Inclusive Growth and Innovation: A Dynamic Simultaneous Equations Model on a Panel of Countries†

Georges Bresson*, Jean-Michel Etienne, & Pierre Mohnen*****

Abstract

Based on the work of Anand et al. (2013) we measure inclusive income growth, which combines growth in gross domestic product (GDP) per capita and growth in the equity of the income distribution. Extending the work of Causa et al. (2014), we estimate a dynamic simultaneous structural equations model of GDP per capita and inclusive income on panel data for 63 countries over the 1990-2013 period. We estimate both equations in error correction form by difference GMM (generalized method of moments). Among the explanatory variables of the level and the distribution of GDP per capita we include R&D (research and development) expenditure per capita. In OECD countries we obtain a large positive effect of R&D on GDP. R&D is found to have a positive effect on the social mobility index but its impact on the income equity index at first decreases, then switches around to become slightly positive in the long run. In non- OECD countries, R&D is found to decrease inclusive income, mostly through a negative growth effect but also because of a slightly increasing income inequity effect.

Keywords
dynamic simultaneous equations model, inclusive growth, income distribution, income equity index, social mobility index, panel data
JEL classification: C33, C36, 011, 032.

† We thank the participants of the 8th Conference on Micro Evidence on Innovation and Development (MEIDE), New Delhi, 10-12 Feb. 2015, for their valuable comments
* Professor, Université Paris II/Sorbonne Universités, Paris, France, bresson-georges@orange.fr
** Associate Professor, Université Paris-Sud 11, Orsay, France, jean-michel.etienne@u-psud.fr
*** Corresponding author, Professor, UNU-MERIT Maastricht University, The Netherlands, mohnen@merit.unu.edu

1. INTRODUCTION

Theory predicts that innovation by expanding demand or reducing costs increases productivity and thereby gross domestic product (GDP). A lot of empirical evidence confirms that innovation, proxied by patents, new products, processes or other kinds of innovations, leads to economic growth. But many voices argue that growth in itself is not enough. Income should be more equally distributed, and greater equality would even be conducive to more growth. A concept that is gaining attention in the debate on inequality and growth is the one of inclusive innovation. Inclusion can have various meanings. First, it could imply a more widespread participation in innovation activities across regions, social classes or industrial sectors. We may think of phenomena like grass-root innovations, which encourage innovation at the village or community level through micro-financing or protection of traditional knowledge. Second, inclusion can mean a wider distribution of the direct users of the innovation, bottom of the pyramid types of innovation that cater to lower income strata of the population, which have their own affordable needs and desires. Finally, inclusion can mean more sharing of the benefits from innovation, not necessarily in using the new products but in ultimately benefiting from the increase in GDP fueled by innovation.

It is in this third dimension that we understand inclusion in this paper. We shall investigate whether innovation has led to a decrease in income inequality besides the increase in average income. In other words, has innovation lead to more income per capita (the growth aspect) and/or to a reduction in income disparity across income classes (the distributional aspect)? We shall examine these questions using macro data from 63 countries for the period stretching from 1990 to 2013.

The paper is organized as follows. In section 2, we define the notions of income, social mobility and equity in the distribution of income. In section 3, we explain the econometric model that we estimate in order to examine the role of innovation in economic growth and changes in equity. In section 4, we present and discuss the data underlying our analysis. In section 5, we present and interpret the econometric results. In section 6, we conclude.

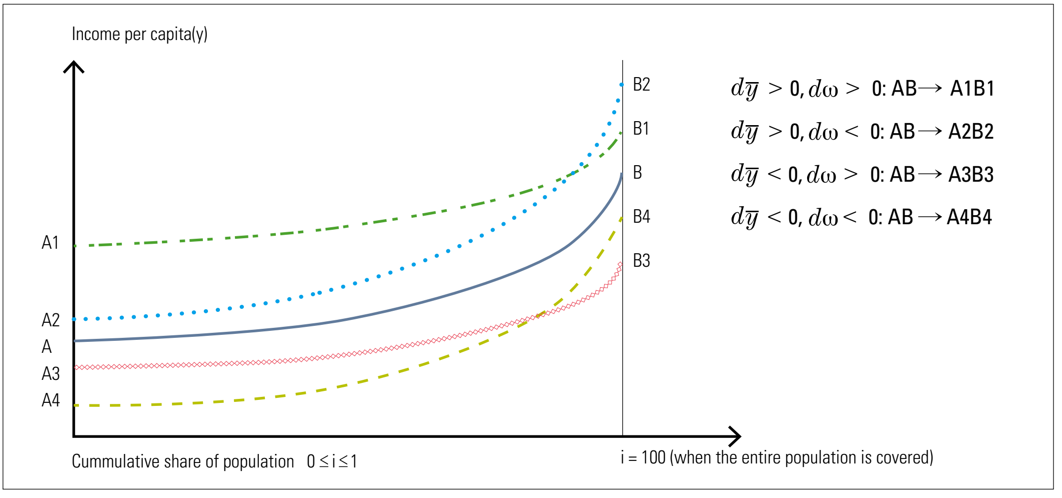
2. INTEGRATED MEASUREMENT MODEL OF THE LEVEL AND THE DISTRIBUTION OF INCOME

We adopt the measure of inclusive growth proposed by Ali and Son (2007) and applied by Anand, Mishra and Peiris (2013). Assume there is a continuum of persons and rank them in the increasing order of their income. Compute for each bottom p percent of the population the cumulative average income ($\overline{y}_p$). Joining these average incomes in a graph with the percentiles of the population on the horizontal axis (from 0% to 100%) and the cumulative average incomes on the vertical axis ranging from the income of the poorest person to the average income of the whole population ($\overline{y}$), we obtain what Ali and Son (2007) call the social mobility curve. They define the social mobility index (*SMI*) as the area under the social mobility curve: $y^{*}=\int_0^{100} \overline{y}_p \, dp$. If the income is the same for all i, then $\overline{y} = y^{*}$ and there is no inequality in income distribution. The inequality in income distribution is measured by the income equity index $\omega = y^*/\overline{y}$. Inclusive income, as measured by the social mobility index y^*, is then the product of average income and the income equity index (*IEI*). The growth in inclusive income can be decomposed into the growth in average income and the growth in the income equity index:

$$\frac{dy^*}{y^*} = \frac{d\overline{y}}{\overline{y}} + \frac{d\omega}{\omega} \quad (1)$$

If both are positive, then there is both an increase in average income and in income equity. But there can also be a growth in average income with a decrease in income equity as illustrated in the figure below borrowed from Anand, Mishra, and Peiris (2013).

FIGURE 1. Social Mobility Curves



Source: (Anand, Mishra, & Peiris, 2013)

The shifts from AB to A1B1 and from AB to A2B2 both correspond to an increase in average income (the right-hand end of the curve increases). The shifts from AB to A3B3 or A4B4 correspond to a decrease in average income (the right-hand end of the curve decreases). The shift from AB to A1B1 corresponds to an increase in the equity index (the curve gets closer to a horizontal line) whereas the shift from AB to A2B2 corresponds to a decrease in the equity index (the curve moves further away from a horizontal line). If the social mobility curves do not intersect, everybody benefits from an increase in average income; if they do intersect some experience a decrease and others an increase in average income as the aggregate income increases (as a shift from A1B1 to A2B2) or decreases (as a shift from A4B4 to A3B3).

3. DYNAMIC SIMULTANEOUS STRUCTURAL MODEL OF GDP AND INCOME DISTRIBUTION

Following the lines of Causa, de Serres and Ruiz (2014), we use a structural dynamic model explaining the level and the distribution of GDP per capita. More precisely we specify a simultaneous error correction model (ECM):

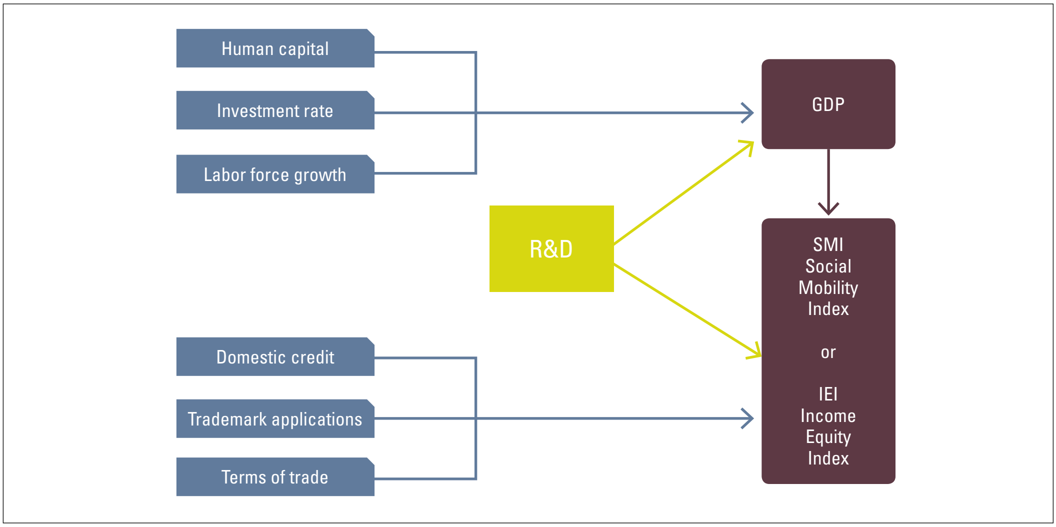
$$\begin{cases} \Delta y_{1,it} = \begin{cases} \phi_{11}\Delta y_{1,i,t-1} + \sum_{k=1}^{K_1}\theta_{1,k}\Delta x_{1,k,i,t} \\ -\gamma_1\left[y_{1,i,t-1} - (\alpha_1 + \sum_{k=1}^{K_1}\beta_{1,k}x_{1,k,i,t-1})\right] + \mu_{1,i} + \varepsilon_{1,i,t} \end{cases} \\ \Delta y_{2,it} = \begin{cases} \phi_{22}\Delta y_{2,i,t-1} + \phi_{21}\Delta y_{1,i,t} + \sum_{k=1}^{K_2}\theta_{2,k}\Delta x_{2,k,i,t} \\ -\gamma_2\left[y_{2,i,t-1} - (\alpha_2 + \varphi_{21}y_{1,i,t-1} + \sum_{k=1}^{K_2}\beta_{2,k}x_{2,k,i,t-1})\right] \\ + \mu_{2,i} + \varepsilon_{2,i,t} \end{cases} \end{cases} \quad (2)$$

for $i = 1, \ldots, N$, $t = 1, \ldots, T$. The dependent variables are: $y_{it} = [y_{1,it}, y_{2,it}]' = [\ln(GDP)_{it}, \ln(SMI)_{it}]'$ or $[\ln(GDP)_{it}, \ln(IEI)_{it}]'$ where $(SMI = y^*)$ and $(IEI = \omega)$ have been defined in the previous section. The explanatory variables are given by:

$$x_{1,it} = [\ln(Invest)_{it}, \ln(n+\delta)_{it}, \ln(h)_{it}, \ln(RD)_{it}]',$$
$$x_{2,it} = [\ln(RD)_{it}, \ln(Credit)_{it}, \ln(TM)_{it}, \ln(TT)_{it}]'$$

Invest is the investment rate, *h* is a measure for human capital, *n* is the labour force growth rate, δ is the depreciation rate (fixed at 0.05 as is standard in the literature). *Rd* stands for R&D expenditure per capita. All the monetary variables are in 2005 US$ at purchasing power parities. *Credit* is the domestic credit per capita given by banks to the private sector and measures the financial openness (deepening). *TM* are the trademark applications per capita. *TT* measures the induced effects of the terms of trade (that is to say, the evolution of export prices relative to import prices). This structural model can be represented by a flowchart (see Figure 2).

FIGURE 2. Flow Chart



$\Delta y_{m,it}$ are the first-differences of the m dependent variables for $m = 1, .., M$ (=2). In equation 1, instantaneous variations $\Delta y_{1,it}$ depend on their lagged values, on actual variations of the other explanatory variables and on an error term (between brackets). In this error term, if $\Delta y_{1,i,t-1}$ is above the equilibrium value $(\alpha_1+\sum_k \beta_{1,k} x_{1,k,i,t-1})$, the equilibrium error is positive. Then, an additional negative adjustment is generated: $-\gamma_1 \left[y_{1,i,t-1} - (\alpha_1+\sum_k \beta_{1,k} x_{1,k,i,t-1})\right]$. The speed of adjustment towards equilibrium is defined by the coefficient γ_1 and the stability of the system implies that $0 < \gamma_1 < 1$.

$\varepsilon_{m,it}$ are the error terms assumed to be normally distributed and correlated across equations, i.e., $\varepsilon_{m,it} \sim N(0, \Sigma_\varepsilon)$ with $\Sigma_{\varepsilon,mn} = [\sigma_{\varepsilon_m \varepsilon_n}]$. The individual specific effects $\mu_{m,i}$ are also supposed to be correlated among equations $\mu \sim N(0, \Sigma_\mu)$ with $\Sigma_{\mu,mn} = \sigma_{\mu_m \mu_n}$. The first equation is a Solow augmented model. The second equation captures changes in the income distribution in terms of *SMI* or *IEI*. Depending on which one is estimated, *SMI* or *IEI*, the other one can be calculated residually. R&D expenditures per capita are taken as a proxy for innovation. So, we explicitly introduce R&D expenditures in the second equation to estimate the inclusiveness of innovation, i.e., the positive effects of innovation on the social mobility growth or income equity growth. Moreover, as the GDP is explicitly introduced in the second equation, we are able to measure the inclusiveness of growth, i.e., its effect on the growth of social mobility and/or income equity.

The system of equations is estimated using a two-stage two-step generalized method of moments (GMM) approach. At the first stage, we estimate separately the two equations using difference two-step GMM on panel data. The first differences of each equation (i.e., $\Delta^2 y_{m,it}$ the difference of the differences) sweep away the individual effects $\mu_{m,i}$. Using the estimated residuals, we compute the variance-covariance $\hat{\Sigma}_{\varepsilon,mn} = [\hat{\sigma}_{\varepsilon_m \varepsilon_n}]$. The Cholesky decomposition of $\hat{\Sigma}_{\varepsilon,mn}$ allows us to define the transformation $\hat{\Sigma}_{\varepsilon,mn}^{-1/2} \otimes I_{NT}$ applied to the system (2)

$$\tilde{Y} = \tilde{Z}\delta + (I_M \otimes Z_\mu \tilde{\mu}) + (I_M \otimes \tilde{\varepsilon}) \tag{3}$$

where

$$\tilde{Y} = (\hat{\Sigma}_{\varepsilon,mn}^{-1/2} \otimes I_{NT})\, Y,\; Z = \begin{pmatrix} Z_1 & 0 \\ 0 & Z_2 \end{pmatrix},\; \delta = \begin{pmatrix} \delta_1 \\ \delta_2 \end{pmatrix},\; \mu = \begin{pmatrix} \mu_1 \\ \mu_2 \end{pmatrix},\; \varepsilon = \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \end{pmatrix}$$

$$Y = \begin{pmatrix} \Delta y_1 \\ \Delta y_2 \end{pmatrix},\; Z_1 = [\Delta y_{1,-1}, \Delta x_1, y_{1,-1}, x_{1,-1}$$

$$Z_2 = [\Delta y_{2,-1}, \Delta y_1, \Delta x_2, y_{2,-1}, y_{1,-1}, x_{2,-1}$$

$Z_\mu = I_M \otimes \iota_T$, Δy_m is a (NT x 1) vector, Z_m is a (NT x K_m) matrix, μ_m is a (N x 1) vector of individual effects, ε_m is a (NT x 1) vector of disturbances, I_{NT} is an (NT x NT) identity matrix and ι_T is a (T x 1) vector of ones. At the second stage, the system (3) is estimated using difference two-step GMM[1].

[1] Anand et al. (2013) estimate a single equation to explain the determinants of inclusive growth. The social mobility growth (i.e., $\Delta\log(SMI)$) is regressed on one-period lagged per capita income and on the following main variables: investment, education, trade openess, credit-to-GDP, government consumption, inflation and GDP volatility.

Once the parameters of the model are estimated, we can compute the dynamic cumulative multipliers, which indicate how the endogenous variables of the model vary over time after an initial shock is given to an exogenous variable. In the rest of this section we derive the formulae for computing these multipliers. We can rewrite and actually estimate the system (2) with an unrestricted form:

$$\begin{cases} \Delta y_{1,it} = \phi_{11} y_{1,i,t-1} + \sum_{k=1}^{K_1} \theta_{1,k} \Delta x_{1,k,i,t} + a_1 y_{1,i,t-1} + \sum_{k=1}^{K_1} b_{1,k} x_{1,k,i,t-1} + d_1 + \mu_{1,i} + \varepsilon_{1,i,t} \\ \Delta y_{2,it} = \begin{cases} \phi_{22} \Delta y_{2,i,t-1} + \phi_{21} \Delta y_{1,i,t} + \sum_{k=1}^{K_2} \theta_{2,k} \Delta x_{2,k,i,t} + a_2 y_{2,i,t-1} \\ + c_{21} y_{1,i,t-1} + \sum_{k=1}^{K_2} b_{2,k} x_{2,k,i,t-1} + d_2 + \mu_{2,i} + \varepsilon_{2,i,t} \end{cases} \end{cases} \quad (4)$$

The dependent variables are: $y_{it} = [y_{1,it}, y_{2,it}]' = [\ln(GDP)_{it}, \ln(SMI)_{it}]'$ or $y_{it} = [\ln(GDP)_{it}, \ln(IEI)_{it}]'$. The explanatory variables are given by: $x_{1,it} = [\ln(Invest)_{it}, \ln(n+\delta)_{it}, \ln(h)_{it}, \ln(RD)_{it}]'$, $x_{2,it} = [\ln(RD)_{it}, \ln(Credit)_{it}, \ln(TM)_{it}, \ln(TT)_{it}]'$.

The system (4) leads to a simultaneous ARDL(2,1), i.e., an autoregressive distributed lag with two lags in the dependent variable and one lag in the explanatory variables :

$$\begin{cases} y_{1,it} = \begin{cases} (1+\phi_{11}+a_1) y_{1,it-1} - \phi_{11} y_{1,it-2} + \sum_{k=1}^{K_1} \theta_{1,k} x_{1,k,i,t} \\ + \sum_{k=1}^{K_1} (b_{1,k} - \theta_{1,k}) x_{1,k,i,t-1} + d_1 + \mu_{1,i} + \varepsilon_{1,i,t} \end{cases} \\ y_{2,it} = \begin{cases} (1+\phi_{22}+a_2) y_{2,it-1} - \phi_{22} y_{2,it-2} + \phi_{21} y_{1,i,t} \\ + (c_{21} - \phi_{21}) y_{1,i,t-1} + \sum_{k=1}^{K_2} \theta_{2,k} x_{2,k,i,t} \\ + \sum_{k=1}^{K_2} (b_{2,k} - \theta_{2,k}) x_{2,k,i,t-1} + d_2 + \mu_{2,i} + \varepsilon_{2,i,t} \end{cases} \end{cases} \quad (5)$$

or

$$\Gamma_0 y_{it} = \Gamma_1 y_{it-1} + \Gamma_2 y_{it-2} + B_0 x_{it} + B_1 x_{i,t-1} + d + \mu_i + \varepsilon_{it} \quad (6)$$

with

$$y_{it} = [y_{1,it}, y_{2,it}]', \quad x_{it} = [x_{1,it}, x_{2,it}]', \quad \mu_i = [\mu_{1,i}, \mu_{2,i}]'$$

$$d = [d_1, d_2]', \text{ and } \varepsilon_{it} = [\varepsilon'_{1,it}, \varepsilon'_{2,it}]'$$

y_{it} is a $(M (\equiv 2) \times 1)$ vector: $y_{it} = [\ln(GDP)_{it}, \ln(SMI)_{it}]'$ or $[\ln(GDP)_{it}, \ln(IEI)_{it}]'$.

x_{it} is a $(R (\equiv 7) \times 1)$ vector: $x_{it} = [\ln(Invest)_{it}, \ln(n+\delta)_{it}, \ln(h)_{it}, \ln(RD)_{it}, \ln(Credit)_{it}, \ln(TM)_{it}, \ln(TT)_{it}]'$.

Causa et al. (2014) estimate a system of simultaneous equations in ECM form in which the dependent variables are the growth rate of GDP ($\Delta\log(GDP)$) and the growth rate of different income standards across the distribution of income, such as the median income, the income of the lower middle class or the income of the poor. The first equation is a Solow augmented model where $\Delta\log(GDP)$ is regressed on $[\ln(Invest), \ln(n+\delta), \ln(h)]$. The second equation regresses the growth rate of the income standards on $[\log(GDP), \ln(TT)]$. They use a SURE approach to estimate their system.

$$\Gamma_0 = \begin{pmatrix} 1 & 0 \\ -\phi_{21} & 1 \end{pmatrix}, \Gamma_1 = \begin{pmatrix} (1+\phi_{11}+a_1) & 0 \\ (c_{21}-\phi_{21}) & (1+\phi_{22}+a_2) \end{pmatrix},$$

$$\Gamma_2 = \begin{pmatrix} -\phi_{11} & 0 \\ 0 & -\phi_{22} \end{pmatrix}$$

$$B_0 = \begin{pmatrix} \theta_{1,1} & \theta_{1,2} & \theta_{1,3} & \theta_{1,4} & 0 & 0 & 0 \\ 0 & 0 & 0 & \theta_{2,1} & \theta_{2,2} & \theta_{2,3} & \theta_{2,4} \end{pmatrix}$$

$$B_1 = \begin{pmatrix} B_{11} & (b_{1,4}-\theta_{1,4}) & 0 \\ 0 & (b_{2,1}-\theta_{2,1}) & B_{12} \end{pmatrix}$$

with

$$\begin{pmatrix} B_{11} \\ B_{12} \end{pmatrix} = \begin{pmatrix} (b_{1,1}-\theta_{1,1}) & (b_{1,2}-\theta_{1,2}) & (b_{1,3}-\theta_{1,3}) \\ (b_{2,2}-\theta_{2,2}) & (b_{2,3}-\theta_{2,3}) & (b_{2,4}-\theta_{2,4}) \end{pmatrix}$$

The reduced form of (6) is given by

$$y = \nabla_1 y_{-1} + \nabla_2 y_{-2} + \Pi_0 x + \Pi_1 x_{-1} + \zeta + \upsilon + \xi \tag{7}$$

where

$$\begin{aligned} \nabla_m &= \Gamma_0^{-1}\Gamma_m,\ m = 1,2\ (\equiv p) \\ \Pi_n &= \Gamma_0^{-1}B_n,\ n = 0,1\ (\equiv s),\ \zeta = \Gamma_0^{-1}d,\ \upsilon = \Gamma_0^{-1}\mu,\ \xi = \Gamma_0^{-1}\varepsilon \end{aligned} \tag{8}$$

Following Stewart and Venieris (1978) and Lütkepohl (2005), we can derive the dynamic multipliers. Ignoring the vector of constants and disturbances, we can re-write the reduced form as first-order vector difference equation:

$$Y = AY_{-1} + Bx \tag{9}$$

where

$$Y = \begin{pmatrix} y \\ y_{-1} \\ \cdots \\ y_{-(p-1)} \\ x \\ x_{-1} \\ \cdots \\ x_{-(s-1)} \end{pmatrix}, B = \begin{pmatrix} \Pi_0 & I_R \\ 0 & 0 \\ \cdots & \cdots \\ 0 & 0 \end{pmatrix} \tag{10}$$

$$B = \begin{pmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{pmatrix} \tag{11}$$

$$A_{11} = \begin{pmatrix} \nabla_1 & \nabla_2 & \cdots & \nabla_{p-1} & \nabla_p \\ I_M & 0 & \cdots & 0 & 0 \\ 0 & I_M & \cdots & 0 & 0 \\ & & \ddots & & \\ 0 & 0 & \cdots & I_M & 0 \end{pmatrix}, A_{12} = \begin{pmatrix} \Pi_1 & \Pi_2 & \cdots & \Pi_s \\ 0 & 0 & \cdots & 0 \\ 0 & 0 & \cdots & 0 \\ & & \ddots & \\ 0 & 0 & \cdots & 0 \end{pmatrix}$$

$$A_{21} = \begin{pmatrix} 0 & 0 & \cdots & 0 & 0 \\ 0 & 0 & \cdots & 0 & 0 \\ 0 & 0 & \cdots & 0 & 0 \\ & & \ddots & & \\ 0 & 0 & \cdots & 0 & 0 \end{pmatrix}, A_{22} = \begin{pmatrix} 0 & 0 & \cdots & 0 \\ I_R & 0 & \cdots & 0 \\ 0 & I_R & \cdots & 0 \\ & & \ddots & \\ 0 & 0 & \cdots & I_R \end{pmatrix}$$

Y is a $((Mp + Rs) \times 1)$ vector, x is a $(R \times 1)$ vector, A is a $((Mp + Rs) \times (Mp + Rs))$ matrix and B is a $((Mp + Rs) \times R)$ matrix. As in our case, $p = 2$ and $s = 1$, we get:

$$Y = \begin{pmatrix} y \\ y_{-1} \\ x \end{pmatrix}, B = \begin{pmatrix} \Pi_0 \\ 0 \\ I_R \end{pmatrix}, A = \begin{pmatrix} \nabla_1 & \nabla_2 & \Pi_1 \\ I_M & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \tag{12}$$

Successive substitutions for lagged Y's gives

$$Y = JA^t Y_0 + \sum_{j=0}^{t-1} JA^j Bx_{-j} \tag{13}$$

where J is a $(M \times (Mp + Rs))$ matrix defined as $J = [I_M, 0, 0, ..., 0]$. As $JA^t Y_0 \rightarrow 0$ as $t \rightarrow \infty$, then

$$Y = \sum_{j=0}^{\infty} JA^j Bx_{-j} \tag{14}$$

The dynamic multipliers matrix D_τ is the coefficient matrix of the x variables in the final form representation:

$$D_\tau = JA^\tau B, \ \tau = 0, 1, 2, ..., \tag{15}$$

The k^{th} cumulative dynamic multipliers matrix is given by:

$$CD_k = \sum_{j=0}^{k} JA^j B, \ J(I_{Mp+Rs} + A + A^2 + ... + A^k)B \tag{16}$$

and the total (or long-run) dynamic multipliers matrix is:

$$TD_\infty = \sum_{j=0}^{\infty} JA^j B = J(I_{Mp+Rs} - A)^{-1}B \tag{17}$$

4. DATA

The data concern 63 countries over the period 1990 — 2013. They come from the World Bank datasets and the Penn World Tables (PWT8.0). The variables *SMI* and *IEI* have been calculated from the estimated average income for all deciles in the income distribution computed from the percentile income-share data and the real GDP per capita, using the Povcal software[2] of the World Bank (http://iresearch.worldbank.org/PovcalNet). The variables used are:

---

[2] "PovcalNet is an interactive computational tool that allows you to replicate the calculations made by the World Bank's researchers in estimating the extent of absolute poverty in the world. Povcal-Net also allows you to calculate the poverty measures under different assumptions and to assemble the estimates using alternative country groupings or for any set of individual countries of the user's choosing. PovcalNet is self-contained; it has reliable built-in software that quickly does the relevant calculations for you from the built-in database" (http://iresearch.worldbank.org/PovcalNet, p.1). Average income for decile is calculated using the decile income-share data and real GDP per capita (in PPP 2005 international dollars). Decile income shares are multiplied by the GDP per capita variable and multiplied by 10 to arrive at the average income per decile, as

$$\frac{Yd}{Pop_d} = \left(\frac{Yd}{Y}\right)\left(\frac{Yd}{Pop}\right)\left(\frac{1}{d}\right), \ d = 1, 2, ..., 10$$

where Y_d denotes the total income of decile d, Pop_d is population in decile d, Y is the economy-wide income, and Pop is the economy-wide population (see IMF, 2007).

- *GDP*: GDP per capita (in constant 2005 international $ using PPP)
- *SMI*: social mobility index
- *IEI*: income equity index
- *RD*: R&D expenditure per capita (in constant 2005 international $ using PPP)
- *Invest*: investment rate in % of GDP (in constant 2005 international $ using PPP)
- n: growth rate of working age population
- $n + \delta$: effective rate of capital depreciation in the Solow model
- *School*: years of schooling above age 15 / minimum years of schooling above age 15
- *Credit*: domestic credit to private sector by banks per capita (in constant 2005 international $ using PPP)
- *TM*: trademark applications per capita
- *TT*: terms of trade, exports prices/import prices, price level of USA GDP in 2005=1.

As some values were missing, we first used B-splines interpolations to balance the initial datasets. Table 1 gives some summary statistics for all countries ($N = 63$), OECD (Organization for Economic Cooperation and Development) countries ($N = 25$) and non-OECD countries ($N = 38$) (see the list of the countries and the regional distribution in Appendix Tables 1to 3). We can see a large difference between OECD and non-OECD countries. The ratio of the average GDP per capita (OECD / non-OECD) is 3.6. Those of SMI, IEI, RD and Credit are 4.34, 1.16, 14.9 and 6.6. For the investment rate, school, trademark applications and terms of trade, the ratios are lower: 1.16, 1.35, 1 and 0.96. Table 2 shows that correlations between GDP and SMI (in level or in growth rate) are high while those between GDP and IEI are small.

TABLE 1. Summary Statistics for the 25 OECD Countries and the 38 Non-OECD Countries (1990-2013)

25 OECD countries	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
GDP per cap.	24542.082	9699.139	6913.579	49101.773	600
SMI	14920.315	6338.974	2642.938	32900.351	600
IEI	0.599	0.077	0.382	0.765	600
Investment rate	0.248	0.064	0.08	0.444	600
n	0.001	0.287	-3.096	2.594	600
School	8.599	1.497	3.863	10.951	600
RD per cap.	43403.546	34005.828	14.717	129030.445	600
Domestic credit per cap.	21360.594	16914.946	440.061	85600.234	600
Trademark appl. per cap.	0.001	0.001	0	0.008	600
Terms of trade	1.026	0.065	0.795	1.324	600
38 non-OECD countries					
GDP per cap.	6690.839	3903.527	579.86	20106.156	912
SMI	3435.252	2214.928	298.331	13332.003	912
IEI	0.513	0.101	0.304	0.794	912
Investment rate	0.213	0.09	0.029	0.684	912
n	0.001	0.461	-4.841	4.371	911
School	6.375	1.694	1	9.73	912
RD per cap.	2913.587	3636.14	2.949	22015.711	912
Domestic credit per cap.	3220.366	3765.392	20.806	24965.99	912
Trademark appl. per cap.	0.001	0.001	0	0.005	912
Terms of trade	1.06	0.15	0.421	2.165	912

TABLE 2. Correlation Matrices for the 25 OECD Countries and the 38 Non-OECD Countries (1990-2013)

OECD (in level)	GDP per cap.	SMI	IEI
GDP per cap.	1		
SMI	.970	1	
IEI	.300	.493	1
non-OECD (in level)	**GDP per cap.**	**SMI**	**IEI**
GDP per cap.	1		
SMI	.933	1	
IEI	.003	.323	1
OECD (in growth rate)	**GDP per cap.**	**SMI**	**IEI**
GDP per cap.	1		
SMI	.911	1	
IEI	.098	.499	1
non-OECD (in growth rate)	**GDP per cap.**	**SMI**	**IEI**
GDP per cap.	1		
SMI	.833	1	
IEI	-.046	.515	1

More interesting is the evolution of the income inclusion over time. Figures 3, 4 and 5 show the social mobility curves revealing the inclusiveness for three countries over two decades. The average income of the bottom d deciles of the population ($\bar{y}_{d,it}$, $d = 1, ..., 10$) are given for several years. China's inclusive growth is primarily coming from the growth of average incomes. Rapid growth in per capita income has benefited everyone but the gains have been much greater for the rich leading to an increasing inequity. The growth rates of SMI and IEI for China are respectively 7.81% and -0.89%. India has also known an inclusive growth but with a lower increase in inequity. The growth rates of SMI and IEI are respectively 4.46% and -0.15%. On the other hand, the increase in inclusiveness in Burkina Faso has come from both growth as well as improvement in equity. The growth rates of SMI and IEI are respectively 4.06% and 1.28%.

FIGURE 3. China: Average Income per Capita

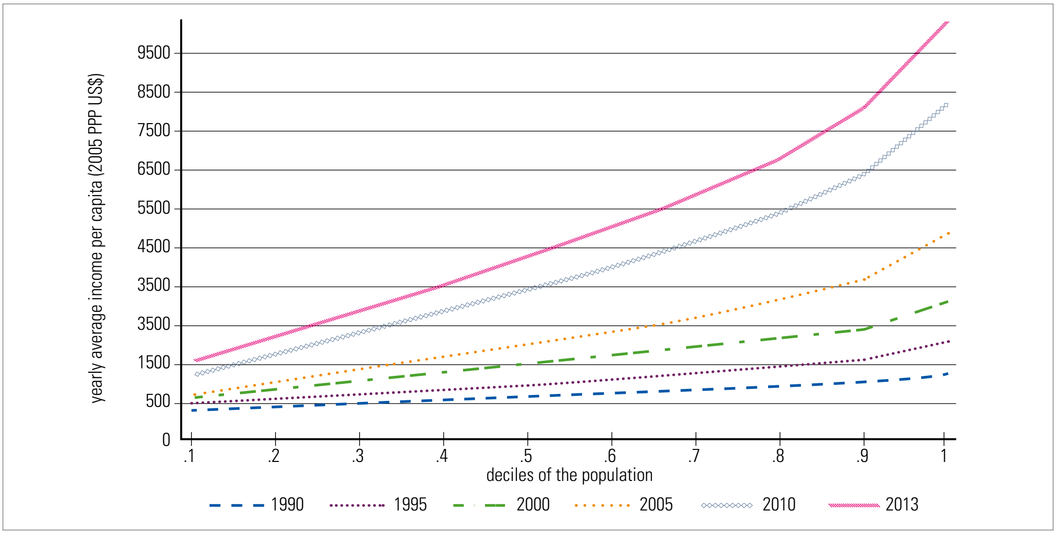


FIGURE 4. India: Average Income per Capita

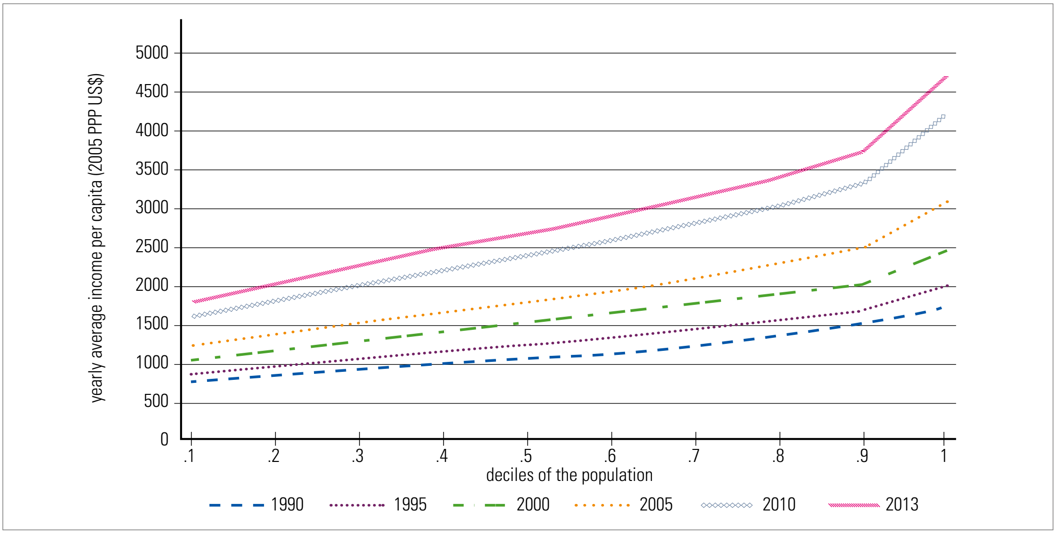
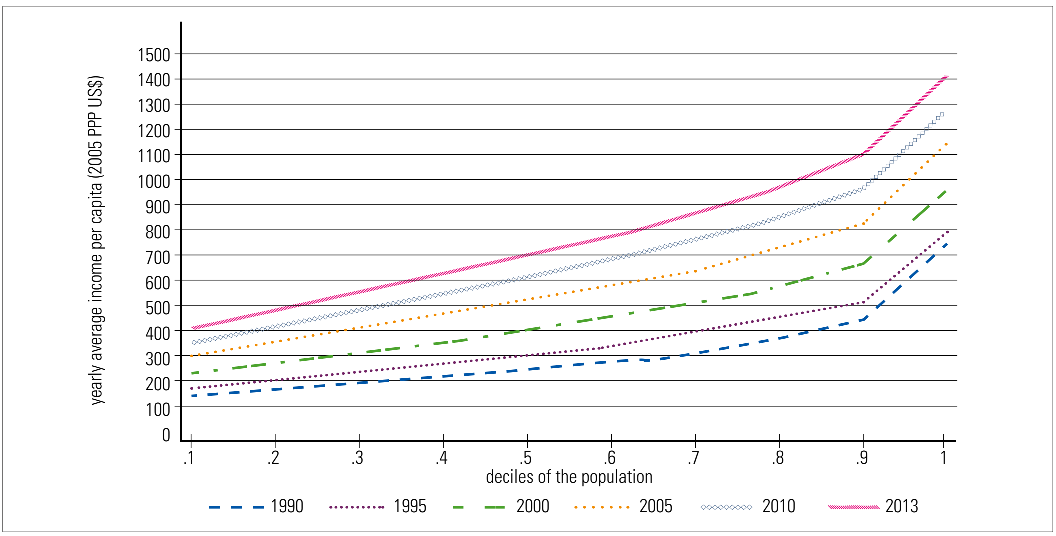


FIGURE 5. Burkina: Faso Average Income per Capita



The scatter plot of Figure 6 shows the inclusiveness matrix, where countries are positioned with respect to the growth rates of SMI and IEI. Whereas most countries have experienced more income inclusion (Madagascar and Macedonia being the exceptions), many countries have seen a decline in income equity, such as China, Croatia, South Africa, Italy and Belgium, while others display an increase in income equity (i.e., an increase in income inclusion that is higher than the increase in GDP/capita) such as Greece, Ukraine, Brazil and Burkina Faso. OECD countries are more homogeneous compared to non-OECD countries, which are more spread out. The northeast quadrant defines positive growth rates for both SMI and IEI. In that case, inclusive growth is associated with an increase in equity (this is the case of Burkina Faso). On the northwestern quadrant, inclusive growth is associated with a slight increase in inequity (this is the case of China). Figures 7 and 8 show that China is a specific case with a high growth rate of GDP per capita, a high growth rate of SMI (inclusiveness) but a 1% growth rate of inequity. The case of India is a medium case while Burkina Faso is a model student[3].

FIGURE 6. Inclusiveness Matrix

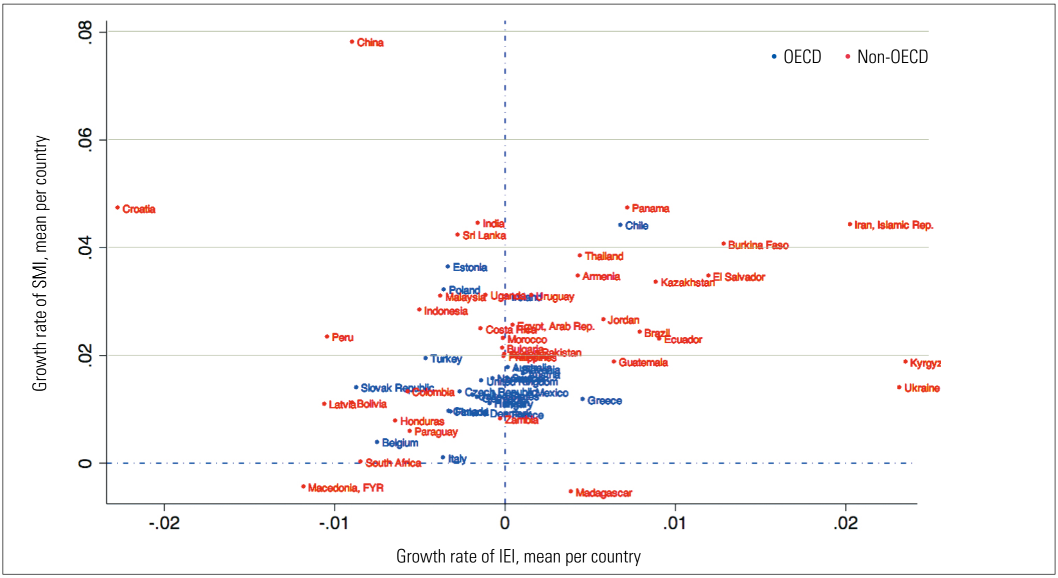
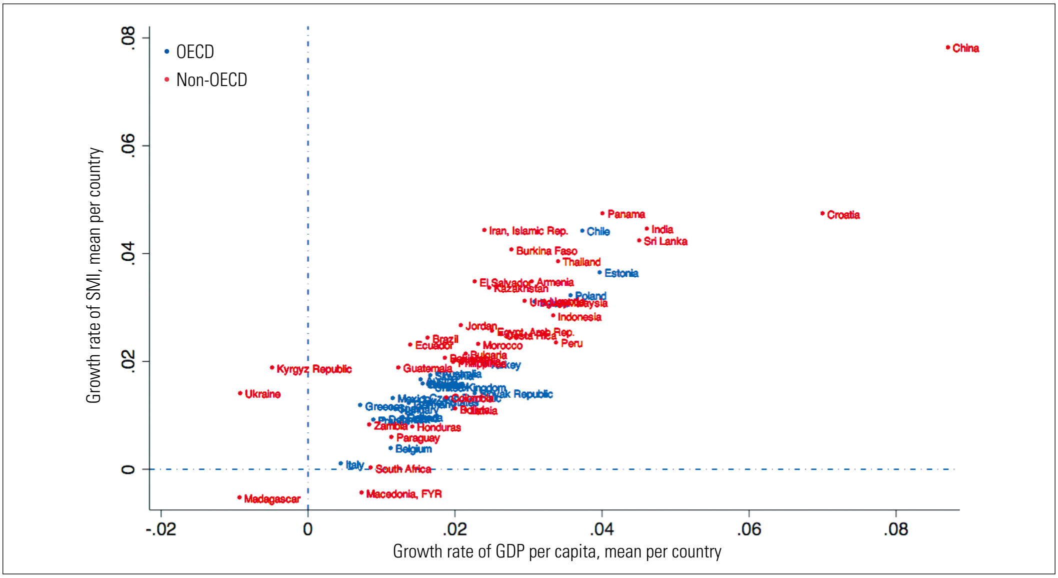
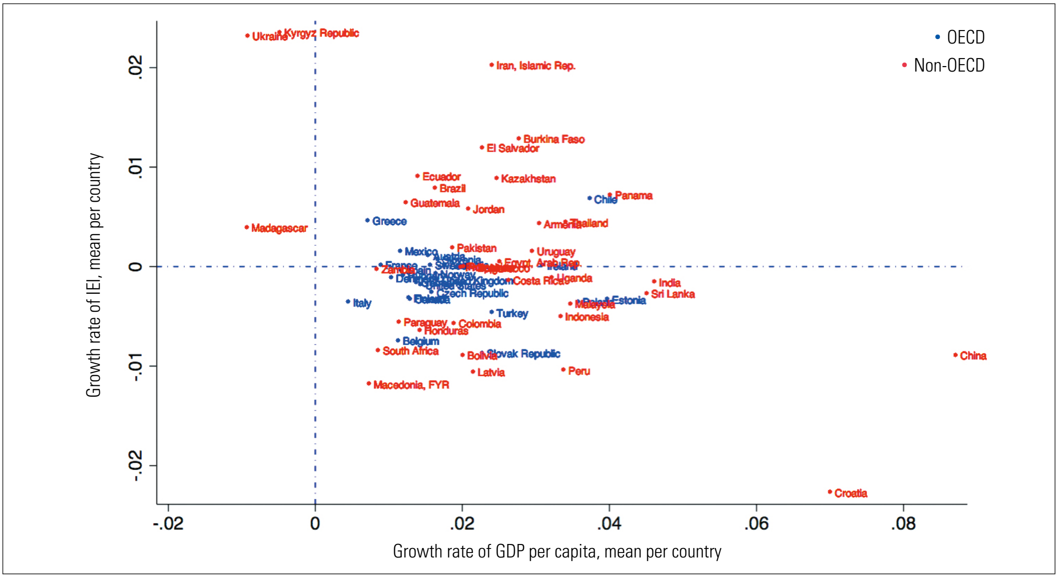


FIGURE 7. Growth Rates of SMI and GDP per Capita



[3] Our inclusion matrices are by and large consistent with those presented in Anand, Mishra, & Peiris (2014).

FIGURE 8. Growth Rates of IEI and GDP per Capita



5. RESULTS

We estimate the system (2) separately for the 25 OECD countries and for the 38 non-OECD countries. At the first stage, we estimate each unrestricted equation using difference GMM[4]. For the first equation, the instruments are $\Delta y_{1,it}$ lagged from $T - 2$ to $T - 3$, $\Delta x_{1,it}$ lagged from $T - 3$ to $T -$ 5, $\Delta^2 x_{1,it}$ (i.e., difference of the difference), $\Delta x_{1,it\text{-}1}$. For the second equation, the instruments are $\Delta y_{2,it}$ lagged from $T - 2$ to $T - 3$, $\Delta y_{1,it}$ lagged from $T - 3$ to $T - 15$, $\Delta x_{2,it}$ lagged from $T - 3$ to T — 15, $\Delta^2 y_{1,it}$, $\Delta^2 x_{2,it}$, $\Delta y_{1,it\text{-}1}$, $\Delta x_{2,it\text{-}1}$. Even though we reduce the number of instruments as compared to the standard approach of Arellano and Bond[5], there are still a lot of instruments. But the Sargan tests of overidentifying restrictions are satisfactory (their p-values tend to unity). The instrument sets are valid. Moreover, the Arellano-Bond tests for zero autocorrelation in first-differenced errors reject the null of no first-order and second-order serial correlations. But they do not reject the null for higher-order serial correlations. This is what we could expect in a first-difference equation of an already first-differenced process (i.e., an ECM). Once we get the estimated variances of the disturbances $\hat{\Sigma}_{\varepsilon,mn} = [\hat{\sigma}_{\varepsilon_m \varepsilon_n}]$ of the first stage, we use the Cholesky decomposition of this variance-covariance matrix to transform the initial system (3) and to estimate it using difference GMM[6]. The instruments are $\tilde{y}$ lagged from T — 3 to 3, $\tilde{Z}$ lagged from T – 2 to T – 3, $\Delta\tilde{Z}$, $\Delta^2\tilde{y}_{-1}$, $\Delta^2\tilde{Z}$, and t.

4 We do not reproduce here the Tables of these results to save space. Results are available upon request.

5 See Roodman (2009) or Bun and Sarafidis (2014) for a discussion on the problem of too many instruments.

6 In the first stage, the 95% confidence intervals of the coefficients (ϕ_{mm}) of the lagged endogenous variables overlap, so, for the second stage we consider a restricted model with a unique coefficient for these variables in the simultaneous system ($\phi_{11} = \phi_{22}$). We also tried to add regional dummies but they have the same effects (no differences in the estimated coefficients of the regional dummies).

In Table 3, we give the GMM estimation of the whole transformed system of GDP and SMI equations for the OECD countries. The results are satisfactory in terms of the Sargan test and the Arellano-Bond test. The Maddala-Wu tests for checking unit root on the estimated residuals show that we reject the null of unit root. The disturbances follow a stationary process. As already shown by several authors, the two-step difference GMM (and even the system GMM) estimation of the standard errors could be downward biased for small T samples. Windmeijer (2005) has proposed a "finite-sample correction" for the standard errors which works well for "large N - small T samples". But this procedure can over-robustify the standard errors when T is large (which is our case (T = 24)). This is why we only present the non robust two-step GMM estimations of this simultaneous equations model. In the first equation, most of the coefficients of the ECM are significantly different from zero and have the expected signs with positive effects of the investment rate, the effective rate of capital depreciation, human capital and R&D expenditures on GDP. For the second equation, only GDP seems to have a positive effect on SMI while the impacts of R&D, trademarks and credit constraints seem to be negative. But, we must be careful, the effects of all equations have to be combined, and only dynamic multipliers that take the complete model into account are appropriate for calculating the marginal effects.

TABLE 3. GMM Estimation of the Simultaneous Model GDP-SMI for the 25 OECD Countries (1990-2013)

$\Delta ln(GDP)$	Coefficient	(Std. Err.)
$\Delta ln(GDP)_{-1}$	0.087**	(0.019)
$\Delta ln(Invest)$	0.182**	(0.010)
$\Delta ln(n+\delta)$	0.009**	(0.000)
$\Delta ln(School)$	0.162	(0.603)
$\Delta ln(RD)$	0.011**	(0.004)
$ln(GDP)_{-1}$	-0.118**	(0.039)
$ln(Invest)_{-1}$	0.040**	(0.012)
$ln(n+\delta)_{-1}$	0.009**	(0.001)
$ln(School)_{-1}$	0.393*	(0.177)
$ln(RD)_{-1}$	0.005*	(0.002)
$\Delta ln(SMI)$	**Coefficient**	**(Std. Err.)**
$\Delta ln(SMI)_{-1}$	0.087**	(0.019)
$\Delta ln(GDP)$	1.151**	(0.083)
$\Delta ln(RD)$	-0.005**	(0.002)
$\Delta ln(Credit)$	-0.017	(0.012)
$\Delta ln(Trademark)$	-0.009**	(0.002)
$\Delta ln(Trade)$	0.005	(0.016)
$ln(SMI)_{-1}$	-0.485**	(0.077)
$ln(GDP)_{-1}$	0.616**	(0.097)
$ln(RD)_{-1}$	-0.004†	(0.003)
$ln(Credit)_{-1}$	-0.021†	(0.011)
$ln(Trademark)_{-1}$	-0.016**	(0.004)
$ln(Trade)_{-1}$	0.022	(0.023)

Significance levels: † : 10% * : 5% ** : 1%

Sargan test: $x^2(600)$ = 31.99868 p-value: 1.0000

Arellano-Bond test

order: 1 z: -2.8604 p-value: 0.0042, order: 2 z: 0.3481 p-value: 0.7277, order: 3 z: -1.4845 p-value: 0.1377, order: 4 z: 1.5804 p-value: 0.1140

Maddala-Wu ADF(3) unit root test: $x^2(100)$ = 125.4486 p-value: 0.0434

TABLE 4 . GMM Estimation of the Simultaneous Model GDP-SMI for the 38 Non OECD Countries (1990-2013)

$\Delta ln(GDP)$	Coefficient	(Std. Err.)
$\Delta ln(GDP)_{-1}$	0.046†	(0.024)
$\Delta ln(Invest)$	0.109**	(0.005)
$\Delta ln(n+\delta)$	0.003**	(0.001)
$\Delta ln(School)$	0.761**	(0.137)
$\Delta ln(RD)$	0.009**	(0.002)
$ln(GDP)_{-1}$	-0.200**	(0.043)
$ln(\text{Invest})_{-1}$	0.034**	(0.013)
$ln(n+\delta)_{-1}$	0.001†	(0.001)
$ln(School)_{-1}$	0.558**	(0.143)
$ln(RD)_{-1}$	-0.002	(0.003)
$\Delta ln(SMI)$	**Coefficient**	**(Std. Err.)**
$\Delta ln(SMI)_{-1}$	0.046†	(0.024)
$\Delta ln(GDP)$	1.077**	(0.030)
$\Delta ln(RD)$	-0.006*	(0.003)
$\Delta ln(Credit)$	-0.007*	(0.004)
$\Delta ln(Trademark)$	0.000	(0.001)
$\Delta ln(Trade)$	0.019	(0.029)
$ln(SMI)_{-1}$	-0.464**	(0.060)
$ln(GDP)_{-1}$	0.500**	(0.063)
$ln(RD)_{-1}$	-0.009**	(0.002)
$ln(Credit)_{-1}$	-0.004	(0.005)
$ln(Trademark)_{-1}$	0.002†	(0.001)
$ln(Trade)_{-1}$	0.111*	(0.048)

Significance levels: † : 10% *: 5% ** : 1%

Sargan test: $x^2(744) = 51.02638$ p-value: 1.0000

Arellano-Bond test

order: 1 z: -4.2341 p-value: 0.0000, order: 2 z: 1.6019 p-value: 0.1092, order: 3 z: -0.1522 p-value: 0.8790, order: 4 z: -0.0159 p-value: 0.9873

Maddala-Wu ADF(3) unit root test: $x^2(152) = 189.9875$ p-value: 0.0198

The estimation of the simultaneous equations model GDP-SMI for the 38 non-OECD countries is reported in Table 4. As for the case of the OECD countries, we do not report here the results of the first stage of the GMM estimation. The results are also satisfactory in terms of the Sargan test and the Arellano-Bond test. The Maddala-Wu tests for checking for the presence of a unit root in the estimated residuals show that we reject the null of unit roots. If we look at the estimates, R&D is no longer significant in the long run in the GDP per capita equation and is significantly negative in the second equation. Trade and trademarks now have a positive effect on the long-run social mobility index.

Tables 5 and 6 present the GMM estimation of the whole transformed system of the GDP and IEI equations, respectively for OECD and non-OECD countries. The results from the estimation of the GDP-IEI system are in line with those of the GDP-SMI system. The speeds of adjustment are not significantly different in the two specifications nor across the two groups of countries. GDP per capita adjusts to its optimal level at a speed of 12 to 20 percent, whereas SMI (or IEI) adjusts to its long-run equilibrium at a speed of 43 to 53 percent.

TABLE 5. GMM Estimation of the Simultaneous Model GDP-IEI for the 25 OECD Countries (1990-2013)

Δ*ln*(*GDP*)	**Coefficient**	**(Std. Err.)**
$\Delta ln(GDP)_{-1}$	0.110**	(0.020)
$\Delta ln(Invest)$	0.178**	(0.010)
$\Delta ln(n+\delta)$	0.009**	(0.000)
$\Delta ln(School)$	0.792	(0.636)
$\Delta ln(RD)$	0.009*	(0.004)
$ln(GDP)_{-1}$	-0.163**	(0.050)
$ln(Invest)_{-1}$	0.044**	(0.013)
$ln(n+\delta)_{-1}$	0.009**	(0.001)
$ln(School)_{-1}$	0.475*	(0.195)
$ln(RD)_{-1}$	0.004†	(0.002)
Δln(IEI)	**Coefficient**	**(Std. Err.)**
$\Delta ln(IEI)_{-1}$	0.110**	(0.020)
$\Delta ln(GDP)$	0.228*	(0.115)
$\Delta ln(RD)$	-0.005*	(0.002)
$\Delta ln(Credit)$	-0.021†	(0.013)
$\Delta ln(Trademark)$	-0.005**	(0.001)
$\Delta ln(Trade)$	-0.025	(0.037)
$ln(IEI)_{-1}$	-0.429**	(0.037)
$ln(GDP)_{-1}$	0.178**	(0.064)
$ln(RD)_{-1}$	-0.005	(0.004)
$ln(Credit)_{-1}$	-0.025*	(0.010)
$ln(Trademark)_{-1}$	-0.008**	(0.001)
$ln(Trade)_{-1}$	-0.036	(0.073)

Significance levels: † : 10% *: 5% ** : 1%

Sargan test: $x^2(600)$ = 29.21495 p-value: 1.0000

Arellano-Bond test

order: 1 z: -2.7901 p-value: 0.0053, order: 2 z: 0.4280 p-value: 0.6686, order: 3 z: -1.2679 p-value: 0.2048, order: 4 z: 1.5846 p-value: 0.1131

Maddala-Wu ADF(3) unit root test: $x^2(100)$ = 127.8148 p-value: 0.0318

TABLE 6. GMM Estimation of the Simultaneous Model GDP-IEI for the 38 Non-OECD Countries (1990-2013)

Δ*ln*(*GDP*)	**Coefficient**	**(Std. Err.)**
$\Delta ln(GDP)_{-1}$	0.095*	(0.047)
$\Delta ln(Invest)$	0.103**	(0.013)
$\Delta ln(n+\delta)$	0.004**	(0.001)
$\Delta ln(School)$	0.784*	(0.312)
$\Delta ln(RD)$	0.011**	(0.001)
$ln(GDP)_{-1}$	-0.190**	(0.037)
$ln(Invest)_{-1}$	0.023†	(0.014)
$ln(n+\delta)_{-1}$	0.004**	(0.001)
$ln(School)_{-1}$	0.354**	(0.086)
$ln(RD)_{-1}$	0.000	(0.002)
Δ*ln*(*IEI*)	**Coefficient**	**(Std. Err.)**
$\Delta ln(IEI)_{-1}$	0.095*	(0.047)
$\Delta ln(GDP)$	0.084**	(0.026)
$\Delta ln(RD)$	-0.007**	(0.002)
$\Delta ln(Credit)$	-0.007	(0.004)
$\Delta ln(Trademark)$	-0.001	(0.001)
$\Delta ln(Trade)$	-0.031	(0.027)

ln(*IEI*)-1	-0.534**	(0.054)
ln(*GDP*)-1	0.090**	(0.033)
ln(*RD*)-1	-0.005*	(0.002)
ln(*Credit*)-1	-0.014*	(0.006)
ln(*Trademark*)-1	0.001	(0.001)
ln(*Trade*)-1	-0.024	(0.055)

Significance levels: † : 10% * : 5% ** : 1%

Sargan test: $x^2(771)$ = 47.42686 p-value: 1.0000

Arellano-Bond test

order: 1 z: -3.5559 p-value: 0.0004, order: 2 z: 1.8710 p-value: 0.0613, order: 3 z: 0.2265 p-value: 0.8208, order: 4 z: 0.0209 p-value: 0.9833

Maddala-Wu ADF(3) unit root test: $x^2(152)$ = 154.7068 p-value: 0.4237

The cumulative dynamic multipliers show the effects of a unitary shock of the explanatory variables on the level of the dependent variables over time. As the models are written in logs, these cumulative marginal effects may be interpreted as elasticities. Figures 9 and 10 represent the cumulative dynamic multipliers for the GDP-SMI system of equations while Figures 11 and 12 represent the cumulative dynamic multipliers for the GDP-IEI system of equations, for both OECD and non-OECD countries. We can see on Figures 9 and 11 the different trajectories of the curves of cumulative marginal effects for the GDP equation and the strong gap between OECD and non-OECD countries. The cumulative effects of investment and of the effective rate of capital depreciation are always higher in the OECD countries than in the non-OECD countries. For human capital the effect is also higher in the long run for OECD countries, but in Figure 9 the effect only becomes higher in OECD countries after a period of approximately 12 years whereas in Figure 11 it is always higher in OECD countries. The big difference between the OECD and non-OECD countries concerns the cumulative effect of innovation. The elasticity of GDP to R&D starts at 0.01 in the short run and goes up to 0.025/0.04 in the long run in the OECD countries. Those elasticities are in line with those reported in the literature (Hall, Mairesse, Mohnen, 2010). But, in non-OECD countries this elasticity starts at about the same level of 0.01 in the short run but then dwindles down to zero or even -0.01 in the long run.[7] Let us now turn to Figure 10, which depicts the cumulative marginal effects of the explanatory variables on the social mobility index. Investment, human capital, the effective rate of capital depreciation and GDP have a positive effect on social mobility, which is higher in OECD than in non-OECD countries. Access to credit and trademarks have almost no effect in non-OECD countries and a negative effect in OECD countries, whereas trade has only a minor effect on social mobility in OECD countries but a strong effect (with a long-run elasticity of 0.3) in non-OECD countries. The big difference is in terms of innovation (proxied by R&D). Innovation has a positive effect on social mobility in OECD countries but a negative effect in non-OECD countries. Thus, innovation as a whole appears to be inclusive in OECD countries but non-inclusive in non-OECD countries. Finally, Figure 12 depicts the cumulative effects of the explanatory variables on

[7] The multiplier effects may be slightly different between the two models because of a different variance-covariance matrix of the estimates in the first stage. Calculating the confidence intervals of those cumulative multiplier effects is not easy. But just looking at some key estimated parameters that enter these multipliers, we notice that the confidence intervals of these estimates often overlap and make us believe that the reported differences in the multpliers may not be statistically significant.

the income equity index. The directions of the effects are the same as for the social mobility index, but since IEI is the ratio of SMI and average income the magnitudes of the effects are dampened. Innovation has almost no effect on the income equity index in the OECD countries and a slightly negative effect in the non-OECD countries. The opposite holds for trademarks. Growth in income per capita decreases income inequality in both OECD and non-OECD countries, but more so in OECD countries.

FIGURE 9. Cumulative Dynamic Multipliers: GDP Equation in the GDP/SMI Model

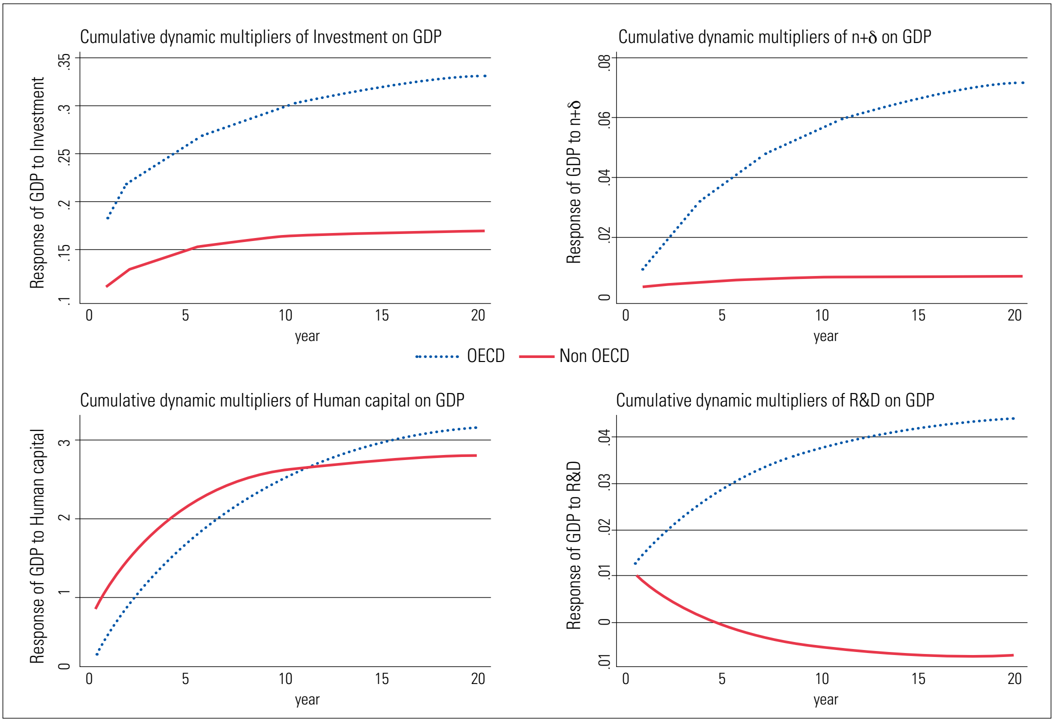
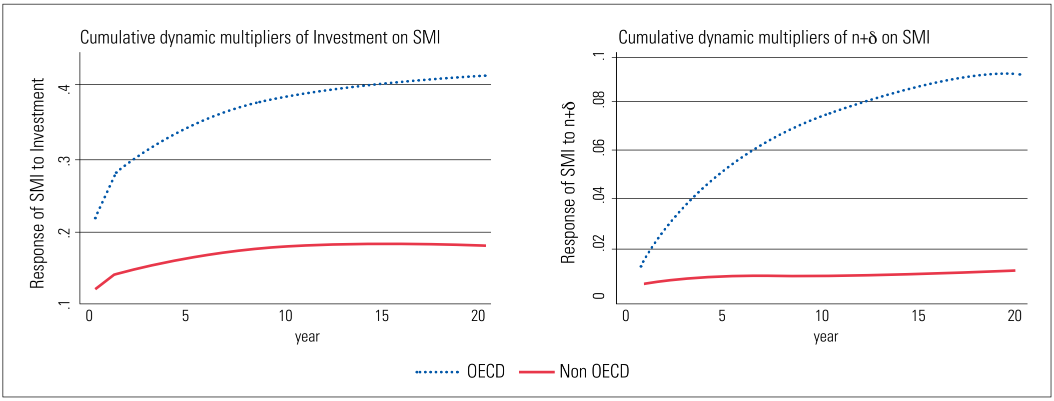


FIGURE 10. Cumulative Dynamic Multipliers: SMI Equation in the GDP/SMI Model



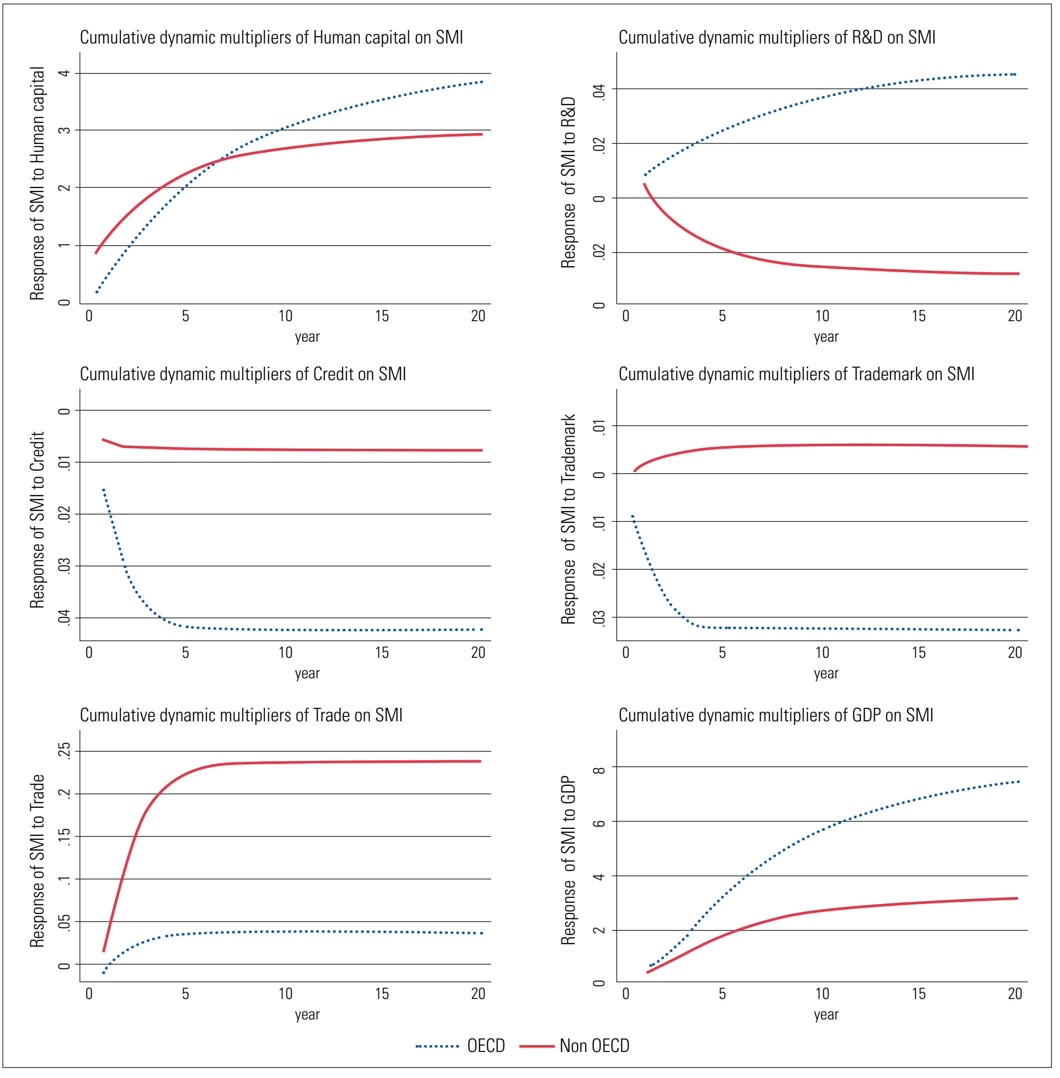
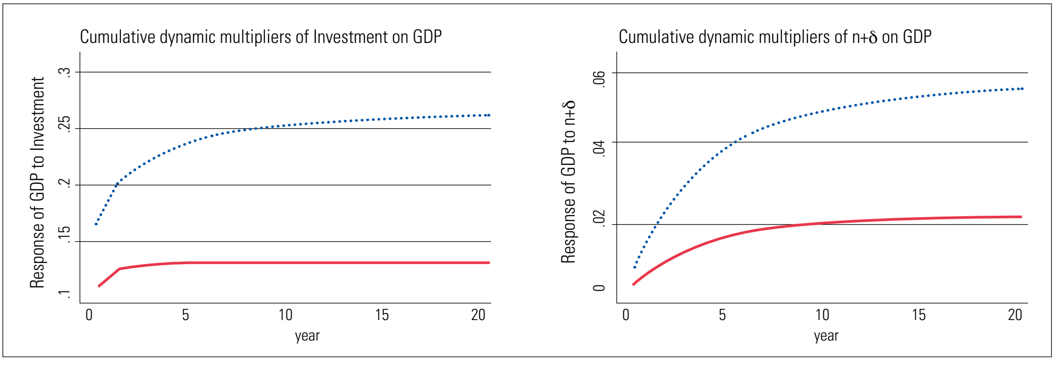


FIGURE 11. Cumulative Dynamic Multipliers: GDP Equation in the GDP/IEI Model



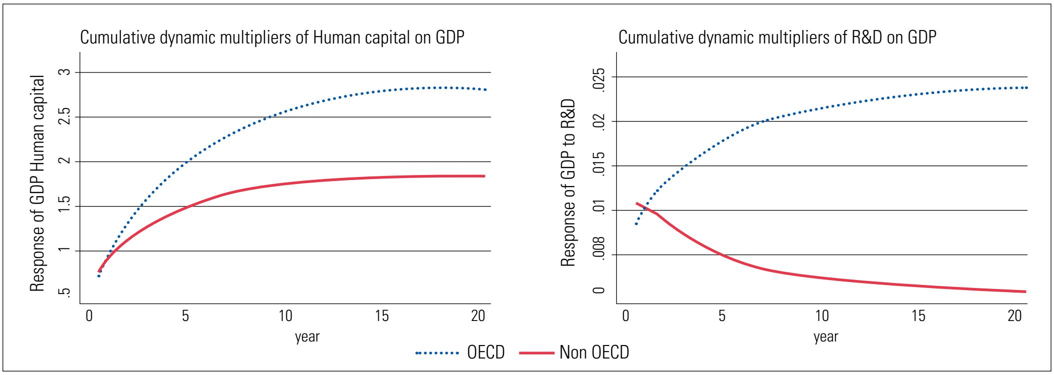
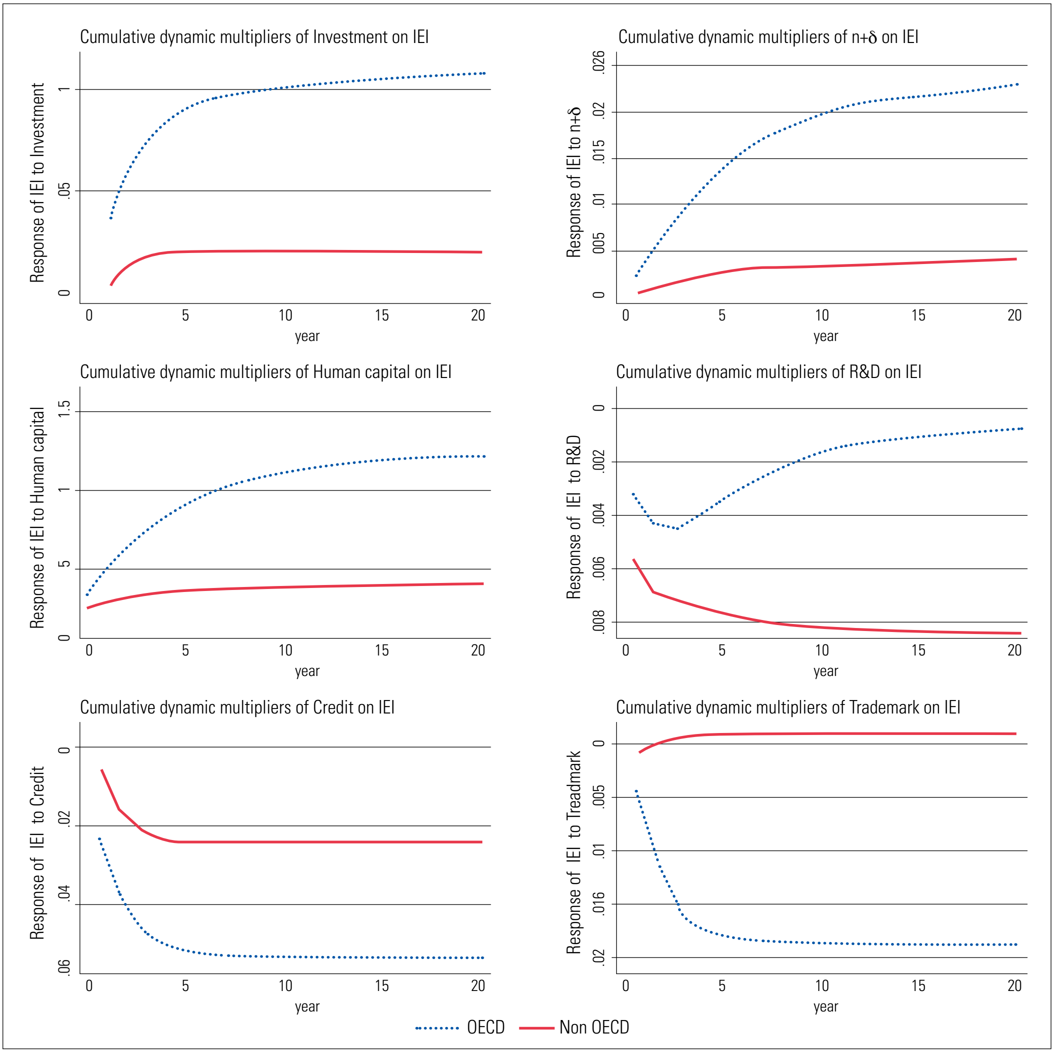
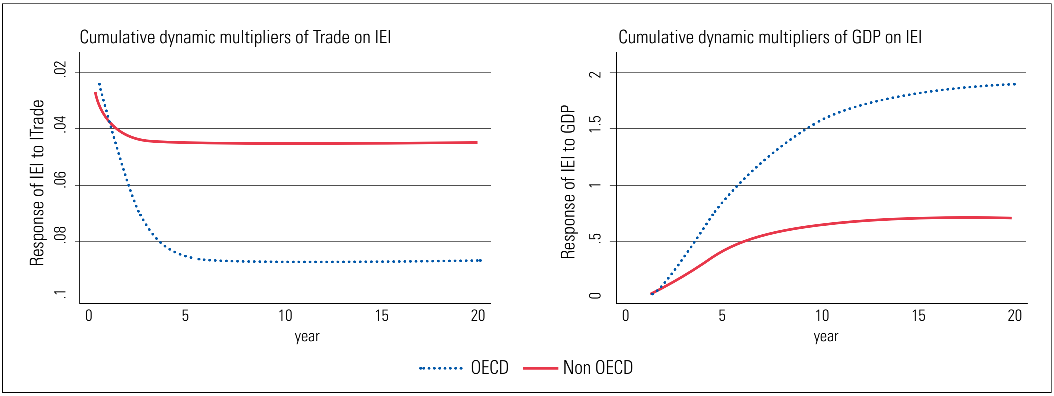


FIGURE 12. Cumulative Dynamic Multipliers: IEI Equation in the GDP/IEI Model





6. CONCLUSION

On the basis of the measurements of inclusive innovation and equity in income distribution that were proposed by Ali and Son (2007) and applied by Anand, Mishra and Peiris (2013), we have estimated the determinants of the levels and the inclusiveness of income in a dynamic simultaneous equations model applied to the panel data of 63 countries from 1990 to 2013. From the estimated coefficients of the model we then have calculated the effects, in particular of innovation and starting income, on the growth and the equity of income distribution. We conclude that growth reduces inequality in the income distribution in both OECD and non-OECD countries, but that R&D is inclusive only in the OECD countries. The opposite holds for trademarks.

Not all innovation is based on R&D, and it may well be that formal R&D is not the most productive and inclusive way of achieving growth in developing countries. There may be grassroots innovations that do not emerge from formal R&D projects but from the ingenuity of individual inventors (see examples in OECD, 2015) that tend to be inclusive both in the sense of meeting the needs of low-income people and of making income distribution more equitable. Technology adoption and adaptation to the local circumstances may be another more promising way of catching up for developing countries than big R&D projects.

Our estimates may also depend on the strong heterogeneity that exists even within each set of countries, e.g. between Madagascar and China or between Chile and the United States of America. First differencing might not be sufficient to neutralize unobserved country-specific effects. Moreover, the estimation by GMM, despite the results of the Sargan tests for the quality of the instruments, still requires some act of faith. In future work we think of applying a random coefficients model which would allow all marginal effects to be country and time specific.

APPENDIX TABLE 1. OECD Countries (25)

Australia	Austria	Belgium	Canada
Chile	Czech Republic	Denmark	Estonia
Finland	France	Germany	Greece
Hungary	Ireland	Italy	Mexico
Norway	Poland	Slovak Republic	Slovenia
Spain	Sweden	Turkey	United Kingdom
United States			

APPENDIX TABLE 2. Non-OECD Countries (38)

Armenia	Bolivia	Brazil	Bulgaria	Burkina Faso
China	Colombia	Costa Rica	Croatia	Ecuador
Egypt, Arab Rep.	El Salvador	Guatemala	Honduras	India
Indonesia	Iran, Islamic Rep.	Jordan	Kazakhstan	Kyrgyz Republic
Latvia	Macedonia, FYR	Madagascar	Malaysia	Morocco
Pakistan	Panama	Paraguay	Peru	Philippines
Romania	South Africa	Sri Lanka	Thailand	Uganda
Ukraine	Uruguay	Zambia		

APPENDIX TABLE 3. Regional Distribution

Regions	**OECD**	**non-OECD**	**All**
North America	.08		.0317
Central & South America	.08	.3158	.2222
Western Europe	.52		.2063
Eastern Europe	.24		.1904
Africa		.1842	.1111
Middle East	.04	.1579	.1111
Asia Pacific	.04	.1842	.1269
	1.0	1.0	1.0

REFERENCES

Ali, I. & Son, H. H. (2007). Measuring inclusive growth. *Asian Development Review, 24*(1), 11-31.

Anand, R., Mishra, S. & Peiris, S. J. (2013). *Inclusive growth: Measurement and determinants*. *Working paper* (WP/13/135). Washington, D.C: Asia Pacific Department, IMF.

Bun, M. J. G. & Sarafidis, V. (2014). Dynamic panel data models. In B. Baltagi (Ed.), *The Oxford handbook of panel data* (pp. 76-110). Oxford; New York: Oxford University Press.

Causa, O., de Serres, A. & Ruiz, N. (2014). *Can growth-enhancing policies lift all boats? An analysis based on household disposable incomes*. *Economics department working paper* (1180). Paris: OECD.

Hall, B., Mairesse, J. & Mohnen, P. (2010). Measuring the returns to R&D. In B. H. Hall & N. Rosenberg (Eds.), the *Handbook of the economics of innovation* (pp. 1034-1082). Amsterdam: Elsevier.

Lütkepohl, H. (2007). *Introduction to Multiple Time Series Analysis*. Berline; Heidelberg; NY: Springer-Verlag.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal*, *1*, 86-136.

Stewart, D. B. & Venieris, Y. P. (1978). Dynamic multipliers: a note on the generalization to many lags. *Journal of Regional Science*, *18*(3), 459-462.

The Organization for Economic Cooperation and Development (2015). *Innovation policies for inclusive development. Scaling up inclusive innovations*. Paris: OECD.

Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics*, *126*, 25-51.