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SPATIAL EFFECTS ON THE AGGREGATE DEMAND[1]

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ABSTRACT

This paper analyses if several spatial variables coming from cities and transportation system affect money market specially the income velocity of circulation. Assuming a unit-elastic aggregate demand function and considering money velocity as a conventional variable, fluctuations in the velocity of circulation caused by some non-strictly economic variables, can affect output and prices level. The empirical specification has been deduced from Baumol and Tobin model for transaction money demand, and has the income velocity of circulation as endogenous variable and the country's first city population, the population density, the passenger-kilometers transported by railways, and several ratios referred to some geographical variables, as regressors. This model has been applied across 64 countries during the period 1978-1998. Panel data techniques has been used for estimating the model. Estimation results indicate that most of the explanatory variables are significant. Moreover, the another variable a part from velocity, which affects a unit-elastic aggregate demand curve is the quantity of money in the equilibrium, M, that we will take as a new endogenous variable for checking if the explanatory variables of velocity can also affect the quantity of money. The equilibrium is finally affected by these spatial variables by means of a multiplier effect, and prices and output levels maybe influenced of that.

Key words: spatial variables, transportation, income velocity of circulation, panel data.
JEL Class.: R-12 / L-92 / E-41 / C-33.

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[1] I am very grateful to Masayuki Sekine, Kennett Button, Luigi F. Signorini, Maurice Catin, Kevin O'Connor, David Pitfield, Francisco Mochón, and Jose Mª Labeaga for several comments and suggestions to a previous version of this paper. The usual disclaimer applies.

1. **INTRODUCTION**

Spatial issues are generally neglected in conventional macroeconomic modeling, because the goods market is usually assumed to be in perfect competition. In fact, most spatial models are microeconomic and do not embody the money market. Incorporating space into macroeconomic models implies to consider product differentiation, and hence imperfect competition in goods market, as indicate in Gabszewicz and Thisse (1980), and in Thisse (1993). New Keynesian economics seems the framework in which space can be embodied in macroeconomic modeling. So, real rigidities due to agglomeration economies which lead to increasing returns to scale and hence coordination failures, together with the probable existence of nominal frictions due to near-rationality, cost-based prices and the externalities coming from aggregate demand fluctuations, can cause nominal rigidities and hence can provoke that money would not be neutral because the output fluctuates, according to Nishimura (1992). Space generates generally imperfect competition and real rigidities, but if space could also cause some nominal frictions which provokes fluctuations in aggregate demand, then space can be responsible of some nominal rigidities, an hence can cause indirectly non neutrality in money. Moreover, not only there are a great difficulty to include the space in a macroeconomic model, but also in reverse, is not easy to introduce the money market in a spatial microeconomic model. The best microeconomic model which incorporates the money in a framework of imperfect competition is the model of Blanchard an Kiyotaki (1987), which considers monopolistic competition with product differentiation in Dixit-Stiglitz sense. In this model, households choice between a composite good, and money. Following the Dixit-Stiglitz (1977) approach, each household has a CES utility function because is the best form to introduce money in the choice of consumer, and faces a usual budget constraint. The household problem is to maximize the utility function subject to the budget constraint and, as a result of this optimization, we will have the individual demand functions. Then, we can obtain the aggregate demand function by aggregating these individual demands:

$$Y = \frac{\sum_{j=1}^{n} P_j Y_j}{P} = \frac{g}{1-g}\frac{M}{P} \qquad \{1\}$$

Where Y is the real income, and g is a constant. M is money in equilibrium and P is the prices level. This aggregate demand function is one-elastic, and reflect apparently a neo-quantitative theory of money, where the coefficient (g/(1-g)) play the role of income velocity of circulation (V). The parameter g is the exponent of real money balances in a CES utility function. This microeconomic aggregate demand function has two versions in macroeconomics: A neoclassical form, used from Fisher (1911), until Lucas (1973), where V is considered a constant. The other version is considered in a new-keynesian framework, basically in Blanchard, Mankiw and Corden; in this version V can be not constant. Then, if the macroeconomic aggregate demand function considered in our problem is typically unit-elastic such as Lucas (1973) or Corden (1980) case: P.y = M.V, fluctuations in the amount of money (M) can affect output (y) in a Keynesian framework. In a Neoclassical framework, fluctuations in the amount of money affect level of prices (P) only, because money velocity (V) is constant in this model. In a conventional Keynesian model, the income velocity of circulation is not a relevant variable because the aggregate demand function here considered is not generally unit-elastic, and V results an erratic variable. One important question that we are worried about, is: If income velocity of circulation is neither constant nor a erratic ratio, but it is a conventional variable, can then V affect the output or prices? Maybe the income velocity of circulation (V) was a variable neither so erratic as some authors say, nor a short-run constant as others say. The fact that V was identically equal to the ratio of two macroeconomic variables such as nominal income and the stock of money, both measured in nominal terms, means that V was only measurable as a real figure. 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 apart from the well-known macroeconomic 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 analysis 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 was included as an additional explanatory variable. They find a significant role for this variable in the explanation of US money demand patterns during that period. We study the possible relationship between money velocity (as a proxy for money demand), and several space variables, fundamentally derived from the Baumol-Tobin model of transactions demand for money. The specification of this model is in sections 2 and 3 of this paper; section 4 contains the analysis of spatial dependence, and the section 5 the empirical model; The section 6 contains the spatial effects on aggregate demand anf an finally in section 7 there are some conclusions.

2. A THEORETICAL MODEL

In this section, we will study the possible existence of a relationship between economic geography variables and velocity and, in such a case, to specify a model which embodying some of the considerations made previously. 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 the money stock 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)An unit-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). This is a Keynesian-type approach in which the optimum number of exchanges between bonds and money made by an individual agent, is related with individual nominal income. Other additional restriction is given by the consideration of a representative agent, which obtains with a monthly frequency a certain level of nominal income (Y_m). If the volume of every exchange between bonds and money is always the same (Z) and the agent makes n exchanges, it can be said that:

$$nZ = Y_m \qquad \{2\}$$

The average monthly balance (m) will be in any case Z/2, and, because of that:

$$m = Z/2 = Y_m/(2n) \qquad \{3\}$$

that is, given the number of exchanges and people's nominal income, we can know the average money balance in nominal terms kept by the agent (*m*). If the nominal interest rate is *i*, the opportunity cost of keeping money will be:

$$rm = iY_m/(2n). \qquad \{4\}$$

We will assume that the agents incur a fixed nominal cost (c) every time an exchange is made. The total cost of keeping money for frequent transactions versus keeping bonds will be:

$$C = cn+(iY_m)/(2n) \qquad \{5\}$$

The number of monthly exchanges is optimum when the cost is minimum

$$\partial C/\partial n = 0 = c-(iY_m)/(2n^2) \Rightarrow \quad n = (iY_m/2b)^{1/2} \qquad \{6\}$$

and it is easy to show that second derivatives fullfil condition of minimum. The average nominal balances that minimize the cost of maintaining money by agent and month is :

$$m = (bY_m / 2i)^{1/2} \qquad \{7\}$$

An agent obtains an income of $12Y_m$ per year and makes 12n exchanges. The annual nominal average balances (m_a) by individual is:

$$m_a = 12Y_m / (2(12n)) = Y_m/(2n) = m \qquad \{8\}$$

If we assume that the total population of the country is (PO), the total money demand for transactions (MD) is:

$$MD = PO.m_a = PO.m = (PO.c(12Y_m.PO)/(24i))^{1/2} \qquad \{9\}$$

where ($12Y_m$.PO) is the aggregate annual nominal income (Y). If the money market is in equilibrium we have that MD = MS (money supply) = M(quantity of money in circulation). The income velocity of circulation is defined as V = Y/M, and after substituting we have:

$$V = (24iY/PO.c)^{1/2} \qquad \{10\}$$

and separating the nominal interest rate:

$$V = (24(r + \pi)Y / PO.c)^{1/2} \qquad \{11\}$$

where π is the inflation rate and r the real interest rate. The last expression explains V as a function of some conventional macroeconomic variables, except for PO. The total number of optimal exchanges that the total population of the country made during a year is:

$$N = 12n.PO = (6iY.PO/c)^{1/2} \qquad \{12\}$$

and hence:

$$V = (24iY/(c.PO))^{1/2} = (2/PO)(6iY.PO/c)^{1/2} = 2N/ PO \qquad \{13\}$$

which is a result similar to that obtained in Barro (1991). 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 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 ir 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. We consider for the analysis of the number of journeys the simplest cities system of W. Christaller: A metropolitan area with a central place and six small similar cities around. The Christaller's system assumes monopolistic competition in partial equilibrium with vertical product differentiation in Chamberlin sense. Our preference for this type of differentiation versus the horizontal differentiation from Hotelling (1929) until Fujita and Krugman (1992) is due to reasons of simplicity, and because there are not fall in the generality of this problem. Following this simple model, if population of the central place is PC , and the population of each satellite city is P_i , the number of journeys generated between central place and one satellite city can be expressed according to a gravity model:

$$n_c = \square . PC.P_i / d^{\square} \qquad \{14\}$$

where □ and □ are constants to be estimated, and (d) is the distance between cities. If we consider that PO is the total area population, then total journeys across the center is:

$$Nc = 6\square .PC.P_i / d^{\square} = (\square / d^{\square})(PC.PO-(PC)^2)$$

{15}

If we assume, for simplicity, that □ and □ are constant into the area, the transversal journeys generated between satellite cities is:

$$Nt = 6\square(P_i)^2/d^{\square} = (\square/6d^{\square})((PO)^2-2\ PC.PO + (PC)^2)$$

{16}

The total number of journeys generated in the area and expressed in journeys per head will be:

$$Ncs/PO = (Nc + Nt)/PO = (\square/6d^{\square})((PO)^2 + 4\ PC.PO - 5(PC)^2)$$

{17}

In the same sense, and remembering that in our model we consider only the road and railways transportation, we can try now to calculate the number of journeys made into a metropolitan area by both transportation systems. Following Thomas (1993), Valdés (1988) and Button et al.(1993) for road transportation, the generation and attraction of traffic by road is a function of cars and trucks stock and the cars / trucks ratio in the area. Considering that the greater part of this traffic is by cars, a possible function of road traffic's generation- attraction is:

$$Nrd = k.(AUT).\square_1(CAM,\ AUT/CAM)$$

{18} where (Nrd) is the total number of road journeys, by cars and trucks, into the area, AUT is cars' stock, CAM is trucks' stock, both in circulation, k is a constant and $\square_1$ is a function. The total journeys by road system per head are:

$$Nrd / PO = k(PC / PO)(AUT/ PC).\square_1(CAM,\ AUT/CAM)$$

{19}

In the same way, following Izquierdo (1982), Oliveros (1983) and Friedlaender et al.(1993) for railways transportation system , the total journeys during a year by train are dependent basically on passenger-kilometer (PASKM) and net ton-kilometer (TNKM) carried and PASKM/TNKM ratio. Passengers-kilometer is defined as the sum of kilometers traveled by each passenger per year. Net ton-kilometer is the sum of kilometers that each ton is carried per year. Considering that the greater part of traffic's volume by railways are freight, a possible function for the volume of traffic is:

$$Nrw = k.(TNKM).\square_2(PASKM,\ PASKM / TNKM)$$

{20}

where (Nrw) are journeys by railway, passengers and freight, into the area during a year, k is some constant and $\square_2$ is a certain function. The traffic volume per inhabitant will be:

$$Nrw/PO = k(PC/PO)(TNKM / PC).\square_2(PASKM, PASKM / TNKM)$$

{21}

The total number of journeys (Nts) due to the transportation system into the area during a year is Nts = Nrd + N rw. In per capita terms it is expressed:

$$Nts/PO=\square(PC/PO)((AUT/PC).\square_1(CAM,AUT/CAM)+(TNKM/PC).\square_2(PASKM, PASKM / TNKM)).$$

{22}

where □ is a parameter to be estimated. It can be useful to remember here that the total number of journeys per capita due to the cities system was:

$$Ncs / PO = (\square / d^{\square})(PO + 4PC(1-(5/4)(PC/PO)))$$

{23}

where □ is a constant. Both systems (transportation and cities) provide different variables for explaining the same problem that is the total individual journeys made during a year within an area. Hence, it must exist a certain probability that journeys' explanatory variables will be a composition, probably non linear, of these two systems. By simplifying explanatory variable names, we will call PCPO to PC/PO; AUTPC to AUT/PC ; AUTCAM to AUT/CAM; PKMTKM to PASKM/TNKM ; and TKMPC to TNKM/PC. With these considerations, total journeys per head can be expressed as a function as follows:

$$N^*/PO = f(PO, PC, PCPO, CAM, PASKM, AUTPC, TKMPC, AUTCAM, PKMTKM)$$

{24}

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

$$N / PO = \square(N^*/PO)$$

{25}

but remembering equation (13): V(money velocity) = 2N / PO = 2□(N*/ PO), we have the final specification of the income velocity of circulation model as follows:

V = F (PO, PC, PCPO, CAM, PASKM, AUTPC, TKMPC, AUTCAM, PKMTKM)

{26}

where income velocity (V) is made dependent on the population of the main city of the concerned country (PC), the country's total population (PO), the ratio of PC to the country's total population (PCPO), the number of road passenger vehicles located into the country divided by population of country's first city (AUTPC), the number of trucks located into the country (CAM), the number of passenger-kilometer transported by railways (PASKM), the passengers-kilometer/ net ton-kilometer railways ratio (PKMTKM), the cars/trucks road ratio (AUTCAM), and the number of net ton-kilometer transported by railways divided by population of country's first city (TKMPC). All the variables are referred to a particular year.

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 which was finally estimated was a linear one such as:

$$V_{it}=\square_{it}+\square_{i}+B_1(PCPO)_{it}+B_2(PC)_{it}+B_3(PKMTKM)_{it}+B_4(AUTCAM)_{it}+B_5(PASKM)_{it}+$$
$$+B_6(AUTPC)_{it}+B_7(PO)_{it}+B_8(CAM)_{it}+B_9\,(TKMPC)_{it}+\square_{it}$$

{30}

where V is the endogenous variable and the rest are the explanatory variables. The variables are measured as follows: V is the ratio between GDP at market prices and M1 monetary aggregate, both in national currency units; PC and PO are measured in millions inhabitants; The ratio PCPO is an agglomeration index measured as 100(PC/PO); the ratios AUTCAM and PKMTKM are directly AUT/CAM and PASKM / TNKM, respectively; AUT and CAM are measured in thousands units; PASKM and TNKM are both measured in millions, and AUTPC and TKMPC are directly AUT/PC and TNKM/PC respectively. Velocity (V) and the AUTCAM and PKMTKM are real numbers; the AUTPC ratio is measured in physical quantities divided by physical quantities, and the rest of variables are measured in physical quantities. All variables are hence deflated. The data set includes yearly variables for 64 countries (19 European, 17 Asian, 14 African, and 14 American), and the period of 21 years (1978 to 1998). 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 are collected basically from several sources, mainly: National Accounts Statistics, Tables 1992. United Nations Statistical Year Book, 37-38-39-40-41-42-43 issues; United Nations. International Financial Statistics Yearbook, (1990-1999); International Monetary Fund. Statistical Trends in Transport, (1965-1989); E.C.M.T. World Tables, (1991). World Bank and The Europe Year Book, (1989-1995). E.P.L. A group of relevant data are shown in Table 1. On the other hand, in the specification of the theoretical model appear the distance (d) as a variable that we do not finally consider. However, Fotheringham and O'Kelly (1989) obtain some formulations linking distance and surface. Calling surface (SF), equation (23) above becomes: Ncs/PO = □ (PO/SF) + □ (PC/SF) + □(PC/SF)(PC/PO), where □, □ and □ are parameters. It is necessary to note that (PO/SF) is the population density which now appears in model' specification. Other new variables which appear in this specification are surface (SF), or also (PC/SF). Mulligan and Sala i Martin (1992) introduce population density in their model as explanatory variable of money demand in the U.S. Surface (SF) is measured in thousands of squared kilometers. Population density is defined by 1000(PO/SF) and called DENSID in our model , and the other new variable called PCSS is defined by 1000(PC/SF). Thus, we add these new variables to our specification. The omitted variables being non-significant are surface (SF) and (PCSS). Population density (DENSID) is significant in some models. Country's surface is non-significant in any relevant model and hence we can, probably, extend the analysis beyond metropolitan areas. The former model has been estimated using panel data techniques, following the basic references of Hsiao (1986) and Greene (1995). First, we estimate specification (26), although we present in the two first columns of Table 2 the results after dropping the non-significant regressors.

3. **THE AGGREGATE DEMAND AND THE MONEY VELOCITY**

A more general aggregate demand function than the MV-constant of Corden is the coming from the Synthesis Model. This last function can be particularised for the very short run (Keynesian Model, or for the long run (Classic Model). Assuming that in the equilibrium of capital goods stock market, the optimum stock of capital is related with an investment demand function, linear by simplicity, whose form is $I = I_0 - b\ r$, where b is a parameter real and positive and I_0 is an autonomous variable with respect both the real income and real interest rate (r), and assuming in other sense that the demand money function is also linear in the form: $L = \square y - h\ i + \square$, where $\square$, h, and $\square$ are real and positive parameters, we can express the joint equilibrium among real goods and financial markets following an IS-LM linear approoach, as follows:

$$\text{LM:} \quad i = \left[\frac{\square}{h} \square \frac{1}{h}\left(\frac{OM}{P}\right)\right] + \frac{\square}{h} y \qquad \{31\}$$

$$\text{IS:} \quad y = k[A_0 - (b + a)i] \qquad \{32\}$$

where A_0 is a term which contain the real components of real income:

$$A_0 = [C_0 + I_0 + G_0 + \square(TR - T_0) + X_0 - M_0 + (b+a)\square^e + \square\frac{B_0}{P}] \qquad \{33\}$$

and C_0, I_0, G_0, T_0, X_0, and M_0 are the autonomous componenets of consumption, investment, public expenditure, taxes, exports and imports respectively; TR are the Governement transferences to the households. The term $\square^e$ reflects the expected inflation rate and $\square\frac{B_0}{P}$ is a term which reflect the wealth effect on consumption. Substituting the LM into the IS supposing P as a variable, we can obtain the aggregate demand function:

$$y = \frac{1}{\frac{1}{k} + \frac{\square(b+a)}{h}} \left[A_0 + \frac{b+a}{h}\square + \frac{OM}{P}\right] \qquad \{34\}$$

In the very short run, the parameters b, c, y $\square$ tend to zero and h tends to infinite. In the long run we have that h and $\square$ tent to 0, and hence:

$$\lim_{h \square 0} \left[\frac{1}{\frac{1}{k} + \frac{\square(b+a)}{h}} \left[A_0 + \frac{b+a}{h}\square + \frac{OM}{P}\right]\right] = \frac{1}{\square}\left(\frac{OM}{P}\right) \qquad \{35\}$$

Then, the aggregate demand function at long run (Classic) will be:

$$y = \frac{1}{\square}\left(\frac{OM}{P}\right) \qquad \{36\}$$

which is a rectangular hyperbola where (1/□) is the income velocity of circulation in the long run (V_L). Remember that the expression of the quantitative equation is *Py = V.OM*. Like money velocity must be bigger than one, then always □ □ 1 and non negative: 0 □ □ □ 1. Substituting (V_L) in the aggregate demand function we have the following:

$$y = \frac{1}{\frac{1}{k} + \frac{(b+a)}{hV_L}} \left[A_0 + \frac{b+a}{h}\square + \frac{OM}{P} \right] \qquad \{37\}$$

For prices level fixed, we can obtain the output level in the short run (y_C):

$$y_C = \frac{1}{\frac{1}{k} + \frac{\square(b+a)}{h}} \left[A_0 + \frac{b+a}{h}\square + \frac{OM}{\overline{P}} \right] \qquad \{38\}$$

where the first term of second member, off the brackets, is the multiplier of the goods market in the short run (Synthesis model) so-called □. The relationship between the money velocity at short run (V_C) and at long run (V_L), is the following:

$$V_L = \frac{V_C}{1 + \frac{\square}{\frac{OM}{P}} + \frac{h}{(b+a)k}(V_{mc} \square V_C)} \qquad \{39\}$$

where V_{mc} is the money velocity in a very short run. But if we can assume that V_{mc} □ V_C, we could obtain:

$$V_L = \frac{V_C}{1 + \frac{\square}{\frac{OM}{P}}} = \square V_C \qquad \{40\}$$

where □ is a parameter which value is: 0 □ □ □ 1, because □ and OM/P are positive.

If now in the aggregate demand function at short run, we define: $[A_0 + \frac{b+a}{h}\square] = E$, diferencing the expression of the real income in equilibrium at short run () uner the hypothesis that money velocity is a variable, we can obtain the variations of real income caused by fluctuations in the expectations of money velocity al long run V_L, oscilations in the real components of real income *E*, and in the real money balances OM/P:

$$dy = d(\square E) + \left[\square \frac{b+a}{hV_L} \right]^2 \left(\frac{OM}{P} \right) dV_L + \square \frac{b+a}{h} d\left(\frac{OM}{P} \right) \qquad \{41\}$$

4. **SPATIAL DEPENDENCE IN MONEY VELOCITY.**

Estimates obtained from a regression model that does not account for spatial effects coming from spatial interactions between neighbouring jurisdictions are inefficient in the presence of spatial error dependence, and are biased and inconsistent in the presence of sustantive spatial dependence. The former occurs when the error term in the regression model follows a spatial autoregressive process. The latter occurs when the dependent variable itself follows a spatial autoregressive process. Hence, as in Anselin (1988a) there are two broad classes of spatial effects: the spatial correlation in the dependent variable, or sustantive spatial dependence also so-called as lag dependence, and the spatial correlation in the errors, or error dependence.

The specification of the spatial interaction structure is typically represented by a spatial weight matrix (**W**), *K x K*, where *K* is the number of countries or regions. The first measure of the degree of spatial association or correlation is the I test of Moran [Moran (1950)]: for N observations of a variable x , where $\bar{x}$ is the average the test I Moran is:

$$I(x) = \frac{N}{S_0} \frac{\sum_i \sum_j w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_i (x_j - \bar{x})^2} \qquad \{42\}$$

where $S_0 = \sum_i \sum_j w_{ij}$, being w_{ij} a generic element belonging to **W**. After this initial suggestion Cliff and Ord (1972), and Hordijk (1974), applyed this test to the residuals of a OLS regression:

$$I(e) = \frac{e'We}{e'e} \qquad \{43\}$$

where *e* is the vector of residuals. Moran's I is asymtotically normally distributed for OLS residuals whenever the population errors are random independent drawings from a normal population. A handicap of Moran´s I is that it cannot separates lag and error dependences. Some other alternatives to Moran´s I are based in the Lagrange multipliers. The most important of these are the LM (err) test due to Burridge (1980), for error:

$$LM(err) = \frac{\left(\frac{e'We}{e'e/N}\right)^2}{tr(W'W + W^2)} \qquad \{44\}$$

where *tr* is the trace operator. This statistic is distributed by $\square^2$ with one degree of freedom. To the specific detection of lag dependence Anselin (1988b) proposses the following LM(lag) test:

$$LM(lag) = \frac{\left[\dfrac{e'Wy}{e'e/N} \right]^2}{tr(W'W + W^2) + \dfrac{(WX\square)'[I \square X(X'X)^{\square 1} X'](WX\square)}{e'e/N}} \qquad \{45\}$$

distributed following a $\square^2$ with one degree of freedom.

5. EMPIRICAL MODEL

Calling the endogenous variable as y, being X the explanatory variable and v the error, supposing the following autoregressive model *AR(1,1)*:

$$y = \square y_{-1} + \square X + v \qquad \{46\}$$

$$v = \square v_{-1} + \square (i\ i\ d) \qquad \{47\}$$

Adding now the follwing spatial autoregressive process *SAR(1,1)*:

$$y = \square Wy + \square X + u \qquad \{48\}$$

$$u = \square Wu + \square (iid) \qquad \{49\}$$

Solving this system we can deduced that:

$$y = \square[Wy]+(\square + \square)\square_1[Wy_{-1}]- \square\, \square_1\square_2[Wy_{-2}]-\square(\square + \square)\square_1[WWy_{-1}]+ \square\square\, \square_1\square_2[WWy_{-2}]+ \square X$$
$$+[(\square + \square)\square_1 -\square\, \square_1][X_{-1}]-\square\, \square_1\square_2 [X_{-2}]-\square\square [WX]-\square[(\square + \square)\square_1 -\square\, \square_1][WX_{-1}]+\square\square\square_1\square_2[WX_{-2}]$$
$$+ \square(iid). \qquad \{50\}$$

Following this model, if $\square$, $\square_1$ and $\square_2$ are zero there is not sustantive dependence; if $\square=0$, there is not error dependence, and if $\square=\square=0$, there is not dynamic model. The model (11) reflect the dynamic and the spatial dependence, and in this sense it seems an available model to apply on panel data when there exist neighbouring sectors. When we apply the model (11) to panel data, the spatial weights matrix W is: W_{KTxKT} = $\mathbf{W}_{KxK}$ I_{TxT} , where I is the identity matrix (TxT) and **W** is the neighbourhood matrix (KxK), above defined; is the Kronecker product. Results of estimation of the equation 50 when the endogenous variable is the Money velocity of circulation (VELOC) and the explanatory variables are the spatial ariables above mentioned is collected in table 2. In the two first columns are the estimations assuming no spatial dependence. Rest of columns collect the general results including the posibility of spatial dependence, dropping non significant variables. Models 4 and 5 reflect spatial dependence (Moran's I > 2), and both models indicate that there are both spatial lag and error dependence as remarks the LM (lag) and LM (err) statistics. Like spatial errors are multidirectional the models 6 and 7 could fournishe biased estimations. The model 5 has been estimated by 2SLS method for avoiding this and reflects the best regression of Money velocity on the spatial variables. In the model 5 appear three variables lagged in time, and hence it fournises a short run estimation. The variables WVELOC, WAUTPC and WDENSID are a transformation of the values that in the contiguous countries take VELOC, AUTPC and DENSID. The explanatory variables which are affected by WW reflect the impact coming from neighbour countries no necesarily contiguous. Moreover, our interest is not in the Money velocity at short run, but in Money velocity at long run because this affect the aggregate demand. In a fisrt view, the best long run estimation of Money velocity is collects in the column 4 of table 2, but it must fulfill some requirements. If the series of the endogenous and explanatory variables are stationary time series, then the estmation in levels (column 4) will be the long run estimation. To know if a series is time stationary is necessary to proof that it has not any unit root. In time series this is relatively easy but in a panel data it have some difficulty. Since the appareance of the paper by Levin and Lin (1992), the use of panel data unit root tests has become popular among empirical researchers with access to a panel data set. It is by now a generally accepted argument that the commonly used unit root tests like Dickey-Fuller, augmented Dickey-Fuller and Phillips-Perron tests lack power in distinguishing the unit root null from stationary alternatives, and that using panel data unit root tests is one way of increasing the power of unit root test based on a single time series. Initial theoretical work on the non-stationary panel data focused on testing for unit roots in univariate panels. Early examples include Levin and Lin (1993) and Quah (1994). More recently, Im, Pesaran and Shin (1997) and Maddala and Wu (1999) suggest several panel unit root tests, which also permit heterogeneity of the autoregressive root under the alternative hypothesis. Applications of panel unit root methods have included Wu (1996), Lee, Pesaran and Smith (1997), Phillips y Moon (1999), Harris and Tzavalis

(1999) and Breitung (2000). To proof the existence of unit roots in the model 4 of table 2, we selected the Harris Tzavalis test. Harris and Tzavalis apply the unit roots test to models type:

$$y_{it} - \overline{y_t} = \rho (y_{i\,t-1} - \overline{y_{t-1}}) + v_{it} \qquad \{51\}$$

estimated by panel without fixed effects, where the v_{it} are independent and identically and normally distributed (*niid*) , having $E(v_{it}) = 0$ and $Var\ (v_{it}) = \sigma_V^2 < \infty$, $\forall\ i,\ t$. Assuming this, under the null hypotesis of existence of unit roots in the series y_{it} ($\rho = 1$), they obtain that:

$$\sqrt{\frac{NT(T-1)}{2}}\left(\hat{\rho}_{LSP} - 1\right) \xrightarrow{L} N(0,1) \qquad \{52\}$$

Once estimated $\hat{\rho}_{LSP}$, if $|\hat{\rho}_{LSP}| < 1$ the series y_{it} wil be stationary. But if $|\hat{\rho}_{LSP}| \geq 1$ the series will have unit roots and it will not be stationary. In this last case we would apply the cointegration techniques to know if there exists a long run relationship among series.

Applying the Harris-Tzavalis test, the estimated $\hat{\rho}_{LSP}$ are: 0.88012 (VELOC), 1.0126 (PC), 0.99731 (PCPO), 0.96564 (PASKM), 0.98446 (AUTCA), 0.95547 (PKMTK),0.92140 (AUTPC), 1.0107 (DENSID), 0.89760 (WVELOC), 1.0072 (WDENSID) and 0.95503 (WAUTPC). There are un our problem three no-starionary series: PC, DENSID and WDENSID. We must proof the cointegration techniques.

Applications of the panel cointegration tests have been developed in Pedroni (1995, 1997a) and Kao (1999), Kao, Chiang and Chen (1999) and McCoskey and Kao (1999). In our paper we select the Chiwa Kao (1999) Dicky-Fuller cointegration test. Estimating the model:

$$y_{i,t} = a_i + X'_{i,t}\beta + u_{i,t} \qquad \{53\}$$

where $X'_{i,t}$ is a matrix with all regressors, the test D-F for Kao is calculated from the estimated residuals (e) of the above equation, regressing again the following model:

$$e_{i,t} = \rho\, e_{i,t-1} + v_{i,t} \qquad \{54\}$$

For testing the null hypotesis of no cointegration (H_0: $\rho = 1$), the estimate ρ must be distributed following the D-F test:

$$\text{D-F}\square = \frac{\sqrt{K}T(\square\square 1) + 3\sqrt{K}}{\sqrt{10.2}} \text{ --------- Asintotically--------> N (0,1)} \qquad \{55\}$$

In our case the endogenous variable is VELOC, and its estimated □corresponding is: 0.909074. The D-F□ for VELOC is: 3.8237. If D-F□ is significant (D-F□ > 2), then the series are cointegrated and the estimation in levels reflect the long run relationship and there are not spurious correlation. Hence, in our case the model 4 of table 2 is the long run estimation of Money velocity, or V_L estimated. With respect to the causality relations in the models 4 and 5 of the table 2 all explanatory variables of Money velocity Granger cause significant on Money velocity, except for PASKM that is not significant.

6. SPATIAL EFFECTS ON THE AGGREGATE DEMAND

Apart from Money velocity, the other variables which have power on aggregate demand funcion, following the equation 41 are the real money balances OM/P so-called OMP and □E. The estimations of these two variables are collected in table 3. The theoretical specification of this variables are the following:

$$\frac{OM}{P} = \frac{cPO}{24iP}V \qquad \{56\}$$

from the Baumol-Tobin model, being V the Money velocity and P the prices level (DEFLPIB). Hence we must regress OMP on PO, P, *i*, and the explanatory variables of VELOC. From the Synthesis model we have that:

$$\square E = \frac{cPO}{24iP}\left[V^2 \square \frac{1}{\frac{Vh}{k(b+a)} + h} \right] \qquad \{57\}$$

And hence we must regress □E on the explanatory variables of VELOC plus PO, *i*, and P. In the table 3 the best etimation for OMP is the model 8 and for □E the model 10. In the long run, the aggregate demand function is an rectangular hyperbola with constant unit elasticity between prices and output. The variables which determine its fluctuation are VELOC, if it is non constant, and money supply OM, both in the long run. The theoretical especification of VELOC was analysed above, and with respect to OM, from the Baumol-Tobin model we have that:

$$\text{OM} = \frac{cPO}{24i}V \qquad \{58\}$$

Hence we must regress OM on PO, *i*, and the explanatory variables of VELOC. The results of this last estimation is in the table 5, and the best estimation of OM at long run is the model 13. With respect to the estimation of VELOC at long run, it is in the model 4 of table 2. The estimations of MONTRY (nominal income) and DEFLPIB (the indicator of general level price) are in table 6. The theoretical especification of MONTRY come from the Baumol-Tobin model:

$$MONTRY = \frac{cPO}{24i}V \qquad \{59\}$$

The best estimation of MONTRY is the model 19 of the table 5, and the best regression of DEFLPIB is collected in the model 15 of the same table 5. The theoretical especification of DEFLPIB depends of the aggregate supply. With all these last specifications we can observer now what is the total impact on aggregate demand and equilibrium. For verify this question we try to estimate the following equations system, for dependence of real income measured by World Bank method:

$$\begin{cases} PCPO = PCPO_0 + \square(yreal) \\ PC = PC_0 + \square(yreal) \\ PKMTKM = PKMTKM_0 + \square(yreal) \\ AUTCAM = AUTCAM_0 + \square(yreal) \\ PASKM = PASKM_0 + \square(yreal) \\ AUTPC = AUTPC_0 + m(yreal) \\ DENSID = DENSID_0 + g(yreal) \\ yreal = \square_0 + \square_1 PCPO + \square_2 PC + \square_3 PKMTKM + \square_4 AUTCAM + \square_5 PASKM + \\ + \square_6 AUTPC + \square_7 DENSID \end{cases} \qquad \{60\}$$

where the terms sub ($_0$) are autonomous components not dependents of real income. The results of the estimation of real income (YSCTES) are in the table5; the best model is model 16. The results of the last two equations system estimations are collected in Tables 6 and 4 respectively.

7. CONCLUDING REMARKS

In this paper I have specified a model which links the income velocity of circulation and some geographical variables. The model is constructed assuming a unielastic aggregate demand function which contains the income velocity of circulation as conventional variable.

The central point of the theoretical specification was the Baumol-Tobin model for transaction money demand. The connections with the Spatial Economy come from basically of Christaller's central place theory and some gravity models for the transportation system. The model is estimated using panel data techniques for a sample of 64 countries during 21 years. The best results are obtained in the random effects model making a correction by assuming a first order auto-regresive process in the residuals. We have found a positive relationship between the income velocity of circulation and the ratio between central place and total country' population, the ratio between cars and trucks stock in the country and finally the central place population in absolute terms. We also have found a negative relationship among income velocity of circulation and the passenger-kilometer transported by railways in absolute terms, and the ratio between passenger-kilometer and net ton-kilometer transported by railways into the country. The regression coefficients show the variation of the income velocity of circulation when fluctuating each explanatory variable; and hence, the income velocity of circulation increases when increasing the conditionings whose coefficients are positive like the ratio between central place and total country's population (PCPO), the ratio between cars and trucks stock (AUTCAM), and the central place population (PC), or when decreasing the explanatory variables whose coefficients are negative, i.e., the passenger-kilometer in absolute terms transported by railways (PASKM) and the population's density (DENSID). The variables PC and AUTCA affect the total aggregate demand in same sense causing fluctuations in output and prices level, that maybe cause of possible nominal friction. If the variables PCPO and DENSID coming down, or rise the another spatial explanatory variables, then output also can rise. Fluctuations in PCPO not affects the output. Prices level rise if PASKM or DENSID come down or the another spatial variables goes up.

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TABLE 1. Relevant Data across Countries

Country	**Algeria**	**Cameroon**	**Congo**	**Egypt**	**Ethiopia**	**Kenya**	**Madagasc.**	**Malawi**
Money Unit	dinars	francs	francs	pounds	birr	shillings	francs	kwacha
Averag.Vel.	1.700	7.738	7.300	2.717	4.097	6.723	6.238	9.873
PO-1980	18.67	8.50	1.53	42.13	38.75	16.67	8.78	6.05
PO-1990	25.01	11.83	2.27	52.69	51.69	24.03	11.20	8.29
1st.City	Alger	Douala	Brazzaville	Cairo	Addis Abeba	Nairobi	Tananarive	Blantyre
PC-1980	1.5	0.27	0.48	5.8	1.3	0.81	0.41	0.25
PC-1990	3.0	0.77	0.63	9.0	1.8	1.5	0.67	0.36

Country	**Morocco**	**Tanzania**	**Tunisia**	**Zaïre**	**Zambia**	**SouthAfrica**	**Argentina**	**Bolivia**
Money Unit	dirhams	shillings	dinars	new zaïres	kwacha	rands	pesos	bolivianos
Averag.Vel.	3.416	4.200	3.573	5.190	6.066	7.516	15.272	12.390
PO-1980	20.05	18.58	6.39	26.38	5.56	28.28	28.24	5.60
PO-1990	25.06	25.63	8.07	35.56	8.07	37.96	32.32	7.40
1st.City	Casablanca	Dar es salaa	Tunis	Kinshasa	Lusaka	Johanesburg	BuenosAires	La Paz
PC-1980	2.3	0.85	0.53	2.5	0.61	1.5	9.9	0.81
PC-1990	3.2	1.6	1.1	3.5	0.99	2.3	11.5	1.2

Country	**Brazil**	**Canada**	**Chile**	**Colombia**	**Ecuador**	**U.S.A.**	**Mexico**	**Paraguay**
Money Unit	cruzeiros	can.dollars	pesos	pesos	sucres	US dollars	new pesos	guaranies
Averag.Vel.	11.004	7.876	14.881	8.185	6.904	6.273	12.599	9.981
PO-1980	121.29	24.04	11.14	25.89	8.12	227.76	69.66	3.15
PO-1990	150.37	26.58	13.17	32.99	10.78	249.92	86.15	4.28
1st.City	Sao Paulo	Toronto	Santiago	Bogota	Guayaquil	New York	Mexico DF	Asuncion
PC-1980	6.9	2.9	3.8	4.1	1.0	17.1	8.8	0.70
PC-1990	11.4	3.4	4.3	4.8	1.7	16.2	14.2	0.97

Country	**Peru**	**Uruguay**	**Venezuela**	**Jamaica**	**Bangladesh**	**SouthKorea**	**Philippines**	**India**
Money Unit	new soles	pesos	bolivares	jam.dollars	taka	won	pesos	rupees
Averag.Vel.	8.936	11.145	5.589	7.127	10.031	10.221	12.536	6.410
PO-1980	17.30	2.91	15.02	2.13	88.68	38.12	48.32	675.00
PO-1990	21.55	3.10	19.33	2.41	115.59	42.87	61.48	827.05
1st.City	Lima	Montevideo	Caracas	Kingston	Dacca	Seoul	Manila	Bombay
PC-1980	4.6	1.24	2.9	0.51	3.2	6.5	3.5	7.6
PC-1990	6.2	1.28	3.4	0.64	6.6	10.9	8.4	11.8

Country	**Indonesia**	**Iran**	**Israel**	**Japan**	**Jordan**	**Malaysia**	**Myanmar**	**Pakistan**
Money Unit	rupiah	rials	n.sheqalim	yen	dinars	ringgit	kyats	rupees
Averag.Vel.	9.392	3.452	18.739	3.380	2.028	5.140	4.894	3.616
PO-1980	147.49	39.30	3.88	116.81	2.92	13.70	33.64	82.58
PO-1990	179.30	54.61	4.66	123.54	4.01	17.76	41.67	112.03
1st.City	Yakarta	Teheran	Tel Aviv	Tokyo-Yok	Amman	Kuala Lum.	Rangun	Karachi
PC-1980	6.5	4.7	1.4	11.3	0.85	0.92	2.3	5.0
PC-1990	9.2	6.7	1.8	18.1	1.0	1.7	3.2	7.7

Country	**Sri Lanka**	**Syria**	**Tahiland**	**Hong-Kong**	**Turkey**	**Austria**	**Belgium**	**Czechoslov.**
Money Unit	rupees	pounds	baht	HK dollars	liras	schillings	francs	koruny
Averag.Vel.	7.846	2.109	10.221	5.770	6.705	7.095	4.713	2.500
PO-1980	14.75	8.70	46.72	4.9	44.47	7.55	9.85	15.31
PO-1990	16.99	12.12	56.08	5.9	56.07	7.60	9.84	15.66
1st.City	Colombo	Damasco	Bangkok	Victoria	Istanbul	Wien	Brüxels	Praha
PC-1980	0.58	1.0	4.6	4.5	4.5	1.5	1.0	1.1
PC-1990	0.62	1.8	7.1	5.3	6.6	1.9	0.95	1.2

Country	**Denmark**	**Spain**	**Finland**	**France**	**WGermany**	**Greece**	**Netherland**	**Ireland**
Money Unit	kroner	pesetas	markkaa	francs	deuts.marks	drachmas	guilders	pounds
Averag.Vel.	4.200	3.868	12.413	3.586	5.728	5.784	4.684	6.992
PO-1980	5.12	37.54	4.78	53.88	61.54	9.64	14.14	3.40
PO-1990	5.14	38.96	4.99	56.73	63.23	10.12	14.95	3.50
1st.City	K□benhavn	Madrid	Helsinki	Paris	Hamburg	Atenas-Pireo	Amsterdam	Dublin
PC-1980	1.38	3.1	0.80	8.7	1.6	3.0	0.71	0.86
PC-1990	1.39	3.4	1.0	8.5	1.9	3.4	0.68	0.93

Country	**Italy**	**Norway**	**Poland**	**Portugal**	**U.K.**	**Sweden**	**Switzerland**	**Yugoslavia**
Money Unit	lire	kroner	zlotys	escudos	pounds	kronor	francs	new dinars
Averag.Vel.	2.593	4.891	4.027	3.140	5.375	8.334	2.886	5.058
PO-1980	56.43	4.09	35.58	9.77	56.33	8.31	6.32	22.30
PO-1990	57.66	4.24	38.12	9.87	57.41	8.56	6.71	23.82
1st.City	Roma	Oslo	Warszawa	Lisboa	London	Stockhölm	Zürich	Beograd
PC-1980	2.83	0.64	1.5	1.5	7.6	1.3	0.71	1.4
PC-1990	2.80	0.66	1.7	1.6	6.8	1.6	1.20	1.6

TABLE 2: Estimation results of Money Velocity of Circulation (1978-1998)

Estim. Meth.:	1	2	3	4	5	6	7
Endog. Var: **VELOC**	**Within AR1**	**Random AR1**	**Spatial err Depend.ML**	**2SLS-FIX AR1**	**2SLS-FIX AR1**	**Within AR1**	**Random AR1**
Expl. Var:	No spatial	No spatial	Spacial	**Long Run**	Sp. & Dyn.	Sp. & Din.	Sp. & Dyn.
WVELOC	-------------	-------------	--------------	0.13433 (3.238)	0.1717 (3.696)	-0.681E-01 (-1.449)	-0.831E-01 (-1.833)
WWVELOC1	-------------	-------------	--------------	--------------	2.1152 (18.71)	1.3109 (13.32)	1.3322 (13.68)
WWVELOC2	-------------	-------------	--------------	--------------	-1.270 (-13.71)	-0.200 (-2.047)	-0.1889 (-1.938)
WVELOC2	-------------	-------------	--------------	--------------	-0.2591 (-4.926)	0.559E-01 (1.046)	0.442E-01 (0.836)
WAUTPC	-------------	-------------	--------------	-0.437E-03 (-3.873)	-0.227E-03 (-2.465)	-0.155E-03 (-1.442)	-0.924E-04 (-1.182)
WDENSID	-------------	-------------	--------------	0.138E-01 (2.599)	0.503E-02 (1.158)	0.494E-02 (0.796)	-0.936E-03 (-0.277)
PCPO	0.850E-01 (2.214)	0.1034 (3.407)	0.1154 (4.082)	0.833E-01 (2.205)	0.913E-01 (2.950)	0.433E-01 (1.134)	0.497E-01 (2.048)
PC	0.1530 (2.150)	0.1784 (2.983)	0.3505 (5.783)	0.15428 (2.152)	0.1266 (2.185)	0.913E-01 (1.224)	0.484E-01 (0.973)
PKMTK	-0.1855 (-1.888)	-0.189E-01 (-1.954)	-0.203E-02 (-0.014)	-0.170E-01 (-1.758)	-0.114E-01 (-1.463)	-0.952E-02 (-1.326)	-0.116E-01 (-1.653)
AUTCA	0.1561 (2.833)	0.1455 (2.750)	0.1987 (1.993)	0.13050 (2.391)	0.609E-01 (1.373)	0.488E-01 (1.161)	0.619E-01 (1.556)
PASKM	-0.137E-04 (-2.438)	-0.149E-04 (-3.152)	-1.859E-05 (-4.691)	-0.222E-04 (-3.545)	-0.147E-04 (-2.900)	-0.930E-05 (-1.535)	-0.699E-05 (-1.552)
AUTPC	-0.388E-03 (-2.466)	-0.394E-03 (-2.968)	-0.567E-03 (-3.374)	-0.342E-03 (-2.193)	-0.117E-03 (-0.932)	0.359E-04 (0.254)	-0.815E-05 (-0.078)
DENSID	-0,361E-02 (-1.061)	-0.543 (-0.221)	0.288E-02 (1.650)	-0.584E-02 (-1.665)	-0.455E-02 (-1.603)	-0.105E-01 (-2.528)	0.152E-02 (0.676)
INTERES	-0.979E-04 (-0.771)	-0.754E-04 (-0.595)	--------------	-0.129E-03 (-1.031)	-0.948E-04 (-0.937)	-0.199E-03 (-2.365)	-0.189E-03 (-2.253)
Constant	Fixed Effects	5.915 (6.840)	3.520 (4.711)	Fixed Effects	Fixed Effects	Fixed Effects	-1.744 (-2.492)
[illegible]	-------------	-------------	0.24 8 (3.66)	0.134 (3.23)	0.171 (3.6)	-------------	-------------
Tests:							
R^2	0.82	0.22	0.28	0.83	0.89	0.88	0.67
R^2-adjusted	0.81	0.22	0.25	0.82	0.88	0.88	0.67
I Moran	-------------	-------------	--------------	3.329	4.169	-------------	-------------
LM(err)	-------------	-------------	9.111	9.935	14.89	-------------	-------------
K-R (err)	-------------	-------------	26.18	-------------	------------	-------------	-------------
LM (lag)	-------------	-------------	--------------	19.31	25.67	-------------	-------------
LM (sarma)	-------------	-------------	--------------	22.30	------------	-------------	-------------
DW	2.20	2.20	1.98	1.81	1.67	1.73	1.72
Amemiya	0.49E+01	0.49E+01	--------------	0.491E+01	0.44E+01	0.39E+01	
Akaike	0.82E+01	0.82E+01	--------------	0.799E+01	0.52E+01	0.31E+01	
F.	0.71E+02			0.708E+02	0.11E+03	0.10E+03	
Lagrange Mlt	3845.2	3845.2				2463.7	2463.7
Hausman	0.0005	0.0005				0.0002	0.0002

Note: t-ratios in brackets

TABLE 3: Estimation results of real money balances and real income (1978-98)

Estim.Met:	8	9	Met.Estim:	10	Met.Estim:	11	12
Endog.Var: **OMP**	**2SLS-FIX AR1**	**Random AR1**	Var.Endog: **□ E**	**Between**	Var.Endog: **YSCTES**	**FIXED E. AR1**	**2SLS-FIX AR1**
Expl.Var:	Spa.& Dyn	Spa.& Dyn	Var.Expl:	Spatial	Var.Expl:	Spa.&Dyn .	Spa.&Dyn
WOMP	0.02037 (0.310)	0.149E-01 (0.244)	W□ E	0.15812 (1.511)	WYSCTES	0.16228 (2.972)	0.15623 (2.857)
WOMP2	0.05054 (0.602)	-0.299E-02 (-0.039)	W□ E2	------------	WYSCTES2	-0.07157 (-1.118)	-0.06985 (-1.091)
WAUTPC	-0.176E-02 (-0.532)	-0.409E-03 (-0.143)	WAUTPC	0.517E-02 (0.191)	WAUTPC	-0.248E-01 (-2.399)	0.217E-01 (2.095)
WDENSID	0.60205 (3.096)	0.33568 (2.509)	WDENSID	-0.21937 (-0.337)	WDENSID	1.4538 (2.671)	1.4814 (2.722)
PCPO	-0.2291 (-0.198)	-0.2002 (-0.223)	PCPO	2.12115 (0.397)	PCPO	-0,1275 (-0.039)	-0.1495 (-0.046)
PC	20.446 (9.035)	19.469 (11.09)	PC	86.0408 (5.397)	PC	31.872 (4.952)	30.520 (4.762)
PKMTK	-0.2379 (-1.122)	-0.2654 (-1.265)	PKMTK	-1.91614 (-0.237)	PKMTK	-0.89527 (-1.428)	-0.9494 (-1.515)
AUTCA	2.8382 (2.377)	2.3094 (1.990)	AUTCA	-13.9634 (-0.570)	AUTCA	37.954 (11.40)	39.431 (12.17)
PASKM	0.4506E-03 (2.519)	0.593E-03 (3.812)	PASKM	-0.479E-03 (-0.442)	PASKM	0.288E-02 (5.769)	0.291E-02 (5.819)
AUTPC	0.2049E-01 (4.945)	0.257E-01 (7.265)	AUTPC	0.13845 (4.270)	AUTPC	0.958E-01 (8.335)	0.971E-01 (8.426)
DENSID	-0.94581 (-7.108)	-0.50861 (-5.481)	DENSID	-0.63185 (-1.529)	DENSID	-1.8107 (-4.673)	-1.7341 (-4.489)
INTERES	-0.541E-03 (-0.239)	-0.726E-03 (-0.321)	INTERES	-0.33957 (-1.781)	INTERES	-0.108E-02 (-0.171)	-0.989E-03 (-0.371)
PO	0.826E-03 (0.721)	0.936E-03 (0.399)	PO	1.034E-03 (0.773)	PO	0.999E-03 (0.652)	1.104E-03 (0.898)
Constant	Fixed Effects	-45.188 (-1.940)	Constant	-177.45 (-1.236)	Constant	Fixed Effects	Fixed Effects
Tests:			**Tests:**		**Tests:**		
R^2	0.94	0.59	R^2	0.72	R^2	0.98	0.98
R^2-adjusted	0.94	0.58	R^2-adjusted	0.64	R^2-adjusted	0.98	0.98
DW	2.36	2.46	DW	2.05	DW	1.89	1.78
Amemiya	0.105E+02	0.903E+01	Amemiya	0.491E+01	Amemiya	0.125E+02	0.125E+02
Akaike	0.218E+04	0.489E+03	Akaike	0.799E+01	Akaike	0.168E+05	0.169E+04
F.	0.257E+03	0.111E+04	F.	0.708E+02	F.	0.761E+03	0.773E+03
Lagrang.M.		4638.3	Lagrang.M.		Lagrang.Mult		5069.8
Hausman		42.55	Hausman		Hausman		80.23

Note:t-ratios in brackets

TABLE 4. Regressions of Spatial Variables on Real Income (yreal). (1978-98)

EndogVar	PCPO	PC	PKMTKM	AUTCAM	PASKM	AUTPC	DENSID
Estimatio Method:	**Within AR1**	**Random AR1**	**2SLS AR1**	**Random AR1**	**Random AR1**	**Random AR1**	**Within AR1**
Expl.Var: YREAL	- 0.00443 (-6.86)	0.00304 (14.80)	-.2e-3 (-3.62)	0.00053 (2.45)	33.082 (9.91)	2.0786 (15.78)	0.0333 (4.54)
Constant	Fixed Effects	4.8036 (7.02)	1.9797 (3.85)	4.7967 (8.52)	14159. (1.29)	1383.6 (2.81)	Fixed Effects
Tests:							
R^2	0.88	0.36	.90e-4	0.028	0.1514	0.32	0.95
DW	3.0401	3.1793	1.94	2.3515	3.2856	3.3045	3.008

F.	46.83		0.044				117.9
Lagrang.M		900.05		1087.29	942.43	928.71	
Hausman		0.0242		0.07686	0.3117	0.1533	

Note: t ratios in brackets.

TABLE 5: Estimation results of Money supply, Prices level and Nominal income. Long run (1978-98)

	13	14	15	16	17	18	19
Estim. Met:	**2SLS-FIX AR1**	**FIXED E. AR1**	**FIXED E. AR1**	**2SLS-FIX AR1**	**FIXED E. AR1**	**FIXED E. AR1**	**2SLS-FIX AR1**
Endog. Var:	**OM**	**OM**	**DEFLPIB**	**YSCTES**	**YSCTES**	**MONTRY**	**MONTRY**
Expl. Var:	Spa.&Dyn	Spa.&Dyn	Spa.&Dyn	Spa.&Dyn	Spa.&Dyn.	Spa.&Dyn	Spa.&Dyn
	WOM 0.164E-01 (0.517)	WOM 0.177E-01 (0.557)	WDEFPIB 0.75549 (26.82)	WYSCTES 0.10423 (3.877)	WYSCTES 0.10907 (4.072)	WMONTRY 0.981E-01 (3.388)	WMONTRY 0.964E-01 (3.070)
WAUTPC	-0.99E-02 (-1.889)	-0.10E-01 (-1.952)	-0.439E-04 (-3.020)	-0.206E-01 (-1.997)	-0.237E-01 (-2.301)	-0.563E-01 (-3.186)	-0.554E-01 (-2.888)
WDENSID	0.88771 (2.293)	0.91227 (2.349)	0.152E-02 (1.376)	1.5620 (2.895)	1.5374 (2.851)	1.7046 (1.407)	1.6904 (1.289)
PCPO	-1.0771 (-0.513)	-1.2272 (-0.584)	0.123E-01 (2.094)	-0.62958 (-0.196)	-0.62162 (-0.194)	-7.7713 (-1.190)	-7.7663 (-1.098)
PC	49.481 (11.23)	50.037 (11.29)	0.947E-01 (7.397)	30.208 (4.714)	31.522 (4.903)	138.88 (9.900)	139.13 (9.156)
PKMTK	-0.48516 (-1.289)	-0.4638 (-1.232)	0.287E-02 (2.764)	-1.2633 (-2.267)	-1.2169 (-2.185)	-2.3865 (-2.039)	-2.3771 (-1.875)
AUTCA	5.5864 (2.757)	5.3447 (2.636)	0.853E-02 (1.509)	38.958 (12.12)	37.480 (11.35)	55.288 (8.775)	54.808 (8.005)
PASKM	0.630E-03 (1.939)	0.629E-03 (1.938)	-0.660E-05 (-7.197)	0.293E-02 (5.861)	0.290E-02 (5.816)	0.427E-02 (4.218)	0.431E-02 (3.926)
AUTPC	0.282E-01 (4.195)	0.299E-01 (4.427)	0.391E-04 (2.064)	0.971E-01 (8.418)	0.958E-01 (8.328)	0.14163 (6.736)	0.12247 (3.731)
DENSID	-1.8057 (-7.051)	-1.8939 (-7.026)	-0.576E-03 (-0.754)	-1.8489 (-4.967)	-1.9273 (-5.164)	-5.4031 (-6.488)	-5.4148 (-6.003)
INTERES	0.121E-02 (0.236)	0.118E-02 (0.231)		-0.103E-02 (-0.164)	-0.106E-02 (-0169)	0.125E-02 (0.078)	0.151E-02 (0.087)
PO	0.785E-03 (0.774)	0.939E-03 (0.655)	----------------	0.456E-03 (0.899)	0.776E-03 (0.999)	0.575E-03 (0.444)	0.696E-03 (0.597)
Constant	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects
Tests:							
R^2	0.92	0.92	0.73	0.98	0.98	0.96	0.95
R^2-adjusted	0.91	0.91	0.71	0.98	0.98	0.95	0.95
DW	2.36	2.46	2.18	1.88	1.93	1.96	2.05
Amemiya	0.112E+02	0.903E+01	0.052E+01	0.125E+02	0.125E+02	0.135E+02	0.136E+02
Akaike	0.455E+04	0.489E+03	0.003E+01	0.440E+05	0.168E+05	0.168E+05	0.516E+04
F.	0.126E+03	0.111E+04	0.306E+02	0.266E+03	0.774E+03	0.761E+03	0.226E+03
Lagrang.M.		2096.7					5069.8
Hausman		64.48					80.23

Note: t -ratios in brackets