The Simple Analytics of Neoclassical Growth with Migration

Luca Correani, Fabio Di Dio, Stefano Patrì
Working Papers

The working paper series promotes the dissemination of economic research produced in the Department of the Treasury (DT) of the Italian Ministry of Economy and Finance (MEF) or presented by external economists on the occasion of seminars organized by MEF on topics of institutional interest to the DT, with the aim of stimulating comments and suggestions. The views expressed in the working papers are those of the authors and do not necessarily reflect those of the MEF and the DT.

© Copyright:

2011, Luca Correani, Fabio Di Dio, Stefano Patri.

The document can be downloaded from the Website www.dt.tesoro.it and freely used, providing that its source and author(s) are quoted.
The Simple Analytics of Neoclassical Growth with Migration

Luca Correani (†), Fabio Di Dio (**) e Stefano Patrì (***)

Abstract

This paper investigates the economic consequences of migration in the Ramsey-type dynamic optimizing context. In contrast to Hazari and Sgro (2003) conclusions, we show that with a Cobb-Douglas production function migration unambiguously reduces per-capita domestic consumption growth, whereas necessarily raises the long-run per-capita consumption of domestic residents when production is “sufficiently” capital intensive. Our findings are supported by several empirical studies and confirmed by simulation analyses in an international context, suggesting that changes in technological adjustment in response to migrants inflows may take some years to translate into productivity, generating some crowding out effects. The gains for natives materialize in the long run when the specialization of natives adjusts, firms invest in capital and adopt appropriate technologies.

Key words: Migration, Domestic consumption, Growth

JEL classification: F2, 04

1. Introduction

In recent years, policy-makers of many countries are increasingly concerned about growing migration pressure from developing countries. In fact, the rapid growth of population, changes in geo-political structure and the wide inequality in income have led to a rapid increase in the number of migrants from emerging economies to advanced ones (Hanson, 2006, 2010; Hanson and McIntosh, 2010). In some cases migrant-receiving countries must maintain a delicate balance between economic needs, that would involve a beneficial increase of workforce of an ageing population no longer willing to accept unskilled works, and the political commitment that typically results in high restrictive migration policies. Then, the need of understanding this mounting phenomenon has gained a remarkable revival of interest in these issues, answering to questions concerning the migrants flows determinants, economic causes and features, and its effect on welfare. As such, literature about this topic has consequently grown rapidly (Borjas, 2003; Hanson, 2009; Peri, 2009). In addressing these issues, the literature has examined

(†) Department of Economics and Management, Tuscia University, Viterbo, Italy. E-mail: correani@unitus.it.
(**) Consip S.p.A., Department of Public Finance, Macroeconomic Modelling Unit, Rome, Italy. E-mail: fabio.didio@tesoro.it.
(***) Department of Methods and Models for Economics, Territory and Finance, Sapienza University, Rome, Italy. E-mail: stefano.patri@uniroma1.it.
in particular whether in the high-migrants countries consumption grows more rapidly (after controlling for the determinants of their steady state) than in relatively low-migrants countries (Barro and Sala-i-Martin, 2004; Palivos and Yip, 2007; Palivos, 2009)), and whether there is an empirical long-run relationship between domestic welfare effect and the substitution of input productive factors (Quibria and Islam, 2010; Ottaviano and Peri, 2006, 2008).

In this paper we reexamine the welfare effect of immigration developed by the preliminary and pioneering study of Hazari and Sgro [The simple analytics of optimal growth with illegal migrants, Journal of Economic Dynamics and Control 28 (2003), 141-151] and afterward reviewed by Moy and Yip [The simple analytics of optimal growth with illegal migrants: a clarification, Journal of Economic Dynamics and Control 30 (2006), 2496-2475].

Hazari and Sgro (2003) develop a Ramsey-type model to show that migration necessarily lowers the per-capita domestic consumption if migrants and domestic residents are perfect substitutes in production.

In the Moy and Yip (2006) reexamination, the welfare effect (i.e., the effect on per capita domestic consumption) of migration is instead ambiguous as result from the influence of two opposing effects: an intra-temporal positive effect (exploitation effect) and a negative inter-temporal effect. However, in both cases, they state that per capita domestic consumption growth rises as result of migrants in the case of Cobb-Douglas production technology. In contrast to this finding, we show a negative short-run relation between per-capita consumption growth and migrant labor. In fact, using a Cobb-Douglas production technology in intensive form, which corresponds to the empirical relevant case of imperfect substitution between foreign and domestic labor (see Borjas, et al., 2008; Ottaviani and Peri, 2006), we find that in presence of migration, per-capita consumption growth is lower than in absence of migration; however, the long-run effect of migration on per-capita domestic consumption is positive when production is “sufficiently” reactive to capital. So, in this context, economies with a higher elasticity of capital receive wider benefits from the migration flows. We provide an economic interpretation to these results: the changes in specialization, investment response, technological adjustment, innovation as response to migrants inflows may take some years to translate into productivity, generating some crowding out effects, more competition and costs even if it has long-run benefits. The gains for natives materialize in the long-run when the specialization of natives adjusts, firms invest in capital and adopt appropriate technologies (Ortega and Peri, 2009). Our analytical results are supported by several empirical and theoretical studies, that the effect on per-capita consumption growth is negative in the short run and that migration flows facilitate the growth of capital-intensive economies in the long run (see Ho, 2007; Peri and Sparber, 2009). Furthermore, other studies using simulations to assess the effects of migration on domestic consumption find that migrants can generate significant welfare gains for the natives in the long run (Ho, 2007; Liu, 2010). Our contribution departs from the current literature under several respects.

First, unlike the previous studies of Hazari and Sgro (2003) and Moy and Yip (2006), we explicitly consider the effect of migration on both short- and long-run period. In fact, in Hazari
and Sgro (2003) there is not an explicit analysis of long-run per-capita consumption in the context of imperfect substitution of workers but really they address the relationship between migration and short-run consumption growth rate (see Hazari-Sgro (2003), pag. 150); on the contrary, in Moy and Yip (2006) the only steady-state relationship between consumption and migrants is analyzed in the case of perfect substitution between workers.

Our contribution generalizes and complements some results of the papers cited above. In particular, we generalize the case of perfect substitution between foreign and domestic labour to the case of imperfect substitution by using an intensive form of Cobb-Douglas production function. Furthermore, we extend the analysis to the long period generalizing and integrating in one model the results of both the previous contributions.

Finally, while the previous studies examine only theoretically the impact of migrant workers on domestic consumption, the current study complements the theoretical analysis providing some empirical evidence and literature widely supporting our results. The remainder of paper is organized as follows.

Section 2 describes the Ramsey model augmented with migrants illustrating the theoretical structure (subsection 2.1) and then analyzing the equilibrium properties in the short and long run (subsection 2.2). In doing so, we explore the main differences with the basic Ramsey growth model (proposition 1 and 2). Section 3 is devoted to empirical evidence in order to support our results and section 4 concludes the paper.

2. The one-sector model with migration

In this section we compare the standard version of Ramsey growth model (basic Ramsey model, BRM) with an augmented Ramsey model with migrant workers.

We first develop a Ramsey growth model which incorporates migrant workers (paragraph 2.1); then, in order to compare it to the Ramsey-one-sector model without migration, we find the equilibrium conditions (in the short as well as in the long period) in the two models (paragraph 2.2). As in the models developed by Hazari-Sgro (2003) and Moy-Yip (2006) we use a Cobb-Douglas production function in an intensive form, and we conclude that per-capita domestic consumption growth unambiguously decreases with migration (short-run effect) and that the long-run per-capita consumption of resident workers increases with migrants if the elasticity of capital is “sufficiently” high. In fact, we find that there is a long-run positive relationship between per-capita domestic consumption and elasticity of capital.
2.1. Theoretical basic structure

We consider a one-sector growth optimizing model of Ramsey type. The economic system produces a single commodity $Y$ using capital, native and foreign labor. The aggregate production function shows constant return to scale in physical capital $K$, native labor $L$ and migrant workers $M$ with diminishing returns of factors:

$$ Y = f(K, L, M). $$

We note that in this formulation the production function assumes imperfect substitution between migrant and domestic labor as they enter as separate factors of production. The intensive form of the aggregate production function links output to the productive inputs in term of total labor and can be expressed as:

$$ y = f(k, l, m), $$

where $y$ denotes the per capita output, i.e. $y = Y/(L + M)$, $k$ is the capital intensity, i.e. $k = K/(L + M)$, $l$ is percentage of domestic workers on total workforces, i.e. $l = L/(L + M)$, and $m$ the percentage of migrants workers on total workforces $m = M/(L + M)$.

We assume that foreign workers are paid less than native workers because of labor market duality reflecting relative disadvantages of the migrants (skill, language etc.) in specific national labor markets. Indeed, segmentation characterizing labor markets in advanced industrial economies is to a large extent due to the inherent duality between domestic and foreign workers (see among others, Aydemir and Borjas, 2011). This dualism is likely to induce systematic wage differentials for the two groups of workers (native and foreign born). In such a case we have:

$$ w_m = \beta w, \quad \text{with} \quad 0 < \beta < 1 $$

where $w_m$ and $w$ are, respectively, the migrants wage and the domestic wage, and $\beta$ captures institutional features and policies implemented in the host country as well as other factors which determine wage differential.

Following Hazari-Sgro (2003) and Moy-Yip (2006) we assume that migrants do not save nor accumulate capital so that the resource constraint is:

$$ C = Y - \dot{K} - \beta w M, $$

where $C$ is domestic consumption and the dot notation represents the time derivative.

Dividing by $L + M$ the constraint in (4) and rearranging the terms it becomes:

$$ lc = y - \frac{\dot{K}}{L + M} - \beta w m, $$

where $c = C/L$ is the per capita domestic consumption.
In this context the firm profits are given by:

\[ \Pi = f(k, l, m) - rk - wl - \beta wm, \]  

(6)

where \( r \) denotes the rental interest on per capita capital \( k \), \( wl \) and \( \beta wm \) are respectively the per capita wage bill of domestic and migrant workforces.

Profit maximization produces the following conditions:

\[ f_k(k, l, m) = r, \]  

(7)

\[ f_l(k, l, m) = w, \]  

(8)

\[ f_m(k, l, m) = \beta w, \]  

(9)

where \( f_k, f_l, f_m \) are, respectively, the marginal product of capital, domestic and migrant labor.

Given the homogeneity of the production function we can apply the Euler theorem and write:

\[ f(k, l, m) = kf_k + lf_l + mf_m, \]  

(10)

By using formula (10) we can compact the equations (7), (8) and (9) as follows:

\[ w = \frac{f(k, l, m) - kf_k}{l + \beta m}. \]  

(11)

As in Hazari and Sgro (2003) we assume that the flow of migrants into the economy follows the rule\(^1\):

\[ \dot{M} = (\beta w - w_0)^\xi, \]  

(12)

where \( 0 < \xi < 1 \) and \( w_0 \) is the reservation wage in the country of origin.

The growth equation for domestic workers is:

\[ L = Loe^{nt}, \]  

(13)

which implies a positive and constant growth rate of domestic labour force \( \dot{L}/L = n \), with \( 0 < n < 1 \).

As in Hazari and Sgro (2003)\(^2\) when the migration ceases in the long run, the migrant population grows at the same rate as domestic: \( \dot{M} = M_0e^{nt} \).

By using the time derivative of \( k = K/(L+M) \), after some algebra we obtain \( \dot{K}/(L+M) = \dot{k} + k (\dot{L} + \dot{M})/(L+M) \). Substituting it into the resource constraint (5) and rearranging it, we have:

\[ \dot{k} = f(k, l, m) - k g(t) - lc - \beta wm, \]  

(14)

---

\(^1\)We use this assumption to have a suitable comparison to the case of perfect substitution of Hazari and Sgro. However, we note that, in the case of imperfect substitution, Hazari and Sgro change it (see Hazari and Sgro (2003), formula (28), pag. 148).

\(^2\)Hazari and Sgro (2003), pag 145.
where

\[ g(t) = \frac{L + M}{L + M} \approx n. \]  

(15)

We are now ready to formulate the optimization problem of the representative domestic household in the Ramsey tradition (1928):

\[ \max_c \int_0^\infty e^{-\rho t} U(c) \, dt, \]  

(16)

such that \[ \dot{k} = f(k, l, m) - kn - lc - \beta wm, \]  

(17)

\[ k(0) = K_0, \]  

(18)

\[ 0 \leq c \leq f(k, l, m), \]  

(19)

The Hamiltonian associated to this problem is:

\[ H = e^{-\rho t} U(c) + \lambda [f(k, l, m) - kn - lc - \beta wm], \]  

(20)

from which, by applying the maximum principle, we derive the following first order conditions:

\[ e^{-\rho t} U'(c) - \lambda \dot{l} = 0, \]  

(21)

\[ \dot{\lambda} = -\lambda \left[ f_k - n + \frac{\beta M}{L} k f_kh \right], \]  

(22)

where in the condition (22) we used the equation (11) and the approximation:

\[ \frac{\beta m}{l + \beta m} \approx \frac{\beta M}{L}, \]  

which holds if we have the reasonable condition: \( M/L \ll 1 \).

Differencing the equation (21) with respect to time and substituting \( \lambda \) and \( \dot{\lambda} \) into equation (22), we have the following equation:

\[ \frac{\dot{c}}{c} = \frac{f_k - \rho - n + \frac{\beta M}{L} k f_kh}{\eta(c)}, \]  

(23)

where \( \eta(c) = -cU''(c)/U'(c) \). The equation (23) and equation (14) together constitute a dynamical system in \( c \) and \( k \) of Ramsey model augmented with migrant labor. In order to compare the condition in (23) to the zero migration case (basic Ramsey model) in the short- and the long-run, note that

\[ g(t) = \frac{L/L + M/L}{1 + M/L} = \frac{n + M/L}{1 + M/L}. \]  

From the reasonable assumption that \( M/L \ll 1 \), it follows: \( 1 + M/L \approx 1 \) and \( M/L \approx 0 \).
long-run period we use a Cobb-Douglas production function and a special case of a constant elasticity of substitution utility function. Hence, we first compare the growth rate of consumption (23) with migrant workers to assess whether it is higher or lower than the solution without migration; then we explore the solution in the long period (i.e., when \( \dot{c} = 0 \)), to assess whether the presence of migrant workers is able to increase the long-term per-capita consumption.

2.2. Equilibrium analysis in the short and long run period

The analytical form of a Cobb-Douglas production technology with migrants in intensive form is:

\[
f(k,l,m) = k^{\delta} l^{\rho} m^{1-\delta-\rho},
\]

(24)

with \( \delta, \rho \in (0,1) \) and \( \delta + \rho \leq 1 \). Following Hazari and Sgro (2003), we use a standard Constant Relative Risk Aversion (CRRA) utility function:

\[
U(c) = \frac{c^{1-\alpha}}{1-\alpha},
\]

(25)

where \( \alpha \in (0,1) \).

By using these analytical forms explicitly, we can rewrite the equation in (23) in the form:

\[
\frac{\dot{c}}{c} = \frac{(\delta - h_1) \gamma_1 k^{\delta-1} - \rho - n}{\alpha},
\]

(26)

and using the equation (11) we can write the aggregate constraint (14) as:

\[
\dot{k} = \gamma_1 k^{\delta} \left(1 - \frac{h_1}{\delta}\right) - kg(t) - lc,
\]

(27)

where \( h_1 := \beta \delta (1 - \delta) M/L \) and \( \gamma_1 := \rho m^{1-\delta-\rho} \).

The case without migration (in the basic Ramsey model (BRM), i.e. where there is a single type of workers) produces the following condition on consumption growth rate 4:

\[
\frac{\dot{c}}{c}_{_{BRM}} = \frac{\delta k^{\delta-1} - \rho - n}{\alpha}.
\]

(28)

Now we are ready to make a comparison between the equations (26) and (28). The results are summarized by the following proposition:

---

4The solution for capital equation in the basic Ramsey model is: \( \dot{k} = k^\delta - nk - c \). See Barro and Sala-i-Martin (2004) for the development of a standard Ramsey model. We note that in Hazari and Sgro (2003), their model solution in (30) does not reduce to standard Ramsey model as they state in their paper (for more details, see Hazari and Sgro (2003), pag. 150).
**Proposition 1.** Over the transitional path towards the steady state, the growth rate of per capita consumption in the basic Ramsey model is ever higher than the growth rate of per capita consumption in the model with migrant workers.

**Proof:** we have to prove that:
\[
\left. \frac{\dot{c}}{c_{BRM}} \right|_{\delta} > \left. \frac{\dot{c}}{c} \right|_{\alpha},
\]
(29)
or equivalently that:
\[
\left. \frac{\dot{c}}{c_{BRM}} \right|_{\delta} = \frac{\delta k^\delta - \rho - n}{\alpha > \frac{(\delta - h_1)\gamma k^{\delta-1} - \rho - n}{\alpha},
\]
(30)
from which, after some simplifications, we have:
\[
\left. \frac{\dot{c}}{c_{BRM}} \right|_{\delta} = \delta k^\delta > (\delta - h_1)\gamma k^{\delta-1}.
\]
(31)
Because the following relations hold by construction:

1. \( \delta > h_1 \)
2. \( \gamma_1 \ll 1 \)
   given that:
\[
\gamma_1 = \frac{L^\theta M^{1-\delta-\theta}}{(L + M)^{1-\delta}} = \left( \frac{M}{L + M} \right)^{1-\delta} \left( \frac{M}{L} \right)^{-\theta} \approx \left( \frac{M}{L} \right)^{1-\delta-\theta} \ll 1
\]
we discover that the inequality in (29) must hold. □

In this proposition we are comparing growth rates along the stable arm; in fact, it is not a comparison between growth rates in steady state, as usual in endogenous growth theory. Therefore, proposition 1 involves a short-run relationship between two different growth rates of consumption.

A long-run relationship is now studied comparing the steady-state consumption values in the two models, as fixed in proposition 2 below. Imposing \( \dot{c} = 0 \) and \( \dot{k} = 0 \) in (23) and (27) we obtain the steady state value of per capita consumption with migrants:5
\[
c^* = \frac{1}{l} \gamma_2^{\frac{1}{\delta-\theta}} \left\{ \left( \frac{\delta - h_2}{\rho + n} \right)^{\frac{1}{\delta-\theta}} \left( 1 - \frac{h_2}{\delta} \right) - n \left( \frac{\delta - h_2}{\rho + n} \right)^{\frac{1}{\delta-\theta}} \right\} := \frac{1}{l} \gamma_2^{\frac{1}{\delta-\theta}} \cdot \Gamma,
\]
(32)
where \( \Gamma \) is defined as:
\[
\Gamma := \left( \frac{\delta - h_2}{\rho + n} \right)^{\frac{1}{\delta-\theta}} \left( 1 - \frac{h_2}{\delta} \right) - n \left( \frac{\delta - h_2}{\rho + n} \right)^{\frac{1}{\delta-\theta}}.
\]

5It is worth to remember that, in the long run, \( M = M_0 e^{\pi t} \) and \( \gamma_1 \) becomes \( \gamma_2 = \frac{L^\theta M_0^{1-\delta-\theta}}{(L + M_0)^{1-\delta}} \) and \( h_1 \) becomes \( h_2 = \beta \delta (1 - \delta) M_0 / L_0 \). We also have that \( t = \frac{L_0}{L_0 + M_0} \).
while the steady state value of consumption obtained in the basic Ramsey model without migration is:

\[
c^* = \left( \frac{\delta}{\rho + n} \right)^{\frac{1}{1-\delta}} - n \left( \frac{\delta}{\rho + n} \right)^{\frac{\delta}{1-\delta}}.
\]  

(33)

The comparison between \(c^*\) and \(c_{BRM}^*\) produces the following result:

**Proposition 2.** When production is “sufficiently” capital intensive (i.e., \(\delta\) is “sufficiently” high), the steady state per-capita consumption with migrant workers is higher than the steady state per-capita consumption in the basic Ramsey model. In other words: there exists a threshold \(0 < \tilde{\delta} < 1\) such that \(c^* > c_{BRM}^*\) for every \(\delta < \tilde{\delta} < 1\).

**Proof:** we have to prove that:

\[
\lim_{\delta \to 1} c^* > \lim_{\delta \to 1} c_{BRM}^*,
\]

or equivalently that:

\[
\lim_{\delta \to 1} \left[ \frac{1}{\tilde{\delta}^{\frac{1}{1-\delta}}} \cdot \Gamma \right] > \lim_{\delta \to 1} \left[ \left( \frac{\delta}{\rho + n} \right)^{\frac{\delta}{1-\delta}} - n \left( \frac{\delta}{\rho + n} \right)^{\frac{\delta}{1-\delta}} \right].
\]

(35)

To do so, we observe that:

(i) \(\frac{1}{\tilde{\delta}^{\frac{1}{1-\delta}}}\) is a continuous and growing function of \(\delta \in (0,1)\) with

\[
\frac{1}{\tilde{\delta}^{\frac{1}{1-\delta}}} = \left( 1 + \frac{M_0}{L_0} \right) \left( \frac{M_0}{L_0} \right)^{1-\frac{\delta}{1-\delta}},
\]

and

\[
\lim_{\delta \to 1} \left( 1 + \frac{M_0}{L_0} \right) \left( \frac{M_0}{L_0} \right)^{1-\frac{\delta}{1-\delta}} = \nu \gg 1,
\]

(ii) the term \(\Gamma\) in (35) is a convex function of \(\delta \in (0,1)\) and lower than \(c_{BRM}^*\) for \(\delta \in (0,1)\). Moreover it converges to \(c_{BRM}^*\) as \(\delta \to 1\) because \(\lim_{\delta \to 1} h_2 = 0\).

In practice, we observe that when \(\delta\) grows, the term \(\Gamma\) tends toward \(c^*\); so, the inequality (35) holds because for \(\delta \to 1\), the term \(\frac{1}{\tilde{\delta}^{\frac{1}{1-\delta}}}\) is strictly higher than 1.

So, by virtue of the mathematical definition of limit, we conclude that there exists a \(\overline{\delta} \in (0,1)\) such that, for some \(\delta > \overline{\delta}\) we have \(c^* > c_{BRM}^*\). \(\square\)

The device which explains this result is quite intuitive and connected with the wage setting mechanism we have assumed in (3).

In our theoretical framework firms, whose production function is characterized by a certain degree of substitutability between capital and labor (of internal and migrant type), can pay different wages to workers according to their productivity. Therefore, in equilibrium immigrants
are less productive and paid lower wages than internal workers (see equations (8) and (9)); firms will tend to substitute internal with migrants workers recording a worsening in productivity and cheaper labor costs. The substitutability between internal and migrants workers will continue until the reduction of labor cost is greater than that of productivity: when the substitution involves a reduction of labor cost smaller than that of productivity, firms will tend to invest in capital or, in other words, to substitute labor with capital.

With a Cobb-Douglas specification the firm capital intensity is represented by $\delta$ factor: the impact on domestic consumption will be negative if $\delta$ factor is low; the impact will be positive if $\delta$ factor is “sufficiently” high.

Empirical evidence on this issue is extremely rich and we widely review it in the next section.

3. Empirical evidence and related literature

The aim of this section is to provide some evidence in order to empirically support the theoretical propositions in the previous section. Although the empirical analysis of the impact of immigration on the host countries is an highly debated topic because of the complexity of the phenomenon and the lack of appropriate and reliable data, most empirical contributions have highlighted that immigrants have adverse effects in the short run (Borjas, 1994, 1995, 1999) and that these effects disappear in the long period, when capital adjusts to take advantage of higher returns triggered by inflows of migrants (among others see Peri 2010a). These studies strongly confirm our basic intuition by showing that the impact of migrants flows on the rate of domestic consumption growth is negative in the short run and the per-capita consumption is positive in the long run after some capital adjustments.

It should be emphasized that our analysis of the relationship between consumption and migrants involves an assessment of the simple correlation rather than an attempt to establish causality links or econometric evaluations. This section presents a mixture of empirical evidence employing two alternative strategies to bring the predictions of our model to data. The first, based on a sample of international data of OECD countries, evaluates the association between averages of rate of consumption growth and the percentage of migrants on total labor force for windows of ten years. The second strategy, based on single country data (i.e., U.S.A., Peri 2010a), provides empirical evidence of the long run domestic consumption and intensity of capital.
Table 1: Correlation between per-capita growth rate of consumption and the share of foreign labor force for a sample of OECD countries

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>1.1</td>
<td>11.5</td>
<td>-0.99</td>
</tr>
<tr>
<td>Belgium</td>
<td>1.0</td>
<td>8.9</td>
<td>-0.75</td>
</tr>
<tr>
<td>Denmark</td>
<td>1.4</td>
<td>3.7</td>
<td>-0.30</td>
</tr>
<tr>
<td>Finland</td>
<td>2.6</td>
<td>1.9</td>
<td>-0.88</td>
</tr>
<tr>
<td>France</td>
<td>1.7</td>
<td>5.7</td>
<td>0.84</td>
</tr>
<tr>
<td>Germany</td>
<td>0.8</td>
<td>9.0</td>
<td>-0.44</td>
</tr>
<tr>
<td>Italy</td>
<td>0.8</td>
<td>4.8</td>
<td>-0.90</td>
</tr>
<tr>
<td>Greece</td>
<td>3.1</td>
<td>6.2</td>
<td>-0.95</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1.3</td>
<td>3.7</td>
<td>0.30</td>
</tr>
<tr>
<td>Norway</td>
<td>2.9</td>
<td>6.0</td>
<td>-0.71</td>
</tr>
<tr>
<td>Portugal</td>
<td>1.9</td>
<td>3.9</td>
<td>-0.92</td>
</tr>
<tr>
<td>Spain</td>
<td>2.0</td>
<td>4.9</td>
<td>-0.98</td>
</tr>
<tr>
<td>Sweden</td>
<td>2.1</td>
<td>4.8</td>
<td>0.75</td>
</tr>
<tr>
<td>Switzerland</td>
<td>0.8</td>
<td>20.7</td>
<td>-0.60</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>2.3</td>
<td>5.0</td>
<td>-0.97</td>
</tr>
</tbody>
</table>

Source: our elaboration on Eurostat data

Table 1 sets out some information on the correlation between per-capita consumption growth rate and the stock of foreign labor force in selected OECD countries. It provides prima facie evidence in support to the key prediction of our theoretical model (proposition 1).

It is worth noting that different European countries have effectively undertaken different migration policies with the intercountry movements of migrants being sometimes very small and sometimes very high. Partly as a consequence of these factors, migrant flows in Europe exhibit enormous diversity.

The first column provides averages of per capita growth rate of consumption\(^6\) over ten years (1998-2007); the second column presents the average of the stock of foreign labor force as percentage of total labor force over the same period; the third column presents the correlation index between these two variables.

\(^6\)In order to smooth out both the cycle and year-on-year noise the correlation index is calculated on the permanent component of consumption by using the Hodrick-Prescott filter (\(\lambda=100\) on annual data).
The immediate point that stands out is the enormous differences in the European percentages of foreign labor force. These stretch from 1.9 in Finland to 20.7 in Switzerland and likely reflect country-specific migration policies and country-specific features of labor market. A closer look at Table 1 raises two additional points. First, most European countries show a highly negative relationship between per capita growth rate of consumption and the stock of foreign labor force (on average). This relationship is true for countries having very different migration policies and a very different structure of the labor market. Second, there are some exceptions. France, Sweden and Netherlands show a positive value of the correlation index. Their immigration policies are based on assimilation and naturalization (Stalker, 2002; Freeman, 2004; Adepoju et al., 2010) and tend to facilitate naturalization of immigrants respect to countries such as Switzerland and Austria “characterized by labour market dominated by a guest worker migration policy” (Gustafsson-Zheng, 2006). In Sweden and Netherlands immigrants have basically the same rights and freedoms as natives (but they cannot vote in parliamentary election) and after a few years they can apply for naturalization, even if the immigrant is unemployed; the unique prerequisite is the knowledge of, respectively, Swedish or Hollander language. France facilitates the assimilation of immigrants from ex-colonies, especially Algeria and Morocco, allowing naturalization after few years. Immigrants from ex-colonies have usually a perfect knowledge of French language. These migration policies produce a significant reduction of the number of migrants because of strong naturalization, and increase native workers with the consequence that the ratio $M/(L + M)$ decreases producing, in our sample, the observed positive correlation between the growth rate of consumption and the share of foreign workers.

To summarize, Table 1 suggests an empirical evidence in favour of a negative relation between rate of growth of consumption and the migrant labor. It also suggests that countries with a low level of migrants have an high rate of consumption growth (on average): in practice, when the share of immigrants is small, an increase in this share leads to a soft reduction in domestic per capita consumption rate of growth.

Another important aspect that contributes to explain the migrant flows is the business cycle. In fact, the cyclicality of migrants inflows is widely documented. Some estimates suggest that the inflow of immigrants in Europe as well as in USA increases and decreases with the employment opportunities, and then with the business cycle (Hatton, 2010; Hatton and Williamson, 2006).

Peri (2010a) estimates the effect of immigration over the whole U.S. business cycle suggesting that “in the long run immigrants increase productivity and hence average income. This finding is consistent with the broad existing literature on the impact of immigration in the United States”. On the other hand, “the short run impact of immigration, however, finds some mild negative effects: immigration may slightly reduce...average income...because the economic adjustment process is not immediate” (Peri, 2010a, pag. 6).

These estimates for U.S. provide useful insights to get the effects of migration in the short- and the long-run period (see table 2 in appendix). In the short run (1 year differences) mi-
migration produces some crowding out effects mainly in the recession scenario. Obviously, these
effects are much reduced in expansion because of the influence of business cycle (Hatton, 2010).
On average, the GDP response to net immigration rates in the short run is negative point-
ing at an impact near -0.38%. In the long run (7 year difference) the impact becomes hardly
positive on both output, capital and total factor productivity (TFP) reflecting the long run
gains from immigration for natives. They are not negligible (+0.2 increase in GDP per person
for an increase of immigrant population of 1%). These results are consistent with other
works (Card and Shleifer, 2009), confirming the positive long run effect of immigration of the
average income of Americans. Quibria and Islam (2010) show the crucial role of the innovation
elasticity in determining the positive long-run impact on some macroeconomic variables in a
simple growth model, confirming that in the short run the impact of immigration on economic
outcomes is negative. In a similar fashion but using different techniques, many recent works
on this topic confirm these findings in other countries as well. By using a market equilibrium
approach Ottaviano and Peri (2006, 2008) estimate a positive long-run effect on some macroeco-
nomic variables in the US with a moderate degree of substitutability between the two groups
of workers; D’Amauri et al., (2010), document the same thing using data for Germany. Other
contributions (Ho, 2007; Liu, 2010) quantitatively evaluate the welfare effect of migration by
using simulations. Ho (2007) calibrates the dynamic migration by Hazari and Sgro (2003) for
eight countries finding that migration shifts up the time path of long-run per-capita domestic
consumption, increasing the domestic welfare between 0.99 and 2.93 among countries supporting
our theoretical results. Liu (2010) develops a dynamic general equilibrium model of labor
market search type and evaluates the long run impact of immigration on the consumption.
Under a benchmark calibration, the model generates a negative relationship between the pop-
ulation share of migrants and domestic consumption in the short run (when the population
share of migrants is small) but this relation becomes positive once that the population share
of migrants passes a certain threshold (i.e., in the long run). Finally, we focus the relation
between per-capita domestic consumption and the intensity of capital searching for a soft
evidence of the relation issued from the Proposition 2. In short, our results suggest that, other
things being equal, in the long run firms respond to the inflow of migrants by increasing their
long-run capital-labor ratio. In practice, firms invest to change the technological structure
because the flows of migrants stimulate competition, differentiation of products and efficiency
inducing the adoption of appropriate technologies (see Quispe-Agnoli and Zavodny, 2002). So,
in the long run this creates benefits on productivity and consumption: “Immigration’s economic
benefits mostly result from its effect on immigrant and native workers’ occupational choices, ac-
companied by employers’ investment and reorganization of the firm. For instance, immigrants
are usually allocated to manual-intensive jobs, promoting competition and pushing natives to
perform communication-intensive tasks more efficiently. This process, at the same time, rer-

\footnote{Implicitly, we assume the short-run impact on income as proxy of impact on consumption.}
ganizes firms’ structure, producing efficiency gains and pushing natives towards cognitive and communication-intensive jobs that are better paid” (Peri, 2010a, pag. 6).

Most of the empirical literature on this issue stress how immigration changes a country production structure. In these studies, the basic idea is that a high share of migrants may cause a reallocation of resources towards firms whose technology requires more of these workers or firm-level shifts towards less labor intensive productions and technologies (see Doms and Dunne, 1998; Gandall et al., 2004). Empirical evidence corroborates quite neatly this hypothesis. Lewis (2005) and Card and Lewis (2005) show that most of the increase of the migrant population (with low productivity) from Mexico to USA has been absorbed by changes in capital intensity. In practice, the USA firms “downgrade” their technologies when the relative supply of low-productive works increase (see also Dustmann et al., 2008). Gandall et al. (2004) find an analogous effect for Russian-immigration in Israel while Dustmann et al. (2010) find similar results for Germany suggesting that the technological adjustment is due to the within firm component: factor intensities, indeed, shift toward a relative more intense use of low-productivity migrant workers.

To sum up, there is a broad consensus on the empirical ground both of a short run crowding out effect (on the rate of consumption growth, consistent with our theoretical Proposition 1) and a positive effect on the long run (under some technological adjustments, consistent with our theoretical Proposition 2).

4. Conclusions

A simple model of Ramsey type with migrant labor implies that the growth rate of per capita consumption is negatively related in the short run, while in contrast in the long run the steady-state per-capita consumption with migrant workers is higher than the steady-state per-capita consumption in the basic Ramsey model when the economy is “sufficiently” capital-intensive.

Our contribution generalizes and integrates some results of the literature on this topic (in particular, those in Hazari and Sgro (2003) and Moy and Yip (2006)). In fact, we first generalize the case of perfect substitution between foreign and domestic labour to the case of imperfect substitution by using an intensive form of Cobb-Douglas production function.

Finally, while the previous studies examine only theoretically the impact of migrant workers on domestic consumption, the current study complements the theoretical analysis providing some empirical evidence and literature widely supporting our results. We employ two alternative strategies to bring the predictions of our model to data. The first, based on a sample of international data, evaluates the association between averages of rate of consumption growth and the percentage of migrants on total labor force for windows of eleven years. The second strategy, based on single country data (i.e., U.S.A.), provides empirical evidence of the long run domestic consumption and intensity of capital. Although these findings are more likely to reflect other factors as well such as institutions and migration policies, the empirical results show
consistency with both the predictions of the theoretical model: lower migrants are associated to higher rate of domestic consumption growth and capital intensity is positively correlated to steady-state domestic consumption.

References


[38] Palivos T., (2009), Welfare Effects of Illegal Immigration, Journal of population economics 22, 131-144;


Appendix

Table 2: Response to Net Immigration Rates in Periods of Expansion and Downturn in the Short- and Long-Run Period

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>1-year differences 1994-2008</th>
<th>7-year differences 1994-2008</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Output gap (&lt; 0)</td>
<td>Output gap (≥ 0)</td>
</tr>
<tr>
<td>% Response of GDP per worker</td>
<td>-0.59 (0.18)</td>
<td>-0.17 (0.12)</td>
</tr>
<tr>
<td>% Response of TFP</td>
<td>-0.57 (0.22)</td>
<td>0.01 (0.17)</td>
</tr>
<tr>
<td>% Response of capital intensity</td>
<td>-0.85 (0.73)</td>
<td>0.01 (0.38)</td>
</tr>
</tbody>
</table>

Source: Our elaboration on Peri 2010a,c

Note: A technical explanation of the method of estimation and a detailed description of the methodology are contained in Peri 2010a. Heteroskedasticity- and cluster-robust standard errors are reported in parenthesis. Each regression includes time fixed effects.
Ministry of Economy and Finance
Department of the Treasury
Directorate I: Economic and Financial Analysis

Address:
Via XX Settembre, 97
00187 - Rome

Websites:
www.mef.gov.it
www.dt.tesoro.it

e-mail:
dt.segreteria.direzione1@tesoro.it

Telephone:
+39 06 47614202
+39 06 47614197

Fax:
+39 06 47821886