and exogenous factors, or it will not run.

The earlier discussion on labor force participation rates reflects precisely this point. The problems cited were not evident in the original DT model and only become apparent once the long-term demoeconomic interactions were modeled and simulated.

Our results, as indicated, follow from defensible values of the parameters. Table 1 provides a summary of these values. Many of them are similar in order of magnitude to those employed by DT. The export elasticity with respect to regional income growth is lower in the developing region (region 2) because a younger

Parameter	Advanc (Regi		Region 1)	Develo (Reg	pin ion	g Region 2)
ELASTICITIES	-					
Elasticity of export growth wrt income growth (1)	Υı	=	0.60	Υ2	=	0.55
Elasticity of population growth wrt income growth (1)	φ ¹ ₁	-	0.65	φ ¹ ₂	n	0.70
Elasticity of labor force growth wrt income growth (1)	¢ 2 1	-	0.10	φ ² ₂		0.10
Price Change elasticity wrt export growth (2)			-1.50 1.50			1.50 -1.50
Elasticity of world demand change wrt export growth (2)	ε 1	=	1.00	€ ₂	11	1.10
Elasticity of income growth wrt technological change (4)	λ	=	0.50	λ,2	=	0.70
Elasticity of income growth wrt employment growth (7)	μ ₁	=	0.30	µ 2	=	0.40
OTHER COEFFICIENTS						
Coefficient in determination of elasticity of labor force partici- pation rate change wrt wage rate change (6)	đ1	=	3.00	đ2	=	2.00
Coefficients in determination of the	α1	=	0.0700	α2	=	0.0725
migration rates (9)	βı	=	0.25	βı	=	0.30
Coefficient in determination of elasticity of unemployment rate change wrt labor force participation rate change (11)	e aı	=	6000	a2	H	3000
OTHER PARAMETERS						
Price mark-up factor (3)	τ1	=	0. 015	τ2	=	0.015
Exogenous rate of technologic al change (4)	\bar{r}_1	=	0.025	r2	=	0.025
Exogenous element of the wage growth rate (5)	\bar{w}_1	=	0.015	<u>w</u> 2	=	0.015
Rate of natural increase (8)	\mathtt{b}_1	Ŧ	0.01	b2	=	0.013
INITIAL CONDITIONS						
Initial population (in thousands)	N 1 0	=	7,500	N 2 0	=	2,500
Initial unemployment rate	u 10	=	0.05	u ₂₀	=	0.035
Initial labor force part. rate	ρ10	=	0.35	P 2 0	Ŧ	0.37
NON-REGIONALIZED PARAMETERS			_			
Bounds on labor force part. rate (6)			$ \rho_{\mathbf{r}}^{\mathbf{l}} = \rho_{\mathbf{r}}^{\mathbf{l}} = $	0.30 0.42		
Bounds on unemployment rate (11)			$u^{l}_{r} = u^{r}_{r} =$	0 0.10		
Rate of change of world demand (2)			z =	0.04		

Table 1. Summary of parameter values and initial conditions.

region is usually more trade dependent, causing smaller internal foreign trade multiplier effects. The elasticity of regional population growth with respect to income growth is slightly larger in the developing region, suggesting that the developing region has greater (dynamic) opportunities for import substitution.

All price elasticities of export demand are greater, in absolute value, than unity. In fact, DT invoke values of 1.5 for these, as we do. The justification for a price elasticity in the elastic part of the demand curve rests on the small region (vis-a-vis the rest of the world) assumption: as the region's export price rises by one percent, the demand for its exports falls by about 1.5 percent. Yet, since the crosselasticities are also elastic, this assumption must be tempered. Since any price increase is met by a fall in "own" demand and an almost equivalent rise in the competing region's demand, we have the case of close substitutability of the export, most of which is supplied by these two regions.

The next difference in parameter values involves the elasticity of world demand change with respect to export growth. This parameter is larger for the growing region, showing a greater orientation to external demand. Also, regional growth has a stronger effect on induced innovation in the younger region which has far less durable capital to depreciate before innovation can proceed.

Employment growth is more sensitive to economic development in region two $(\mu_2 > \mu_1)$ since it is entirely plausible that growth in that region would include labor intensive processes.

The coefficient d_i in equation (6) has a greater value for the advanced region. This means that the elasticity of wage rate change with respect to labor force participation rate change is <u>more</u> sensitive to fluctuations in the levels of the LFPR in the advanced region. At the same time, market institutions in the advanced economy may be more developed, permitting greater scope in these wage adjustments or less wage rigidity than in the traditional but emerging region. Perhaps the most important of these institutional differences is in information channels that underlie the labor market and aid the job search process.

The outmigration rates from the developing region are thought to be slightly more sensitive to economic conditions since the younger population of that region is probably made up of more economic opportunity seekers. Thus, $\alpha_2 > \alpha_1$ and $\beta_2 > \beta_1$.

Turning to equation (11), the coefficient a_i is significantly larger for the first region. This is because the labor force participation rate varies more in a region where pensions and other non-labor incomes are possible. In other words, the more advanced region is thought to have a social service apparatus which makes leaving the labor force more plausible.

The rate of natural increase is, of course, slightly larger in the developing region with its younger population. The remaining regional parameters are common to the two regions.

Turning to the initial conditions, the older region has three times the population of the developing region. Its initial unemployment rate is larger and its labor force participation rate is lower for the reason that its population contains more older people. The bounds on the labor force participation and unemployment rates used in the formulation of the nonlinear equations (6) and (11) are the same in the two regions.

Finally, the rate of change of world demand which drives the model is taken equal to 4 percent, as in the DT model. Results of the simulations are shown in Tables 2, 3 and 4.* In discussing these results of the simulation, it is difficult to identify simple cause and effect relationships because of the large number of second-order effects. Most important among these are the interregional feedback effects. Also, since migration and population levels appear as independent as well as dependent variables throughout the model, it is almost impossible to

^{*}Additional simulation results are shown in Appendix 1.

Annual growth rates of main variables. Table 2.

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7 711.2 260.7.1 7.155 2.001.1 2.	6 7794,2 7974,1 7155 2494,4 1114,1 1114,5 2154,4 1 6197,5 2797,4 7914,4 1114,1 1114,5 2154,5 1 6197,5 2797,4 7914,4 1114,1 1114,5 2154,5 1 6197,5 2797,4 7914,4 1114,1 1114,5 2154,5 1 6197,5 2794,4 1114,1 1114,5 2154,5 2154,5 1 6197,5 2794,4 1114,1 1114,5 2154,5 2154,5 2 6197,5 2794,4 1114,5 2164,5 2154,5 2154,5 2 6197,5 2794,4 1114,5 2164,5 2154,5 2154,5 2 6197,5 2794,4 1114,5 2164,5 2154,5 2154,5 2 6194,5 2794,5 2144,5 2144,5 2154,5 2 6194,5 2194,5 2144,5 2144,5 2154,5 2 1114,1 1114,5 2144,5 2144,5 2144,5 2 1114,5 2144,5 2144,5 2144,5 2144,5 2 2 2144,5 2144,5 2144,5 2144,5 2	5	1	7 2457 7	2437,5	2774.7		0.0495		2088.9	948.9	9.44.8	6,3642	C. C364
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9 917 5777 5777 6.757 5777 6.757 5777 6.757<	9 917,4 775,5 797,4 7,75 1,939 2617,4 2,944,4 2,947,4 2,944,4 <td>80</td> <td></td> <td>8347 ° 6</td> <td>2132.4</td> <td>2873.6</td> <td></td> <td>6.0491</td> <td></td> <td>2196.4</td> <td>991.4</td> <td>1019.3</td> <td>0,3645</td> <td>1725.3</td>	80		8347 ° 6	2132.4	2873.6		6.0491		2196.4	991.4	1019.3	0,3645	1725.3
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11 <	11 6444 74444 7444 7444 7444	9		3262.5	2798.6	2942.5		6970 9		2867.4	1.5401	1042.2	0,3635	0,0375
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13 6573, 6 2773, 6 1855, 8 1174, 6 1174, 7 8,156, 8 1175, 5	13 6573, 6 2775, 6 2775, 6 1177, 6 1177, 6 1177, 6 1177, 6 1177, 6 1177, 6 1177, 7 <	12		8432.5	2444.9	3413.6	~	0.3487		2938.4	1024.9	1065.2	0,3625	0.0378
114 0.077,8 2071,1 2704,6 2,040 3774,6 1206,6 1206,6 1206,6 0.1591 255 11114,0 11114,6 1119,6 1119,6 1119,6 1119,6 1119,6 1119,6 0.1591 255 11114,6 1119,6 1119,6 1119,6 1119,6 1119,6 0.1591 255 11119,6 1119,6 1119,6 1119,6 1119,6 0.1591 255 11119,6 1119,6 1119,6 1119,6 1119,6 0.1591 255 1119,6 1119,6 1119,6 1119,6 1119,6 0.1591 255 1119,6 1119,6 1119,6 1119,6 1119,7 255 1119,7 1119,7 1119,7 1119,7 1119,7 255 1119,7 1119,7 1119,7 1119,7 1119,7 255 1119,7 1119,7 1119,7 1119,7 1119,7 255 1119,7 1119,7 1119,7 1119,7 1119,7 255 1119,7 1119,7 1119,7 1119,7 1119,7 255 1119,7 1119,7 1119,7 1119,7 1119,7 255 1119,7 1119,7	14 6407, 8 7394, 9 2,944, 9	13	1	8519.6	2951.9	3952.0	~	0,9446		2973.9	1035,8	1976.7	0,3621	0.0343
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4.3 11371.1 4.273.7 4.21377 4.2137 4.2137	0 11721.4 0279.7 0.1731 0.1731 0.1731 0.1731 0.1731 0.1321 5 11979.4 0779.1 0771.5 540.6 0.7731 0.7771 0.7	35		1×735.5	3793.7	3978,2		P. J464		3616.5	1392.4	1357.3	0.3556	0.0424
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56 12571,2 5747,1 4.747,4 2.3445 5572,4 1756,2 1791,6 1551,6 75 1574,1 5747,1 5747,1 1794,5 1794,5 1794,5 1794,4 0.1558 75 1574,1,5 5747,1 5747,1 5747,1 2.3443 5757,1 1.941,5 2.1441,1 0.1558 65 1574,1,5 5741,1 0.757,4 0.1558 2.2443 2.547,5 2.4451,5 2.1744,1 0.1552 65 1570,1,7 571,7 2.1443 5724,5 2.247,5 2.247,2 2.157,2 65 1627,0 0.137,7 0.1442 0.757,5 2.247,5 2.247,2 2.247,2 2.247,2 65 1627,0 0.1442 0.1442 0.1442 7.247,5 2.247,2 </td <td>50 12591,3 4755,3 8,945 8,952 <td< td=""><td>÷ t</td><td></td><td>1939.4</td><td>4278.8</td><td>6.5811</td><td><u>~</u></td><td>0 Nu55</td><td></td><td>426.9</td><td>1447.0</td><td>1 50.6 8</td><td>6.3541</td><td>0,0413</td></td<></td>	50 12591,3 4755,3 8,945 8,952 <td< td=""><td>÷ t</td><td></td><td>1939.4</td><td>4278.8</td><td>6.5811</td><td><u>~</u></td><td>0 Nu55</td><td></td><td>426.9</td><td>1447.0</td><td>1 50.6 8</td><td>6.3541</td><td>0,0413</td></td<>	÷ t		1939.4	4278 . 8	6.5811	<u>~</u>	0 Nu55		426.9	1447.0	1 50.6 8	6.3541	0,0413
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63 110711,5 5117,3 5116,2 51174,4 0,557 0,0444 557.5 1774,4 0,557 75 15514,4 5117,5 5117,5 5117,5 1874,4 0,557 65 1574,4 573,5 573,5 573,5 574,7 544,4 0,557 65 1570,4 5741,5 5741,5 5741,6 573,5 675,4 275,5 275,4 275,5 275,4 275,4 275,5 2747,2 244,7 2755,5 2747,4 2755,5 2747,4 2755,5 2747,4 2755,5 2747,4 2755,5 2747,4 2755,5 2747,4 2755,5 2747,7 244,7 2755,5 2747,4 2755,5 2747,4 2755,5 2747,4 2755,5 2747,7 2744,7 2755,5 2747,4 2755,5 2747,7 2747,7 2744,7 2755,5 2744,7 2755,5 2744,7 2755,5 2544,7 2755,5 2744,7 2755,6 2544,7 2755,6 2544,7 2755,6 2544,7 2755,6 2555,5 2544,7 2755,6 2555,6 2555,6 2555,6 <td>63 14071.5 5117.4 0.3577 0.3572 0.3577 0.3572 0.3577 0.3572 0.3572 0.3572 0.3572 0.3572 0.3552 0.3572 0.3572 0.3552 0.3572 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552</td> <td>- 55</td> <td></td> <td>13279.1</td> <td>4 H I B 5</td> <td>5044.3</td> <td>•</td> <td>3,9448</td> <td></td> <td>4757.6</td> <td>1410.6</td> <td>1680.1</td> <td>0.3531</td> <td>0,0414</td>	63 14071.5 5117.4 0.3577 0.3572 0.3577 0.3572 0.3577 0.3572 0.3572 0.3572 0.3572 0.3572 0.3552 0.3572 0.3572 0.3552 0.3572 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552 0.3552	- 55		13279.1	4 H I B 5	5044.3	•	3,9448		4757.6	1410.6	1680.1	0.3531	0,0414
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253 93455.5 37298.8 38798.8 0.4152 0.0339 55874.7 19117.9 19916.9 0.3564 ####################################	R53 93455.5 37296.6 36796.8 0.4152 0.0369 55874.7 19117.9 19916.9 0.3566 R00 # POPUPATION EVE EVE EVE EVE 16117.9 19916.9 0.3566 R00 # POPUPATION EVE EVE EVE EVE 16117.9 19916.9 0.3566 R00 # POPUPATION EVE EVE EVE EVE 16117.9 19916.9 0.3566	24.0		15411.4	34224.6	35426.9	4	0.0399		48314.1	16522.0	17213.6	6 35¢5	0.0402
POP = POPUPATION LEVEL FMP = RMPLOYMENT LEVEL LE = LAKOR FORCE LEVEL	POP = POPUPATION LEVEL EMP = EMPLOYMENT LEVEL LF = LAGOR FORCE LEVEL LFPR = LAGOR FORCE PARTICIPATION RATE	253	<u>.</u>	13455.5	37288.0	38798.8	1	0.0389		55874 5	9117.9	91916	B.3564	0.040.0
 POPUPATION Employments Labor Force 	<pre># POPUPATION LEVEL # EMPLOYMENT LEVEL # LAGOR FORCE LEVEL # LAGOR FORCE PANTICIPATION</pre>	*					I .					:	-	
<pre>s rupurallux s Employmentux s Lafor Force</pre>	<pre>* rup(1)*110* Level * Emp[0*meint level * Labor Force level ? * Labor Force Panticipation</pre>										:			
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Table 4. Migration-related variab

0.7182 0.7182 0.0182 0.0182 0.0182 0.0182 0.0182 0.0182 0.0182 0.0182 0.0182 0.0183 0.0185	136,5 $137,6$ $138,9$ $140,2$ $141,6$ $143,0$ $144,4$ $145,9$ $147,4$ $149,0$ $157,6$ $157,6$ $155,4$ $155,4$ $155,4$ $155,4$ $155,7$ $174,9$ $184,6$ $194,9$ $205,7$ $217,3$ $224,5$ $242,4$ $256,2$ $272,7$ $236,2$ 7	C. 3755 C. 3580 O. 3447 C. 3233 O. 3154 O. 3127 C. 3233 O. 3154 C. 2932 O. 2932 O. 2932 O. 2932 O. 2859 C. 2859 O. 2859 O. 2859 O. 2778 O. 2691 O. 26414 O. 2645 C. 26416 O. 2645 C. 26416 O. 2645 C. 26416 O. 2645 C. 2655 C. 26555 C. 265555 C. 265555555555555555555555555555555555	9518 97523 975235 975235 975235 975235 975235 975235 975235 975235 975235 975235 975235 975235 975235 975335 975335 975335 975355 975355 975355 975355 975355 975355 975355 975355 975355 975355 975355 975355 975355 975355 975355 975355 975355 97535 97535 97535 97535 97535 97535 97535 97535 97535 97535 97535 97535 97535 97535 97535	129,4 132,8 134,8 137,6 141,9 144,2 146,3 150,4 156,4	$\begin{array}{c} 0, 1596\\ 0, 1359\\ 0, 1359\\ 0, 1359\\ 0, 1016\\ 0, 0848\\ 0, 0779\\ 0, 0646\\ 0, 0576\\ 0, 0576\\ 0, 0474\\ 0, 0,$	7.54.21.100.001.12.23.04.56.07.788.8.99.9
0.0182 0.0162 0.0162 0.0162 0.0162 0.0162 0.0162 0.0162 0.0163 0.0163 0.0183 0.0183 0.0183 0.0183 0.0183 0.0183 0.0183 0.0183 0.0183 0.0183 0.0183 0.0183 0.0184 0.0184	135.9 140.2 141.6 143.0 144.4 145.9 147.4 149.0 157.6 157.6 155.4 155.4 155.7 174.9 184.6 194.9 205.7 217.3 242.4 256.2 27.7 236.2	0 3440 0 327 0 327 0 3154 0 3154 0 3154 0 3154 0 3154 0 3154 0 3154 0 3154 0 217 0 2459 0 2459 0 2778 0 2778 0 2691 0 2691 0 2694 0 2691 0 2692 0 2694 0 2694 0 2694 0 2691 0 2644 0 2642 0 2645 0 2645 0 2645 0 2645 0 2644 0 2645 0 2645 0 2649	0,1523 0,2525 0,2525 0,2529 0,2531 0,2533 0,2533 0,25335 0,253535 0,25555 0,25555 0,25555 0,25555 0,25555 0,25555 0,25555 0,25555 0,25555 0,25555 0,25555 0,25555 0,25555 0,25555 0,25555 0,255555 0,25555 0,25555 0,25555 0,255555 0,255555 0,255555 0,255555 0,25555555 0,25555555555	134,8 137,3 139,6 144,7 144,2 144,2 146,3 158,4 156,4 156,4 156,4 156,4 156,4 156,4 156,4 156,4 156,4 156,4 156,4 156,4 156,4 156,4 156,4 160,4 156,4 160,4 156,4 160,4 156,4 160,4 156,4 160,4 156,4 160,4 156,4 160,4 156,4 160,4 156,4 160,4 156,4 160,4 156,4	$\begin{array}{c} 0 & 1171 \\ 0 & 1016 \\ 0 & 0848 \\ 0 & 0779 \\ 0 & 2686 \\ 0 & 0676 \\ 0 & 0676 \\ 0 & 0474 \\ 0 & 0422 \\ 0 & 0744 \\ 0 & 0422 \\ 0 & 0744 \\ 0 & 0422 \\ 0 & 0753 \\ 0 & 0256 \\ 0 & 0753 \\ 0 & 0358 \\ 0 & 0753 \\ 0 & 0358 \\ 0 & 0753 \\ 0 & 0358 \\ 0 & 0753 \\ 0 & 0358 \\ 0 & 0753 \\ 0 & 0358 \\ 0 & 0753 \\ 0 & 0358 \\ 0 & 0753 \\ 0 & 0358 \\ 0 & 0753 \\ 0 & 0358 \\ 0 & 0753 \\ 0 & 0358 \\ 0 & 0753 \\ 0 & 0053 \\ 0 & 0053 \\ 0 & 0053 \\ 0 & 0053 \\ 0 & 0053 \\ 0 & 0053 \\ 0 & 0053 \\ 0 & $	4, 2, 1, 9, -0, -1, -2, -2, -3, -4, -5, -7, -8, -9, -9,
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R. 0142 8. 0162 6. 0162 9. 0162 9. 0162 9. 0162 9. 0162 9. 0162 9. 0163 9. 0163 9. 0163 9. 0163 9. 0163 9. 0163 9. 0163 9. 0163 9. 0165 9. 0165 9. 0166	141.6 143.0 144.4 145.9 147.4 149.6 152.2 153.4 155.4 155.4 155.4 165.7 174.9 184.6 194.9 205.7 217.3 229.5 242.4 256.2 272.7 2366.2	0,3233 0,3154 0,5%27 0,2977 0,2977 0,2977 0,2594 0,2594 0,2594 0,2691 0,2691 0,2691 0,2691 0,2641 0,2692 0,2685 0,2685 0,2687 0,2687 0,2689	0 526 0 2529 0 2529 0 2529 0 2531 0 2531 0 2531 0 2531 0 2531 0 2531 0 2533 0 2533 0 2533 0 2533 0 2535 0 2535 0 2535 0 2535 0 2533 0 2533	139,6 144,9 144,2 148,3 152,4 154,4 154,4 158,4 158,4 158,4 168,4 187,1 272,4 2155,4 238,0 251,3 266,1	$\begin{array}{c} 0 & $	1.
2. 2162 C. 0162 0. 0162 0. 0162 0. 0162 0. 0163 0. 0164 0. 2134 0. 2134 0. 2134 0. 2135 0. 2165 0. 2165 0. 0166 0. 0166	143,0 144,4 145,9 147,4 149,0 157,6 157,6 155,4 155,4 155,1 155,1 154,9 184,6 194,9 205,7 217,3 242,4 256,2 278,7 236,2	0,3154 0,3:06 0,3:02 0,2977 0,2932 0,2694 0,2459 0,2859 0,2859 0,2859 0,2859 0,2859 0,2641 0,2641 0,2641 0,2642 0,2642 0,2645 0,2655	0.7529 0.7529 0.7530 0.7531 0.7533 0.75333 0.75333 0.75333 0.75333 0.75333 0.75333 0.75333 0.75333 0.75333 0.75333 0.75333 0.75333 0.75335 0.7535 0.7535 0.7535	144,2 144,2 145,3 158,3 158,4 156,4 156,4 156,4 158,4 160,4 158,4 182,6 191,1 272,0 213,4 238,6 251,3 266,1	$\begin{array}{c} 0, 0686\\ 0, 0676\\ 0, 0274\\ 0, 0420\\ 0, 0420\\ 0, 0329\\ 0, 0291\\ 0, 0291\\ 0, 0291\\ 0, 0291\\ 0, 0291\\ 0, 0291\\ 0, 0291\\ 0, 0253\\ 0, 0368\\ -0, 0218\\ -0, 0201\\ 0, 0201\\ 0, 0201\\ \end{array}$	1,00,-00,-11,-22,-33,-45,-7,-8,-9,-9,-9,-9,-9,-9,-9,-9,-9,-9,-9,-9,-9,
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0, 0162 0, 162 0, 162 0, 2162 0, 2162 0, 2162 0, 2162 0, 2162 0, 2162 0, 2162 0, 2163 0, 2163 0, 2163 0, 2165 0, 21	145.9 147.4 147.4 158.6 158.6 158.4 155.4 155.4 155.4 155.7 174.9 184.6 194.9 205.7 217.3 229.5 242.4 256.2 278.7 236.2	8,3327 9,29377 9,2932 9,2694 9,2694 9,2859 0,2859 0,2778 9,2691 0,2691 0,2641 0,2641 0,2642 0,2645 0,2645 0,2645 0,2647 0,2649	0. 9530 0. 1531 0. 05531 0. 05532 0. 05532 0. 05533 0. 05533 0. 05533 0. 05535 0. 0535 0. 05535 0. 05533 0. 05535 0. 05555 0. 05555000000000000000000000	146,2 148,3 150,4 154,4 158,4 158,4 158,4 160,4 178,6 191,1 272,0 213,4 238,0 251,3 265,3 265,3	$\begin{array}{c} \varphi & 2536 \\ \varphi & 0474 \\ \varphi & 6422 \\ \varphi & 2372 \\ \varphi & 3291 \\ \varphi & 2291 \\ \varphi & 2291 \\ \varphi & 2291 \\ \varphi & 2291 \\ \varphi & 2296 \\ \varphi & 2130 \\ \varphi & 2078 \\ \varphi & $	-0. -1. -2. -3. -4. -5. -7. -7. -8. -9.
U. 2182 0. 2182 0. 2182 0. 2182 0. 2182 0. 2182 0. 2183 0. 2183 0. 2183 0. 2184 0. 2184 0. 2184 0. 2184 0. 2184 0. 2185 0. 2185 0. 2185 0. 2185 0. 2185	147,4 149,0 158,6 152,2 153,4 155,4 157,1 165,7 174,9 184,6 194,9 205,7 217,3 229,5 242,4 256,2 278,7 236,2	P. 2932 Q. 2694 Q. 2859 Q. 2859 Q. 2829 Q. 2859 Q. 2859 Q. 2878 Q. 2878 Q. 2878 Q. 2878 Q. 2878 Q. 2690 Q. 2695 Q. 2695 Q. 2645	0 . 9531 0 . 9531 0 . 9532 0 . 9533 0 . 9533 0 . 9533 0 . 9533 0 . 9535 0 . 9535 0 . 9535 0 . 9535 0 . 9535 0 . 9534 0 . 9534 0 . 9534 0 . 9534	150,3 152,4 154,4 154,4 160,4 178,6 191,1 272,4 213,4 238,6 251,3 265,3 260,1	$\begin{array}{c} 0 & 0 & 47 & 4 \\ 0 & (0 & 42 & 2 \\ 0 & 2 & 37 & 2 \\ 0 & 2 & 37 & 2 \\ 0 & 0 & 2 & 91 \\ 0 & 0 & 2 & 91 \\ 0 & 0 & 2 & 91 \\ 0 & 0 & 2 & 5 & 3 \\ 0 & 0 & 1 & 30 \\ 0 & 0 & 1 & 5 & 3 \\ 0 & 0 & 1 & 5 & 3 \\ 0 & 0 & 1 & 5 & 3 \\ 0 & 0 & 0 & 1 & 5 \\ 0 & 0 & 0 & 2 & 1 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \\ \end{array}$	-1, -2, -3, -4, -5, -6, -7, -7, -7, -8, -8, -9,
U. 2182 0. 2182 0. 2182 0. 2182 0. 2182 0. 2182 0. 2183 0. 2183 0. 2183 0. 2184 0. 2184 0. 2184 0. 2184 0. 2184 0. 2185 0. 2185 0. 2185 0. 2185 0. 2185	149,0 150,6 152,2 153,0 155,4 155,4 155,7 174,9 184,6 194,9 205,7 217,3 249,5 242,4 256,2 278,7 236,2	P. 2932 Q. 2694 Q. 2859 Q. 2859 Q. 2829 Q. 2859 Q. 2859 Q. 2878 Q. 2878 Q. 2878 Q. 2878 Q. 2878 Q. 2690 Q. 2695 Q. 2695 Q. 2645	0 . 9531 0 . 9531 0 . 9532 0 . 9533 0 . 9533 0 . 9533 0 . 9533 0 . 9535 0 . 9535 0 . 9535 0 . 9535 0 . 9535 0 . 9534 0 . 9534 0 . 9534 0 . 9534	152.4 156.4 156.4 158.4 158.4 187.6 191.1 272.0 213.4 238.0 251.3 265.1	0.6422 0.2372 0.7291 0.6256 0.2130 0.0753 0.0308 -0.6718 -0.6718 -0.6718 -0.6718 -0.6718 -0.6718 -0.6721 -0.6721	-1, -2, -2, -3, -3, -4, -5, -7, -7, -7, -7, -8, -8, -9, -9,
C. 9162 0. 9162 0. 9163 0. 9163 0. 9163 0. 9163 0. 9163 0. 9163 0. 9163 0. 9164 0. 9165 0. 9166 0. 9166	150,6 152,2 153,6 155,4 157,1 165,7 174,9 184,6 194,9 205,7 217,3 224,5 242,4 256,2 278,7 236,2	0 2859 0 2829 0 2778 0 2778 0 2778 0 2778 0 2778 0 2778 0 2778 0 2691 0 2641 0 2642 0 2632 0 2635 0 2635 0 2635 0 2637 0 2647 0 2647	0, 4531 0, 6532 0, 6533 0, 6533 0, 6533 0, 6533 0, 6535 0, 6535 0, 7535 0, 7555 0, 75555 0, 75555 0, 75555 0, 75555 0, 75555 0, 7555 0, 7555	152.4 156.4 156.4 158.4 158.4 187.6 191.1 272.0 213.4 238.0 251.3 265.1	0.2372 0.7329 0.2291 0.2256 0.3130 0.0753 0.2008 -0.0075 -0.0078 -0.00	-2. -3. -4. -5. -6. -7. -8. -8. -9.
0.0102 0.9102 0.9102 0.9103 0.9103 0.9103 0.9103 0.9103 0.9103 0.9104 0.9105 0.9105 0.9105	152.2 153.4 155.4 157.1 165.7 174.9 205.7 217.3 229.5 242.4 256.2 272.7 236.2	Q.2829 D.2802 D.2778 N.2691 V.2641 Q.2644 Q.2642 Q.2642 Q.2645 C.2645 C.2645 Q.2645 Q.2647 Q.2647 Q.2647 Q.2649	0,0532 0,0533 0,0533 0,0533 0,0533 0,0535 0,0535 0,0535 0,0535 0,0535 0,0535 0,0535 0,0534 0,0534 0,0534	156,4 158,4 160,4 170,4 182,6 191,1 272,9 213,4 225,4 238,C 251,3 265,3 265,3	0,0329 0.0291 0.0296 0.0130 0.0753 0.00753 0.0078 -0.0718 -0.0718 -0.0718 -0.0718 -0.0718	-2, -3, -4, -56, -7, -7, -8, -8, -8, -9,
0.9182 0.9162 9.9163 9.9163 9.9183 0.9183 0.9183 0.9183 0.9183 0.9184 0.9184 0.9185 0.9186	155,4 157,1 165,7 174,9 184,6 194,9 205,7 217,3 229,5 242,4 256,2 278,7 236,2	Q.2829 D.2802 D.2778 V.2691 V.2641 Q.2614 Q.2614 Q.2612 Q.2600 Q.2605 C.2605 C.2605 C.2645 Q.2645 Q.2647 Q.2647 Q.2649	0,9533 0,4533 0,7534 0,9535 0,9535 0,9535 0,9535 0,2535 0,2535 0,2535 0,9534 0,9534 0,9533	158,4 160,4 170,4 182,6 191,1 272,9 213,4 225,4 238,C 251,3 260,1	0,0291 0,0256 0,0130 0,0753 0,0753 0,0758 -0,0718 -0,078 -0,078 -0,078 -0,078 -0,078 -0,078 -0,078 -0,0718	- 3 - 4 - 5 - 6 - 7 - 7 - 7 - 8 - 8 - 8 - 8 - 9
0,0152 0,0163 0,0163 0,0183 0,0183 0,0183 0,0183 0,0183 0,0183 0,0183 0,0184 0,0182 0,0185 0,0186	155,4 157,1 165,7 174,9 184,6 194,9 205,7 217,3 229,5 242,4 256,2 278,7 236,2	0.2778 0.2691 0.2641 0.2644 0.2644 0.2642 0.2640 0.2645 0.2645 0.2647 0.2647 0.2649	0.4533 0.7534 0.7535 0.7535 0.7535 0.7535 0.7535 0.7535 0.7535 0.7535 0.7534 0.7534 0.7534	160.4 170.4 187.6 272.0 213.4 225.4 238.0 251.3 260.1	0,0256 0,2130 0,0753 0,2008 -0,0753 -0,0753 -0,0758 -0,0758 -0,0759 -0,0759 -0,0759 -0,0759 -0,0759 -0,0751 0,0718	-3, -4, -5, -6, -7, -7, -8, -8, -9, -9,
0,0163 0,0183 0,0183 0,0183 0,0183 0,0183 0,0183 0,0183 0,0184 0,0185 0,0185 0,0186	157.1 165.7 174.9 184.6 194.9 205.7 217.3 224.5 242.4 256.2 272.7 236.2	0.2778 0.2691 0.2641 0.2644 0.2644 0.2642 0.2640 0.2645 0.2645 0.2647 0.2647 0.2649	0.4533 0.7534 0.7535 0.7535 0.7535 0.7535 0.7535 0.7535 0.7535 0.7535 0.7534 0.7534 0.7534	160.4 170.4 187.6 272.0 213.4 225.4 238.0 251.3 260.1	0,0130 0,0753 0,0768 -0,0718 -0,079 -0,0731 -7,0726 -0,0721 -0,0721 0,0718	-4 -5 -7 -8 -8 -8 -9 -9 -9
0.0143 0.0183 0.0183 0.0183 0.0183 0.0183 0.0184 0.0184 0.0185 0.0165 0.0186	165.7 174.9 184.6 194.9 205.7 217.3 229.5 242.4 256.2 278.7 236.2	0,2691 0,2614 0,2614 0,2614 0,2692 0,2690 0,2695 0,2655 0,2657 0,2657 0,2689	0,9535 0,9535 0,9535 0,9535 0,9535 0,9535 0,9534 0,9534 0,9533	182.6 191.1 272.0 213.4 238.0 251.3 265.3 265.3	0.0753 0.2308 -0.0718 -0.0718 -0.0718 -0.0731 -7.0726 -0.0718 -0.0718	- 5 - 6 - 7 - 7 - 8 - 8 - 8 - 9 - 9
P, 0183 e.0183 0, 0183 7, 2194 0, 0184 2, 2184 2, 2184 2, 2185 0, 2185 0, 2185 0, 0186	174.9 184.6 194.9 205.7 217.3 224.5 242.4 256.2 278.7 236.2	6,2641 9,2672 9,2672 7,2600 0,2605 9,2615 9,2615 9,2653 9,2657 9,2689	0,9535 0,9535 0,9535 0,9535 0,9535 0,9535 0,9534 0,9534 0,9533	182.6 191.1 272.0 213.4 238.0 251.3 265.3 265.3	0,2308 -0,6718 -0,6718 -0,6729 -0,6731 -7,6724 -0,6721 -0,67218	-6 -7 -7 -8 -8 -9 -9
2.0183 0.0183 7.2194 0.0184 2.2184 0.2185 0.2185 0.2185 0.2185 0.0186	184,6 194,9 205,7 217,3 229,5 242,4 256,2 276,2 276,2	0,2614 0,2632 0,2635 0,2635 0,2645 0,2645 0,2647 0,2647 0,2689	0,0535 0,0535 0,7535 0,7535 0,7535 0,7535 0,3534 0,7534 0,7534 0,7534	191.1 272.0 213.4 225.4 238.C 251.3 265.3 269.1	•0.0718 •0.0029 •0.0029 •0.0725 •0.0715 •0.0201 •0.0218	-7 -7 -8 -8 -9 -9
0.0183 0.0184 0.0184 2.2184 0.2185 0.2185 0.2185 0.0186 0.0186	194,9 205,7 217,3 229,5 242,4 256,2 278,7 236,2	0,2532 0,2500 0,2505 0,2516 0,2547 0,2647 0,2647 0,2649	0,0535 0,2535 0,2535 0,0535 0,0534 0,2534 0,2534 0,2533	213,4 225,4 238,C 251,3 265,3 260,1	-0,0029 -0,0031 -0,0021 -0,0015 -0,0021 0,0018	-7 -8 -8 -9 -9
0.2194 0.0186 0.2184 0.2185 0.2185 0.2185 0.2185 0.0186 0.0186	205,7 217,3 229,5 242,4 256,2 278,7 286,2	0.2600 0.2605 0.2616 0.2616 0.2617 0.2647 0.2687 0.2689	0,9535 9,0535 9,0535 9,0534 9,9534 0,9533	213,4 225,4 238,C 251,3 265,3 260,1	-0,0029 -0,0031 -0,0021 -0,0015 -0,0021 0,0018	-8 -8 -9 -9
0.0184 2.2134 2.2135 0.2135 0.2135 0.2135 0.0156 0.0156	217.3 229.5 242.4 256.2 278.7 286.2	P.2616 P.2630 Q.2647 D.2667 Q.2669	0,0535 0,0534 0,0534 0,0533	238.C 251.3 265.3 260.1	-4,6226 -0,4215 -0,8221 0,0218	- 8 - 8 - 9 - 9
2,2134 2,2135 0,2135 0,2135 0,2135 0,0156 0,0186	229,5 242,4 256.2 278,7 286.2	0,2630 0,2647 0,2667 0,2689	0,9534 0,9534 0,0533	251 .3 265.3 260.1	-0.4215 -0.2221 0.0218	-8 -9 -9
0,2135 0,2165 0,2165 0,0166 0,0166 0,0186	242,4 256.2 278.7 286.2	0,2630 0,2647 0,2667 0,2689	0,9534 0,9534 0,0533	251 .3 265.3 260.1	-0.0201 0.0018	-9 -9
0,7165 0,2185 0,0156 0,0186	256.2	0,2647 0,2667 0,2689	0.0534 0.0533	265.3	0.0018	- 9
0.0186 0.0186 0.0186	218.1	8,2667 9,2689	0.0533	280.1	0.0018	- 9
0.0156 0.0186	5992	0.26A9				
0,0186					0,0000	- 7,
			8.2531	312.4	0.4561	- 9
0.0187	322.1	0.2737	0.9532	330.0	0,0086	= 9
0,3166	334 7	9.2762	0.0529	348.6	0,0112	- 9
0.2139	358.5	7 2788	0.0526	368.4	0,0140	-10
0.0159	379.5	0.2015	0.0527	389.4	0.0168	- 9
0 0190	401.8	0.2842	0.2526	411.7	0.0197	- 9
0 2193	459.9	0.2696	0 0523	460.4	2.0257	
0.0195	505.6	0.2951	0 0519	515.5	0.0319	• 9
0.0198	569.7	0.32.44	0,0516	577.8	0.2380	- 8
0.0211	641.3	0 3057	0.0512	648.3	0.0442	-6
	7.2.7	8.3108	0.0578	728.0	8,0504	- 5
		0.3158	2.0543	818.3	8,0565	-3,
0.0214	920.1	9.3207	0.0498	920.6	0.0626	-0
0.2218	1039 4	0.3255	0.0492	1036.4	0,8665	3
0.9224		0.3303	0 0486	1167.6	0.0752	7,
0.2230	1329.5	0.3351	0 0480	1316.1	0.4850	13,
		0.3482		1484.2	0,0893	21,
	1705.8	0,3458	0.0465	1674.1	0,0976	31,
0.9251	1934 8	0,3522	0,0457	1848,5	0,1076	46,
	2197 6	0.3603	8.0447	2129.6	0,1265	68,
	2501.6	0,3716	0,0436	2399,0	0,1394	102
	0.0209 0.0214 0.0214 0.0218 0.0224 0.0236 0.0236 0.0243 0.0256 0.0243 0.0256 0.0256 0.0256 0.0256 0.0256 0.0256 0.0256 0.0256 0.0256 0.0256 0.0256 0.0256 0.0256 0.0256 0.0251 0.0256 0.0270 0.0256 0.0270 0.0256 0.02700 0.02700 0.02700 0.02700 0.0270000000000	0,0209 815.1 0,0214 920,1 0,0218 1039,4 0,0224 1175,1 0,2230 1329,5 0,2230 1329,5 0,2230 1329,5 0,2230 1329,5 0,2251 1934,8 0,0251 1934,8 0,0251 1934,8 0,0250 2501,6 ****	0.02:09 815.1 0.3158 0.0214 920.1 9.3207 0.0214 920.1 9.3227 0.0214 920.1 9.3255 0.0224 1175.1 0.3355 0.0234 1329.5 0.3551 0.0234 1329.5 0.3551 0.0251 1934.8 0.3522 0.0251 1934.8 0.3552 0.0260 2197.6 0.3603 0.0270 2501.6 0.3716 *** *** *** X *** *** N FLOW * ***	0.72:39 815.1 0.3158 2.0533 0.0214 920.1 0.3257 0.6498 0.2218 1039.4 0.3255 0.492 0.2218 1079.4 0.3255 0.492 0.224 1175.1 0.3303 0.4486 0.2250 1329.5 0.3351 0.4486 0.2250 1329.5 0.3351 0.4486 0.2250 1329.5 0.3351 0.4486 0.2251 1934.8 0.3522 0.2457 0.2251 1934.8 0.3522 0.4457 0.2260 2197.4 0.3603 0.0447 0.9260 2197.4 0.3716 0.9436 **** **** **** ****	0.02:09 815.1 0.3158 2.0503 818.3 0.0214 920.1 0.3227 0.0496 920.6 0.0218 1039.4 0.3255 0.2492 1036.4 0.0218 1039.4 0.3355 0.2492 1036.4 0.0229 1329.5 0.3351 0.2486 1167.6 0.0230 1329.5 0.3351 0.2480 1316.1 0.0230 1329.5 0.3351 0.2480 1316.1 0.0230 1329.5 0.3458 0.0473 1484.2 0.0251 1934.8 0.3528 0.2477 1888.5 0.0260 2197.6 0.35716 0.2436 2399.6 **** **** **** **** **** **** X **** **** **** **** **** X **** **** **** **** X **** **** **** **** X **** **** **** ****	0.0209 815.1 0.3158 2.0503 818.3 0.0565 0.0214 920.1 0.3207 0.0498 920.6 0.0626 0.0214 920.1 0.3255 0.0498 920.6 0.0626 0.0214 1039.4 0.3255 0.0498 920.6 0.0626 0.0224 1175.1 0.3303 0.0486 1167.6 0.0752 0.0230 1329.5 0.3351 0.0486 1167.6 0.0752 0.0230 1329.5 0.3351 0.0473 1484.2 0.0833 0.0241 1775.8 0.3458 0.0455 1674.1 0.0976 0.0251 1934.8 0.3522 0.0435 1674.1 0.0976 0.0260 2197.6 0.3603 0.0447 2129.6 0.1265 0.0270 2501.6 0.3716 0.0436 2399.0 0.1394

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isolate the causal influences on net migratory flows; while migration is responding to economic conditions, it is also fostering many of them.

Yet, it is important to note that the model does generate oscillations in many of the important growth rates (such as output, employment and population). The same applies to the growth rates of the labor force participation rate which peaks in the first region between the fifth and the eleventh time periods while hitting lows in region two between 75 and 90, and again at the end of the simulation.

Table 3 shows that the actual labor force participation and unemployment rate levels for region two oscillate. Moreover, both regions' rates stay within ranges of values which are entirely reasonable and also consistent. Thus, although we see, from Table 2, that actual levels of population, employment and labor force increase regularly, labor force participation and unemployment rates do not take on implausible values.

Net migration oscillates too. Initially, there exists a net flow of migrants from the advanced to the developing region in which employment opportunities were better (higher employment growth, lower unemployment rate). But as employment opportunities worsen in the developing region, this flow tends to diminish leading to a reversal in the direction of the net flow of migrants between the two regions. But, toward the end of the simulation, the developing region regains a better position and the direction of the net migration flow is once more reversed.

To see how the direction of the net flow of migrants depends on the relative economic conditions of both regions, we can, from equation (9), formulate an expression for the net migratory flow from region 1 to region 2. Substituting (9) into the identity $RNET_t = m_{it}N_{it} - m_{jt}N_{jt}$ leads to

$$\operatorname{RNET}_{t} = \frac{\operatorname{N}_{it}^{N}_{jt}}{\operatorname{N}_{\cdot t}} \left[\alpha_{i} - \alpha_{j} + (\alpha_{i}\beta_{i} + \alpha_{j}\beta_{j}) \left(\frac{\operatorname{e}_{jt}}{u_{jt}} - \frac{\operatorname{e}_{it}}{u_{it}} \right) \right] \quad . \quad (9a)$$

Thus, there is a net flow of migrants from the advanced region to the developing region as long as the difference between the two regional indices appearing in (9a) remains higher than $\frac{\alpha_j^{-\alpha_i}}{\alpha_i\beta_i^{-\alpha_j}\beta_j}$, i.e., 0.064 (see the last two columns of Table 4 for a confirmation of the result). Yet, it must be recalled, that through its effect on regional population growth and through that effect on regional output growth (equation 1), we have a more complex situation than (9a) might imply. In fact, as we have seen, the oscillation of net migration is a response to, as well as a cause of, other fluctuations.

The main point suggested by this simulation is, then, that the two regions' growth rates are induced to also fluctuate, ruling out the possibility of evermore income divergence over the long run. Thus, the demoeconomic extension of the DT model has been the impetus for a non-linear approach which, in turn, has released us from the implausible inexorable income divergence of the DT model.

ADVANTAGES AND DISADVANTAGES OF THE DEMOECONOMIC APPROACH

In compiling a ledger on the demoeconomic approach, we note immediately that linearity and tractable reduced form results, as obtained by DT, are unlikely. On the benefit side, a more believable result is obtained. That is, we should not expect any two regions to settle on steady state growth rates over the long term <u>and</u> our demoeconomic model shows that this will not occur. We have seen that demoeconomics obviates much of the linearity of the DT model. This is so because steady state growth of employment and population could distort the labor force participation rate which is often defined in the model as a residual quantity. By forcing us to reconsider linearity or to respecify labor force participation, the demoeconomic approach aids in model building. As usual, we pay for an increment in realism by surrendering an amount of simplicity. In addition, the inclusion of a transition matrix from interregional demography necessarily introduces difference equations; any demoeconomic model would have to be dynamic. This is surely a benefit as is the notion that, rather than taking migration rates as fixed, we make them endogenous. In fact, the model allows us to observe how migration rates and labor force participation rates interact with each other and with unemployment rates. This allows for a superior analysis of labor markets (it makes them spatial) and job search.

The model did not deal in terms of an age-sex specific breakdown of cohorts, and we did not model the effect that changes in the age compositon would have on the economic variables. That would be the obvious next step. The population does age inexorably and this momentum has well known economic consequences. In fact, the demoeconomic approach also has the potential for introducing age-sex detail into regional economics. Just as regional economists prize the sectoral detail of input-output model results, so ought they to value demographic detail. For example, such detail can give policy makers some idea of how formidable a task regional development or revival are likely to be in specific regions.

Finally, by the proper choice of regions, even the parameters of natural population growth can be made endogenous. What this means is that since the demographic transition seems to be a function of urbanization and since urbanization is endogenous in a demoeconomic model which happens to deal with an urban and rural region (or regions), the natural rate of increase could be made endogenous.

All of this appears to be an important break with the sort of regional modeling that has been done heretofore. We hope that the next few years will witness increasing interest in regional and interregional demoeconomics.

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Appendix 1. Annual growth rates of other economic variables.

	T	× 1	Pl	R 1	W 1		X 2	P 2	R2	W2
	1	2.3469	-2,016d	0.0425	0.0115		0.0371	-0,0114	0.0480	0.0216
	S	0,0481	-1.2167	6, 2430	0,0113		P. \$359	-0.0113	0.0471	0.0209
	3	0.0491	-2.01/2	0 0434	0.0112		0.0349	-0.0111	0.0465	0.0203
	4	0 -100	-2.3176	0.0437	0 2110		0 0341	-P.0110	0 0459	0,0199
	5	0,2505	-2.0168	0 0430	0.0179		0.0335	-0.0110	0.0455	0.0195
	6	0.0510	-1 9163	0 0441	0.0138		0.0330	-0.0109	0.0451	0.0192
	7	0.0514	-0.0185	0 0442	0.0107		8,0326	-0.0109	0.0448	0.0189
	8	0.3517	-0.0188	0 0444	0.0105		0.0323	-0.0109	0.0445	0.0185
	9	U 2521	- (A 1419)	8 2445	0 0105		0.0320	-0.0109	0.0443	0.0184
	10	0.0523	-p x191	B 0446	0.0104		0.0317	-0.0110	0.0441	0.0182
	11	0,0524	-0.8193	0,0447	0.0104		0.0316	-0.0110	0.0440	0.0180
	i.e	A 3526	-0.0194	0 0447	0.0103		0.0314	-0.0110	0.0438	0,0178
	13	0.4527	-3.0196	0 0448	0.0102	· •	0.0313	-0.0111	0.0437	0.0177
	14	0 052A	-0.0197	8 8448	2.0122		0.0312	-9.0111	0.0436	0.0175
	15	0 3529	-0.2198	0 0449	0.0101		0.0311	-0.0112	0.0436	0.0174
	23	0,1557	-0.0535	0 0149	•		0.0310	-0.0115	0.0433	•
	25	N 1529	+H 2204	0 0449	0,0098		0.0311	-0.0118	0.0432	0.0169
	30	0.0527	-0.0204		0.0295		0,0313	-0.0121	0.0433	0.0165
	35	0.0523		0 0449 0 0448	N. 0793		0.0317	-0.0124		0,0162
	40		-0.0207		0.0091				0,0434	0,0159
	45	0,0520 0,0516	-0,4247 -9,4248	0.0447 0.0445	0.0089	· ~ _	0.0320 0.0324	-0,0128	0.0435 0.0437	0.0157
	50				0.0088			-0.0131		0,0156
		2.0311	-1.4568	6 0444	0.0086		0,0329	-0.0134	0.0438	0.0155
	55	0.0507	-9.4208	0,3443	2,0435		0,0333	-0,0137	0,0440	0,0153
	63	0.2503	- P. 02 48	0.8441	0.0083		0.0337	-0.0139	0.0442	0.0153
	65	0.0449	 0.9208 0.9208 	0 6440	0.0082		0.0341	-0,0142	0.0444	0.0152
	70	ព. ១4១5	-0.022B	0.0439	0.0081		0.0345	-0,0145	0.0446	0.0151
	75	0.9491	-3.3208	0 0458	0.0989		0.0349	-0.0147	0.0448	0,0151
	80	0,0438	-2-35	0.0436	0.0079		0.0352	-0.0149	0.0450	0,0150
	85	0.0484	-0.8508	0.9435	6.0078		0,2356	-0.0152	0,0451	0.0150
	90	0.3481	-0.7207	Ø.0434	2.6077		0.0359	-2.2154	0.0453	0.0149
	95	2.2477	-0.7207	0 9433	0.0076		0.0363	-0.0156	0.0455	0.0149
	P 14	j 9 . 2474	-0,1207	0,0432	0.0475	- ·	0.0366	-0.0158	0.0457	0.0149
	i 1 ()	0 ° 340 1	-0.0501	ଥ ୍ୟ 3 ମ	0.0073		0.2373	-0.0162	0.0460	0.0149
-	20	0.0461	-C.C.46	0.0427	0.0371		0.0379	-0.0165	0.0464	0.0148
	30	0.0456	- ¢. 0205	0.0425	0.0070		0.7384	-0.0168	0,0467	0,0148
*	4 ()	0.7453	-1.4245	0 0424	0.0969		0,0393	-0,0172	0,0470	0,0148
-	50	0. 1445	-0.9244	ଥ ୍ୟ ଅନ୍ତି ଅନେକ ଅନ୍ତି ଅନେକ ଅନେକ ଅନେକ ଅନେକ ଅନେକ ଅନେକ ଅନେକ ଅନେକ	0.206 7	•	0.0395	-0,0174	0.0473	0,0148
	60	0. Jaan	-9.8204	0.345N	0.0066		0.0400	-0.0177	0.0476	0.0149
	70	0.0435	-4,0203	0.0018	0.0065		0.0405	-0.0180	0.0479	0,0149
-	80	0 <u>-</u> 1 + 3 4	-1,3203	0.0416	0.0064		0.0418	-0.0185	0.0481	0,0149
-	90	0.3425	-u . 2505	N_0415	0.0065		0.0415	-0.0185	0,0484	0.0149
	00	0,0422	-5. N545	0.0413	0.0061	a second second states are a	0.0420	-0.0188	0.0487	0,0149
	10	0.0415	-3.45-11	M.0411	0.0060		0.0425	-0,2191	0.0490	0.0149
	56	0.0408	-0,0200	0,0408	0.0058		0,4432	-0,0195	0.0494	0,0149
	30	6.0401	-v1.0200	0.3406	r.0056		0.0439	-0,0199	0.0498	0,0149
	49	61.1392	-3,0199	0.0402	0.0053		0,0448	-0.0204	0,0503	0.0149
2	50	0.0379	-0.0197	0.0397	0.0050		0.0461	-0.0212	0.0511	0.0149

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X = EXPORT GROWTH RATE P = PRICE GROWTH RATE R = INNOVATION GROWTH RATE W = WAGE GROWTH RATE

Combining equations (1) through (7) of the first block leads to:

$$E_{\sim}(e_{t}) = (h) + F_{\sim}(n_{t}) + G_{t}(1_{t})$$
(A1)

in which
$$\mathbf{E} = [\mathbf{I} + \Gamma \mathbf{n} \lambda] \mathbf{\mu}^{-1}$$

 $\mathbf{F} = \phi^{1} + \phi^{2}$
 $\mathbf{G}_{t} = \Gamma \mathbf{n} \mathbf{D} (\rho_{t} - \rho^{1} \mathbf{I}) (\rho_{t} - \rho^{r} \mathbf{I})^{-1} + \phi^{2}$
 $(\mathbf{h}) = \Gamma \mathbf{n} [(\tau) + (\mathbf{w}) - (\mathbf{r}) + \mathbf{z} \mathbf{E} (\mathbf{i})]$.

In the second block [equations (8'') and (9'), by substituting (9') in (8''), we have

$$(n_{+}) = (k_{+}) + J_{+}(e_{+})$$
 (A2)

in which
$$J_{t} = \frac{1}{N_{t}} N_{t}^{-1} PN_{t} \alpha N_{t} \beta Pu_{t}^{-1}$$

 $(k_{t}) = (b) - \frac{1}{N_{t}} N_{t}^{-1} PN_{t} \alpha N_{t} \alpha N_{t} (i)$.

Finally, the third block [equations (10), (11') and (12)] yields

$$(e_t) = (n_t) + M_t(1_t)$$
 (A3)

in which

$$M_{t} = I - [U_{t} - u^{r}I] (U_{t} - u^{l}I)^{-1}A^{-1}$$

Thus, our demoeconomic model reduces to a three-equation system in three unknowns such that the coefficients of the endogenous variables are known in each period: they are either constant (independent of time) or depend on lagged variables. Then, by combining (A1) through (A3), it is simple to obtain the three reduced form equations of the model concerning (e_{+}) , (n_{+}) and (1_t):

x

$$(e_{t}) = \left[\underbrace{\mathbf{E}}_{\sim} - \underbrace{\mathbf{F}}_{\sim t} \underbrace{\mathbf{J}}_{t} - \underbrace{\mathbf{G}}_{t} \underbrace{\mathbf{M}}_{t}^{-1} (\underbrace{\mathbf{I}}_{\sim} - \underbrace{\mathbf{J}}_{t}) \right]^{-1} \left[(\mathbf{h}) + \left(\underbrace{\mathbf{F}}_{\sim} - \underbrace{\mathbf{G}}_{t} \underbrace{\mathbf{M}}_{\sim}^{-1} (\underbrace{\mathbf{I}}_{\sim} - \underbrace{\mathbf{J}}_{t}) \right) (\mathbf{k}_{t}) \right]$$

$$(A4)$$

$$(n_{t}) = \begin{bmatrix} E J_{t}^{-1} - F + G_{t} M^{-1} (I - J_{t}^{-1}) \end{bmatrix}^{-1} [(h) + (E) \\ - G_{t} M_{t}^{-1} J_{t}^{-1} (k_{t})]$$

$$(1_{t}) = M_{t}^{-1} [(E - F J_{t}) (I - J_{t})^{-1} - G_{t} M_{t}^{-1}]^{-1}$$

$$(A6)$$

$$\left[(h) + \left(\underset{\sim}{F} + \underset{\sim}{G}_{t} \underset{\sim}{M}_{t}^{-1} \underset{\sim}{J}_{t} - (\underset{\sim}{E} - \underset{\sim}{F}_{J} \underset{\sim}{J}_{t}) (\underbrace{I}_{\sim} - \underset{\sim}{J}_{t})^{-1} \right) (k_{t}) \right]$$

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