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1. Introduction

The Middle Eastern countries were a very attractive destination for migrant workers from Asian countries in the 1970s. However, the Middle East closed the door for foreign labor because of stagnant economy in the 1980s. The major new destination for people in Asia may be Japan in the 1990s.

Japan faced an unprecedented influx of foreign labor from neighboring Asian countries in the 1980s. Ten major migrant-sending countries are NIES (Hong Kong, Singapore, Taiwan, and Korea), ASEAN (Malaysia, Thailand, Philippines, Indonesia), China and India.

In general, poverty and a stagnant economy at a home country are considered main push factors to cause external migration to foreign countries, and prosperity and high growth rates of economy in a destination country are considered important pull factors to induce people migrate from abroad into the country. However, the immigration to Japan reveals a pattern that can not be explained by those conventional classic variables. Why did the immigration take place in the 1980s when the major immigrant sending countries had higher growth rates than Japan who was in a recession because of sudden Japanese yen appreciation, resulting in decrease in
volume of exports and higher unemployment rates? Conventional variables for migration can hardly provide rational explanations for the migration between Japan and ten Asian countries in the 1980s. The answer will be found in the Todaro (1969) model providing a rational explanation for accelerating rural-urban labor migration despite the existence of positive marginal products in agriculture and significant levels of urban unemployment.

It is the purpose of this study to test validity of Todaro model for international labor migration. This model is generally used to explain increasing rural-urban migration within a country in spite of significant levels of urban unemployment.

Section 2 briefly review the Todaro model. Section 3 of this paper reports the results of the test. Finally, Section 4 summarizes the test results and gives the concluding remarks.

2. Brief Review of Todaro Model

The basic push-pull factors model is based on the traditional neoclassical theory that individuals maximize their utilities: individuals move from one country to another for better economic opportunities: they move from areas with low wages to areas with relatively high wages. According to Hicks (1932), "differences in net economic advantages chiefly
differences in wages, are the main causes of migration." While there is no doubt that substantial real wage differences are the important factor (even though they are not the most important) to cause international labor migration, this wage disparity doesn’t give a complete explanation for it. Even though there are large disparities in real income between countries, international labor migration does not necessarily happen. Wage differentials are not necessary and sufficient conditions to cause migration. Obviously, the migrant’s decision-making process is influenced by additional motives. However, the model ignores some influential determinants for the migrant’s decision-making such as costs (monetary and psychic) to migrate to other countries, expected return in the future, and possibility of being unemployed abroad.

The human capital approach has been developed to overcome some shortcomings of the push-pull factors model. The human capital model attributes labor migration to the differences in the present value of all the future net gains from migrating or from staying at home. The model is useful in explaining the direction and the stages of migration - from farm to village, from village to town, from town to city, and the microeconomic of migration: who migrates. However, the model does not give a convincing explanation for persisting migration to urban areas with rising unemployment.

A special type of a human capital approach is the Todaro
model. Todaro (1969), and Harris and Todaro (1970) modified and extended the human capital model to overcome the above mentioned shortcoming: accelerating migration to urban areas with high unemployment rates. Harris and Todaro (1970) pointed out a curious economic phenomenon: despite the existence of positive marginal products in agriculture and significant levels of urban unemployment, rural-urban labor migration not only continues to exist, but indeed, appears to be accelerating. The Todaro model includes for a migrant the probability of being unemployed at the destination place. This new explanatory variable is contrary to the pure neo-classical world where wages and prices are flexible, the labor market is always in equilibrium, and therefore there is no unemployment. We briefly explain their basic idea, referring to Yotopoulos and Nugent (1976).

The urban-rural differential, $\alpha$, is a crucial determinant of the labor supply to the urban sector and a function of the pool of urban unemployment in the migration model. $\alpha$ can be written as,

\[ \alpha = \Pi W - R \]  

where $W$ and $R$ are the urban and the rural wage rate
respectively, and $\pi$ is the probability of obtaining a job in the urban sector in any one period. The probability for a worker to find a job is defined as,

$$\pi = \frac{\gamma N}{S-N}$$

(2)

By substitution, we obtain,

$$a = \frac{WYN}{S-N}$$

(3)

The supply of migrant labor to the urban sector, $S$, a function of the rural-urban differential is,

$$S = f_s(a); \quad \frac{\partial S}{\partial a} > 0$$

(4)

On the other hand, the rate of urban job creation can be expressed as a function of the wage rate and a parameter, $k$, where $k$ is the difference between the rate of industrial output growth and the rate of industrial labor productivity growth. In symbols,

$$\gamma = f_d(W, k); \quad \frac{\partial \gamma}{\partial W} < 0; \quad \frac{\partial \gamma}{\partial k} > 0$$

(5)

We can now determine the increase in the urban labor supply.
resulting from an increase in the labor demand conditions as represented by \( k \), that is, the increase in industrial output net of labor productivity changes,

\[
\frac{\partial S}{\partial k} = \frac{\partial S}{\partial k} \frac{\partial \alpha}{\partial k} \frac{\partial \gamma}{\partial k}
\]  

(6)

By substitution,

\[
\frac{\partial S}{\partial k} = \frac{\partial S}{\partial \alpha} \frac{N}{S-N} \frac{\partial \gamma}{\partial k}
\]  

(7)

Urban unemployment increases if the increase in urban labor supply exceeds the increase in the jobs created, that is, if

\[
\frac{\partial S}{\partial k} > \frac{\partial (\gamma N)}{\partial k} \quad \text{or} \quad \frac{\partial S}{\partial k} > N \frac{\partial \gamma}{\partial k}
\]  

(8)

Finally, we can express the wage differential, \( \alpha \) explicitly in terms of the probability of finding a job, and we write,

\[
\frac{\partial S}{\partial \alpha} \left( \frac{(\pi \omega - R)}{\omega} \right) \frac{1}{\omega} = \frac{(S-N)}{S}
\]  

(9)

\[
\left( \frac{\partial S}{\partial \alpha} \right) \left( \frac{\partial S}{\partial \alpha} \right)
\]  

The elasticity can be viewed as the "migration
response function," that is, the elasticity of rural labor supply to the urban sector with respect to the urban-rural wage differential, properly discounted by the probability of finding a job. As long as the "migration response function" exceeds the urban-rural differential, weighted as above, the migration into the urban sector increases in spite of increasing unemployment rates in the urban. Todaro (1969) clearly concluded about accelerating rural-urban migration in spite of significant levels of urban unemployment that "as long as the urban-rural real income differential continues to rise sufficiently fast to offset any sustained increase in the rate of job creation, then even in spite of the long-run stabilizing effect of a lower probability of successfully finding modern sector employment, the lure of relatively higher permanent incomes will continue to attract a steady stream of rural migrants into the ever more congested urban slums."

Later, Todaro (1986a, 1986b) expanded his original model focusing on international labor migration from developing countries to developed countries. The idea behind the various Todaro models is that the decision to migrate depends on the expected relative income differential between the place of origin and the foreign destination. The expected income differential, in turn, depends on actual income differentials, the cost of migration and the probability of employment. In
his decision-making process, a migrant chooses the destination that maximizes the discounted present value of the expected net gains of his labor.

Formulated in mathematical terms Todaro's basic idea can be written as:

\[ V_f(0) = \sum_{t=0}^{n} P_f(t) Y_f(t) e^{-rt} dt - C_m \]  \hspace{1cm} (10)

\[ V_h(0) = \sum_{t=0}^{n} P_h(t) Y_h(t) e^{-rt} dt \]  \hspace{1cm} (11)

where \( V_f \) and \( V_h \) are discounted present values in the destination country and at home, respectively, \( P_f \) and \( P_h \) are for a migrant the probabilities of having a job in the destination country and at home, respectively, \( Y_f \) and \( Y_h \) are actual (or average) income in the destination country and at home, respectively, \( r \) is the rate of time preference, and \( C_m \) is the cost of migration. Then the discounted present value of the net gain from moving abroad is expressed as:

\[ \alpha(0) = V_f(0) - V_h(0) \text{ at } t=0 \]  \hspace{1cm} (12)

If \( \alpha(0) > 0 \), the economically rational potential migrant will decide to move abroad. Assuming a one-period time horizon,
then, the migration function can be expressed as:

\[ M = \phi(\alpha) = \phi(V_t - V_h) \]

\[ = \phi[P_f(U_t) Y_t - C_p(U_h) Y_h] \]  \hspace{1cm} (13)

where \( \phi(0) = 0 \), \( U_t \) and \( U_h \) are the unemployment rates in the destination country and at home, respectively. Here, we assume that the probabilities of having a job in the destination country and at home are functions of the unemployment rates in the destination country \( (U_t) \) and at home \( (U_h) \), respectively.

The Todaro model for international labor migration can be interpreted as stating that the level of migration is a function of both the wage differential between countries and the probability for a migrant to get a job in a destination country.

Lundborg (1991) examined the labor flows of Nordic immigrants to Sweden during the period 1968 to 1985, and found that the differences in the level of real wages, unemployment rates between the destination and the origin are important, and that unemployment rate at destination stands out as an essential determinant for all groups of migrants. Heijke (1987) also confirmed the importance of income disparities, job opportunities in the receiving country in the study of the migration flows between the Mediterranean area.
and North-west Europe.

3. Empirical Testing

On a macroeconomic level, the magnitude of international labor migration depends on mainly wage differentials and labor market conditions in a country of origin and destination. We use GNP per capita of each country as a proxy for wage of each country. By formulating the migration equation based on the neoclassical push-pull factors approach,

$$LM_{it} = \alpha_i + \beta_1 YJ_{it} + \beta_2 YH_{it} + \beta_3 UJ_{it} + \beta_4 UH_{it} + \epsilon_{it}$$  \hspace{1cm} (18)

or

$$LM_{it} = \alpha_i + \beta_1 YDk_{it} + \beta_2 UDk_{it} + \epsilon_{it}$$  \hspace{1cm} (19)

where

- $LM_{it}$ = the logarithm of magnitude of gross migration from country $i$ to Japan, in year $t$,
- $YJ_{it}$ = the per capita income of Japan in year $t$,
- $YH_{it}$ = the per capita income of country $i$ in year $t$,
- $UJ_{it}$ = the unemployment rate of Japan, in year $t$,
- $UH_{it}$ = the unemployment rate of country $i$, in year $t$,
- $YD1_{it}$ = $YJ_{it} - YH_{it}$ = standardized difference in the income per capita of Japan ($YJ_{it}$) and of origin countries ($YH_{it}$),
YD2_{it} = YJ_{it} / YH_{it} = standardized ratio in the income per capital of Japan (YJ_{it}) and of the origin countries (YH_{it}),

UD1_{it} = UJ_{it} - UH_{it} = difference in the unemployment rate of Japan (UJ_{it}) and of the origin countries (UH_{it}),

UD2_{it} = UJ_{it} / UH_{it} = standardized ratio in the unemployment rate of Japan (UJ_{it}) and of the origin countries (UH_{it}),

α_i = dummy variable for cross-sectional unit

k = 1 or 2.
i = 1, 2,...,10,
t = 1, 2,...,15.

This is a push-pull approach including only the very basic, but the most important motives of individual migration derived from a microeconomic view as explanatory variables. The other possible non-economic variables are excluded in this model such as distance, language, religion, etc.

We test the validity of these macroeconomic model specifications empirically by ordinary least squares method, using panel data for ten Asian-Pacific countries over the period 1976 to 1990. Assuming that differences across countries can be captured in differences in the constant term, this model is referred as the least squares dummy variable
We measure the empirical relevance of these push-pull factors by looking at the statistical significance of independent variables. We expect that gross migration level is directly related to the unemployment rate in the origin countries, the income per capita in Japan, and the difference or ratio in the income per capita of Japan and origin countries, and inversely related to the unemployment rate in Japan, the income per capita in the origin countries, and the difference or ratio in the unemployment rate between Japan and origin countries.

Straubhaar (1988) incorporated Todaro's basic microeconomic idea into a simple aggregated form, arguing that if people move to maximize their expected gains from migration or stay, where the expected gains are measured by the ratio between real income abroad and at home weighted by the probability of a new migrant obtaining a higher paid job, the aggregated Todaro migration equation should be written as,

\[ M_{it} = f(TOD_{it}) \]  

(20)

where

\[ TOD_{it} = (1-U_{jt}) \times \frac{Y_{jt}}{Y_{H_{jt}}} \]  

(21)
We calculate two TODs different from the above, and regress three TODs separately on LM, using LSDV model. The other TODs are as follows.

\[
TOD_{2it} = \frac{1}{UJ_{it}} \cdot \frac{YJ_{it}}{YH_{it}}
\]  
(22)

\[
TOD_{3it} = YJ_{it} \cdot (1-UJ_{it}) - YH_{it} \cdot (1-UH_{it})
\]  
(23)

We would expect that the migration is directly related to the Todaro indexes (TOD, TOD2, TOD3). In this simplified form the Todaro model differs from a basic push-pull approach only by combining the independent variables, analyzed separately in the push-pull approach, into a single composite index.

Results

The empirical results of regressing the migration flows (LM) on the independent variables show the following signs for the estimated coefficients (see Table 1).

By looking at the single explanatory variables, we can see that the unemployment rates at home and in Japan show unexpected signs. Neither the "push" nor "pull" effects of changing unemployment rates at home and Japan were useful in explaining changes in the migration flows. For the "push" effect of the changes in the GNP per capita at home and the
"pull" effect of the changes in the GNP per capita in Japan show the expected signs. However, the former is not statistically significant at 10% level, while the latter is statistically significant at 1% level.

The income gap characterizing variable (YD1 and YD2) shows that expected sign at 1% level of significance in any models. The variable characterizing the unemployment rate difference (UD1 and UD2) shows that expected signs, but none of them are statistically significant.
Table 1. Empirical Significance for the Model-Characterizing Variables

(Period: 1976-1990, estimation technique: OLS, indicated are the T-values only, model: one-way LSDV model)

<table>
<thead>
<tr>
<th>Dependent variable: LM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent variable</strong></td>
</tr>
<tr>
<td><strong>Expected sign</strong></td>
</tr>
<tr>
<td><strong>T-values</strong></td>
</tr>
<tr>
<td><strong>Significance</strong></td>
</tr>
<tr>
<td><strong>R²</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent variable</th>
<th><strong>YD1</strong></th>
<th><strong>UD1</strong></th>
<th><strong>YD1</strong></th>
<th><strong>UD2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expected sign</strong></td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td><strong>T-values</strong></td>
<td>9.608</td>
<td>-0.440</td>
<td>10.214</td>
<td>-1.075</td>
</tr>
<tr>
<td><strong>Significance</strong></td>
<td>***</td>
<td>***</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td><strong>R²</strong></td>
<td>0.864</td>
<td>0.865</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent variable</th>
<th><strong>YD2</strong></th>
<th><strong>UD1</strong></th>
<th><strong>YD2</strong></th>
<th><strong>UD2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expected sign</strong></td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td><strong>T-values</strong></td>
<td>4.306</td>
<td>-0.776</td>
<td>5.002</td>
<td>-0.538</td>
</tr>
<tr>
<td><strong>Significance</strong></td>
<td>***</td>
<td>***</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td><strong>R²</strong></td>
<td>0.796</td>
<td>0.796</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent variable</th>
<th><strong>TOD</strong></th>
<th><strong>TOD2</strong></th>
<th><strong>TOD3</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expected sign</strong></td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>T-values</strong></td>
<td>5.027</td>
<td>3.314</td>
<td>10.198</td>
</tr>
<tr>
<td><strong>Significance</strong></td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td><strong>R²</strong></td>
<td>0.795</td>
<td>0.758</td>
<td>0.755</td>
</tr>
</tbody>
</table>

*** = significant at the 1% level

Note) When a coefficient has an unexpected sign, a two-tail test of the null hypothesis is applied and we will use a one-tail test otherwise.

The push-pull factors approach does well in explaining migration flows from Asian countries to Japan.

By looking at the sign of the coefficient for the Todaro-
model-characterizing variables TOD, TOD2, TOD3, we can see that the all of them have the expected sigh at 1% level of significance, and TOD3 has the highest t-value.

Interpretation of Results

All variables characterizing unemployment have the unexpected signs or insignificant coefficients. These unexpected signs or insignificant coefficients on an unemployment rate variable in explaining migration confirms the findings of several empirical studies on internal labor migration. Some possible causes for this finding can be attributed to the use of total migration as a proxy for labor force migration or the ignorance of individual characteristics of the migrants like age or education. In this study on international migration, we focus on migrants as an economic institution, not on individual migrants. Therefore, the economic characteristics of them are expressed by aggregates. As a result, the quality of the empirical results depends on the extent to which simplifying assumptions correspond to reality. Many studies have demonstrated that the disaggregation of migrants by types (age, sex, race and marital status) lead to significantly different conclusions. It is also possible to find the answer to this unexpected phenomenon in the Todaro (1969)'s explanation for continuous and accelerating migration flows from rural to urban despite
high unemployment in urban areas. The results show that the
Todaro's model is applicable to international labor migration,
too. In fact, Japan's higher unemployment rates in the late of
1980s did not affect negatively migration flows from Asian
countries.

The results show that the income in Japan and the income
differences are very important factors to explain migration as
expected by theory.

Among TOD variables, TOD3 is statistically significant
with highest t-value. The result suggests that migration
change is attributed to the expected net gains in year t from
migration to Japan, calculated by [the probability of
obtaining a higher paid job (measured by (1-UJt ), the
employment rate in Japan in year t), times the income per
capita in Japan] - [the probability of obtaining a job
(measured by (1-UHt ), times the income per capita at home].

4. Conclusion

This paper investigated the effectiveness of the Todaro
model for international labor migration. The paper used the
LSDV (least square dummy variables) model, utilizing panel
data for ten major migrant-sending countries over the period,
1976 to 1990. The results found in the push-pull factors
model that income gaps between countries were essential
factors to cause migration, but unemployment rates were not.
This study proved the validity of the Todaro model for international labor migration: as long as the income differential between countries continues to rise sufficiently fast to offset any sustained increase in the rate of job creation, then even in spite of the relatively high unemployment rates at a destination, the lure of relatively higher incomes will continue to attract a steady stream of migrants from Asian countries.

The following suggestions are made to extend the present study. In this paper, wage rates and unemployment rates were treated as exogenous variables. But those variables are also affected by international migration. Hence it would be appropriate to develop a model based on simultaneous equations model including equations for labor mobility, income and unemployment rates.
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