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SPATIAL EFFECTS ON TECHNICAL PROGRESS: GROWTH AND CONVERGENCE AMONG COUNTRIES*

ABSTRACT: This paper analyses how several spatial variables coming from cities and transportation system can affect money market, specially the income velocity of circulation, assuming an unit-elastic aggregate demand function and considering money velocity as a variable. Fluctuations in velocity caused by some spatial variables, under certain conditions, can affect the aggregate demand curve. The specification of the main relation-ship has found in the Baumol-Tobin model for transaction money demand, and in Christaller-Lösch central place theory. The estimation of the model has been based on panel data techniques and applied across 61 countries during 14 years in the 1978-1991 period. Theoretical and econometric results indicates that seven spatial variables like the country's first city population, the population density, the passengers-kilometer transported by railways, and several ratios referred to some geographical variables, can provokes fluctuations on aggregate demand curve in the short run. In the long run, the aggregate supply can be also affected by means of these variables. In order to checking this question, considering that these spatial variables are not product factor, we propose to observe if these variables can affect the technological progress coefficient, A, concerning to an aggregate production function, according to a neo-classical growth model. Results by means of the Mankiw, Romer and Weil method, and also by means of an endogenous growth model of technology diffusion, indicates that some spatial variables affect the speed of convergence relative to the real per head income, across these 61 countries. However, a certain amount in some of these variables generates a congestion process in some countries. For checking it, we utilize a Barro and Sala i Martin endogenous growth model which reflects government activities. The concluding remarks indicates that some of these spatial variables above mentioned increases the speed of convergence but generates congestion in some countries. These spatial variables also affect the aggregate supply, and hence the price and output levels.

Key words: transportation, regional growth, convergence, congestion.
JEL Class.: R41

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1. INTRODUCTION

Spatial issues are generally neglected in conventional macroeconomics modeling, because the goods market is usually assumed to be in perfect competition. In fact, most spatial models are microeconomics, and do not embody the money market. Incorporating space into macroeconomics models implies to consider product differentiation, and hence imperfect competition in goods market, as is indicated in Thisse (1993). New Keynesian economics seems the framework in which space can be embodied at short run in macroeconomics modeling. Not only there are a great difficulty to include the space in a macroeconomics model, but also in reverse, is not still possible to introduce the money market in a spatial model. The best microeconomics model which incorporates the money in a framework of imperfect competition is the model of Blanchard and Kiyotaki (1987), which consider monopolistic competition with product differentiation in Dixit-Stiglitz (1977) sense. In this framework, if the aggregate demand function considered is the typically one-elastic as Lucas (1973) or Corden (1979) and Mankiw (1994) cases: $P.y = M.V$; fluctuations in the amount of money in equilibrium (M) can affect output (y) in a Keynesian framework. In a Classical framework, fluctuations in the amount of money affect level of prices (P) only because money velocity (V) is constant in this model. If income velocity of circulation is neither constant nor an erratic ratio but it is a conventional variable, can then V affect output or prices? Surely, it should be somewhat more considered Irving Fisher's (1911) observation, in the sense of velocity being a variable also depending on the state of transports and communications' infrastructure, as well as institutional factors and the well-known macroeconomics variables such as the price level, real income, the interest rate, the inflation rate or, conversely, the stock of money. A preliminary attempt in this direction has been made by Mulligan and Sala i Martin (1992). These authors estimate a money demand function using data for 48 US states covering the 1929-1990 period, where population density is included as an additional explanatory variable. The main aim of this paper is then, to analyze whether several space variables stemming from the cities and transportation systems would affect the quantity of money demanded in equilibrium, and the income velocity of circulation. The specification of the aggregate demand model is in section 2 of this paper and section 3 contains an empirical application. The analysis of the aggregate supply is in sections 4 and 5 where we also study the conditional convergence among countries in real per capita income, and the possible congestion process; finally some conclusions are in section 6.

2. SPATIAL EFFECTS ON AGGREGATE DEMAND

As a starting point for this analysis, we will establish some previous hypotheses. First, with the aim of simplifying the process, we will assume that money is only demanded for transactional purposes. This restriction does not mean any loss of generality regarding the results, and might be relaxed by including the precautionary and speculative motives in the equation of the demand for money. Second, we assume that money market is in equilibrium. Third, we will use as money stock (*M*) the M1 money aggregate, that is, currency in the hands of the public plus sight deposits. The specification of the model will be based in the three following points: i) Some expansion on the Baumol-Tobin model for transaction money demand. ii) A one-elastic aggregate demand *MV*, where *V* is considered as a conventional variable. iii) The spatial central places theory starting from Christaller and Lösch. Under these assumptions, we will follow, first, the transactions demand for money approach due to Baumol (1952) and Tobin (1956). The income velocity of circulation is defined as $V = I/M$, and after substituting we have:

$$V = (24rI/PO.b)^{1/2} \qquad \{1\}$$

where I is the annual nominal income, PO is the total population of the country, r is the nominal interest rate, and b is a constant which reflect the unitary transaction cost. Following Baumol and Tobin, the total number of optimal exchanges (N), that the total population of the country made during a year is:

$$N = (6rI.PO/b)^{1/2} \qquad \{3\}$$

and hence:

$$V = (24rI/(b.PO))^{1/2} = (2/PO)(6rI.PO/b)^{1/2} = 2N/PO \qquad \{4\}$$

which is a result similar to that obtained in Barro (1990). N is the total number of annual exchanges in the country but also means the number of journeys for changing money to make annual transactions. Perhaps there exists some correlation between the number of exchanges made within a certain area during a year, and the total number of journeys made during that time in that area for made several transactions. These journeys are made by several transport systems. We only consider two of them in our model: road and railway transport but not air, sea and walking transportation, because the impact on land of these last systems is small. At the same time, there are, as usually passenger and freight transportation. The application of the model which we try to specify is going to take place in the context of the so-called metropolitan areas, in a broad sense. The basic configuration of these ones comes from the analysis by Christaller (1933) and Lösch (1954). With these considerations and following Barreiro-Pereira (1998), the total journeys *per head* (N^*/PO) during a year into a country can be expressed by mean of a function as follows:

$$N^*/PO = f\,(PC, PCPO, PASKM, AUTPC, AUTCAM, PKMTKM, DENSID) \qquad \{5\}$$

where (N^*/PO) is made dependent on the population of the main city of the concerned country (*PC*), the ratio of *PC* into the country's total population (*PCPO*), the number of road passenger vehicles located into the country divided into the population of country’s first city (*AUTPC*), the number of passengers-kilometer transported by railways (*PASKM*), the ratio between passengers-kilometer / net ton-kilometer by railway (*PKMTKM*), the cars/trucks road ratio

(*AUTCAM*), and the population density of the country (*DENSID*). All variables are referred to a particular year.

Then, if there exists some correlation between the total journeys and the journeys for made exchanges between bonds an money, we will have:

$$N / PO = \varphi(N^{*}/ PO) \qquad \{6\}$$

But remembering equation (4): *V(money velocity)* $= 2N / PO = 2\varphi(N^{*}/ PO)$, we have the final specification of the income velocity of circulation model as follows:

$$V = F (PC, PCPO, PASKM, AUTPC, AUTCAM, PKMTKM, DENSID). \qquad \{7\}$$

3. EMPIRICAL MODELS FOR THE AGGREGATE DEMAND

The specification of the theoretical model embody probably a non linear model, but following the standard formulation of panel techniques and again for simplicity, the model above developed was finally estimated as a linear one such as:

$$V_{it} = \alpha_{it} + \mu_i + B_1(PCPO)_{it} + B_2(PC)_{it} + B_3(PKMTKM)_{it} + B_4(AUTCAM)_{it} + \\ + B_5(PASKM)_{it} + B_6(AUTPC)_{it} + B_7(DENSID)_{it} + \xi_{it} \qquad \{8\}$$

where *V* is the endogenous variable and the rest are the explanatory variables. The data set includes yearly variables for 64 countries (19 European, 17 Asian, 14 African, and 14 American), and the period of 14 years (1978 to 1991). These countries are: Algeria, Tunisia, Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Uruguay, Venezuela, Iran, Jordan, Malaysia, Syria, South Korea, Thailand, Turkey, Greece, Poland, Portugal, Yugoslavia, Cameroon, Congo, Egypt, Ethiopia, Kenya, Madagascar, Malawi, Morocco, Tanzania, Zaire, Zambia, Bolivia, Paraguay, Peru, Bangladesh, Philippines, India, Indonesia, Myanmar, Pakistan, Sry Lanka, Canada, USA, Japan, South Korea, Israel, Germany, Austria, Belgium, Czechoslovakia, Denmark, Finland, France, Netherlands, Ireland, Italy, Norway, United Kingdom, Spain, Sweden and Swiss, All countries of the sample have road and railways transportation system, and only a small group of countries with railways transportation are excluded from the sample because of incomplete data. The data set are collected basically from several sources, mainly: National Accounts Statistics, Tables 1992. United Nations Statistical Year Book, 37-38-39 issues; United Nations. International Financial Statistics Yearbook, (1994); International Monetary Fund. Statistical Trends in Transport, (1965-1989); E.C.M.T. World Tables, (1991). World Bank and The Europe Year Book, (1989). E.P.L. The former model has been estimated using panel data techniques, following the basic references of Hsiao (1986) and Greene (1995). We present in Table 4 the results after dropping the non-significant regressors. Under the hypothesis of first order serial correlation in the residuals, we choose model VII because of several reasons: i) the Lagrange multiplier test rejects the homogeneous OLS. ii) the Hausman test rejects the fixed effects or within-groups results in favor of this random effects specification, despite its low predictive capability. The second empirical model links the quantity of money in equilibrium and the identical significant explanatory variables of money velocity. These explanatory variables may be to explain also the quantity of money in circulation according to the following model:

$$M_{it} = \beta_{it} + \mu_i + A_1(PCPO)_{it} + A_2(PC)_{it} + A_3(PKMTKM)_{it} + A_4(AUTCAM)_{it} + A_5(PASKM)_{it} + A_6(AUTPC)_{it} + A_7(DENSID) + \xi_{it} \qquad \{9\}$$

where *M* is the quantity of money in equilibrium and is measured in US dollars in power purchasing parity terms, following the PWT data base developed by Summers and Heston (1991). The correlation among the endogenous variable and spatial explanatory variables is not a spurious one because substituting the equation 1 in the definition of *V*, we have the following specification for *M*: $M = (b.PO/24.r)V$ and hence the explanatory variables of *V* can theoretically to explain *M*. In this formulation appears the nominal interest rate, but under the hypothesis of Mundell-Fleming model for small economies, we can assume that it is almost constant among economies because them accept the interest rate of rest of the world, which is the interest rate of developed countries, as say in Mundell (1963). The estimation of this model is reported in Table 5. We can observe that the best method of estimation is 2SLS (column XIII), with all explanatory variables being significantly different from zero. The spatial explanatory variables of income velocity of circulation can also explain the quantity of money in circulation, and therefore, the aggregate one-elastic demand. According to results in Tables 4 for Velocity, and 5 for Money in equilibrium, we can deduce that variables *PCPO*, *PC* and *PKMTKM* affect the endogenous variables *V* and *M* in the same sense, and hence affect the one-elastic aggregate demand. The another four explanatory variables affect the two endogenous variables in contradictory sense, but all explanatory variables affect the aggregate demand curve.

4. SPATIAL EFFECTS ON GROWTH AND CONVERGENCE

The target of this section is to analyze if the seven explanatory variables above mentioned in sections 2 and 3 can affect the economic growth, the real per capita income, and the aggregate supply at long run. For analyzing this question, we suppose for simplicity an economy with a neoclassical Cobb-Douglas growth process labor augmenting, neutral in Harrod sense as: $y = (AL)^{1-\alpha}K^{\alpha}$, where *y* is the output, *L* is labor and *K* is physical capital and α is a constant <1. This production function, in per capita terms, but not measured in efficiency terms, takes the following expression: $Y=A^{1-\alpha}k^{\alpha}$ where *Y* is the real per capita income, *k* is the capital-labor ratio and *A* is the technical progress coefficient; besides we suppose that technical progress grow at an exogenous constant rate *g*. Developing by mean of a Taylor series the growth rate of per capita physical capital (*dk/k*) around the capital-labor ratio in the steady-state (k^*), we can express:

$$\frac{dk}{k} = \left(\frac{dk}{k}\right)_{k^*} + \frac{d}{dk}\left(\frac{dk}{k}\right)(k - k^*) + R \qquad \{10\}$$

Where the Taylor series is developed in the two first terms only and *R* is the Taylor's remainder. Knowing that $(dk/k) = sY/k - (n+\delta)$, where *s* is the save rate, and considering that in the steady-state situation $dk/k = g$ and hence $sA^{*1-\alpha}k^{*\alpha-1} = (n+g+\delta)$, we can obtain the value of the saving rate, and substituting the value of *s* in the above expression we can obtain:

$$\frac{dk}{k} = \frac{dk^*}{k^*} + (\alpha - 1)(n + g + \delta)\left(\frac{A}{A^*}\right)^{1-\alpha}\left(\frac{k^*}{k}\right)^{1-\alpha}\left(\frac{k - k^*}{k}\right) \qquad \{11\}$$

But rearranging 11, considering that $A^*=Ae^{g\tau}$ and $k^*=ke^{g\tau}$, where τ is the time distance to steady-state, we have then: $k^*dk\text{-}kdk^* = (\alpha\text{-}1)(n+g+\delta)(k\text{-}k^*)k^*$, and dividing this expression into $(k^*)^2$, it leads to:

$$\frac{k^*dk - kdk^*}{(k^*)^2} = -(1-\alpha)(n + g + \delta)\left(\frac{k - k^*}{k^*}\right) \qquad \{12\}$$

and considering several periods of time:

$$d\left(\frac{k}{k^*}\right) = -(1-\alpha)(n + g + \delta)\left(\frac{k - k^*}{k^*}\right)dt \qquad \{13\}$$

If now we consider *k** as a constant, we have that:

$$dk = -(1-\alpha)(n + g + \delta)(k-k^*)dt \qquad \{14\}$$

Developing now the initial growth rate of capital per capita (dk_0/k_0) around the steady state capital labor ratio (k^*) in the same form that we developed (dk/k) from the equation 11 until 14, we have:

$$dk_0 = -(1-\alpha)(n + g + \delta)(k_0-k^*)dt \qquad \{15\}$$

Aggregating now the expressions 14 and 15 and rearranging, we can obtain:

$$\frac{d(k + k_0)}{(k - k^*) - (k^* - k_0)} = -(1-\alpha)(n + g + \delta)dt \qquad \{16\}$$

where the term $(1\text{-}\alpha)(n + g + \delta)$ is so-called β and it is considered in a growth process in per capita terms as the speed of convergence from the transition dynamic towards the steady-state. Integrating the expression 16 considering ($k + k_0$) as a variable but considering *k** as a constant, we have that: $ln((k - k^* + k_0 - k^*)/C) = -\beta t$, being *C* the integration constant; and operating we have:

$$e^{-\beta t} = \left(\frac{k - k^* + k_0 - k^*}{C}\right) \qquad \{17\}$$

In this point is necessary to say that in the steady-state $k^* = k_0e^{gt}$; taking here logarithms we have that: $ln(k^*) = ln(k_0) + gt$, but developing $ln(k^*)$ and $ln(k_0)$ by mean of Taylor series, we have that: $k^*\text{-}1 \cong ln(k^*)$, and $k_0\text{-}1 \cong ln(k_0)$ and substituting it we have that $k^* \cong k_0 + gt$. Substituting this in the expression 17, we have:

$$e^{-\beta t} \cong \left(\frac{k - k^* - gt}{C} \right) \qquad \{18\}$$

For t = 0 we obtain that $C = k_0 - k^*$, and hence: $k - k^* - gt = (k_0 - k^*)e^{-\beta t}$, but knowing that when k approaches k^*, at same time Y approaches Y^* at same rate, also we can to write:

$$Y - Y^* = gt + (Y_0 - Y^*)e^{-\beta t} \qquad \{19\}$$

The coefficient β is the speed of convergence and indicates how rapidly an economy's output per worker Y approaches its steady-state value Y^*. Operating in expression 19 we have:

$$Y = gt + Y^*(1 - e^{-\beta t}) + Y_0 e^{-\beta t} \qquad \{20\}$$

And subtracting $(1 - e^{-\beta t})$ in the two parts of this expression and rearranging this equation we have: $Y - 1 = gt + (Y^* - 1)(1 - e^{-\beta t}) + (Y_0 - 1)e^{-\beta t}$. Approaching now the terms (Y-1), (Y^*-1), and (Y_0 -1) by mean of Taylor series, the expression 20 is converted in:

$$\ln Y = \ln e^{gt} + (1 - e^{-\beta t})\ln Y^* + e^{-\beta t} \ln Y_0 \qquad \{21\}$$

and hence:

$$Y = (e^{gt} Y^{*(1-e^{-\beta t})}) Y_0^{e^{-\beta t}} \qquad \{22\}$$

Calling now $(e^{gt} Y^{*(1-e^{-\beta t})})$ as B, and denoting $e^{-\beta t}$ as b, we have finally:

$$Y_T = B\,(Y_0)^b \qquad \{23\}$$

Expression that approaches in discrete time the growth process of the per capita real income respect to average of per capita income, and where b is a coefficient depending of time t.

Absolute Convergence. The growth rate of real per capita income respect to average of per capita income accumulated during the period (0,T) will be $\sum_{t=0}^{t=T} \frac{\Delta Y_t}{Y_t}$; and in the limit we have that:

$$\int_o^T \frac{dY}{Y} = \ln Y_T - \ln Y_o = \ln \frac{Y_T}{Y_o} \qquad \{24\}$$

Taking logarithms in expression 23:

$$\ln Y_T = \ln B + b \,.\, \ln Y_o \qquad \{25\}$$

and rearranging:

$$\ln Y_T - \ln Y_o = \ln B - (1-b) \ln Y_o \qquad \{26\}$$

Relating the expressions 24 and 26, we obtain that the growth rate of per capita real income relative in the (0,T) period is:

$$\ln \frac{Y_T}{Y_o} = \ln B - (1 - b)\ln Y_o \qquad \{27\}$$

where $b = e^{-\beta.T}$, and β is, in the dynamic transition toward the steady-state, a coefficient which indicates the speed of convergence of the real per capita income towards the steady state. Then, the average rate of per capita real income in relative terms will be:

$$\frac{1}{T}\cdot\ln\frac{Y_T}{Y_o} = a - \left[\frac{1-e^{-\beta\cdot T}}{T}\right]\cdot\ln Y_o \qquad \{28\}$$

where a is *(ln B)/T*. This expression denotes how the growth rate of relative real per capita income is related negatively with the logarithm of the initial level of relative real per capita income (lnY_o). That is, for a determined level of interaction parameter (a) related with each steady state, as higher is the per capita income in a country, lower will be the growth rate. If the value of b is positive, and (a) is the same in all countries of the sample, then there exists absolute convergence; if b is zero or negative will exists divergence. The coefficient β means the speed of convergence; if $\beta \geq 0$ and the interaction term (a) is the same for all countries, then the poor economies grow more quickly than the richest ones, and there will exist absolute convergence; in our case, regressing the equation 28 over a sample of 61 countries, this coefficient of absolute convergence is: -0.003. The absolute convergence concept cannot be utilized among economies which have different steady states. For this last, and more common situation there must be utilized the conditional convergence concept.

Conditional Convergence. The conditional convergence concept implicates that in each country the speed of convergence is inversely related to the distance to each steady state. When there exists technical progress, denoted as A, the neoclassical model assumes that this coefficient is the same for all countries, and the model supposes that this coefficient is exogenous and grows at one constant rate (g); then the growth rate of the per capita income beyond steady state will be:

$$\frac{1}{T}\int_{Y^x}^{Y_T}\frac{dY}{Y} = \frac{1}{T}\cdot\ln\frac{Y_T}{Y^x} = g = a - \left(\frac{1-e^{-\beta T}}{T}\right)\ln Y^* \qquad \{29\}$$

and hence the interaction term (a), that now is related with the exogenous technical progress growth rate, tends to the following value:

$$a = g + \left(\frac{1-e^{\beta T}}{T}\right)\cdot\ln Y^* \qquad \{30\}$$

Substituting this term in the convergence equation 28 we have that:

$$\frac{1}{T}\int_{Y_0}^{Y_T}\frac{dY}{Y} = g + \left(\frac{1-e^{-\beta T}}{T}\right)\ln Y^* - \left(\frac{1-e^{-\beta T}}{T}\right)\ln Y_0 \qquad \{31\}$$

and hence:

$$\frac{1}{T}\ln\frac{Y_T}{Y_0} = g + \left(\frac{1-e^{-\beta T}}{T}\right)\left(\ln Y^* - \ln Y_0\right) \qquad \{32\}$$

where real income is in per capita terms. This expression 32 is equivalent to formulation 28 but is available for to explain the conditional convergence because consider terms concerning to steady-state. The problem now is the estimation of per capita income in the steady state (Y^*). For this, we suppose that countries grow by means of a neoclassical model with a neutral technical progress in Harrod's sense, at an exogenous rate fixed (g). Yet, and following Mankiw, Romer and Weil (1992), this growth model embodies the capital factor in a broad sense to include the human capital factor. To keep the neoclassical hypothesis is necessary to consider constant returns to scale and that the marginal productivity of physical capital incorporates diminishing returns. The growth model can be expressed as following:

$$y = K^{\alpha} \cdot H^{\gamma} \cdot [A \cdot L]^{1-\alpha-\gamma} \qquad \{33\}$$

where A denotes the technical progress; in per capita terms, we have then:

$$Y = \frac{y}{L} = K^{\alpha} \cdot H^{\gamma} \cdot A^{1-\alpha-\gamma} \cdot L^{-(\alpha+\gamma)} \qquad \{34\}$$

Taking logarithms in this expression we have that:

$$\ln Y = \ln\left(\frac{y}{L}\right) = \alpha \cdot \ln K + \gamma \ln H + (1-\alpha-\gamma) \cdot \ln A - (\alpha+\gamma)\ln L \qquad \{35\}$$

In one time period, the investment (*Inv*) have an expression as following in the goods market equilibrium:

$$Inv = dK = S_K \cdot y - \delta \cdot K \qquad \{36\}$$

where S_K is the saving rate and δ is the depreciation rate of physical capital (K). Divided into K the last expression, we can wrote the growth rate of physical capital:

$$\frac{dK}{K} = S_K \cdot \left(\frac{y}{K}\right) - \delta \qquad \{37\}$$

But in the steady state under a growth rate (g) of technological progress, the physical capital grew at one rate: $\frac{dK}{K} = n + g$, whereas this rate, in per capita terms grew $dk/k = g$; and substituting now this in the last formulation (37) we have one condition for steady state:

$$S_K \cdot y = (n + g + \delta)K \qquad \{38\}$$

In the same sense for the human capital factor, we have that:

$$S_H \cdot y = (n + g + \delta)H \qquad \{39\}$$

where H is the human capital and S_H is a proxy of them. Rearranging these two equations and taking logarithms we have the following expressions:

$$\left.\begin{array}{l} \ln K = \ln y^* + \ln S_K - \ln(n + g + \delta) \\ \ln H = \ln y^* + \ln S_H - \ln(n + g + \delta) \end{array}\right\} \qquad \{40\}$$

and substituting these two equations, which concerning to steady state, in the expression 35 we will have a measure of income in this steady state:

$$\ln Y^* = \ln\left(\frac{y^*}{L}\right) = \ln y^* - \ln L = \alpha[\ln y^* + \ln S_K - \ln(n+g+\delta)] + \\ + \gamma[\ln y^* + \ln S_H - \ln(n+g+\delta)] + (1+\alpha+\gamma)\ln A - (\alpha+\gamma)\ln L \qquad \{41\}$$

and rearranging this last equation:

$$(1-\alpha-\gamma)\ln y^* - (1-\alpha-\gamma)\ln L = \alpha[\ln S_K - \ln(n+g+\delta)] + \gamma[\ln S_H - \ln(n+g+\delta)] + \\ + (1-\alpha-\gamma)\ln A$$

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Hence:

$$(1-\alpha-\gamma)\ln\left(\frac{y^*}{L}\right) = \alpha \cdot \ln S_K + \gamma \ln S_H + (1-\alpha-\gamma)\ln A - (a+\gamma)\ln(n+g+\delta) \qquad \{43\}$$

And finally we have the estimation of per capita income at steady state:

$$\ln Y^* = \ln\left(\frac{y^*}{L}\right) = \ln A + \left(\frac{\alpha}{1-\alpha-\gamma}\right)\ln S_K + \left(\frac{\gamma}{1-\alpha-\gamma}\right)\ln S_H - \left(\frac{\alpha+\gamma}{1-\alpha-\gamma}\right)\ln(n+g+\delta)$$

{44}

Following Barro and Sala y Martin (1995) and Romer (1996)[1] normally is assumed that the value of $(g+\delta)$ is 0.05. The estimation of average growth rate of per capita income yields, when we substitute the above equation of per capita income at the steady state into the expression 32; and we obtain then:

$$\frac{1}{T}\int_{Y_0}^{Y_T}\frac{dY}{Y} = \frac{1}{T}\ln\frac{Y_T}{Y_0} = g + \left(\frac{1-e^{-\beta T}}{T}\right)\left[\ln A + \left(\frac{\alpha}{1-\alpha-\gamma}\right)\ln S_K + \left(\frac{\gamma}{1-\alpha-\gamma}\right)\ln S_H - \right.$$

{45}

$$\left. - \left(\frac{\alpha+\gamma}{1-\alpha-\gamma}\right)\ln(n+g+\delta) - \ln Y_0\right]$$

From this formulation we can know the coefficients of ln S_K, and ln S_H; in non logarithms terms we have, calling to $\left(1-e^{-\beta T}\right)$ as *(1-b)* that:

$$Y_T = e^{gT} \cdot (n+g+\delta)^{\left[\frac{(b-1)(\alpha+\gamma)}{1-\alpha-\gamma}\right]} \cdot A^{(1-b)}.S_K^{\left[\frac{(1-b)\alpha}{1-\alpha-\gamma}\right]} \cdot S_H^{\left[\frac{(1-b)\gamma}{1-\alpha-\gamma}\right]} \cdot Y_o^b \qquad \{46\}$$

but considering that *(dA/dt)/A = g*, and integrating it, we have that: $e^{gT} = A/A_0$, where A_0 is the initial level of technology; moreover, with the aim of avoiding the initial technical progress A_0, we will estimate the following form of equation 46 in order to estimate the global *b* parameter:

$$Y_T = e^{gT} A^{(1-b)} (n+g+\delta)^{-(\lambda+\nu)} \cdot S_K^{\lambda} \cdot S_H^{\nu} \cdot Y_0^b \qquad \{47\}$$

where S_K and S_H reflects hold fixed levels of physical and human capital. The final form of the equation to estimate is:

$$\ln Y_T = [gT + (1-b)\ln A] - (\lambda+\mu)\ln(n+0.05) + \lambda \ln S_K + \mu \ln S_H + b\ln Y_0 \qquad \{48\}$$

As a result of this estimation we can obtain the coefficient β conditional among global countries, and in our case over 61 countries is: +0.003.

Difussion of technology in open economies. If we suppose now that each economy is an open economy then is possible that technological progress be diffused among all countries supposing a certain number of leading countries technology diffusers. If the diffusion of technology occurs gradually the model above analyzed becomes in an endogenous growth model, which predict a pattern of convergence across economies. The early versions of endogenous growth theories no longer predict conditional convergence, as in Lucas(1988), but the diffusion models predict a form of conditional convergence that resembles the predictions of the neoclassical growth model. If one economy follows an innovator process that produces a number N_1 of intermediate goods (x_j) that have been discovered by this leader economy, then the growth process can be expressed as following:

$$y_1 = A_1 \cdot L^{1-\alpha} \sum_{j=1}^{N_1} \left(x_{ij} \right)^{\alpha} \qquad \{49\}$$

where y_1 is the quantity of final goods produced by a representative firm in a technologically leader country; A_1 can represent here various aspects of government policy, such as taxation, provision of public services, and mainly the level of technology. For simplicity we suppose that the intermediate goods can be measured in a common physical unit, which are employed in the same quantity. Then, the quantity of output will be given by the following expression[2]:

$$y_1 = A_1 \cdot L^{1-\alpha} \cdot N_1 \cdot \left(x_j \right)^{\alpha} \qquad \{50\}$$

The diffusion of technology process must incorporate imperfect competition in final goods market (y_1) when individual's innovations spread only gradually to follower countries, and at same time producing an endogenous growth process, making endogenous the rate of technological progress. In this model, technological progress shows up as an expansion of the number of varieties of producer and consumer products; if this number of capital goods augmenting is considered as a basic innovation because opening up a new industry. The process of production of new technologies begins in the R & D sector where researchers produce designs for new intermediate inputs. Then, they sale these designs to monopolistically competitive firms who produce them, with the price of the design determined by the flow of monopoly profits generated by the purchasing firm. The output of the R & D sector, in terms of

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1 Romer, D. (1996): Advanced Macroeconomics, McGraw Hill.

2 This productive process can be assimilated to one which incorporate human capital and labor augmenting technology similar to the neoclassical model $y = K^{\alpha} H^{\gamma} \left[AL \right]^{1-\alpha-\gamma}$ above mentioned, if the productive process of intermediate inputs x_j follows certain production function such as:

$$x_j = \frac{K}{A \cdot N_1^{1/\alpha}} \left[\frac{H}{AL} \right]^{\frac{\gamma}{\alpha}}$$

where physical capital incorporates non diminishing returns to scale, and hence generates an endogenous process of accumulation. Moreover, globally all goods x_j incorporated in the production function of y_1, embody diminishing returns on physical capital.

new designs for intermediate inputs is determined by means of a different technology defined as:

$$(dA/dt)/A = \tau H \qquad \{51\}$$

such in Romer (1990) and Grossman and Helpman (1994), where τH is the human capital used in research. In the case of follower economies which imitates leader countries the production function for the representative firm will be:

$$y_2 = A_2 \cdot L^{1-\alpha} \cdot N_2 \left(x_j\right)^{\alpha} \qquad \{52\}$$

where $N_2 \leq N_1$; y_2 is the output of the representative firm in the follower countries, and N_2 is the number of products that are available for use in these imitator countries. If assuming that cost of imitation pay by follower countries is an increasing function of the ratio N_2/N_1, following Quah (1996a), and Barro and Sala-i-Martin (1995), the model delivers to a kind of conditional convergence behavior similar to come from neoclassical labor augmenting model of growth. Then, the relationship between the growth rates in follower and leader countries is give by the following expression:

$$\frac{1}{T}\int_0^T \frac{dy_2}{y_2} \cong \frac{1}{T}\int_0^T \frac{dy_1}{y_1} - \frac{\beta}{T}\cdot \ln\left[\frac{N_2/N_1}{\left(N_2/N_1\right)^*}\right] \qquad \{53\}$$

where y_i is in no per capita terms. But considering the expressions 52 and 49 and divides both, we can related the real per capita incomes measured in efficiency units, ($Y^o = y / AL$), for both types of countries, with respects both levels of varieties of intermediate goods (N) produced in each country, and it can be expressed as $(Y_2{}^o/Y_1{}^o)=(A_2/A_1)^{(\alpha/1-\alpha)}\ (N_2/N_1)$; at same time, supposing the real per capita income measured in not efficiency units, we have that: $(Y_2/Y_1)=(A_2/A_1)^{(1/1-\alpha)}\ (N_2/N_1)$. Using these expressions we can substitute them in relation 53 and then this last formulation can be write as follows:

$$\int_0^T \frac{dy_2}{y_2} \cong \int_0^T \frac{dy_1}{y_1} - \beta \cdot \ln\left[\frac{Y_2/Y_1}{\left(Y^\circ{}_2/Y^\circ{}_1\right)^*}\left(\frac{A_1}{A_2}\right)\right] \qquad \{54\}$$

where Y_2 is the real per capita income of each country, and Y_1 is the average of per capita real income in the leader countries; in this equation all terms are observable, except A_i, because we can substitute the ratio $(Y_2{}^o/Y_1{}^o)^*$ by their estimation in relationship 44, and with the aim of to make disappear A, this equation 44 can be expressed in efficiency terms as follows:

$$\ln Y^{o*} = \ln\left(\frac{y^*}{AL}\right) = \left(\frac{\alpha}{1-\alpha-\gamma}\right)\ln S_K + \left(\frac{\gamma}{1-\alpha-\gamma}\right)\ln S_H - \left(\frac{\alpha+\gamma}{1-\alpha-\gamma}\right)\ln\left(n+g+\delta\right)$$

{55}

and in this equation do not appear the coefficient of technical progress *A*. In the relationship 54 A_1 and A_2 are the technological matrix concerning to leader and follower countries respectively. With respect to follower countries, we assuming that they do not have the same access to the technology come from leader countries; in this sense, and looking our countries' sample, we consider two types of technology for the follower countries: A_2 for the developed, but not technologically leader countries, and A_3 concerning to less-developed and the poor countries. We suppose one A_2 technology for the following 21 countries contains in the sample: Algeria, Tunisia, Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Uruguay, Venezuela, Iran, Jordan, Malaysia, Syria, South Korea, Thailand, Turkey, Greece, Poland, Portugal, and Yugoslavia. The A_3 technology concerns to the followings 21 countries: Cameroon, Congo, Egypt, Ethiopia, Kenya, Madagascar, Malawi, Morocco, Tanzania, Zaire, Zambia, Bolivia, Paraguay, Peru, Bangladesh, Philippines, India, Indonesia, Myanmar, Pakistan, and Sry Lanka. The countries technologically leaders considered in this analysis, with A_1 technology, are: Canada, USA, Japan, South Korea, Israel, Germany, Austria, Belgium, Czechoslovakia, Denmark, Finland, France, Netherlands, Ireland, Italy, Norway, United Kingdom, Spain, Sweden and Swiss, in total 19 technological leader countries.

Particular conditional convergence. In a single cross-section analysis, the speed of conditional convergence (β) is identical in both models, neoclassical with exogenous growth, and endogenous with diffusion of technology; but in a panel data both models furnishes different speed of conditional convergence. The problem now in the relation 54 is to calculate the term (A_1/A_2); moreover, if we consider the equation 51, and remembering also that $(dA/dt)/A = g$, we can concluding that: $gT = \tau HT$, and substituting this in formulation 47 using $ln\ (S_H)$ as a proxy of *H,* we will have the following model:

$$Y_T = A^{(1-c)}(n+g+\delta)^{\rho} \cdot S_K^{\lambda} \cdot S_H^{\mu} \cdot Y_0^{c} \qquad \{56\}$$

This model not assumes in necessary form the neoclassical hypotheses formulated about model 47 by Mankiw, Romer and Weil (1992), including the exogenous growth rate of *A*, and that technological progress must be the same for all countries; it results in an endogenous growth model, that is not sure that it predicts convergence. But form model 56 is very easy to obtain the *A* coefficient, by mean of to regress this equation for each group of countries:

$$\ln Y_T = \left[(1-c)\ln A\right] + \rho \ln(n+0.05) + \lambda \ln S_K + \mu \ln S_H + c \ln Y_0$$

Once known the value of coefficient c and substituting it into the constant term, we can know the coefficients A_1, A_2 and A_3; substituting them in the relation 54, we can obtain the particulars speeds of conditional convergence β*'s* for each country. The values of β coefficients are shown in the first column of table 1. Substituting now this values of β's in the relation 28, henceforth that both models, neoclassical and technological diffusion furnishes the same values of β's, we can obtain the interaction parameters (a_i) for each country, corresponding to each steady state.

Global spatial absolute convergence. At same time we can consider now the role of infrastructures and other spatial variables in the growth and convergence process. These variables, coming from of public infrastructures are not exactly a factor input, as assumed in Aschauer (1989) and Barro (1990), because it affect the growth process as a factor productivity externalities; the infrastructure factor productivity externality is incorporated into the production process affecting the technical progress coefficient, as follows: $A^{\#} = AS^{\eta}$, where S is the level scoped by the spatial variables related with infrastructures, corresponding with the level of A; in this case where exist infrastructure externalities, supposing that $e^{gt} = A^{\#}/A^{\#}_0$ and substituting it in formulation 22, we have: $Y = ((A^{\#}/A^{\#}_0)Y'^{*(1-b')})Y_0^{b'}$. If the spatial variables S can affect the real per capita income in steady-state, then Y* tends to Y'*, being Y'* the new real per capita income in the steady-state; in the same sense, the coefficient of convergence (b) will be tend to (b'), being (b') the new coefficient of convergence due to the presence of spatial variables; knowing now that $A_T^{\#} = A_T S_T^{\eta}$, and $A_0^{\#} = A_0 S_0^{\eta}$,the new formulation of 22 expression when exist spatial externalities which affect the steady-state and speed of convergence will be:

$$Y = \left[(\frac{A_T^{\#}}{A_0^{\#}}) Y'*^{(1-b')} \right] Y_0^{b'} = \left[(\frac{A_T}{A_0}) \left(\frac{S_T}{S_0} \right)^{\eta} Y'*^{(1-b')} \right] Y_0^{b'} = \left(\frac{S_T}{S_0} \right)^{\eta} \left[(\frac{A_T}{A_0}) Y'*^{(1-b')} \right] Y_0^{b'} \qquad \{57\}$$

where we assuming that these ratios (S_T/S_o) hold fixed, and η is a certain coefficient of elasticity. Following Bradley, O'Donell, Sheridan, and Whelan (1995) calling (S_T/S_o) as S, that is, the ratio between the final and initial values of an absolute and general spatial variable S, the general form of the growth process of real per capita income when exist infrastructure externalities (S) could be write as follows: $Y = B' S^{\eta} Y_0^{b'}$. The factor productivity externality is associated with improved supply conditions in the economy as a result of the investment in human capital and public infrastructure; these two last variables are incorporated in the model by endogenising the scale parameter A provoking, hence, an endogenous growth model, as say in Barro(1997). The growth process generated by this model, once calculated the income growth rates in annual per capita terms are the following since take logarithms in the above expression:

$$\frac{1}{T} \cdot \ln \frac{Y_T}{Y_o} = a' - \left[\frac{1-b'}{T} \right] \cdot \ln Y_o + \frac{\eta}{T} . \ln \left(\frac{S_T}{S_0} \right) \qquad \{58\}$$

where η is a certain elasticity coefficient, and a is the interception parameter, $a = (1/T)(lnB')$, which is related with the steady state position. In the Barro (1990) model of endogenous growth, which incorporate shocks and factor productivity externalities provoked by mean of human and public capital, during the dynamic transition toward steady state, once we are away from the optimal ratio between human to physical capital there is a higher return to the factor which is relatively scarce, and hence the optimal policy is to accumulate only that factor; as more of this factor is accumulated, the rate of return on it declines and we return to steady state growth path. During the dynamic transition we observe the growth rate declining towards the steady state rate. This means that an economy is from the optimal ratio H/K the higher is its rate of growth. The early endogenous growth model do not generates convergence, but under the above conditions can exist some possibilities of generates a convergence form Barro (1990) model; in this situation, b' is $e^{-\beta_s T}$ being β_s the speed of absolute convergence resulting of to introduce the spatial variables S_i in the growth process if a' is the same or all countries. To calculate the value of η exponent, we obtain from equation 58:

$$\eta = \frac{\partial \ln\left(\frac{Y_T}{Y_0}\right)}{\partial \ln\left(\frac{S_T}{S_0}\right)} \qquad \{59\}$$

where η is the effect caused by the spatial variable on real per capita income growth rate. At same time from the non linear regression of real income in absolute terms (y) on all spatial explanatory variables for estimate the explanation power of these on output level, we obtain:

$$\ln y_{i,t} = a_{it} + \varepsilon \cdot \ln S_{it} + u_{it} \qquad \{60\}$$

where $\varepsilon = \varepsilon_{y,S}$ is the elasticity coefficient of (y) relative to S variable. Estimated this equation, we have that:

$$\hat{\varepsilon}_{y,S} = \frac{\partial \ln y}{\partial \ln S} = \frac{\ln y_T - \ln y_o}{\ln S_T - \ln S_o} = \frac{\ln\left(\frac{y_T}{y_S}\right)}{\ln\left(\frac{S_T}{S_o}\right)} = \frac{\frac{\Delta y}{y}}{\frac{\Delta S}{S}} \qquad \{61\}$$

and we can deduced that: $\ln\left(\frac{y_T}{y_o}\right) = \hat{\varepsilon} \cdot \ln\left(\frac{S_T}{S_o}\right)$, and hence:

$$y_T = \left(\frac{S_T}{S_o}\right)^{\hat{\varepsilon}} \cdot y_o \;. \qquad \{62\}$$

If now we divided this equation into labor, thinking that labor grow at one constant and exogenous rate n: $L_T = L_0 \,.\, e^{nt}$, we will have that,

$$Y_T = e^{-nt} \cdot \left[\frac{S_T}{S_0}\right]^{\hat{\varepsilon}} \cdot Y_0 \qquad \{63\}$$

taking logarithms in this expression we have:

$$\ln Y_T = -n\tau + \hat{\varepsilon} \cdot \ln\left(\frac{S_T}{S_0}\right) + \ln Y_0 \qquad \{64\}$$

and hence:

$$\hat{\varepsilon} = \frac{\partial \ln \frac{Y_T}{Y_0}}{\partial \ln \frac{S_T}{S_0}} \qquad \{65\}$$

and comparing the expressions 59 and 65, we can reduced the problem to: $\eta \cong \hat{\varepsilon}$.

Global spatial conditional convergence. Really, the speed of convergence (*β*) and the interception parameter (*a*), are affected by spatial externalities (*S*). If we follow supposing that technology is spread gradually from leader to follower countries, then the truth speed of convergence when there exist spatial externalities, can be calculated from the formulation number 54 if the real per capita income is measured in efficiency units at steady-state in this formulation; concretely the term $(Y^o_2 / Y^o_1)^*$, will be calculated thinking that Y^{o*} is affected by spatial externalities *S* and after of this, we will call this term as $(Y^o_2 / Y^o_1)^{*S}$. For calculating this, under these conditions, we will suppose a growth process labor augmenting, neoclassical by simplicity, which also embodies these spatial externalities, two of them for example, S_1 and S_2 to generalize:

$$y = K^{\alpha} \cdot H^{\gamma} \cdot [A \cdot L]^{1-\alpha-\gamma} S^{\mu} S^{\lambda} \qquad \{66\}$$

where S_i is the spatial externality measured as the ratio (S_T / S_0) and μ and λ are determined exponents[3]. We suppose with the aim of keeping a neoclassical process, that spatial ratios S_i held constant during the process and also the exponents μ and λ. Developing this process in the same form that the neoclassical model 33, we can conclude as in 55 expression that real per capita income in the steady-state, measured in efficiency units, when spatial variables *S* affect the growth process can be calculated as follows:

$$\ln Y^{o}* = \left(\frac{\mu}{1-\alpha-\gamma}\right)\ln S + \left(\frac{\alpha}{1-\alpha-\gamma}\right)\ln S_K + \left(\frac{\gamma}{1-\alpha-\gamma}\right)\ln S_H - \left(\frac{\alpha+\gamma}{1-\alpha-\gamma}\right)\ln(n+g+\delta) \qquad \{67\}$$

Substituting this in the expression 32, knowing that *ln Y* = ln Yº* + ln A*, and rearranging we have a relationship that remember the 47 equation, considering two different externalities:

$$Y_T = e^{gT} \cdot (n+g+\delta)^{\left[\frac{(b'-1)(\alpha+\gamma)}{1-\alpha-\gamma}\right]} \cdot A^{(1-b')} \cdot S_1^{\left[\frac{\mu(1-b')}{1-\alpha-\gamma}\right]} S_2^{\left[\frac{\lambda(1-b')}{1-\alpha-\gamma}\right]} \cdot S_K^{\left[\frac{(1-b')\alpha}{1-\alpha-\gamma}\right]} \cdot S_H^{\left[\frac{(1-b')\gamma}{1-\alpha-\gamma}\right]} \cdot Y_o^{b'} \qquad \{68\}$$

and taking logarithms in this expression we have:

$$\ln Y_T = [gT + (1-b')\ln A] + \varepsilon_1 (1-b')\ln S_1 + \varepsilon_2 (1-b')\ln S_2 + \left[\frac{(b'-1)(\alpha+\gamma)}{1-\alpha-\gamma}\right]\ln(n+0.05) +$$

$$+ \left[\frac{(1-b')\alpha}{1-\alpha-\gamma}\right]\ln S_K + \left[\frac{(1-b')\gamma}{1-\alpha-\gamma}\right]\ln S_H + b'\ln Y_0$$

which once regressed, it can furnishes b' and hence the spatial conditional β_s among all

[3] In this case the growth process wii be $y = K^{\alpha} H^{\gamma} (A^{\#} L)^{1-\alpha-\gamma}$, but knowing that $A^{\#} = A S_1^{\eta} S_2^{\theta}$ when there are two externalities,and substituting it: $y = K^{\alpha} H^{\gamma} (A S_1^{\eta} S_2^{\theta} L)^{1-\alpha-\gamma} = K^{\alpha} H^{\gamma} (A L)^{1-\alpha-\gamma} S_1^{\eta(1-\alpha-\gamma)} S_2^{\theta(1-\alpha-\gamma)}$. Coming from the 65 relationship we know that $\eta = \varepsilon_1$ and $\theta = \varepsilon_2$,and hence: $\mu = \varepsilon_1 (1-\alpha-\gamma)$, and $\lambda = \varepsilon_2 (1-\alpha-\gamma)$.

countries.

Particular spatial conditional convergence. Once regressed the above expression, we can know the values of coefficients of S_i,*n*, S_K, S_H, and Y_0, and substituting them in the expression 67, of the real per capita income in efficiency units, at steady-state, we can estimate each Y^{o*} for each country and hence also the new term $(Y^o_2 / Y^o_1)^{*S}$, where are included now the impact of spatial externalities. At the same time, in the equation 54, the term (A_1 / A_2) must be substitute by $(A_1^\# / A_2^\#)$, but for each spatial externality, we have:

$$\frac{A_1^\#}{A_2^\#} = \frac{A_1 S_{1i}^{\varepsilon_{1i}}}{A_2 S_{2i}^{\varepsilon_{2i}}}$$

Substituting this new term in the expression 54 and the term $(Y^o_2 / Y^o_1)^{*S}$, we can calculate directly now the particular speeds of convergence for each country (β_S) when it growth process are affected by each spatial externality:

$$\int_{.0}^{.T} \frac{dy_2}{y_2} \cong \int_{.0}^{.T} \frac{dy_1}{y_1} - \beta_S \cdot \ln \left[\frac{Y_2 / Y_1}{\left(Y^\circ_2 / Y^\circ_1 \right)^{*S}} \left(\frac{A_1}{A_2} \right) \frac{\left(\frac{S_T}{S_0} \right)_{1i}^{\varepsilon_{1i}}}{\left(\frac{S_T}{S_0} \right)_{2i}^{\varepsilon_{2i}}} \right] \qquad \{54\}$$

These coefficients β_S are shown in table 1 for each spatial variable and each country.

Like these externalities normally affect the steady-state level of the real per capita income, also affect the values of the interception parameters (a_i) for each country. For made a comparison on how the introduction of spatial externalities in the growth process can affect the interception parameters related with the steady-state's levels, we can calculate these a_i's for each country substituting in the expression 68 each speed of spatial conditional convergence (β_S) above calculated. This coefficients a_i must be compared for each country with its corresponding obtained from equation 28 where the spatial externalities do not affect the growth process.

5. CONGESTION PROCESS

A great number of the spatial variables above mentioned not should be available without the existence of certain infrastructures, as in the case of transportation and cities system infrastructures, in general provides by Government, which playing a role as public goods and hence it may be generates a congestion process; in this model we substitute human by public capital. For analyzing this process we suppose an aggregate production function without diminishing returns in physical capital that furnishes an endogenous growth process with *AK* technology modified by mean of the inclusion by a term that reflects the activities of Government. In this case, the aggregate production function contains the technical progress coefficient in physical capital augmenting form, and it can be wrote as following:

$$y = (AK)^\alpha G^{1-\alpha} \qquad \{69\}$$

where *G* denotes the public capital. Rearranging this equation we obtain: $y^\alpha = (AK)^\alpha (G/y)^{1-\alpha}$, and hence: $y = AK(G/y)^{(1-\alpha)/\alpha}$, that is: $y = AK.f(G/y)$. In this last equation we will consider the term *(G/y)* is considered as a constant so-called τ. Besides with supposing that $f'_{\tau} > 0$ and $f''_{\tau\tau} < 0$, being $A>0$. For simplicity we will supposes that Government have a budget balances in equilibrium, in manner that $G=\tau y=T$, being *T* the total volume of direct taxes. In this model consumers and producers maximize theirs utilities and profits respectively. Moreover the Government is also an economic agent which will maximize a certain social welfare function. In this function the most important component is the per capita real income growth rate. Following Barro and Sala-i-Martin (1995) the results of this maximization process are identical to maximize the following function:

$$\gamma(\tau) = (1-\tau)\cdot f(\tau) \qquad \{70\}$$

The results of this maximization furnishes the optimum sizes of Government sector face to congestion problem. The equation that furnishes this optimum size is the following:

$$\frac{\partial y}{\partial G} = \frac{f'(\tau)}{f(\tau)+\tau\cdot f'(\tau)} = \frac{f'(\tau)}{f'(\tau)} = 1 \qquad \{71\}$$

And this condition is so-called the efficiency condition of the Government Sector. If we suppose now that generally the Governments are efficient in the congestion problem, then the income elasticity with respect to the public expenditure must be for each country the following:

$$\varepsilon_{y,G} = \left(\frac{\partial y}{\partial G}\right)\cdot\left(\frac{G}{y}\right) = 1\cdot\tau = \tau \qquad \{72\}$$

where $0 < \tau < 1$, and hence this elasticity must be <1. When the growth rate of spatial variables be more high that infrastructures rates corresponding, then will appears congestion. Supposing that *S* is a generically spatial variable, the income elasticity with respect this variable become:

$$\varepsilon_{y,S} = \left(\frac{\partial y}{\partial S}\right)\cdot\left(\frac{S}{y}\right) \qquad \{73\}$$

And dividing the formulation 73 into the 72 we have:

$$\varepsilon_{G,S} = \frac{\varepsilon_{y,S}}{\varepsilon_{y,G}} = \frac{\left(\frac{\partial y}{\partial S}\right)\cdot\left(\frac{S}{y}\right)}{\left(\frac{\partial y}{\partial G}\right)\cdot\left(\frac{G}{y}\right)} = \left(\frac{\partial G}{\partial S}\right)\cdot\left(\frac{S}{G}\right) = \frac{\left(\frac{dG}{G}\right)}{\left(\frac{dS}{S}\right)} = \frac{\varepsilon_{y,S}}{\tau} \qquad \{74\}$$

Supposing the efficiency condition and like we know that $\tau < 1$, we can deduce that if $\varepsilon_{y,S} \geq 1$ then must be $\varepsilon_{G,S} > 1$. That is:

$$\varepsilon_{G,S} = \frac{\frac{dG}{G}}{\frac{dS}{S}} > 1 \qquad \{75\}$$

and hence:

$$\frac{dG}{G} > \frac{dS}{S} \qquad \{76\}$$

When the growth rate of public expenditures in infrastructures is more high that the growth rate of the spatial variable corresponding, then implicates not congestion. In abstract the congestion process is submitted in the following scheme:

If $\varepsilon_{y,S} \geq 1$ do not exists congestion

If $\varepsilon_{y,S} < 1$, should be congestion : If $\varepsilon_{y,S} \geq \tau$ there are not congestion

If $\varepsilon_{y,S} < \tau$ produces congestion

These coefficients of elasticity $\varepsilon_{y,S}$ are show for each country and each spatial variable in table 2.

6. CONCLUDING REMARKS

The main results of this analysis are shown in table 2, denoting that if increase the value of any spatial variables, affect positively (+) the growth rate of real per capita income, or negatively (-) depending of sign that take each spatial variable in each country. The table 1 shows the speed of conditional convergence particular β of each country, and at same time, the speed of convergence when the spatial variables affect separately the coefficient of technical progress; this affectation indicates that the seven spatial variables above mentioned also affect the aggregate supply at long run, and the output. In the table 3 we can observer what policy on each spatial variable in each country is well, for augmenting the speed of conditional convergence in real per capita income towards each steady-state, depending of the sign of these values: if the sign is minus, we must diminish the amount of this variable for augmenting the speed of conditional convergence. How we can observe in table 3, in some countries for some spatial variables may appear infrastructure congestion (*CG*), calculated following the explanation in section 5, when we try to increase the β.

Table 1. SPEEDS OF CONDITIONAL CONVERGENCE (1978-1991)

Countries	β	β-PC	β-PCPO	βAUTCAM	β-PASKM	β-AUTPC	βPkmtkm	β-DENSID
Algeria	0.001901	0.001901	0.001901	0.001901	-0.03608	0.001901	0.026826	0.001901
Cameroon	0.004240	0.004240	0.004240	-0.00724	-0.00447	0.004240	0.004240	0.004240
Congo	0.013908	-0.02269	0.013908	0.013908	0.013908	0.018916	0.019699	0.013908
Egypt	0.014068	0.014068	0.008316	0.014068	0.014068	-0.00157	0.014068	0.014068
Ethiopia	0.004877	0.004877	0.004877	0.007744	0.004877	-0.00339	0.004877	0.004877
Kenya	0.002675	-0.00579	0.002675	-0.00053	-0.00319	0.002675	0.009756	0.002675
Madagascar	-0.0002	-0.00022	-0.00022	-0.00041	-0.00022	0.015396	-0.00022	-0.00022
Malawi	0.001306	-0.30148	-	0.001306	-0.00214	-0.00075	0.001306	-
Morocco	0.005095	0.005095	0.005095	0.005095	-0.00412	-0.00099	0.005095	0.005095
Tanzania	0.002723	0.002723	0.002723	0.002723	0.005524	-0.00434	0.002723	0.002723
Tunisia	-0.00343	-0.00343	-0.00343	-0.00343	0.006078	-0.00343	-0.00484	-0.02471
Zaire	-0.00113	-	-	-0.00065	-0.00113	-0.00113	0.001745	-0.27518
Zambia	-0.00822	-	-0.23926	-0.00822	-0.00505	-0.02215	-0.00735	-0.28006
Argentina	-0.07131	-	-	-0.07131	-0.06506	-0.07131	-0.07131	-0.46296
Bolivia	-0.01249	-0.35611	-	-0.01249	-0.01256	-0.01249	-0.01249	-
Brazil	-0.01858	-0.01858	-0.05091	-0.01500	-0.01858	0.027184	-0.03470	-0.01858
Canada	0.019115	-0.30016	-	0.019115	0.012033	0.019115	0.019115	-
Chile	0.007759	-0.28807	-0.20630	0.012495	-0.00167	0.007759	0.007759	-
Colombia	0.003448	0.003448	0.003448	0.003448	0.003448	-0.00852	0.003448	0.003448
Ecuador	-0.00285	-0.00285	-0.00285	-0.00806	-0.00285	-0.00594	-0.00285	-0.00285
U.S.A.	0.024878	0.024878	0.024878	0.024878	0.070773	0.024878	0.052521	0.024878
Mexico	-0.00793	-	-0.28274	-0.00616	-0.00799	-0.01667	-0.00793	-0.28909
Paraguay	0.003196	0.003196	0.003196	-0.00773	0.003196	0.003196	0.003196	0.003196
Peru	-0.02432	-0.02432	-0.02432	-0.05436	-0.03102	-0.02432	-0.01506	-0.02432
Uruguay	-0.00589	-0.00589	-0.00589	-0.00589	-0.00589	-0.00589	-0.00589	-0.00589
Venezuela	-0.03599	-	-	-0.03599	-0.03716	-0.03599	-0.03621	-0.43615
Bangla Des	0.006121	0.006121	0.006121	0.006121	0.006267	0.000037	0.006121	0.006121
South Kore	0.062264	0.062264	0.062264	0.062264	0.002368	-0.00317	0.134479	0.062264
Philippines	-0.00103	-0.00103	-0.00103	-0.01191	-0.00103	0.005902	-0.00207	-0.00103
India	0.010426	0.010426	0.004421	0.010426	0.010426	0.002668	0.010426	0.010426
Indonesia	0.013480	0.013480	0.013480	0.008818	0.008799	0.007457	0.011258	0.013480
Iran	-0.08554	-0.08554	-0.08554	-0.08554	-0.10221	-0.08554	-0.10419	-0.08554
Israel	0.004237	-0.52612	-	0.004237	0.004237	0.004237	0.004237	-
Japan	0.002477	-0.35121	-	0.002477	0.002477	0.001453	0.002477	-
Jordan	0.002888	-0.01074	0.002888	0.002888	0.002888	0.002888	0.002888	0.002888
Malaysia	0.015543	-0.00546	0.015543	0.010999	0.004151	0.015543	0.015543	0.015543
Myanmar	0.007794	0.007794	0.007794	0.054660	0.004367	-0.00616	0.007794	0.007794
Pakistan	0.011359	-0.01207	0.017763	0.011123	0.011359	0.014447	0.011359	0.011359
Syria	-0.01001	-	-0.32930	0.014341	-0.01001	-0.00837	-0.00658	-0.35548
Sri Lanka	0.005809	-0.14716	-0.19125	0.005809	0.005809	0.005809	0.005809	-
Thailand	0.023000	-0.11147	-	0.022632	0.003068	0.023000	0.023000	0.023000
Turkey	0.004314	-0.38425	-	0.039164	0.004314	-0.02353	-0.00005	-
W.Germany	0.017013	-0.20983	-	0.020963	0.017013	0.029107	0.014820	-
Austria	0.016970	-	-0.23719	0.023041	0.024171	0.022291	0.017804	-0.09895
Belgium	0.017635	-	-0.17886	0.017727	0.017635	0.030300	0.017635	0.031411
Czechoslov.	0.002672	-0.23586	-	0.008171	0.002672	0.002672	0.005731	-
Denmark	0.017591	-0.02696	-	0.018662	0.034289	0.024854	0.008718	-0.02557
Spain	0.025309	0.025309	0.035014	0.030948	0.020428	0.102048	0.049553	0.025309
Finland	0.006830	-	-0.14908	0.006830	0.007273	0.036290	0.008367	-0.07299
France	0.019884	0.020979	0.019884	0.030282	0.022570	0.056990	0.004864	0.019884
Greece	-0.05994	-	-0.35619	-0.05633	-0.04112	-0.05994	-0.05994	-0.34627
Netherland	0.026283	-	-0.30321	0.031915	0.033511	0.062660	0.026283	-
Ireland	0.002625	0.002625	0.002625	0.236934	-0.00901	0.041681	0.002625	0.002625
Italy	0.014891	0.048990	0.014891	0.006891	0.024963	-0.00640	0.014891	0.052747
Norway	0.013280	0.023478	0.013280	0.022424	0.013280	0.021918	0.013280	0.013280
Poland	0.038077	-0.28866	-0.12528	-0.01147	0.040637	0.250140	0.038077	-
Portugal	0.016523	0.016523	0.016523	0.016523	0.016523	-0.03990	0.038216	0.016523
U.Kingdom	0.020776	0.020776	0.020776	0.021513	0.026144	0.061049	0.017462	0.020776
Sweden	0.017322	0.017322	0.029725	0.017322	0.018336	0.019333	0.017707	0.021237
Switzerland	0.016734	-	-0.05871	0.016734	0.028515	0.015537	0.016609	0.016734
Yugoslavia	-0.01424	-0.01424	-0.01424	-0.01424	-0.01424	-0.01424	-0.01424	-0.02912

This table show the conditonal β's particular to each countries (column 1), and the particular β_s when the spatial variables affect separately the technical progress coefficient.

Table 2. REAL INCOME-SPATIAL VARIABLES ELASTICITIES (1978-1991)
(Spatial effects on real per capita income growth rate)

Countries	ε-PC	ε-PCPO	εAUTCAM	ε-PASKM	ε-AUTPC	εPKMTKM	ε-DENSID	ln $y_{o\ i}$	ln y_{Ti}
Algeria	0	0	0	1.56004	0	-1.30521	0	-1.30927	-1.13463
Cameroon	0	0	1.20215	0.388574	0	0	0	-1.93998	-1.77410
Congo	3.04068	0	0	0	0.478421	-0.30533	0	-2.09284	-1.67193
Egypt	0	1017311	0	0	0.752358	0	0	-2.52429	-2.07912
Ethiopia	0	0	0.310142	0	-1.03655	0	0	-4.07312	-4.04862
Kenya	0.524	0	-0.27925	0.309295	0	-0.33899	0	-2.93265	-2.91481
Madagascar	0	0	1.23427	0	1.40992	0	0	-3.06102	-3.18694
Malawi	388.841	-393.616	0	0.262827	-0.30605	0	-387.614	-3.17685	-3.24786
Morocco	0	0	0	0.295528	1.39316	0	0	-2.04318	-1.86144
Tanzania	0	0	0	-0.59302	-0.65413	0	0	-4.10520	-4.20834
Tunisia	0	0	0	-0.56911	0	0.424193	2.02856	-1.50553	-1.47459
Zaire	-425.31	426.3	0.046599	0	0	0.912296	426.093	-3.86728	-4.16508
Zambia	-244.994	244.026	0	-0.09861	-0.85118	-0.04084	244.809	-2.24688	-2.53484
Argentina	-724.082	724.291	0	0.382568	0	0	723.998	-0.25853	-0.42040
Bolivia	447.336	-446.478	0	-0.09267	0	0	-447.734	-1.86771	-2.18742
Brazil	0	2.10361	0.90473	0	3.08767	-0.50208	0	-0.73819	-0.74848
Canada	-245.334	246.044	0	0.173311	0	0	250.082	0.94192	1.16853
Chile	437.247	-419.175	-0.67749	-0.29899	0	0	-430.839	-1.34765	-1.06714
Colombia	0	0	0	0	0.512681	0	0	-1.84916	-1.69645
Ecuador	0	0	0.3839	0	0.230495	0	0	-1.88348	-1.91006
U.S.A.	0	0	0	0.338894	0	-0.37109	0	1.03989	1.18899
Mexico	-163.309	163.549	0.373445	0.46572	0.722122	0	163.971	0.93149	-0.85468
Paraguay	0	0	0.148211	0	0	0	0	-1.83615	-1.68882
Peru	0	0	-6.03851	0.692583	0	-0.67867	0	-1.06351	-1.34273
Uruguay	0	0	0	0	0	0	0	0.00400	-0.91327
Venezuela	-738.408	734.519	0	0.042651	0	-0.04230	740.336	-0.09192	-0.97403
Bangla Des	0	0	0	-0.56574	-0.37279	0	0	-3.58486	-3.46225
South Kore	0	0	0	1.42987	0.348044	-1.67906	0	-0.95052	-0.15678
Philippines	0	0	-0.39539	0	0.236084	0.283186	0	-2.20382	-2.22934
India	0	1.29689	0	0	0.469651	0	0	-3.22792	-2.89915
Indonesia	0	0	-0.38630	0.299145	0.476032	-0.17618	0	-2.85311	-2.41350
Iran	0	0	0	0.74499	0	-0.60762	0	-0.37843	-0.98971
Israel	-658.021	655.527	0	0	0	0	661.826	0.22065	0.56659
Japan	-180.923	182.175	0	0	0.740642	0	180.368	0.85112	1.27095
Jordan	1.45589	0	0	0	0	0	0	-2.04916	-1.93175
Malaysia	0.619989	0	0.215313	0.578053	0	0	0	-1.43633	-1.01585
Myanmar	0	0	-4.70149	0.544827	3.38318	0	0	-4.09318	-3.90654
Pakistan	2.24274	-1.9682	0.10984	0	-0.23849	0	0	-3.12897	-2.76255
Syria	-340.198	338.97	-1.49553	0	1.26129	0.170686	343.289	-2.81200	-2.65729
Sri Lanka	305.897	-301.09	0	0	0	0	-301.075	-1.18436	-1.21672
Thailand	15.8891	-25.5658	0.024558	0.816659	0	0	0	-2.12542	-1.47670
Turkey	404.836	-398.828	-0.60629	0	1.04818	-0.33755	-407.838	-1.14539	-0.91210
W.Germany	-157.555	158.985	-0.51251	0	0.526269	-0.23144	156.928	1.02839	1.27117
Austria	92.5716	-92.1748	0.627033	0.334836	0.409051	-0.09662	-92.2965	0.85756	1.11487
Belgium	-123.736	121.608	-0.35570	0	0.324115	0	120.805	0.82304	1007667
Czechoslov.	250.838	-250.627	-0.89364	0	0	-0.29064	-239.265	-1.04387	-0.82661
Denmark	110.011	-106.922	0.445526	0.446955	0.685035	-0.28931	-96.8155	1.10355	1.33257
Spain	0	2.81696	-0.43881	0.256798	0.368524	-0.37979	0	0.37871	0.63951
Finland	38.4184	-37.6519	0	0.056967	1.1115	-0.12892	-40.4204	1.04349	1.42056
France	-1.04596	0	-0.93175	0.157962	1.0023	-0.38022	0	0.92965	1.12932
Greece	-171.79	172.467	0.74645	-0.30529	0	0	174.782	-0.13549	-0.01057
Netherland	-393.435	395.51	-0.21488	0.210626	0.794842	0	395.074	0.88406	1.04664
Ireland	0	0	-0.50270	-0.22270	0.997405	0	0	0.29366	0.65242
Italy	-15.1782	0	0.523808	0.593044	-0.42844	0	10.4094	0.76358	1.04778
Norway	1.62941	0	-0.27232	0	0.39603	0	0	1.02872	1.31842
Poland	1552.79	-1561.71	3.71321	-0.75250	-1.66263	0	-1536.3	-2.48333	-1.40529
Portugal	0	0	0	0	0.612714	0.206321	0	-0.45913	-0.09645
U.Kingdom	0	0	-0.05356	0.403388	0.557265	-0.08059	0	0.70309	0.94188
Sweden	0	1.11531	0	0.188403	0.47812	-0.03006	1.57887	1.15802	1.38586
Switzerland	4.31966	-4.57124	0	0.589671	0.133233	-0.19158	0	1.40462	1.62108
Yugoslavia	0	0	0	0	0	0	2.04598	-0.56243	-0.44728

In this table, we can observe that if we try to increasse the value of an spatial variable, it affect positively (+) or negatively (-) the real per capita income growth rate.

Table 3. CONGESTION AND SPATIAL POLICIES ON β SPEED OF CONDITIONAL CONVERGENCE (1978-1991)

Countries	Δ-PC	Δ-PCPO	Δ-AUTCAM	Δ-PASKM	Δ-AUTPC	Δ-PKMTKM	Δ-DENSID
Algeria	0, CG	0	0	-	-, CG	+, CG	0, CG
Cameroon	0, CG	0	-, CG	-	0	0	0, CG
Congo	-	0	0	0	-, CG	+, CG	0, CG
Egypt	0, CG	-	0	0	-, CG	0	0, CG
Ethiopia	0, CG	0	-, CG	0	+, CG	0	0, CG
Kenya	-, CG	0	+, CG	-	0	+, CG	0, CG
Madagascar	0, CG	0	-, CG	0	-, CG	0	0, CG
Malawi	-	+, CG	0	-	+, CG	0	+, CG
Morocco	0, CG	0	0	-	-, CG	0	0, CG
Tanzania	0, CG	0	0	+, CG	+, CG	0	0, CG
Tunisia	0, CG	0	0	+, CG	0	-, CG	-, CG
Zaire	0, CG	-	-, CG	0	0	-, CG	-, CG
Zambia	0, CG	-	0	+, CG	+, CG	+	-, CG
Argentina	+, CG	-	0	-	0	0	-, CG
Bolivia	-	+, CG	0	+, CG	0	0	+, CG
Brazil	0, CG	-	-, CG	0	-, CG	+, CG	0, CG
Canada	-	+	0	+	0	0	+
Chile	-	+, CG	+, CG	+, CG	0	0	+, CG
Colombia	0, CG	0	0	0	-, CG	0	0, CG
Ecuador	0, CG	0	-, CG	0	-	0	0, CG
U.S.A.	0, CG	0	0	+	0	-	0, CG
Mexico	+, CG	-	-, CG	-	-, CG	0	-, CG
Paraguay	0, CG	0	-, CG	0	0	0	0, CG
Peru	0, CG	0	+, CG	-	0	+, CG	0, CG
Uruguay	0, CG	0	0	0	0	0	0, CG
Venezuela	+, CG	-	0	-, CG	0	+	-, CG
Bangla Des	0, CG	0	0	+, CG	+, CG	0	0, CG
South Kore	0, CG	0	0	-	-	+, CG	0, CG
Philippines	0, CG	0	+, CG	0	-	-, CG	0, CG
India	0, CG	-	0	0	-, CG	0	0, CG
Indonesia	0, CG	0	+, CG	-	-, CG	+, CG	0, CG
Iran	0, CG	0	0	-	0	+, CG	0, CG
Israel	-	+	0	0	0	0	+
Japan	-, CG	+	0	0	+	0	+
Jordan	-	0	0	0	0	0	0, CG
Malaysia	-, CG	0	-, CG	-	0	0	0, CG
Myanmar	0, CG	0	+, CG	-	-, CG	0	0, CG
Pakistan	-	+, CG	-, CG	0	+, CG	0	0, CG
Syria	+, CG	-	+, CG	0	-, CG	-, CG	-, CG
Sri Lanka	-	+, CG	0	0	0	0	+, CG
Thailand	-	+, CG	-, CG	-	0	0	0, CG
Turkey	-	+, CG	+, CG	0	-, CG	+, CG	+, CG
W.Germany	-, CG	+	-	0	+	-	+
Austria	-	-	+	+	+, CG	-	-
Belgium	-	+	-	0	+, CG	0	+
Czechoslov.	-	+, CG	+, CG	0	0	+, CG	+, CG
Denmark	-	-	+	+	+	-	-
Spain	0, CG	+	-	+	+, CG	-	0, CG
Finland	0	-	0	+, CG	+	-	-
France	-, CG	0	-	+	+	-	0, CG
Greece	+, CG	-	-, CG	+, CG	0	0	-, CG
Netherland	0, CG	+	-	+	+	0	+
Ireland	0, CG	0	-, CG	-, CG	+	0	0, CG
Italy	-, CG	0	+	+	-	0	+
Norway	+	0	-	0	+, CG	0	0, CG
Poland	-	+, CG	-, CG	+, CG	+, CG	0	+, CG
Portugal	0, CG	0	0	0	-, CG	-	0, CG
U.Kingdom	0, CG	0	-, CG	+	+	-	0, CG
Sweden	0, CG	+	0	+	+	-, CG	+
Switzerland	-	-	0	+	+, CG	-	0, CG
Yugoslavia	0, CG	0	0	0	0	0	-, CG

In this table, if the sign is (-) we must diminishe the value of this variable, if we want augmenting the speed of conditional convergence. If the sign is (+) we must increase it, but can appear (CG).

Table 4. Empirical results of Income Velocity of Circulation. World Panel (1978-91)

Method:	I	II	III	IV	V	VI	VII
Endg.Var: VELOCID	**Between**	**OLS**	**Within**	**Randm**	**OLS AR1**	**Within AR1**	**Randm AR1**
Expl.Var:							
PCPO	0.1552 (3.199)	0.1529 (11.22)	0.1109 (1.797)	0.1293 (3.621)	0.1540 (10.41)	0.1270 (4.896)	0.1283 (5.630)
PC	0.2779 (1.921)	0.2885 (7.202)	0.5763 (4.818)	0.4160 (5.134)	0.2630 (6.234)	0.1145 (1.856)	0.1507 (2.691)
PKMTKM	0.0273 (0.160)	0.0264 (0.588)	-0.207 (-0.38)	-0.397 (-0.07)	0.5558 (1.244)	0.1018 (2.291)	0.0981 (2.289)
AUTCAM	-0.783 (-0.39)	-0.505 (-0.94)	0.3339 (4.020)	0.2120 (2.889)	-0.135 (-0.02)	0.2604 (3.530)	0.2165 (3.241)
PASKM	-0.198 (-1.98)	-0.200 (-7.12)	-0.386 (-3.33)	-0.259 (-3.47)	-0.193 (-6.51)	-0.143 (-2.91)	-0.155 (-3.53)
AUTPC	-0.120 (-0.43)	-0.148 (-1.93)	0.1883 (1.051)	-0.163 (-1.21)	-0.186 (-2.33)	-0.256 (-2.38)	-0.268 (-2.73)
DENSID	0.5242 (1.231)	0.5154 (4.324)	-0.693 (-1.07)	0.2157 (0.667)	0.4967 (3.872)	0.4497 (1.825)	0.4402 (2.093)
Constant	3.8766 (3.307)	3.8123 (11.79)	Fixed Effects	3.1304 (4.222)	6.0706 (27.65)	Fixed Effects	5.9242 (5.688)
Tests:							
R^2	0.2940	0.2630	0.8837	0.0979	0.2484	0.8159	0.2081
R^2-adjust	0.2008	0.2564	0.8730	0.0145	0.2411	0.7974	
DW			0.7638			2.0636	2.0676
Lagrang.M							2107.0
Hausman				21.508			0.0001

Note: t ratios in brackets

Table 5. Estimation results of Money in equilibrium. World Panel (1978-91)

Method	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI
Endog var: **MPPP**	**Betwee**	**OLS**	**Within**	**Randm Effects**	**2SLS Panel**	**2SLS AR1**	**OLS AR1**	**Withi AR1**	**Randm AR1**
Expl var.:									
PCPO	1.07565 (0.92)	1.07 (2.6)	0.0374 (0.025)	0.8177 (0.970)	1.1529 (2.875)	0.8323 (1.85)	0.94 (2.1)	-0.025 (-0.04)	0.2471 (0.473)
PC	12.9693 (3.94)	12.6 (11.)	6.598 (2.018)	7.7081 (3.801)	12.736 (11.24)	12.791 (11.15)	13.0 (10.)	12.257 (8.53)	12.23 (9.289)
PKMTKM	6.34367 (1.65)	5.80 (4.5)	0.7769 (0.623)	1.3014 (1.107)	6.2529 (4.718)	6.5904 (5.619)	5.22 (4.0)	3.3013 (2.98)	3.5153 (3.32)
AUTCAM	-4.8277 (-0.97)	-5.42 (-3.2)	-3.464 (-1.72)	-8.492 (-4.94)	-5.637 (-3.34)	-17.03 (-8.01)	-7.20 (-3.)	-13.62 (-6.90)	-12.508 (-6.804)
PASKM	0.00077 (3.35)	.7E-3 (9.8)	0.00149 (5.531)	0.00116 (6.803)	0.0007 (9.762)	0.0007 (9.157)	.8E-3 (9.3)	0.0008 (8.09)	0.00085 (8.95)
AUTPC	0.03416 (5.33)	0.03 (16.)	0.07837 (15.57)	0.05256 (16.034)	0.0352 (16.11)	0.0414 (19.06)	0.03 (15.)	0.0384 (15.44)	0.03864 (16.71)
DENSID	-0.1747 (-1.79)	-0.17 (-5.0)	-0.2587 (-1.44)	-0.2314 (-2.962)	-0.174 (-5.17)	-0.117 (-2.88)	-0.16 (-4.)	-0.140 (-2.65)	-0.1441 (-3.095)
Constant	-54.801 (-1.92)	-51.8 (-5.3)	Effects Fixed	-32.462 (-1.761)	-53.27 (-5.43)	-16.77 (-0.86)	-75.9 (-10)	Effects Fixed	-22.68 (-0.82)
Tests:									
R^2	0.705	.689	0.97918	0.57389	0.6916	0.691	.696	0.9466	0.6855
R^2-adjust	0.666	.685	0.97586		0.6871	0.687	.691	0.9367	
DW			0.76321	0.75365	2.0761	1.905		2.8828	2.8869
F.		152.	294.95		153.81	153.8	137.	95.16	
Lagrang.M				1387.93					791.46
Hausman				57.2138					3.3956

Note: t ratios in brackets.

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