Finance and growth: a Micro-founded approach

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Abstract

The aim of this research is to understand how computable general equilibrium model has been applied in the literature and compare it with alternative approaches for the study of finance and growth issues. Through a preliminary analysis of the aspects of portfolio choice and financial resources management at a micro-level, it is possible to classify individual choice. Re-aggregating behavioral patterns in order to sum up the overall choices at a macro-level, we can evaluate the macroeconomic effects.
The study is an attempt to interface general equilibrium and econometric techniques for a deeper understanding of the finance and growth nexus.

J.E.L. Classifications: D1,D2,D3,D5,H3,O,(D9)

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1 Introduction

This study focuses on the empirical and policy-oriented analysis of the interrelationship between finance and the world economy. The structure of the paper is organized in four main sections. The first part reviews the main issues in this field of analysis. Further, the paper introduces some of the most significative studies which analyze the impact of financial policies through CGE(Computable General Equilibrium). The following section gives a brief reference for alternative methodologies (as SFC, Stock-Flow Consistent model). Consecutively, the article reports some examples in the literature using econometric methodologies to test the linkages between financial structure development and economic growth. We conclude pointing at the complementarities that can be reached joining different approaches and address possible future analysis.
Our contribution wants to provide a procedure to account for a country finance and growth analysis that conciliates more techniques to consider the full range of factors that are worthy to be included.

1.1 Main issues

The instability of the world economy and financial markets requires a deep understanding of the mechanisms characterizing the behavior of the variables involved. Hence, there is an urgent need for a supervisory authority responsible for assessing the financial policies adopted by governments. Generally, public policy is not supported by academic research, and there is no awareness of the global effects on the world economy. Moreover the study of the dynamics of economic and financial variables has grown in recent literature, and the approach is becoming more micro-founded. For this reason this study starts analyzing the implications of the Financial Applied General Equilibrium (FAGE) methodology understanding how it can be manipulated to best fit with this context of analysis.
Through a preliminary analysis of the aspects of portfolio choice that can arise at a micro-level, it is possible to classify individual choice, and thus re-aggregate be-

havioral patterns in order to sum overall choices at a macro-level. Consequently, the role of international financial institutions and central banks in defining their financial policies need also be observed.

The questions to be addressed in this context are:
- which financial variables need to be modified in order to ensure a sustainable financial-economic equilibrium?
- does an optimum and correct balance between freedom and control in financial flows movements exist and, if so, is it really best suited to provide economic growth?
- how can an international financial authority gain control in order to avoid the danger of shocks and lead the world economy out of serious crises?

2 Financial development and structure

A developed financial system allows better reallocation of resources, transferring savings to new investments, monitoring risk for investors and creditors, widening the possibility of choice in portfolio investment, and encouraging a higher level of liquidity and negotiations (see [15]).

However, financial structure development is a complex concept, in which many aggregated aspects are joined together, such as:

- financial openness
- financial efficiency
- suitability of the legal system
- strength of the institutional environment
- financial support to technological innovation.

To complete the study, macro areas should be classified according to the level of the following properties: market openness, market risk premium, market efficiency, financial integration with other countries, capital speed within that market, asset prices' volatility, power of influence on other markets, tendency to be influenced by other markets, financial resources mobilized for technological investment.

A further purpose could be the comparison between countries at an international level, considering both micro data and macro ratios in relation to financial structure and national balance sheets [1]. A description of the financial development per macro area is needed in addition to a description of the general equilibrium or other estimation. The FIR (financial interrelations ratio = domestic credit/GNP)) is a possible index (e.g. on this see Goldsmith(1975)[18]). Other significant indicators are introduced in Levine and Zervos(1998)[13], where we have:

stock market development indicators: size-capitalization, liquidity indicators, international integration measures,

volatility growth indicators: output growth, capital stock growth, productivity growth, savings growth.[2][4]

The overall analysis inevitably implies investigating the possible linkages between economic and financial cycles in each area. The attempt is to draw a methodology that can be applied to systematically study the financial development both at a local and at a macro level.

An interesting interpretation of the financial structure issues comes from Goldsmith(1975) where the author asserts that "*Financial structure may be defined broadly as the relationships existing, at a given date or during a given period, among the components of a country's financial superstructure. In its strictest meaning it is a holistic concept similar to the matrix of coefficients in an input-output table, the cells here measuring the relationship of a given financial item (for example, a claim or debt of a certain type) to the total of all*

[2]See F.Eschenbach(2004) for a complete survey on the finance and growth literature

financial instruments outstanding in a country at a given date, or to the total transactions in financial instruments during a given period". To verify the relationship between financial development and economic growth and make cross-country analysis he indicates some important clues: national balance sheets, the size and structure of assets and liabilities, the distribution of the assets and liabilities of financial institutions, the penetration of the financial system, the degree of concentration, the different type of security issuance, the sources and uses of funds by the main non-financial groups, the role of households, the country's international financial relations, legislation, the effective yield rates and the financial technology.

Many authors followed the "matrix concept" developing their own approach as it will be illustrated in the following paragraph. It is still a hard task to model a general equilibrium approach in the analysis of financial sector.
Some stylization have been introduced for different kind of applications such as analysis of stabilization programs[6], analysis of policy for structural adjustment[2], crowding out effect, impact of liberalization in a financially repressed economy, income distribution policy.
Generally, the main issue is how to conjugate the financial and macro aspects (dynamic) with the real component (static). As a possible way to overcome this problem Lewis(1994)[6], for example, introduces in his model two financial markets (currency and deposits) and credit market segmentation (the cost of borrowing is different for the various sectors).
However, even if we can find some significative applications, some potential area of analysis are still uncontaminated. Since the financial structure can be considered as an instrument to be implemented by government in order to boost growth in real variables, we believe that FAGE could be adapted to measure the development-path sustainability in terms of:

- innovation and technology
- education of human capital.

3 Methodologies

This section estimates the value added that a joined application of different methodos can give to the above mentioned issues. The techniques considered are FAGE, SFC and econometric models.

3.1 Financial computable general equilibrium

In the application of CGE to developing countries we can find two main streams of empirical literature.

The first[7] follows the Walrasian(or *neoclassical*) paradigm basing its analysis on neoclassical real trade theory. This implies that the main focus is on the impacts in the real side of the economy, while macro variables are not considered.

The second one[8], known as *structuralist* macro approach, is based on Keynesian theory and thus incorporates macro variables.

In some sense the FAGE shares some of the characteristics of both the models[3].

In the empirical literature there are many examples of applications that extend the CGE to financial applications. Here, for the purpose of this study, we report two of the most significative examples:

Fargeix and Sadoulet(1994)[2]

They investigate on the correct mix of policies to induce an effective structural adjustment. The model, based on a IS-LM framework, deals with dynamic and multisectoriality aspects. The policy instruments, on which they investigate, are: exchange rate devaluation, fiscal restrictions, monetary restrictions.

Lewis(1994) [6]

The author simulates a series of shocks in the Turkish economy due to stabilization program: remittances gradual increase, nominal interest rate on foreign loans rise, increase of world price of heavy industry imports(such as oil and capital).

[3]See Robinson(1991)[20] for a complete comparison between the two approaches.

He further implements the model adding changes in policy with different level of intervention: moderate policy adjustment(i.e.: real rate devaluation by 10%) and extensive policy adjustment(i.e. switching to flexible exchange regime, government expenditure reduction, financial sector liberalization, financial crises etc).

In order to provide a complete picture of world finance, it is necessary to adopt a micro-based methodology as it is the case of general equilibrium approach. The main reason for the use of a FAGE model is that we need to consider the whole cause-effect chain that originates from shocks in financial variables, and to quantify the effect of different financial policies. Usually authors have focused on the presence of agents such as households and firms. Focusing our attention on these two agents, we can observe that, within the economy, the flow of savings from households meet the requirements of the firms for their needing of working capital. Thus, the change in working capital requirement by firms, net of internal financing constitute the demand for investments. This demand for investment can be fulfilled only if there is a corresponding availability of loans from the households, through the intermediation of commercial banks[4]

Moreover, this model allows us to verify how cross-country flows reverberate through the financial and economic system of each country, influencing the level of investment, government financing mix, portfolio adjustment and the distribution of wealth. In particular, micro-level topics of finance to be developed includes issues as:

- households and firms saving functions and portfolio choices
- incentives and constraints on saving of families
- how households allocate their financial wealth across different financial instruments.
- constraints on business and financial investments faced by firms

[4]Eduardo Lora gives emphasizes these points in his review to the Lewis' article[6].

- the role of banks, stock market, or other financial intermediaries

Therefore the application requires to calculation the economic and financial variables directly affected by changes in financial policy. Within a Walrasian framework these variables are determined when all the markets involved clear out: the outcome values(such as prices of goods and assets or dividend payment) guarantee the convergence to an equilibrium. The supply and the demand side in each markets is given by the aggregation of individual choices undertaken by the agents to solve their optimization problem. The peculiarity of FAGE is to model behavioral equations that best fit both economic and financial effects of the action played by each agent. The idea is to identify the complete set of factors that have to be taken into account in order to represent the consequences released by agents'decisions.
In order to focus on the specific agents' decision rule, we decide to classify the categories of agents separating between economic agents that play also a role in the financial market and those who do not.

This classification allows us to observe different composition in agents' balance sheet and portfolio, as well as differences in their behavior accounting for the presence of financial assets. Families are divided into investors class and non-investors class. A further classification is the distinction between households which run their own business and households which do not own any firm. The author alerts that this however is only a primarily type of classification that could further be integrated with other criteria.
The functional form adopted for families, firms and government are assumed to be CES functions. Depending on the relative prices, the elasticity of substitution between factors, products of public expenditure types changes.
The only exception is the aggregate production function which is a CD function of the value added and of the total intermediate inputs. Conversely, the value added is a CES function of labor and capital, while the total intermediate input is a CES function of the intermediate composite inputs (given by the input-output tables).

Table 1: Households classes

CLASSES	
Investors	With household enterprise
	Without household enterprise
Non Investors	With household enterprise
	Without household enterprise

The use of the CES function is justified by the fact that it provides a constant "relative price" between the elements of the function. Therefore if we calculate the derivative of the function with respect to the elasticity coefficient we obtain always the same value, whatever point we consider.

On the basis of recent literature on financial development [5] the following equations can be displayed:

HOUSEHOLDS

Assumption1 : no pensions
Assumption2 : no government transfers
Assumption3 : CES utility functions

Aggregated utility function

$$U = \left\{ \sum_{h=1}^{H} a_h (X_{h,i}^d)^{-\rho_U} \right\}^{-\frac{1}{\rho_U}} \tag{1}$$

[5]Most of the model is drawn on the basis of Barzi,Magnani and Perali (forthcoming)[3] See also Thissen (1999) [10]for a detailed literature on FCGE.

Income and Portfolio function for each classes

CASE A: Non Investor Class with no enterprise

Household income

$$Y_h = \{(1-\tau)(w_L L_h + r_D D)\} \tag{2}$$

Household Portfolio

$$\wp_h = \{\gamma_{3_h} D^{\rho_\wp}\}^{-\frac{1}{\rho_\wp}} \tag{3}$$

CASE B: Investor Class with no enterprise

Household Income

$$Y_h = \left\{(1-\tau)[w_L L_h + \sum_i (r_{A_i} A_i + r_{B_i} B_i) + r_D D + r_T T]\right\} \tag{4}$$

Household Portfolio

$$\wp_h = \left\{\sum_i (\gamma_{1_h} A_i^{\rho_\wp} + \gamma_{2_h} B_i^{\rho_\wp}) + \gamma_{3_h} D^{\rho_\wp} + \gamma_{4_h} T^{\rho_\wp}\right\}^{-\frac{1}{\rho_\wp}} \tag{5}$$

CASE C: Non Investor Class with enterprise

Household income

$$Y_h = \left\{(1-\tau)[w_L L_h + \sum_i (a_h d_i \Pi_i) + r_D D]\right\} \tag{6}$$

Household Portfolio

$$\wp_h = \left\{\sum_i \gamma_{3_h} D^{\rho_\wp}\right\}^{-\frac{1}{\rho_\wp}} \tag{7}$$

CASE D:Investor Class with enterprise

Household Income

$$Y_h = \left\{ (1-\tau)[w_L L_h + \sum_i (a_h d_i \Pi_i + r_{A_i} A_i + r_{B_i}) B_i + r_D D + r_T T] \right\} \quad (8)$$

Household Portfolio

$$\wp_h = \left\{ \sum_i (\gamma_{1_h} A_i^{\rho_\wp} + \gamma_{2_h} B_i^{\rho_\wp}) + \gamma_{3_h} D^{\rho_\wp} + \gamma_{4_h} T^{\rho_\wp} \right\}^{-\frac{1}{\rho_\wp}} \quad (9)$$

FIRMS

Aggregated Production Function

$$X_i^s = CD(VA_i, TINT_i)$$

$$VA_i = CES(F_{i,k}) \quad (10)$$

$$TINT_i = CES(INT_{j,i}) \quad (11)$$

Firm's Profit

$$\Pi_i = \left\{ P_{X_i^s}(1-\tau_\Pi) - P_{VA_i} VA_i - P_{TINT_i} \quad TINT_i \right\} \quad (12)$$

The firm need financial resources to fulfill the internal working cycle requirements. Therefore we need to incorporate the cost of working capital finance into the model. In the above mentioned examples there we can find two kind of approach:

Fargeix and Sadoulet(1994): they calculate the working capital of the firm as a proportion of the nominal value of the firm's production.

$$WC_i = \gamma_i P_{X_i^s} X_i^s \quad (13)$$

Lewis(1994): He considers the working capital as a proportion of the total sum of the cost of production.

$$WC_i = \gamma_i(\Sigma_k w_k F^d_{i,k} + P_{TINT_i} TINT_i) \tag{14}$$

In any case the total need of resources is given by the sum of resources needed to finance the change in net working capital and the funds needed to fulfill the requirement of fixed investment(that is given in turn by the investment demand net of retained profits).

$$FINV^d_i = INV^d_i - RET\Pi_i \tag{15}$$

$$CR_i = FINV^d_i + \Delta WC_i \tag{16}$$

where CR is the total demand for financial resources for sector i. Possible sources of credit for firms are the banking system, the government (with institutional projects, or subsidized loans), the stock market, other financial intermediaries, the stock market or unofficial curb markets. As suggested in Lewis(1994), there could be a distinction between classes of firms that have access to advantageous loans (with subsidized conditions, or with a high power of negotiation in credit contracts) and firms with less favorable conditions that can obtain their credit only from banks and through a rationed range of credit tools.

GOVERNMENT

$$TG = \left\{ \sum_{i=1}^{I} a_G G_i^{-\rho_G} \right\}^{-\frac{1}{\rho_G}} \tag{17}$$

$$Y_G = \tau \sum_{i=1}^{I} P^d_i X^s_i + \tau \sum_{h=1}^{H} w_L L_h + \tau \sum_{i=1}^{I} \sum_{h=1}^{H} (\gamma_{1_h} A_i^{\rho_\wp} + \gamma_{2_h} B_i^{\rho_\wp} + \gamma_{3_h} D + \gamma_{4_h} T) - P_i G - r_T T \tag{18}$$

DYNAMICS

The dynamic aspect can be overcame by introducing agents with adaptive dynamic behavior and intertemporal objective function. The main variables that

involved dynamics are investments, capital accumulation, productivity growth and all the financial variables embedded in the model. The calibration procedure is also different then static models, since time series econometric estimation should be applied for the parameter calibration.

3.1.1 Financial dataset

The application of this model to reality require the organization of a complex dataset. Since the recent direction in the literature is to use more microeconomic-based methodologies, it is necessary to have a complete information about agents' balance sheets.

The most straight forward way to map data is to display a matrix which account for all the agents in the economy and in the financial market. In this way, data are organized in a logical and consistent order registering all the transactions that occur among the institutions (families, firms, government, central banks, private banks, stock market etc).
The most crucial issue, in a perspective of aggregation, is how to deal with agents' heterogeneity. This problem can be solved through grouping individuals with homogeneous characteristics, as we have previously try to do. In a static framework the classification of these groups can be constant, while in a dynamic context there could some agents switching to another group. On this aspect, new methodologies could be applied. For instance, it could be interesting to verify how long each individuals persist in the same state and which are the criteria of the characteristics that make them to move to another class(through transition tables). Therefore it might be advisable to consider different layers according to different criteria. However homogeneity within classes of agents concerns a full range of features such as the endowments, skillness and type of preferences which are not always directly observable.

Recently the literature on the CGE has pointed out the pros and cons of the feasibility of this approach. In Devarajan and Robinson (2002)[19] the authors assess the policy appraisal of the model, since its application is mainly

required by institutions. The key issues arise when translating the stylized theoretical models into a real applied model due to the risk of exceeding "domain of application" of the CGE. The introduction of the dynamic is also a relevant point.

4 Alternative approaches

Given these considerations we agree on the fact that the CGE application results must be accomplished with other estimations, both of econometric and alternative simulation models. Alternative approaches of CGE modeling can be distinguished as:
1) entire economic modeling - formal macro-econometric modeling (multi-equation structural model based on economic theory); - time series model of macroeconomic variable (focused on the lag structure of variables); - optimal control models of macroeconomic policy ;
2) fix-price general equilibrium approach - input-output and social accounting matrix models; - linear/non linear comparative static models;
3) micro-economic approaches based on partial equilibrium analysis - formal applied partial equilibrium models - time series models of microeconomic variables - dynamic programming models/dynamic optimization/optimal control models.

In particular, compared to macro-econometrics models the CGE framework lacks of the ability to encompass monetary and financial variables, and the outcomes are not suitable to be tested. Since both the methodologies provide facilities and deficiencies they could be applied for analysis as complements. With reference to the financial analysis framework, a feasible alternative approach that could be used in order to compare the results of the applied CGE is the Stock-Flow Consistent model.

4.1 Stock-Flow consistent model

In order to consolidate a finance and growth analysis it could be interesting to consider the Stock-Flow consistency model where the aim is to measure the financial situation of a country both in terms of flows and of stocks. This approach analyzes the institutional structure of a market considering all the agents involved, analyzing the interflows between their balance sheets.
The methodology of this model implies the setting of a matrix derived from SAM in GE, even though it is significantly different. In particular the FAM (financial accounting matrix) provides "a systematic listing of the financial stocks" (Taylor, 2004)[9] where the assets of the agents are displayed by rows and liabilities by columns. Despite the SAM structure, this matrix does not have to obtain the same total sum for both rows and columns, allowing a higher level of flexibility.
Another valuable aspect of the structuralist approach is that, since it does not require the balance of the totals , there is evidence of the net worth and this give the possibility to analyze where this additional positive or negative result is directed. In this sense the modeler is no longer reasoning following a static perspective but he is drawing the reality thinking of a possible cycle of iterated in-flows and out-flows.
Following the previous introduction about the two different approaches, the SFC can be placed in the structuralist models. Therefore the empirical works reflect the theoretical debate.

4.2 Econometric analysis

This section reviews the main studies of econometrics applied to finance and growth analysis. The methodologies can be grouped into three main techniques: cross-country, time-series, panel data analysis.

The main technical issues in applying econometrics to financial and growth analysis refer to these points:
- how to build up indicators of financial development

- the direction of casuality and the problem of simultaneity between finance and growth
- the effect of financial operations on capital accumulation and productivity growth
- other factors that affect long-run growth
- omitted unobservable variables (latent variables).

The choice of the methodology to apply is due to technical aspects [6]. The cross section analysis avoids the time-dimension ignoring misidentification due to omitted unobservable and reverse causation (in the sense that finance and growth can mutually influence with each other). In particular, cross-country studies defect for correlation between financial, institutional, legal and regional factors, and this makes it impossible to isolate the true impact of financial factors upon growth. Panel data overcome these issues helping to reveal the direction of causation and to verify the presence of time-invariant unobservable variables[7]. Moreover, since the latter technique considers also the time-series dimension, dynamics can also be observed.

4.2.1 Applications

CROSS COUNTRY

The pioneer in the cross-country analysis was Goldsmith(1969)[16]. He tried to measure the financial development of a country through some indicators. Other authors implemented his results introducing further ratios and observations. The stylized models can be reported as it follows:

[6] For a critical survey of the main econometric applications in this context see [11]
[7] [21]

King and Levine(1993a)[17]

$$\mathbf{G}_j = a + b\mathbf{F}_i + c\mathbf{X} + e \tag{19}$$

where

- G is a vector of growth indicators for country j:

1. Average rate of real per capita GDP growth
2. Average rate of growth in the capital stock per individual
3. Total productivity growth(Solow residual)=Real per capita GDP growth-0.3*Real per capita Capital growth

- F is a vector of financial indicators:

1. DEPTH =(Liquid liabilities)/GDP
2. BANK =Deposit bank domestic credit/(Deposit bank domestic credit+Central Bank domestic credit)
3. PRIVY =Credit to private enterprises/GDP

- X is a matrix of other explanatory variables:

initial income, initial secondary school enrollment, ratio of government consumption expenditures to GDP, inflation rate, ratio of exports plus imports to GDP.

Levine and Zervos(1998a)[14]

In their article they demonstrate that it is not sufficient to deal with the resources aspect, in order to ensure the strengthening of growth but it is important to consider also the technological issue. The system must provide itself

the capability of firms to grow stimulating positive technological shock. Analyzing the impact of stock market size on economic growth, capital accumulation, productivity growth they introduce the turnover ratio as a possible financial indicator: Turnover ratio=Total value of shares traded on a country's stock exchange/ Stock market capitalization.

PANEL DATA

As above mentioned, panel data technique allows for considering both cross-country and time-series variation, for extracting the unobserved country specific variables and for including lagged variables(dynamic panel data).

Jayaratne and Strahan (1996)[5]

The authors analyze the impact of a reform relaxing restrictions in intrastate bank branching[8] on economic growth. They demonstrate that the positive impact following the application of this reform is linked to the quality improvement of bank lending. This change implies an higher capability of the financial system to invest in higher quality project, stimulating increases in growth rate. The model through which they lead their counterfactual analysis is:

$$\frac{Y_{t,i}}{Y_{t-1,i}} = \alpha_{t,j} + \beta_i + \gamma D_{t,i} + \epsilon_{t,i} \tag{20}$$

where i=1,...,I and t=t,...,T

Y(t,i)/Y(t-1,i)=ratio of growth in real per capita income during t in state i

D(t,i)=dummny variable for branching, equal to one for the states without restrictions on bank branching

beta(i)=state-specific component of long-run economic growth

alpha(t,j)=economywide shock to growth at time t, which controls for business cycle effects in region j, at time t

[8]In particular they refer to the reform held in United States in 1994 with the Riegle-Neal Interstate Banking and the Branching Efficiency Act. The new legislation eliminated many restrictions on bank acquisitions allowing for interstate bank branching

gamma=growth effect on per-capita income stemming from branch deregulation.

The state-specific component stands for other unexplained variables that influence differences across states. Examples of unobservables are given by income and tax rates, environmental regulations, public rates of investments.

Levine, Loyaza, Beck (2000)[12]
This study demonstrates that differences in legal and accountancy system can influence the economic growth. This support the logic concept that a higher defense of investors rights and a better regulation of negotiation rules stimulate financial development and therefore boost economic growth. The instrumental variables included in the estimation are given by the legal origin of the country.

$$y_{i,t} = ay_{i,t-1} + bX_{i,t} + u_i + e_{i,t} \tag{21}$$

where
y(i,t) = logarithm of the real per capita GDP
X(i,t) = explanatory variables with lagged GDP
u(i) = unobserved country specific effect
e(i,t) = error term.

5 Conclusion

The primary aim of this study is methodological: to interface a Financial Applied General Equilibrium model with econometrics estimations in order to understand the impact of financial structure level on the economic growth. The underlying reason for this research follows the logic that econometric analysis can be supported by general equilibrium and viceversa. The two types of analysis seem to be complementary. Considering the case of a counterfactual analysis on the impact of a reform, the econometric estimation inform us only on the negative or negative consequences on the dependent variable observed. Simulating a FAGE beyond the econometric estimation, we gain information about the overall mechanism underpinning the changes occurred after the reform. In addition, this allows to identify possible lacks of the reforms, pointing at the variables on which the government should address its further interventions. However, the main task of this purpose would be primarily the calibration of FAGE as to make it fit as much as possible with the available datasets before and after the policy change. Secondarily exogenous schocks influencing the economy should be embedded in the model in order to perfectly reproduce the context in which the reform has been applied. Further researches could consider how to deal with these issues in order to enrich this micro-econometric approach.

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