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THE EVALUATION OF THE FISCAL SUSTAINABILITY OF TRANSPORTATION INFRASTRUCTURE INVESTMENT WITHIN TERRITORIAL PROGRAMS

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ABSTRACT

The present paper focuses the fiscal conditions for governmental investment in transportation infrastructure. These conditions may only be sound or sustainable if the infrastructure investment is more deeply related to effective (and measurable) economic growth fostered by the creation of new locational advantages. Thus these investments are to be embedded into a broader investment package which is here referred as territorial programs. These programs shall link infrastructure investment with other industrial investments which are more directly value adding and thus prone to generate the sufficient tax receipts. It is the aim of the proposed paper to design the conceptual scope of models which will compute the fiscal and financial results of territorial programs. The aimed model should encompass the feasibility studies of the projects of the private sector and the fiscal impact of their support by the government as well of the impact of direct public investment and administrative costs that are incurred in the course of territorial programs. The paper restates initially the underlying modeling problem and develops a general procedure for the calculation of the economic and fiscal impacts of territorial programs.

Keywords: portation infrastructure, transustainable fiscal, territorial programs, public investment

1. INTRODUCTION

There is a vast amount of literature that recognizes the importance of infrastructure for economic growth (Aschauer 1989, The World Bank 1994, Lu 1996, Banister and Berechman 2001, OCDE 2003, Estache and Fay 2007). On the other hand, the requirements of fiscal discipline, especially in countries in macroeconomic disarray (e.g., Brazil and other Latin-American nations) have burdened them with severe restrictions for making public investments that would be essential for their development and growth (Carvalho 2007, Afonso and Biasoto Jr. 2007, Carneiro 2006, Ter-Minassian and Allen 2004). Once the traditional fiscal resources of these investments reached their

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limits, including new debt, hope has been laid on private investments made by means of concessions and public-private partnerships. However, even the international agencies that in the past strongly advocated for this kind of strategy have finally recognized that it cannot cover a significant part of the investment needs, given the hard requirements imposed by the financial market for its “bankability” (Zulhabri and Abdullah 2006, Griffin 1999, GHK Research Training 2001, Spoehr 2002). Additionally, the private sector has more stringent limitations for assuming risks than the public sector (Beckers 2005). Thus, fiscal funding of infrastructure investment, especially in the transportation industry, is still the mainstream solution.

Therefore, the fiscal limits to public investment returns to be the fundamental issue in infrastructure funding. In principle, the implicit rationale for justifying fiscally this massive public investment is the hope that the subsequently fostered economic growth should somehow imply in tax and other returns for the public finance. It may be observed that the idea of putting transportation infrastructure investment in direct relation to economic growth and to the corresponding fiscal gains seems to be a prospective solution to resolve the feasibility gap of these investments. Such gap arises when traditional economic evaluation approaches of infrastructure projects (e.g., COBA, multicriteria analysis, value engineering, among others) deliver an economic justification of the project but are not able to determine where the financial resources for its execution will come from. In turn, a fiscal balance approach that compares rising public expenses with rising public revenues due to the investment in a given transportation project could reflect its economic value and indicate the financial resources that could be raised for its funding.

On the other side, much research has been devoted to analyze the straightforward links between transportation investments and economic growth (Rivas et al. s.d a and b, Beckers et al. 2008, Department for Transport 2007 and 2009, Johansson 2007, Lakshmanan 2007, Vickerman 2007, Marshall and Webber 2009, Banister and Berechman 2001). Hereby, the link between transportation infrastructure investment and economic growth is not so straightforward. Putting it in more concrete terms, it is rarely possible to link regional economic growth results and the respective fiscal gains directly to a particular infrastructure investment (Kessides 1993, Boarnet 1997, Smith 1999, Raisuddin and Donovan 1992, Creightley 1993). Moreover, economic growth results from a combination of different factors, especially from industrial investment decisions, which are dependent upon a set of different considerations, such as strategic market location, local economies, and the political and regulatory environment. Of course, logistic costs are also important for investment decisions. However, as pointed out by Banister and Berechman (2001), the more developed the existing regional infrastructure is, the less considerable a role it will play in diminishing production and logistic costs, and the less the logistic costs themselves can be accounted as an important share of the total production cost. At most, a tighter correlation between the transportation infrastructure investment, the improvement of logistics, on one other side, and, on the other, industrial investment and economic growth will be more easily determined in lesser industrialized regions but with positive growth potentials.

As the fiscal sustainability approach presented above must not rely on isolated transportation infrastructure projects because they are not the core factor for regional economic growth, the idea put forward here is to link transportation infrastructure investment to other industrial investments in the region so that the whole regional investment package may prove directly growth producing. Other necessary policy actions and complementary infrastructure projects (waste, energy, education, health, and so on) shall be added to this regional investment package, which will from now on be referred to as territorial program. The analytical problem to be solved is to prove that

this whole package is fiscally sustainable, i.e., that it will produce enough growth as well as fiscal gains that are straightforwardly attributable to the package. It may be observed that this evident discourse on the fiscal results of public investments in infrastructure has in fact already given birth to different economic and fiscal impact analysis methods, especially in the United States, and in lesser degree also in Europe (Raidenbach et al. 2007). Such evaluation efforts have been introduced as a (in the rule, secondary) complement to traditional COBA and environmental evaluation of projects (Leistritz 1988).

The aim of this paper is discuss the concept of territorial program as an innovative approach to infrastructure policy and funding and to appoint a methodological for calculating the economic and fiscal impacts of this kind of program as well the final results for fiscal sustainability of the program. Initially, section 2, the preliminary considerations are presented. In section 3 the concept of territorial program will be shortly sketched, and its justification and constituent parts are discussed. The subsequent section 4 sketches the gross model structure for calculating the economic and fiscal impacts. Finally, the section 5 details the general definition of fiscal sustainability and the specific adaption of this notion for evaluating territorial programs, and appoints indicators that may be useful for measuring and evaluating the fiscal sustainability of territorial programs. The paper closes with a short concluding section 6.

2. PRELIMINARY CONSIDERATIONS

The economic impact analysis tries to evaluate the multiplier effects of industry and infrastructure projects on the regional and local economy by estimating the employment and gross product impacts along the different layers of suppliers and retail services for the locals, the fiscal impact analysis is more directly concerned with the balance between government expenditures and tax revenues, especially of supporting infrastructure investments. In the rule, economic and fiscal impact analyses are executed in separate studies: some projects are submitted only to the economic impacts of major infrastructure and industrial interventions without calculating the fiscal consequences; and others solely to the analyses of the immediate fiscal impacts of infrastructure and real estate development. In other cases, both analyses are mutually integrated (see Heuer et al. 2005). The calculation of wider economic impacts of major infrastructure and industrial project require more sophisticated modeling approaches, as complex inter-industrial linkages and chains are to be considered, which are effective not only on the local and regional, but also on the national level. Export base theory and Input – Output (I-O) models come in the rule to application, and more recently, the use of GIS tools is spread out (Leistritz 1998).

However, this present practice of impact analyses has severe limitations for guiding broader investment policies. In the rule, the evaluation efforts restrict themselves to isolated projects, even if the numerous linkages between them and the economic surroundings are taken into consideration. Invariably, the aim is to evaluate and subsequently endorse or not the project. Also, the simple confrontation of governmental revenues and costs does not account for other relevant impacts for the fiscal policy as the evolution of public debt, the vulnerabilities of the fiscal position and other events that endanger fiscal sustainability, as it will be discussed further.

The territorial program approach discussed here proposes a step further on the path to foster the economic and fiscal efficiency of the governmental investment and expenditure projects. Although the evaluation methods used in the discussed impact analyses shall be considered in the approach, the point is here to design programs that are effectively fiscally and economically

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efficient, rather than simply to evaluate if they are or not. Moreover, fiscal efficiency of the programs does not mean solely the production of surplus, but shall also consider the impact on other relevant measures of the fiscal policy as the evolution and vulnerability of public debt, the exposition to exchange and interest risks, among other aspects. One further aspect is that industrial and infrastructure project are to be integrated, forming a new economic landscape, which is the proper project to be evaluated.

The fiscal sustainability of these programs is then to be ensured by the imbalance between the different public expenditures (e.g. public support to private projects in form of tax reductions and holidays, guarantees, capital participations, lending and transfers, direct public investments and services and general administrative expenditures) caused by the different actions and projects on the one side and, on the other, by the different fiscal earnings (tax receipts, investment rewards, debt repayments and the like). Moreover, the permanent control of the liquidity of the program cash flow and of the general public finances has also to be ensured.

However, due to the multifunctional character of public finances, i.e. as mean to fund public expenditures and to ensure macroeconomic stability, it is not easy to determine reliable and consentaneous parameters to measure if the public finances are properly managed in order to maintain fiscal sustainability or not. Consent is especially difficult to be obtained in macroeconomic matters, thus concepts and measurement of fiscal sustainability will differ according to the different schools of thought.

3. THE CONCEPT OF TERRITORIAL PROGRAM

The central idea of the territorial program is to execute a coordinated set of public and private investments within a determined territory (program territory) that could foster economic growth and consequently the increase of fiscal receipts in a given program territory. Hereby, the involved public expenditures should deserve a privileged treatment by the fiscal authorities, as is would proof to be fiscally sustainable. Thus, the expenditures could be exempted from the limits put to the expenditures and deficits in general by fiscal policy, especially in periods when cuts are in th order of the day. Typically, a territorial program would be composed of following mutually integrated component projects:

- the spatial configuration of the territory;
- the corresponding accessibility and mobility facilities;
- other infrastructure (water, sewage, energy, communication, emergency management etc.);
- a set of business projects which relate to the infrastructure projects (supplying industries and related services within the productive chain of the infrastructure project);
- a set of industrial projects which will benefit from the infrastructure projects and the integrative policy projects;
- a set of integrative policies and facilities which are necessary to catalyze the growth process, such as incentive policies for entrepreneurship, training and education, health, housing, culture, leisure, sports, public safety, social promotion and environment protection.

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The Figure 1 below illustrates the aimed synergic effects of the territorial program, assuring not only a stronger flow of private investments, but also the fiscal sustainability of governmental investment, expenses as well support to private industry.

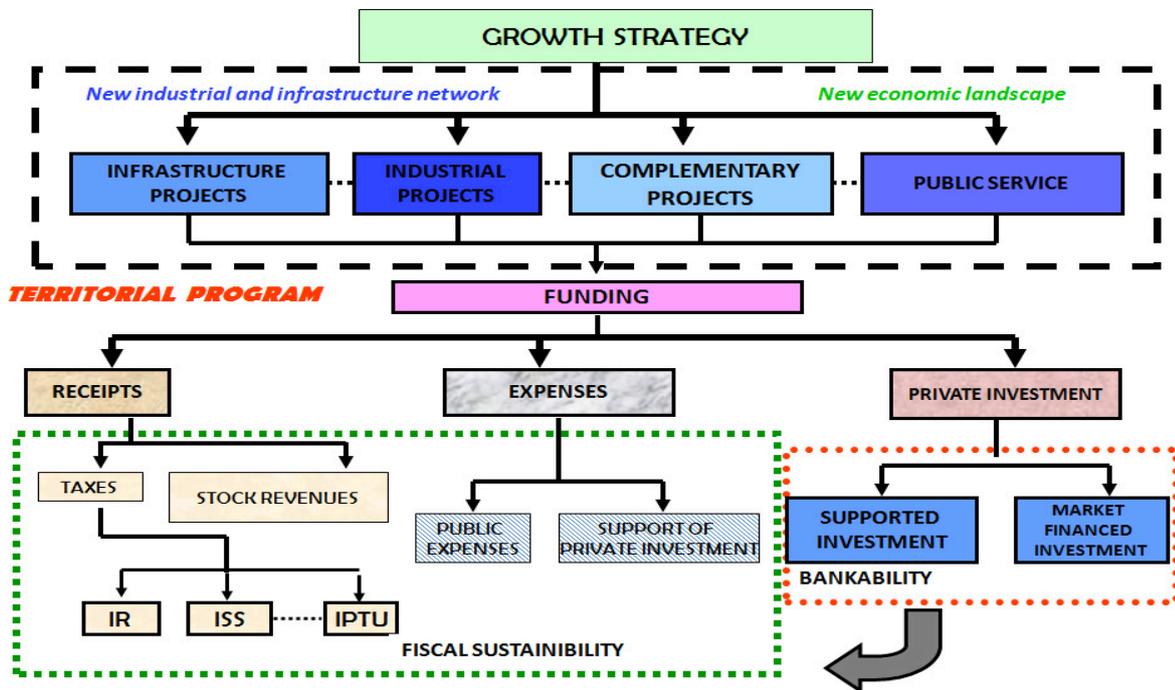


Figure 1 – The synergy effects between component projects within a territorial program

It is expected that the setup of a territorial program will be a very complex undertaking, requiring a sophisticated approach. The authors are working hard at developing this approach which they have baptized as “Engineering of the Territory”¹. As suggested by the Figure 2 below, the setup procedure starts from a given set of projects belonging to the categories listed above, which shall produce a new economic system (or landscape). On its turn, the income effects but also the negative and positive impacts on public finances of this new economic landscape are to be tested by different steps: if the different component projects may be supported by private finance, letting with the governmental only the investments and actions which are within its constitutional duties, the program may be considered fiscally sustainable if the flow of governmental expenses, investments and receipts comply with the fiscal sustainability rules which will be described further.

But when major private investments are foreseen, its funding solely by ordinary private finance may turn out unfeasible, and the government may be involved with its support by different means (investment participation, subsidy, guarantees, and the like). In this case, additional expenses are to be included in the governmental cash flow. Once again, if the now increased flow of governmental expenses, investments and receipts comply with the fiscal sustainability rules, the program may be considered fiscally sustainable.

In the case that the rules are not complied with, which means that the tested program is still not fiscally sustainable, the program should be enriched with additional “growth-driving” projects, which may be originated from the growth strategy of the territorial program. This done, the new set of

¹ See Brasileiro A, Aragao J J G, Santos, E M, Orrico Filho R D (2009): *Fundamentals for an Engineering of the Territory*. Texto para Discussão no. 5. Brasília: CEFTRU/UnB.

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project shall be once again submitted to the test procedure, until the fiscal sustainability requirements are satisfied.

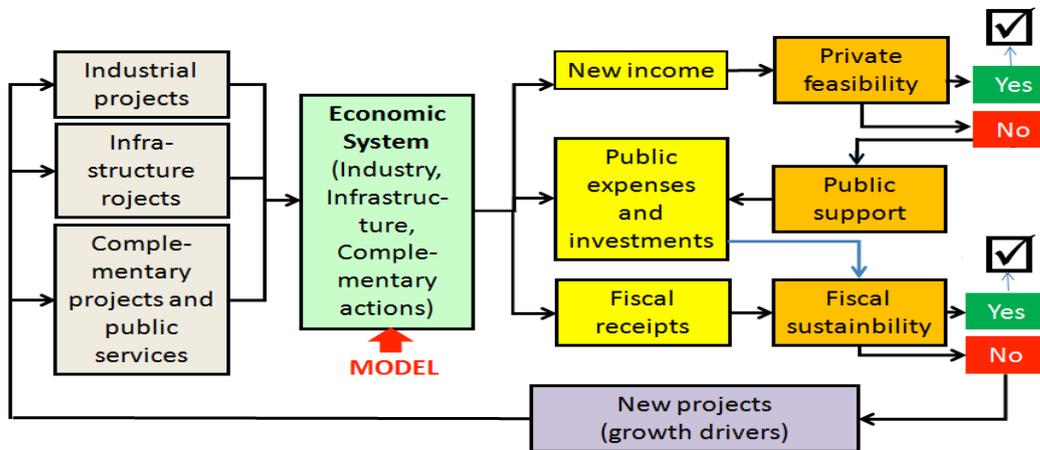


Figure 2 – The general construction and testing procedure for territorial programs

4. THE MODEL STRUCTURE

As appointed in the Figure 2 above, the calculation of the final financial results (income, public expenses and receipts) is activated by inputs which are the economic outputs of the new economic system/landscape. These refer to costs and revenues, settlements, locations and infrastructure networks, economic and transport flows, employment and income effects and other data which arise in the single projects when they are put together. In order to obtain these inputs, a complex model is put to work, which will be based mainly on input-output analysis and be combined with land use and transport submodels.

The industry, land-use and transportation sub-model would be informed by the input/output matrix of the included production chains and their respective location and production targets (obtained, on its part, by the means of an equilibrium model); by the general land use pattern; as well by the proposed infrastructure network and other public services. Based on these inputs, it would calculate the resulting material flows, which will yield the traffic flows (goods and persons) and logistic costs, but shall also simulate the evolution of factors such as: land use pattern, urban poles, public services pattern and also industry structure.

A preliminary step to understand this task and to construct the appropriated model (and also to evaluate the already available packages) would be to reproduce the calculation starting from the inputs of the projects, going through the calculation of their costs and revenues, feasibility conditions, the necessary governmental involvement and respective costs, their economic and fiscal impacts, and arriving to the calculation of the indicators of fiscal sustainability, as it will be discussed further.

The Figure 3 below reproduces the coarse contours of this task. Beginning from the right end of the flow chart, the calculation of indicators of the fiscal sustainability of the program result from the sum of the annual fiscal balances of the program, which are in their turn the sum of the annual fiscal balance of the different constituent projects. For each project the calculation starts then from

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its commercial feasibility study (IRR, LPV, VaR) and the definition of the concrete governmental support needs to become break-even (Square 1). Eventually, the project will be run entirely by the Government, if the private sector decides to not carry it out or if political and legal considerations hinder the private participation. Regarding the support actions by government, for each project the annual incidental (direct governmental) investment, subsidy (including the financial one) and administrative costs are annotated, in order to be confronted to the government revenues. And here begins the next step of the evaluation of each project, which is concentrated in the fiscal balance (Square 2).

At the governmental revenue side, the annual non-tax revenues of the project (dividends, tariffs and others) are summed to the tax revenues. The calculation of the tax revenues requires a more complex procedure, as it has to take in account the direct, indirect and induced impacts of the projects: whereas the direct impacts refer to the private and tax revenues of the project business itself, the indirect impacts refer to the revenues in the supplying business; on their turn, the induced impacts refer to the labor and personal incomes in the project business and in the supplying business, to the revenues and incomes in the different sectors which are involved in the satisfaction of the household consumption needs, as well to the tax revenues resulting from the household consumption and income. For reasons of prudence, the impacts of the catalytic effects, which are highly speculative, should not be considered.

This complex calculation has been developed for and along numerous economic and fiscal impact studies of infrastructure projects (Leistritz 1998, Prognos 2009, Haisch 2008, Pfähler et al. 1997, Heuer et al. 2005, Löhr and Fehres 2005, Reidenbach 2007, Reidenbach et al. 2007, Janssen-Timmen et al. 2002, Burchell et al. 1985, Cooke et al. 1996, Holtzheimer 1998, Siegel et al. 2000, Tischler and Tischler & Associates, Inc. 1989 and 1994, Investissement Québec 2001), and its main tool is the conventional input-output analysis. For the calculation of the fiscal impacts, the economic impacts resulting from the input-output analysis have to be translated into tax revenues by means of a tax matrix (Leung and Bowen 1988), the setup of which still brings up calculative challenges: some revenues (especially the taxes incurred in the production) are in the rule already available in the input-output statistics; others, as the income tax revenue, will need a more complex set of assumptions as to the tax rate accruing to the different household and companies. The calculation of the different tax revenues shall be facilitated by the setup of comprehensive tax matrixes as a complement of the input-output matrixes, which has been be a main point for research by the authors.

Subsequently, the spatial aspects of the territorial programs are to be approached (Square 3). The technical features as well the economic and fiscal results of the transportation and other spatially relevant technical infrastructure, which are in the rule an essential part of territorial programs, will be highly dependent on the spatial structure of the industries and the flows between them. Thus the input-output framework shall be developed in order to deliver interregional flows between different parts of the territory as well from and to different regions outside. Once the material or value flows are calculated, they shall subsequently be transformed into transportation flows, which will depend on the transportation technology and network.

The next step deals then with the projects of spatial infrastructure (Square 4). These networks may start from a pre-defined structure and then iteratively adjusted in order to maximize locational and network efficiency. In the case of transportation infrastructure, a land use and transport model will come to application. Subsequently, the feasibility as well the economic and fiscal impact studies of

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the infrastructure projects shall complement the calculation of the final fiscal balance, following the procedure described for the other projects.

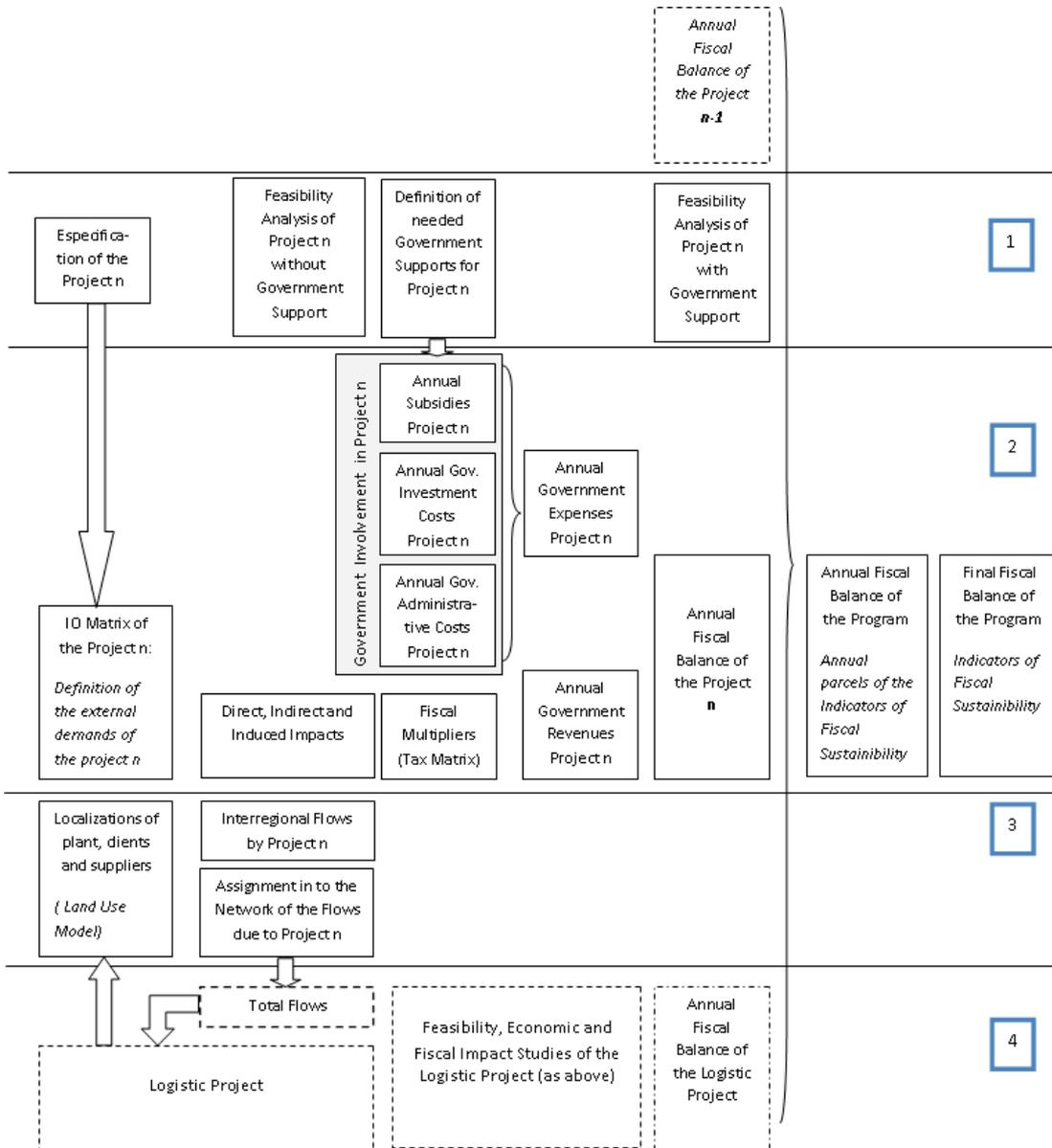


Figure 3 – Proposed general calculation procedure for the fiscal sustainability of territorial programs

At last, some rules are to be established with regard to the relationships between the different component projects of the program and to the sequence, in which they shall be submitted to the analytical procedure described above. As components of a program that will explore synergies in order to maximize the overall output, a hierarchical structure will arise between final demand (e.g. export oriented) projects and other that will have rather a supplying or catalytic function (supplying industries, technical, social and urban infra-structure, trade and commercial centers, training centers, P&D institutions, and the like). For this reason, a previous reconstruction of the involved production chains will help to determine the relationships and the sequence of the analysis, which will begin at the rather end-demand or export oriented projects and end at the projects that will have a supplying and catalytic role. A first round of calculation will produce a common end-demand vector that will then be applied to the input-output analysis.

Up to this point, a general description of the calculation procedure has been exposed. The more concrete technicalities of the economic and fiscal multipliers as well of the interregional treatment are detailed in a manuscript which is still under preparation for publication², where a simplified procedure is presented for evaluating territorial programs in less developed regions.

5. FISCAL SUSTAINABILITY: DEFINITION AND ITS APPLICATION TO TERRITORIAL PROGRAMS

5.1 The general concept of fiscal sustainability

In general, the term sustainability of a procedure or policy suggests the ability of maintaining it during a long period without major changes. Applying this notion to fiscal policy, Chalk and Hemming (2000) as well Burnside (2005) propose that FS has to do with the government's ability to indefinitely maintain the same set of policies while remaining solvent. The word solvency leads then to the main focus of the FS debate, which is precisely the debt management of the government. Indeed, the debt crises of the eighties and nineties are the historical background of the issue, and therefore the ability of the governments of servicing the debt constitutes the starting point of most of the literature on FS.

However, the multilateral agencies have also recognized that the sustainability of the fiscal policies is not only about the proper management of government debt and deficits, but also of the whole economic policy, since the vulnerability of the private financial sector, the contingent liabilities assumed by the government on behalf of the private sector (e.g. governmental guarantees for foreign borrowings by the private industry) and even countercyclical measures to deem general economic crises will impact on the public finances and raise questions on the ability of the government to maintain its obligations under control .

Taking all these aspects into consideration, the International Monetary Fund (2002) has tried to set up a more comprehensive definition of FS by incorporating, but also differentiating between, the following requirements:

- Solvency: the present discounted value (PDV) of the current and future primary deficit shall be no greater than the PDV of its current and future path of income, net of any initial indebtedness;
- Liquidity: regardless of the general solvency condition, the liquid assets and available financing shall be sufficient to meet or roll-over its maturing liabilities;
- Sustainability: the conditions above shall be satisfied without any major correction in the balance of income and expenditure given the fluctuation of the costs of financing it faces in the market.

It emanates from these definitions that the sustainability condition imposes, more than the mere compliance with solvency and liquidity rulings, the soft continuity of the policies, since the need for major corrections may provoke political disturbances which will hinder the adoption of the

² Aragão J J G, Y Yamashita: The Evaluation of the Fiscal Sustainability of Territorial Programs – Sketching the Tool.

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necessary but painful corrective measures. Taking under consideration the stochastic nature of the cash flows to be under control, the documentation includes also the vulnerability – which means “the risk of that the liquidity or solvency conditions are violated and the borrower enters a crisis” – into the components of the sustainability framework.

Therefore, the IMF’s framework on FS is not only about the management of governmental debt and considers also the health of the financial sector as well the more general balance of payments and the stability of the exchange rate. In consequence, a very comprehensive assessment framework has been adopted by this institution, whereby the diagnostic of the fiscal health of each country is analyzed by means of an extensive plethora of data and indicators and also by case specific records on its historical evolution.

The IMF and its framework continue as a reference for the literature on FS, but its case-by-case nature of the evaluation approach each country challenges the authors to develop more objective analytical assessment methodologies and techniques. However, the attempts to come to a proper mathematic formalization imply that the Fund’s general approach is abandoned and that more limited aspects of the notion of sustainability are focused. As put by Balassone and Franco (2002), the definitions proposed are thus “based on partial equilibrium analysis and therefore point to necessary but not sufficient conditions for sustainability... To assess the maximum sustainable debt level we should take the interaction of public finance and the economy into account”.

In fact, the present and future solvency of the public sector is the starting point for the theoretical analysis (Buiter 2004). A major concern is that the public debt does not explode, creating a situation that is referred to as a “Ponzi game” (Blanchard 1990, Chalk and Hemming 2000, Polito and Wickens 2005, Burnside 2005). By assuring it, the government shall not be forced to politically difficult measures as the rise of taxes, a substantial cutting of expenses or going in to default in order to solve a debt crisis (Blanchard 1990, Buiter 2004, International Monetary Fund 2002).

Focusing this limited debt aspect, a first set of conditions which will be central for the further formal development is put forward by the literature (Balassone and Franco 2002, Polito and Wickens 2005):

- the evolution of the debt to GNP ratio has to remain finite, eventually converging to its initial level;
- the present discounted value of the ratio of primary deficits (surplus) to GNP is equal to the negative (positive) value of the current level of debt to GNP.

As fiscal policy is a permanent activity of the government, the analytical frameworks choose undetermined or even infinite time horizons, but limited terms are also admitted for the application of the mathematical models (Polito and Wickens 2005). Invariably, the intertemporal compliance with the budget constraint and, in every period, the compliance with a static budget constraint is the starting point of the models (Chalk and Hemming 2000). Therefore, the mathematical formulation of the fiscal sustainability of the public finances starts from the general budget constraint (GBC). The equation (1) reproduces the basis idea whereby for each period the change in public debt shall be equivalent to the expenses liquid of the receipts and added by the old debt (included the interest rate liquid of the growth rate)³.

³ We disregard here seigniorage gains, as the management of a territorial program will not deal with monetary policy and therefore will not have this resource at his disposal.

$$b_t - b_{t-1} = g_t - t_t + (r_{t-1} - n_{t-1})b_{t-1} \quad (1)$$

Where:

b = face value of the government debt stock (as a fraction to GNP);
 g = governmental expenses liquid of interest payments (as a fraction to GNP);
 t = tax receipts (as a fraction to GNP);
 r = interest liquid of taxes;
 n = real growth rate of the economy.

This equation shows that if the tax-free interest rate (r) is steadily greater than the growth rate of the economy (n), a positive debt level may increase in the long run and consecutively the respective service payments. In order to comply with the sustainability condition, the government would have to raise the receipts. If the contrary happens, deficits are acceptable. In intertemporal terms, the sustainability condition is expressed by the equation (2), and hereby its compliance will depend on the capacity of the government to run surpluses and on the evolution of the second term of the right side of the equation.

$$b_t = \sum_{j=0}^{\infty} R(t, t+j)^{-1} S_{t+j} + \lim_{T \rightarrow \infty} R(t, t+T)^{-1} b_{t+T+1} \quad (2)$$

Hereby, S represents the surplus (gt - tt), and $R(t, t+j) = \prod_{k=0}^j R_{t+k}$, the discount factor applying between periods t and t+j. In order to prevent an explosion of the debt (Ponzi game), following condition has to held:

$$\lim_{T \rightarrow \infty} R(t, t+T)^{-1} b_{t+T+1} \leq 0 \quad (3)$$

This means than that the fiscal policy should respect following constraint:

$$b_t = \sum_{j=0}^{\infty} R(t, t+j)^{-1} S_{t+j} \quad (4)$$

This constraint represents the present value of the budget surplus for an intertemporal fiscal policy with an infinite (undetermined) time horizon.

5.2. Understanding and Measuring Fiscal Sustainability in the Context of Territorial Programs

As shown in the quick literature overview on fiscal sustainability, this term is generally linked to the overall management of public finances, with some extension to the economic policy. As this overall management is seen as a permanent action of the government, its time horizon is in the rule undetermined (infinite, for formalization purposes). The insertion of finite territorial programs with a specific scope into the fiscal sustainability issue demands therefore some previous discussion.

Firstly, the central idea of the territorial program is, as proposed above, to execute a coordinated set of public and private investments that could foster economic growth and consequently the increase of fiscal receipts in a given program territory. These investments involve transport and other economic infrastructure as well industrial plants and other complementary investments and services that should foster productivity and economic growth in the territory of the program. Hereby, the involved public expenditures should deserve a privileged treatment by the fiscal authorities, as is would proof to be fiscally sustainable. Thus, the expenditures could be exempted

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from the limits put to the expenditures and deficits in general by fiscal policy, especially in periods when cuts are in the order of the day.

Secondly, the special fiscal features of the territorial programs must be underlined in order to analyze, if and how the terminology of FS applies to their assessment. These features are:

- a) The programs have a finite, even when long (some decades lasting), term, and so their managing institution (a public special purpose vehicle);
- b) The fiscal management of these programs will have only a limited action space compared to a fiscal authority. For instance, the program management will not have at its disposal seigniorage gains, will hardly have a power to change tax policy as well to influence interest and exchange rates, and even in the budget policy the margin for influence will be narrow. On the other side, all these restrictions do not mean that the fiscal management within the limits of the program will not be affected by inflation, exchange and interest and the tax system.

With all these differences to the overall fiscal policy, why should be spoken of fiscal sustainability of territorial programs? Should the term sustainable not be linked with permanent, intertemporal processes, and could we not use “fiscal consistence” or “fiscal compatibility” of the programs, instead? The insistence on the term fiscal sustainability could be however justified in order to point out the central point of the territorial programs: that they do not harm but instead support directly fiscal sustainability in general, even when they imply in higher governmental expenditures. For this aim, they will have to fulfill the following conditions:

- a) The programs are to be internally solvent and liquid;
- b) The program shall not deteriorate the overall fiscal balance; especially, the additional public debt caused by the program shall comply with the set rules and control indicators for the whole public debt;
- c) The fiscal management within the program shall ensure robustness with respect to different vulnerabilities as fluctuation of the interest, exchange and growth rates, distortive behavior regarding tax evasion, investment, consummation, savings and other risk phenomena to be detected;

This said, following formalization of these conditions could be proposed for the above mentioned conditions.

- a) Internal solvency and liquidity of the programs

Starting from the initial idea of fiscal self-sustaining programs, the core parameter to be controlled here is the fiscal surplus to be generated by program. The fiscal revenue to be produced along the project should therefore compensate the costs, which on its turn would incorporate different kind of expenditures and interest payments. The formulation put by (5) starts from the general budget restriction equation. Hereby, the needed surplus takes an explicit position.

$$\frac{S_t}{y_t} = \frac{T_t}{y_t} - \frac{g_t}{y_t} = \frac{R_t}{(1+\pi_t)(1+\gamma_t)} \frac{b_{t-1}}{y_{t-1}} - \frac{b_t}{y_t} \quad (5)$$

As the program does not assume any prior public debt ($b_{t-1} = 0$), the solvency formula, put in terms of LPV for the life time of the program (LT) will be expressed by (6),

$$\sum_{j=0}^{LT} R(t, t+j)^{-1} \left[\frac{T_t}{y_t} - \frac{g_t}{y_t} - \frac{R_t}{(1+\pi_t)(1+\gamma_t)} \frac{b_t}{y_t} \right] = 0$$

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(6)

where again $R(t, t + j) = \prod_{k=0}^j R_{t+k}$, the discount factor applying between periods t and t+j.

With respect to the liquidity condition, it could be derived from the expression that characterizes the dynamic control of solvency as suggested by Burnside (2005). If seigniorage gains are again disregarded, the debt evolution in each period t should attend the following restriction (7):

$$\bar{b}_t - \bar{b}_{t-1} = \bar{i}_t - \bar{x}_t - \frac{\pi_t}{1 + \pi_t} \bar{b}_{t-1} - \frac{g_t}{1 + z_t} \bar{b}_{t-1} \quad (7)$$

Where \bar{b}_t is the real end-of-period t debt of the program measured as a ratio to the GDP, \bar{i}_t is the real interest paid as a ratio to GDP, \bar{x}_t is the real primary surplus as a ratio to GDP, π_t is the inflation rate during period t, g_t is the growth rate of the GDP, and $z_t = (1 + \pi_t)(1 + g_t)$ ⁴.

As said before, the territorial program does not begin at t0 with previous debt ($b_{t-1} = 0$); but for the first years one could suppose that the investment needs will imply a high debt accumulation and low payment ability. The liquidity analysis of the program should consider that fact, and therefore the management of the cash flow and of the debt dynamics foreseen by the equation (7) will be critical for the financial survival of the program.

For this aim, the financial manager could apply a liquidity index (IL_t), whose value should be higher than 1 for the whole program period. That is:

$$(IL_t) \geq 1 \quad \forall t \quad (8)$$

This index could be calculated accordingly to (9):

$$IL_t = \frac{D_t}{P_t} \geq 1 \quad (9)$$

Whereby:

D_t = cash resources at t;

P_t = payments foreseen to the period t.

b) Consistency with the overall fiscal policy

As put before, even if the internal solvency and liquidity of each approved territorial program is preliminarily assured by a respective baseline calculation, a too large lot of such "self-sustainable" programs may still threaten the overall fiscal balance. Thus a further condition is needed to ensure that the additional public debt caused by each program shall comply with the set overall limits for public debt. Of course, since there will be years where a program shall be at a stage of heavy investments, it seems not to be sensible that the debt target of the overall fiscal policy is to be attained every year and by all means: a adaption period of J years may be established for complying with the debt limit rules.

Following again the suggestions of Burnside (2005), the equation (10) establishes a primary balance target in order to assure that a debt target \bar{b}^* indicated by the fiscal authorities is achieved by the period (t+J). For this aim, it could be established that for every year the fiscal surplus

⁴ Some sophistication of this expression in order to distinguish between indexed and non-indexed debt, fixed and flexible interest rates, as well foreign and domestic currency denominated debt is put forward by Burnside (2005).

(deficit) of the program should be compatible with the respective target for the overall fiscal policy (\bar{b}^*), so that:

$$(10) \quad \bar{x} = \bar{r} \frac{(1 + \bar{r})^J \bar{b}_t - \bar{b}^*}{(1 + \bar{r})^J - 1}$$

where $\bar{r} = (r - g) / (1 + g)$.

Other control indicators could be:

- the ratio between the public debt and the fiscal receipts within the territorial program, which should maintain the proportion established for the whole economy;
- the ratio between debt level and the gross product within the program, which should maintain the proportion established for the whole economy;
- the ratio between foreign debt and export revenues within the program, which should maintain the proportion established for the whole economy;
- the ratio between debt service and export revenues within the program, which should maintain the proportion established for the whole economy;
- the ratio between foreign and total debt within the program, which should maintain the proportion established for the whole economy.;

c) Robustness with respect to different vulnerabilities

As put before, the main vulnerability factors to be considered refer to the fluctuation of the interest, of the exchange and growth rates, to the distortive behavior regarding tax evasion, investment, consumption, savings and to other risk phenomena still to be detected. The understanding of these phenomena and its modeling will still require further research efforts and cannot be delivered here. As long this research aim is not accomplished, some ad-hoc rules may be proposed here:

1. With respect to interest fluctuation, it seems to be prudent to follow the targets put by the fiscal authorities with respect to the relation between the amounts of debt subject to fixed and variable interests. Another control parameter would be the composition of the debt maturity periods.
2. With regard to exchange rate vulnerability, following the suggestion put by Burnside (2005) the mix between foreign and domestic debt should envisage to maintain the proportion indicated by (11), where \bar{b}_t^D and \bar{b}_t^F are, respectively, the domestic and foreign debt in real terms and expressed as a ratio to GDP; R_{t-1}^D and R_{t-1}^F are, respectively, the interest rates applicable to domestic and foreign debt; \bar{x}_t is the primary balance expressed in real terms and as a ratio to GDP, S_t is the exchange rate for the year t, and again $z_t = (1 + \pi_t)(1 + g_t)$. Complementarily, the relation of foreign debt to exportation within the territorial program could follow the respective proportion established for the whole economy.

$$\bar{b}_t^D + \bar{b}_t^F = \left(\frac{1 + R_{t-1}^D}{1 + z_t} \right) \bar{b}_{t-1}^D + \frac{S_t}{S_{t-1}} \frac{1 + R_{t-1}^F}{1 + z_t} \bar{b}_{t-1}^F - \bar{x}_t \quad (11)$$

6. CONCLUDING REMARKS

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The present paper continues the research efforts for the setup of the Territorial Engineering concept and for the design and test of corresponding territorial programs, as exposed in our previous work. The particular aim of the paper was to sketch a model for the evaluation of fiscal sustainability of territorial programs. After a short explanation of the territorial program concept and of the general evaluation procedure of the fiscal sustainability of such kind of program, a gross structure of the corresponding model has been presented, which should combine together input-output analysis with land-use and transport model. The final part of the paper has dealt with the concept and measure of fiscal sustainability, and how they should be adapted for territorial programs.

The innovative approach discussed here emerged from the issue of funding infrastructure and from the search for new funding strategies, since the current approaches of fiscal funding and private investment have reached their limits. It was argued that because infrastructure investment is expected to contribute to economic growth, its viability should be analyzed by demonstrating the resulting profit and tax gains. However, the direct link between such an investment and economic growth is not straightforward, since this growth is produced by a complex set of factors, whereby only in rare cases the specific contribution of a given infrastructure project may be filtered. In some cases, it may even produce a negative result (e.g., when a new link between a dynamic area and a rather peripheral one destroys the industry of the latter). Therefore, infrastructure investment should not be analyzed per se but it should be contextualized in a broader investment package for a given area. Such investment should comprise industrial and infrastructure investment projects and of a set of integrative policies. That package was termed territorial program and it should produce synergetic growth results for the area (i.e., the program territory). This economic growth is expected to ensure the bankability of the project investments and the fiscal sustainability of the governmental expenditures in supporting private investment, in direct public investments and in supplying public services in general.

With respect to the modeling tool, their role is not only to test, but also to appoint design rules for, the territorial programs in order that these may prove themselves to be fiscally sustainable and to comply with other policy directives with respect to environmental and social sustainability as well to political and technical (managerial) feasibility. For the first moment, however, the priority of the model development has been set on the evaluation of the financial results, both for the private and the government sectors, and this first priority is exclusively concerned in the present document. The set of modeling problems to be mastered has been exposed and a general procedure for the calculation of the fiscal and financial results of territorial programs has been explained. The described procedure follows the general procedure of the evaluation of economic and fiscal impacts of projects already available in the literature, which use the current input-output analysis tools. Hereby, direct, indirect and induced impacts of single component projects are estimated as well their fiscal results (costs and revenues) and summed together in order to obtain the yearly and final fiscal balance of the program. As the projects are tied together, it is recommended that the projects that have a rather "end-demand" function with regard to other "supplying" projects should be evaluated first and have then their impact on other component projects estimated.

Of course, the explained procedure may cause some criticism and doubts because of the imprecise and biased results that they will produce. On the other hand, it is expected that the data available for the modeling of complex territorial programs will never be so precise and detailed that more elaborate calculation procedures with e.g. revealed preferences could justify. Above all, it is not the aim of the evaluation model to obtain precise final fiscal results, but to assure that the

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revenues will be enough to cover the fiscal expenses of the programs. Hereby, an attitude of prudent conservatism will lead up to a deliberate underestimation of the revenues and overestimation of the costs. So it will be sufficient for the purposes of the model to assure that the revenues will be enough to cover the costs, and if this condition is not met, the program should be supplemented with additional growth driving projects in order to assure the fiscal sustainability condition.

Proceeding to the issue of the fiscal sustainability concept and to its measure, it has been argued that this concept is rather tied to the analysis of the whole fiscal policy and not of isolated, timely limited albeit comprehensive territorial programs, and it admits undefined or even infinite assessment periods. As argued introductorily, the insistence on the fiscal sustainability terminology is nevertheless justified as the large introduction of territorial programs shall not be considered as a mere funding tool for infrastructure investment (which was the original stumbling block for the development of Territorial Engineering), but as a strategic tool for fiscal policy. Thus, the numerous set of territorial programs shall contribute to the achievement of the set targets for the fiscal balance and its intertemporal sustainability.

For this point, the results of the present paper, which has a rather exploratory character, may be resumed to following main points:

- On the basis of an analysis of the literature on fiscal sustainability, which goes beyond the current comparison between governmental revenues and expenditures at development projects by the already practiced fiscal impact analysis, a set of specific parameters have been suggested for the application of this notion in territorial programs,. The programs have subsequently to present internal solvency and liquidity profiles, but they have also to be consistent with the general fiscal control parameters, by not raising the debt position of the government caused by the program beyond a target value established for the overall debt position. Other control targets are related to foreign exchange exposition and the mix of fixed and variable interests that are to be attained in the debt funding operations of the government. For some of these parameters, a set of indicators have been proposed. Other parameters will require further research.
- The analysis of the vulnerability of the sustainability position as foreseen by the baseline simulations to different risk factors have also been considered, although the explorative character of the paper merely indicates the type of tests that have still to be developed. Although the establishment of the set of vulnerability events to be considered will require further research, for a first moment obtained for the baseline scenario have to be submitted to fluctuation of the growth rate of the economy, as well of the interest and exchange rates.

Some final remarks shall complement the basic content of this paper. Firstly, the fiscal sustainability concept proposed here differs substantially from the fiscal impact analysis that is already practiced, mostly in the United States. This sort of analysis confronts basically fiscal revenues with governmental costs of local development programs. In the rule, the fiscal balance calculation considers only one or two administrative levels (local and regional governments), does not deliver a comprehensive analysis of the fiscal position (e.g., does not include the impacts on debt position and other aspects of the fiscal balance). Moreover, the development programs are more concerned with real estate and infrastructure investments, and the consideration of the links

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of these investments to local economic growth strategies is very poor. Actually, the fiscal impact analysis approach aims to test the liquid fiscal results of local development projects.

In contrast, the approach proposed here starts from a quite different policy aim that is to finance in a fiscally sustainable manner major infrastructure projects, especially those devoted to transport infrastructure, by linking the respective investment to a broader local economic growth strategy. Hereby, growth effects, and not only immediate fiscal costs and revenues, are a central concern of the approach. For this aim, the projects for transport and other infrastructure are to be tied to a set of industrial projects and policy actions within a program territory, whereby the responsible bodies for these projects are not only governmental agencies of the different levels, but also different kind of institutions of the private sector. The application of the Territorial Engineering concept is not a passive test of program propositions but rather an active design process of sustainable programs that includes their political construction. Thus, the fiscal sustainability analysis is not aimed to assess if a program is already sustainable or not, but rather to point out the program features and the ways to achieve this sustainability.

In second place, by setting up fiscally sustainable programs, the included governmental expenditures should be allowed for being excluded from the current fiscal deficit or surplus accounting established for the general fiscal policy; therefore, the stringent link of Territorial Engineering to the fiscal balance considerations implies a deeper analysis of the effects for the different parameters of the fiscal policy, and not only of the mere balance between fiscal costs and revenues of the projects, as practiced by the current fiscal impact analysis.

All this differences turn the Territorial Engineering approach more comprehensive than the fiscal impact analysis and more scientifically challenging, too. The definition of sustainability parameters and the procedure of their measures are a first hurdle to overcome. The difficulties go along with the construction of complex data warehouse and modeling packages that would be able to simulate economic and financial flows within the territorial programs and the component projects and actions. The lessons for fiscal policies and the design of territorial programs should also be part of the research agenda to be developed. Altogether, this immense R&D challenge will be time and resource consuming, but may be worth of being accepted as the gridlock of public investment constrains progressively economic development.

Thirdly, the execution of such a research program will require a considerable amount of resources, especially highly skilled human resources. Such an R&D investment will require a commitment and political decision of the authorities, which must be preliminarily persuaded of the vantages of such a comprehensive and complex approach. This investment perspective may provoke some resistance for the introduction of the proposed Territorial Engineering approach by politicians and official seeking after actions and projects with more immediate effects, without losing times with complex and expensive analyses. Moreover, as shown by Raidenbach et al. (2007), the fiscal impact analysis practice shows that fiscal transparency may be antagonized by officials and investors which will not accept arguments on some governmental support to development projects.

Notwithstanding, the conflict between the investment needs in infrastructure and the duty to assure fiscal balance may open windows of opportunities for new approaches like the one proposed here. Especially in periods of fiscal consolidation, where expenditures are submitted to painful cuts, the political conflicts may aggravate and reproduce attitudes where investments are the first victims, since the continuity of the administrative costs has their strong constituencies. To scrutinize the net

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fiscal results of investment programs and other governmental expenditures could contribute considerably to raise fiscal efficiency, to prevent projects and actions that actually promote or are necessary for fostering growth and therefore for regaining fiscal balance to be unduly sacrificed. But since economic growth effects cannot be attributed to single infrastructure projects, the comprehensive territorial programs may have a new chance, albeit the complexity of their design, implementation and evaluation.

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