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The Link between Access to Bank Loans and Income Distribution in Agent Based Modeling: Empirical Validation

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Preface

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The Link between Access to Bank Loans and Income Distribution in Agent Based Modeling: Empirical Validation *

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Abstract

This paper empirically validates the results obtained in the first paper which theoretically linked firms' access to bank loans and income distribution. Descriptive output and econometric (external) validations techniques were used as an indirect identification strategy to examine the link between access to bank loans and income distribution. We used Ethiopian firm level data from the medium and large manufacturing industries in the country and the national personal income distribution data from the Ethiopian Ministry of Finance and Economic Development. The major conclusions are: (i) firms' access to bank loans is one mechanism through which distributional issues can be explained,(ii) firms' financial structures matter, that is, whatsoever the source of funds, if they are used for investments in fixed capital there is improvement in functional income distribution, and (iii) functional income distribution is strongly associated with personal income distribution. This paper will contribute in terms of policy and enriching the limited literature base on finance-inequality relations.

Keywords: Income distribution, bank loan, ACE, empirical validation, indirect validation.

JEL Classification Codes: C60; C600; C63.

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1. Introduction

The main goal of any empirical validation is to evaluate the capabilities possessed by theoretical models to examine if they reflect some real world stylized facts. Thus, taking our ACE model to investigate the compatibilities between the results obtained from theoretical simulations and what the data speaks comprises this validation study.

This paper examines whether the agent-based computational economics (ACE) model of the first paper is able to generate statistical properties which reflect the properties of the real data. Operationally, the whole process of validation is to investigate how good a model is. Noting that models are generally considered satisfactory if and only if they are able to reproduce empirical evidence and statistical regularities to some extent, the right question to be posed is in fact empirical in nature: are the micro-rules driving the evolution of income distribution supported by empirical evidence from the actual data? The answer we give for this question is essential to decide whether our model is valid or not.

Given the simulated results in the first paper, the validity of our claims remains to be dealt with. Achieving good emerging phenomenon from theoretical simulation is a necessary condition while empirically validating these emergent phenomena with real data using different validation techniques is a sufficient condition for accepting a model as a valid one for further analysis. The main objective here is to empirically investigate if those regularities obtained in the first paper can be justified by real data. Therefore, this paper answers the following questions:

- Is there any association between access to bank loans and income distribution?
- Is there any association between functional income distribution and personal income distribution?
- Is the model plausible given our understanding of the processes?
- Does our ACE model inform us about the evolution of inequality?

The rest of the paper is organized as follows. Section 2 presents the theories of income distribution. Section 3 discusses the methodology and identification strategy for validating our ACE model, the data and main results. Section 4 summarizes the main features of the paper.

2. Theory of income distribution: Literature review

In the 2000 edition of the *Handbook of Income Distribution*, Atkinson and Bourguignon say that one of the fundamental questions that motivated the systematic study of economics was: Why are some countries rich and some poor? He further points out that this may well be correct according to the motivations of some of the leading economists who are interested in economic growth starting with this puzzle.

However, for a large majority of mankind who, at least until fairly recent times, had little opportunity to obtain firsthand knowledge of the economic conditions in foreign countries, one would have thought that a more obvious question would have been: Why are some people rich and some poor? This question might naturally have come to mind as individuals went about their everyday business in a world of large inequalities of income and standard of living (Atkinson and Bourguignon, 2000).

The theory of income distribution deals with the explanation of who earns what, who owns what, and why. In simple terms, it is about how income and wealth have changed over time. The details are documented in the introductory chapters of Reynolds (2006).

Literature on income distribution is as old as economics itself. This is evidenced by the fact that revolutionary literature on income distribution goes back to the 1950s and 1960s. In fact, the whole issue of economic science is concentrated around the how questions, that is, how to generate wealth and how to distribute the generated wealth among the population. It is also one of the most controversial areas in economic theory that has been pushing economists and policymakers to conflicts and bringing greater awareness of the inadequacies of economic analyses. The reasons are provided by Sahota (1978) as:

First, the old and persistent battleground of capital theory is involved. Second, distribution theory lies at the crossroads between the microeconomics of the value theory and the macroeconomics of theory pertaining to national income, the general price level and the general level of employment. The inconsistencies and lack of integration within these two fields are inevitably reflected in a curious composite of the income distribution theory. Third, distribution theory has suffered acutely from a number of conflicts concerning methodology in economic analyses. Fourth, more sharply perhaps than in any other field of theory the study of income distribution meets head on the question of the scope of economic analysis and its tools for it runs immediately into problems of the political, as distinct from the strictly economic, elements which determine income shares.

Friedman (1953), states that the traditional theory of distribution is concerned exclusively with the pricing of factors of production and the distribution of income among cooperating resources classified by their productive functions. It has little to say about the distribution of income among individual members of society and there is no corresponding body of theory that does this.

This absence of a satisfactory theory of the personal distribution of income and of a theoretical bridge connecting the functional distribution of income with personal distribution is a major gap in modern economic theory.

In Friedman's view, the functional distribution of income has been primarily treated as a reflection of choices made by individuals through the market: the value of factors is derived from the value of the final products that they cooperate in producing; and the value of final products in turn is determined by choices of consumers among the alternatives that are technically available.

Theoretical literature on income distribution is very vast. Nevertheless, in the interest of space, this review does not pretend to be exhaustive. Instead, it focuses on the two major concepts of income distribution: personal and functional. Thus, influential literature on the two concepts is presented in sequel.

2.1 Theories of personal income distribution

Under this theory, there are different explanations, a majority of which are based on individual characteristics and behaviors: ability theory, stochastic theory, individual choice theory, human capital theory and inheritance theory of income distribution. Sahota (1978) provides a detailed account on this theory.

The ability theory: In Sahota (1978), we can find an elaboration for this theory as among the oldest of all theories of personal income distribution. He also states that under this theory, it is believed that mental and physical abilities are distributed normally, just as various physical traits such as weight and height of the human body are distributed normally. A natural inference from this is that incomes are also distributed normally.

Statistical evidence does not sustain such an inference, however, and the shattering blow to this belief came from Pareto's (Sahota, 1978) empirical findings, according to which incomes were distributed not normally but lognormally and the skewness to the right had a flat tail, meaning substantial unequal distribution. Since then economists have been engaged in reconciling and explaining the discrepancy between the distribution of abilities and incomes, and their research has been the source of many theories. The development of the modern theory of human capital, however, has all but obscured the ability basis of income inequalities (Sahota, 1978).

The stochastic theory: Is also one of the oldest theories of income distribution which relies for the skewed shape of income distribution mainly on chance, luck and random occurrences. For example, to an econometrician, a theory structured on random errors with no systematic and predictable forces seems ridiculous. Yet the theory is based on the statistical law of probability.

The general idea of this theory is that even if a generation started from a state of strict equality of income and wealth, inequalities of the degree of Pareto distribution could emerge due to stochastic forces. The theory provides a stamp of scientific respectability to age-old myths that the goddess of fortune is blind, poverty hits at random, none is destined to abjection from birth and the sons of poor families have the same chances for success as anyone else.

The individual choice theory: Is an optimizing model of income differences. The theory was developed by Friedman (1953) and may be regarded as the pioneer of the modern human capital theory. According to this theory, the distribution of measured incomes at a point in time is, to an important extent, determined by individual choice among opportunities that yield both different combinations of cash income and non-pecuniary advantages, and different profiles of cash income over time.

The theory applies even when choices are made under certainty. However, Friedman developed this theory in the form of choices under uncertainty of income prospects. The theory is formulated for individuals' choices among different occupations involving different, but insurable risks. These choices are based on the actuarial expectation of utility (not income) from these occupations.

The human capital theory: The modern time of the human capital theory was conceived and developed largely but not exclusively by the Chicago School, starting around the turn of the decade of the 1950s under the intellectual inspiration of Theodore W. Schultz. Since then, it has grown into a colossus, enriching all branches of economic analyses--microeconomics, labor economics, capital theory, growth theory, agricultural economics and, above all, income distribution theories.

From the start, research has been focused on two complementary fronts: on one front, Schultz, Denison, Griliches and following them many others used the human capital framework to analyze the sources of productivity and growth. On the other front, Becker, Mincer and their followers focused on the general theory and the earnings distribution

theory of human capital. The latter authors clarified the relevant costs of the human investment process and analyzed school and post-school investments; spelled out the optimizing decision rules for such investments; and derived implications for earning differences among skill categories across occupations and over age categories.

The human capital theory is developed largely in a competitive setting. Thus, of the two earlier stated classical postulates of labor incomes, human capital theorists accept the principle of equalizing differences and competitive labor markets and pay scant attention to the principle of non-competing groups.

The inheritance theory: The previous theories are addressed primarily to earned incomes. It has been observed that unearned or property incomes are more unequally distributed, even though their shares in overall personal incomes have declined in the past century. It is believed that inheritance is the major source of property class perpetuation. Hence, a theory of distribution that does not include an analysis of property income will present only a partial picture.

For instance, Johnson (1973) notes that estates are built not only from inheritance, but also through current accumulation. Moreover, inheritance need not occur in material form only. Parents can bequeath earning power either by passing on material capital or human capital.

2.2 Theories of functional distribution of income

It is inspiring to read the following sentence by Blaug (1996: 467): 'the great mystery of the modern theory of distribution is why anyone regards the share of wages and profits as an interesting problem'. This suggests that we study issues related to functional income distribution.

Interest in the distribution of income is central in economics. Classical economists were concerned with the issue of how an economy's output is divided among the various classes in society, which, for David Ricardo (1817), was the principal problem of the Political Economy. While classical economists were primarily interested in the functional distribution of income among factors of production (wages, profits and land rents), in modern societies distributional concerns focus at least as much on the personal (or size) distribution of income. In contrast to its paramount importance in 19th-century classical economics, however, income distribution became a topic of minor interest in recent decades. Atkinson and Bourguignon (2001: 7265) note that in the second half of the century, there were times when interest in the distribution of income was at low ebb and economists appeared to believe that differences in distributive outcomes were of second order importance compared to changes in overall economic performance.

However, it remained silent for decades because it was assumed away in standard macroeconomic treatments as constant and straightforwardly derived from and easily explained by a Cobb-Douglas production function (Mankiw, 2007; Hogrefe and Kappler, 2013).

The constancy of the labor share is stated in Kaldor (1955) as in the long-term properties of economic growth; the shares of national income received by labor and capital were roughly constant over long periods. The stability of time-series data on factor shares has long encouraged economists to look favorably on models that attribute the same

aggregate technology to all countries. In particular, these data have frequently been invoked to justify the use of Cobb-Douglas functional forms. The historical basis of this assumption is that the United States (US) data revealed constant factor shares over a long time. Now, it has become theoretical and a policy concern. The wisdom that factors' shares remain constant over a period is challenged.

The assumption of the existence of the aggregate production function of the Cobb-Douglas type has a far-reaching implication for the evolution of economic theory of income distribution. Constant factor share has been accepted comfortably in empirical researches. However, the existence of such an aggregate production function has been persistently challenged (McCombie, 1987; Felipe, 1998, Felipe and Holz, 2001; and Temple, 2006).

Particularly, in Temple (2006), it is documented that because aggregate production functions do not exist except in unlikely special cases, any economic theory that makes use of them is of no scientific value. Any researcher willing to place a false premise at the heart of his analysis can draw no useful conclusions (Temple 2006: 303).

In fact data shows a declining share of factors. For example, Jacobson and Occhino (2012) observe that labor income has been declining as a share of total income earned in the United States for the past three decades while Francese and Granados (2015) observe that the labor's share of income in a group of seven countries has been declining since the 1970s while inequality has been on the rise. On average, the wage share declined by 12 percent whereas income inequality increased by 25 percent in some advanced economies in barely three decades.

The analysis of factor income shares was the subject of 90 percent of the papers presented at a conference of the International Economic Association in 1965 (Marchal and Ducros 1968; Glyn 2009). The dominant theme was that factor shares were important for the macroeconomic performance of economies because they are linked to the potential profit squeeze problem, that is, real wages growing faster than productivity (Glyn and Sutcliffe 1972; Eichengreen, 2007).

Therefore, now it is apparent that the issue of functional income distribution has come on to the policy arena. For example, in 2006 Ben Bernanke, the Chairman of the Federal Reserve, expressed the hope that corporations would use some of the profit margins to meet demands from workers for higher wages, and in 2007 Germany's finance minister asked European companies to give a fairer share of their soaring profits. Interest in these contrasting trends has deepened since the onset of the financial crisis, driven in part by the rescue of financial institutions by many governments together with rising unemployment and inequalities (Francese and Granados, 2015).

A good number of the theories of personal income distribution emphasize human characteristics. However, Walker (2007) points out that economic theory recognizes that income distribution is affected by more than just human characteristics. He further points out that the size distribution of income and hence the degree of inequality of incomes arises out of a functional distribution of income paid to different types of factors of production in the form of wages and salaries, rents and royalties and interest and profits.

Interest in an analysis of factor shares returned in the early 2000s. Atkinson (2009) cites three reasons for this growing attention: first, the analysis of factor shares is useful for

understanding the link between incomes at the macroeconomic level (national accounts) and incomes at the individual or household levels; second, factor shares can potentially help explain inequalities in personal incomes (at least partly, if certain types of income are mainly received by some type of economic agents); and last, they address the concern of social justice with the fairness of different sources of income.

The root of the theory of functional income distribution is the classical economics one which focused on the distribution of income between the main factors of production. What Ricardo had in mind when he made his remark about the principal problem being how these main factors were to be defined was of course a matter of judgment, but classical economists saw them as being labor, capital and land, whose incomes were wages, profits and rent respectively.

The fact that this definition of the three main categories of income should have met with such general acceptance among economists must be seen as a reflection of the fact that this particular functional distribution represented the main class division of society in the late 18thand early 19thcenturies into workers, capitalists and landowners.

In contrast to the neo-classical theory that was developed a century later, the theory of functional distribution did not build on a unified theoretical structure. It is therefore natural to present the theory in three parts, corresponding to the three main categories of income.

Wages: In the great work of Adam Smith, the division of labor is the driving force for increasing productivity (this is well known by the pin factory model, Book one of the Wealth of Nations: 18). Economists predict this increase in productivity to a corresponding increase in labor incomes. However, Smith was aware of the shortcoming of his conclusion as he pointed out that the division of labor was limited by the extent of the market (p. 35). Therefore, even if specialization may by itself be expected to lead to higher productivity and wages, the demand side of the market limits the extent of specialization.

In classical economic theory, wage is determined by the market clearing equilibrium condition. Under this framework, if there is an increase in the supply of capital or land, the labor demand curve shifts to the right. In the short-run, labor supply is approximately inelastic, so that wages rise. But the rise in wages calls forth increased supply through an expanding population. The labor force accordingly increases until a new long-run equilibrium is reached where wages have come back to the level of subsistence, sometimes referred to as the natural price of labor.

According to Ricardo (1817), it is when the market price of labor exceeds its natural price, that the condition of a laborer is flourishing and happy, that he has it in his power to command a greater proportion of the necessaries and enjoyments of life, and therefore to rear a healthy and numerous family. When, however, by the encouragement which high wages give to an increase in population, the number of laborers is increased, wages again fall to their natural price, and from a reaction sometimes fall below it.

Profits: In the classical school, profits are regarded as the rate of return on capital, defined as the rate of interest plus a risk premium that varies with the nature of the capital. Actually, Ricardo gave a more general version of this definition when he stated that a capitalist would take into consideration all the advantages that one type of investment possessed over another.

He may therefore be willing to forego a part of his money profit in consideration of the security, cleanliness, ease or any other real or fancied advantage which one employment may possess over another.

This is very similar to Adam Smith's theory of compensating wage differentials implying a symmetric treatment of equilibrium in the market for labor and capital. But this broad concept of the rate of return does not in fact play much role in the work of Ricardo or of any other classical economist.

According to classical theory, therefore, profit must be seen as the reward per unit of capital that accrues to an individual capitalist. But for a complete theory of the distribution of income from capital, one would also need a theory of the individual distribution of the ownership of capital because the income from capital accruing to an individual capitalist will be equal to the rate of return times the amount of capital owned. The determination of the ownership structure was an issue that did not receive much attention from classical economists, and therefore their theory of the distribution of income within the capitalist class must be considered to be incomplete. This was an issue that did not seem to be of much concern to them. The question that formed part of Ricardo's principal problem was the determination of capital's share of national income, not the sub-division of this share among individual capitalists.

Rent: In the classical school, rent was the income of landowners, defined as the rental rate per unit of land times the number of units in the possession of an individual landowner. The most influential statement of the theory of rent was contained in Ricardo's Principles (1817). Land varies in terms of its quality or productivity. The price of corn (Ricardo's term for agricultural produce more generally) is determined by the cost of the labor and capital required to produce a unit of corn on the land with the lowest quality, that is, the land on the margin of cultivation. On this land rent is zero.

What is likely to happen to the functional distribution of income in a growing economy? Ricardo's view is best explained by starting from his theory of rent. Beginning with a time when wages are above the level of subsistence, the population will expand, the demand for corn will increase and the margin of cultivation will be extended. The share of rent in national income will accordingly go up, and so will the share of labor, even after the wage rate has returned to its level of subsistence. The implication of this is that profits will fall and eventually, because of a weakening of the incentive to invest, bring the process of expansion to a halt.

In summary, it is evident that tremendous strides have been made in income distribution theory over the last two decades. These advances have opened up entire new areas for further research, inductive and deductive alike. While they have increased awareness among many economists of the inadequacy of economics as it stands today, we are far better off than we were before. We have more tools with which to work, more accurate knowledge of economic processes and adjustments in distribution as in other fields and new pointers that may help us in the tremendous tasks that lie ahead.

3. Methodology and identification strategy

Fagiolo, Moneta, and Windrum (2007) noted that models in economics as in any other scientific discipline isolate some features of an actual phenomenon in order to understand it and to predict its future status under novel conditions. These features are usually

described in terms of causal relations and it is usually assumed that some causal mechanism (deterministic or stochastic) has generated the data. They called this causal mechanism the 'real-world data generating process' (rwDGP). A model approximates portions of the rwDGPby means of a 'model data generating process' (mDGP). The extent to which mDGPis a good representation of rwDGP is evaluated by comparing the simulated outputs of mDGP with real-world observations of rwDGP. This procedure is called empirical validation (Fagiolo, Moneta, and Windrum, 2007; Delli Gatti**,** Desiderio**,** Gaffeo**,** Cirillo, and Gallegati, 2011).

As Leigh Tesfatsion points out in her important website on agent-based computational economics[1], the validation of ACE models is becoming one of the major points in the agenda of those researchers who work according to the agent-based approach. In literature, looking at the main methodological aspects, there are three different ways of validating computational models.

Tesfatsion (2006), Fagioloet al. (2007), Bianchi,Cirillo, Gallegati, and Vagliasindi (2007) and Delli Gatti et al. (2011)have provided insightful discussions on the validation of agent-based models. Particularly, Bianchi et al. (2008) note that validation as an intermediate step is necessary for improving the model in order to make predictions and they outline three different ways of validating computational models:

1. Descriptive output validation: Matching computationally generated output against already available actual data. This kind of validation procedure is probably the most intuitive one, and it represents a fundamental step towards a good model's calibration;
2. Predictive output validation: Matching computationally generated data against yet-to-be-acquired system data. Obviously, the main problem concerning this procedure is essentially due to the delay between the simulation results and the final comparison with actual data. This may cause some difficulties when trying to study long time phenomena. In any case, since prediction should be the real aim of every model, predictive output validation must be considered an essential tool for an exhaustive analysis of a model meant to reproduce reality (Bianchi et al., 2008); and
3. Input validation: Ensuring that the fundamental structural, behavioral and institutional conditions incorporated in the model reproduce the main aspects of the actual system. Bianchi et al., (2008) label such validation as *ex-ante* validation; the essence of input validation is that the researcher, in fact, tries to introduce the correct parameters in the model before running it. The information about parameters can be obtained by analyzing actual data. Input validation is obviously a necessary step that one has to take before calibrating the model (Bianchi et al., 2008).

Following the formalization proposed by Mark (2007), we let R to be the observed real world data and M is the model output, five general cases of goodness of fit are possible:

1. No intersection between R and M,$R \cap M = \emptyset$:the model is useless;

[1]http://www.econ.iastate.edu/tesfatsi/empvalid.htm.

2. The intersection $R \cap M$ is not null: the model can display some real world phenomenon but not others, and can exhibit behaviors that do not historically occur: the model is said to be useful;
3. M is a sub-set of R, $M \subset R$: the model is accurate, but incomplete;
4. R is a sub-set of M, $R \subset M$: the model is complete, but inaccurate (or redundant, since the model might tell something about what could yet happen in the world);
5. M is equivalent R, $M \Leftrightarrow R$: the model is complete and accurate.

All in all, the model is said to be useful if it can exhibit at least some of the observed historical behaviors; to be accurate if it exhibits only behaviors that are compatible with those observed historically; and to be complete if it exhibits all the historically observed behaviors (a good explanation is available in Fagiolo et al., 2007).

Another approach in the validation of artificial simulation results is provided by Schram (2005) where he points out that the artificiality of a laboratory simulation is placed in the context of the tension between external and internal validity. Schram notes that most economists consider internal validity to be most important. A proper evaluation of the 'artificiality criticism' (a lack of external validity) requires distinguishing the various goals that experimentalists pursue. External validity is relatively more important for experiments searching for empirical regularities than for theory-testing experiments. As experimental results are being used more often in the development of new theories, a methodological discussion of their external validity is becoming more important (Schram, 2005).External validation is similar to the descriptive output validation technique.

The internal validity of an experiment refers to the ability to draw confident causal conclusions from the research. An internally valid design will yield results that are robust and replicable. External validity refers to the possibility of generalizing the conclusions to situations that prompted the research. There is an obvious tension between the two. Where internal validity often requires abstraction and simplification to make the research more tractable, these concessions are made at the cost of decreasing external validity (Loewenstein, 1999).

Having defined the relationship between the model and the real world system being modeled, what remains to be explained is the way in which a validation procedure can be operationally conducted. Looking at the main methodological aspects developed in this still young but rapidly increasing literature, one can stumble at different taxonomies that classify alternative empirical validation procedures according to different paradigms (Fagiolo et al., 2007).The most common approach in such an exercise is to first validate and calibrate a model.

The relationship between validation and calibration is that validation represents a set of techniques meant to verify if the model is able to reproduce the actual phenomena for which it has been designed within a satisfactory range of accuracy. Calibration represents the ensemble of statistical techniques aimed at improving the precision of the parameters' values used in simulations, according to a backward process that flows from the model's predictions and actual data towards the model's parameters (Fox, 1989). From this point of view, calibration should be seen as an ameliorative development that logically follows validation: first one tests the goodness of fit of the simulation model with respect to actual

data by means of a broad constellation of parameters. Then, if the model is deemed satisfactory, one tries to improve its fitting by intervening on the precision of parameters (Delli Gatti et al., 2011: 43).

As mentioned earlier, the objective of this paper is to validate the model described in the first paper whose results indicated that there is an association between access to bank loans and functional income distribution; more specifically we found that any factor that hinders access to bank loans has a potential negative effect on income distribution. This paper seeks the counterpart for this claim from firm level data. This paper aims to examine if the firm level data shows any relation between firm's access to bank loans and functional income distribution and more specifically if a firm's access to bank loans affects the share of the total value of output going to labor and capital.

A descriptive output validation method is similar to the external validation method. On this ground and owing to its clarity and ease of interpretation, this paper analyzes descriptive output validation and econometric validation techniques.

In recent years, we have witnessed increased interaction between agent-based computational economics (ACE) and econometrics. This paper exploits this new trend of interaction between agent-based models and econometrics. While the link can be bi-directional, most of the work developed so far follows the direction from econometrics to ACE and has gradually consolidated ACE by shaping its econometric foundation (Chen, Chang, and Du, 2012). However, what is perhaps equally important and interesting is the reverse direction, that is, the potential influence of ACE on econometrics. One issue that has long concerned econometricians is the problem of aggregation over individuals, in particular when these individuals are heterogeneous and their composition is dynamically changing (Stoker, 1993; Gallegati et al., 2007). ACE, as a micro-macro model, serves as an ideal approach for studying this problem.

Intuitively, ACE can help econometrics in a micro-macro approach. This micro-macro approach has been reviewed by Stoker (1993) as an approach to address the aggregation problem. The ACE model, as a computational model, provides us with a greater flexibility to deal with various levels of aggregation over individuals. Unlike many other micro-macro models, it does not have to make very stringent assumptions regarding individual behavior in order to have a tractable aggregation. This advantage enables us to include more realistic behavioral aspects of individuals into the aggregation, such as learning and interactions. By using an agent-based consumption asset-pricing model (Chen, Huang and Wang, 2008), demonstrate how the ACE model can help solve the aggregation problem. As far as predictive validation is concerned, we hope to develop it or leave it as a potential area of research for the future.

3.1 Description of the data

This paper uses firm-level data from the CSA database for 1996–2009. CSA collects data of Ethiopian medium and large scale manufacturing firms. There are several different sections out of which we obtained firms satisfying the data needed for this paper. CSA conducts annual surveys. However, the electronically organized data is available up the 2009.

As of 2009, there were 39 industrial groups with a total of 1,943 firms. An electronic dataset is available from 1996 to 2009on a yearly basis. Each survey has different

important sections from which a researcher can extract information relevant to her/him. There are cases where we find that a firm with a unique identification number has two or more establishments under it. Since most of the decisions are made at the firm level, we took the data aggregated at the firm level.

Following the 1992 economic reform program, the financial sector started expanding gradually both in the number of newly entering banks and the quantity of loans advanced to different sectors. As a result the manufacturing sector started receiving bank loans which have been increasing over the period. The number of large and medium scale manufacturing firms varied from 447 in 1996 to 1,947 in 2009 and 2,170 in 2011. While only 67 out of 611 firms had access to bank loans in 1996, only 257out of 1,947 firms had access to bank loans in 2009.

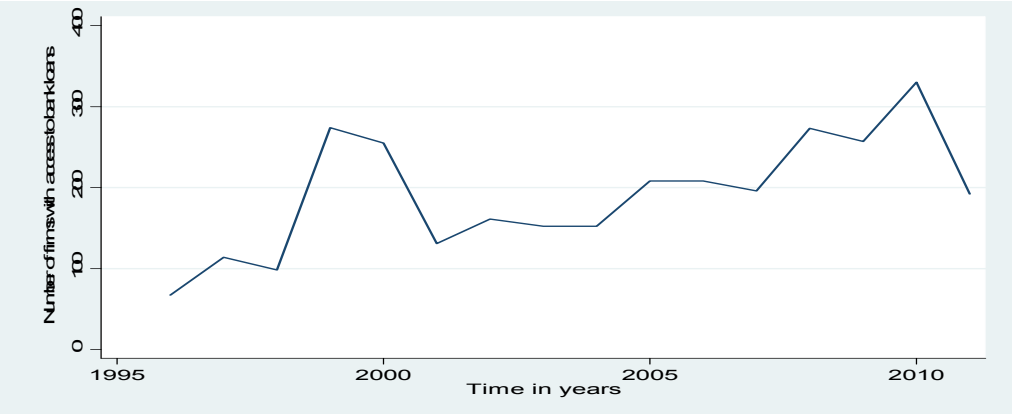

Figure 1.Number of firms with access to bank loans

From Figure 1there is a clear indication that the number of firms with access to bank loans increased during the period for which firm level data is available. However, looking at the trend alone may not enable us to arrive at any conclusion. What is more relevant for us is the portion of the bank loans that is directly related to investments in capital goods which affect productivity, employment creation and profitability of firms which in turn has a direct impact on functional income distribution.

To identify the channel through which bank loans affect functional and hence personal income distribution we observe the data on the number firms, number of firms with access to bank loans (FWBL), investments in fixed capital from bank loans (INOFCFBL), investments in working capital from bank loans (INOWCFBL), investments in fixed capital from own funds (INFCFOF) and investments in working capital from own funds (INOWCFOF) and the data on national income distribution.

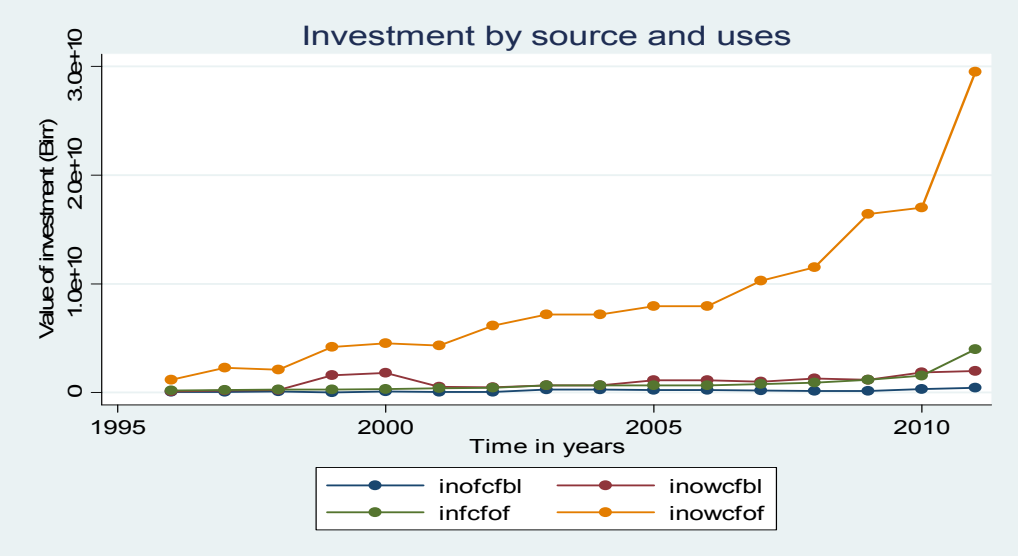

Figure 2.Investment by source and type

Figure 2tells us the sources and uses of funds by those firms which have access to bank loans. It is an increasing trend with INOWCFOF being the largest (140), INOWCFBL (15.8), INFCFOF (13) followed by NOFCFBL (2.57),[2] as the smallest.

There is also a geographical dimension of firms' access to bank loans. For example, firms with access to bank loans are concentrated in Addis Ababa. In 1996 and 2004 respectively 65 and 54 per cent of the firms which had access to banks were located in Addis Ababa. An analysis of the extent to which this information helps us in identifying the mechanisms that link bank loans to functional income distribution is discussed in the following section.

3.2 Descriptive output validation

The descriptive output validation technique compares the conclusions drawn from the simulated data with the one that is extracted from real data. This step is important in that it helps a researcher understand if the information extracted from the real data generating process is consistent with the one obtained from the model data generating process. This technique relies on graphical and statistical explorations, including whether the conclusions drawn from the simulated output can be interpreted in terms of real data.

[2]The figures in brackets are in billion Birr invested during 1996-2009 by all firms with access to bank loans.

Figure 3. Market value of production and total wages measured in Birr

Figure 3 characterizes the extent to which the market value of the manufacturing output and total wage payments grew over time. While there is no distinct economic reason to argue that both values should be closer to each other with a smaller distance, it is possible to question the extent to which they are apart.

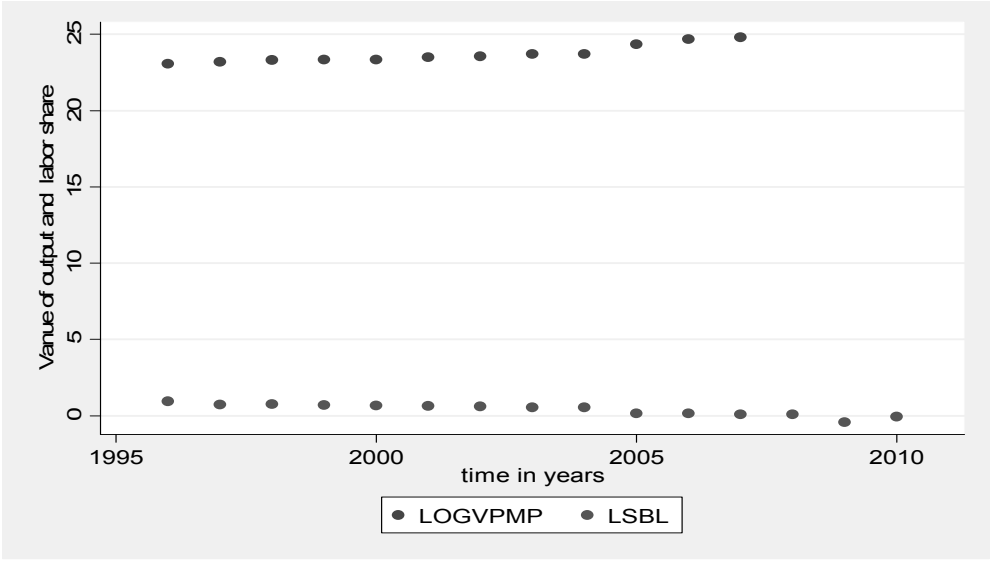

Figure 4.Log of value of production and labor share

In Figure 4the logarithmic transformed value of production and the fraction of it received by labor in the form of wage payments (labor share) tend to move in opposite directions. Even after taking the log of the total output, we observe non-linearity in the relationship

between log of total output and labor's share. This suggests that there should be a clear non-linear relationship between the level value of the total output and labor share. The gap between the total value of the output and the fraction of it going to labor is widening in an exponential manner. Such a large difference between the value of production and the fraction of it received by labor should be reflected in personal income distribution at the national level.

2005 left traces of significant socioeconomic events in Ethiopian history. Following the 2005 national elections, the government started aggressive reforms for economic expansion without noticing their implications on distributional issues. The government started realizing the distributional issues in recent years where it clearly articulated this in the second Growth and Transformation Plan (GTP II).

Next, labor share is computed and averaged across firms for each year for firms with access to bank loans. The national income distribution data is obtained from the Ministry of Finance and Economic Development. We superimposed the labor share of firms without access to bank loans, the labor share of firms with access to bank loans and the national Gini coefficient data on the same plot (Figure5).

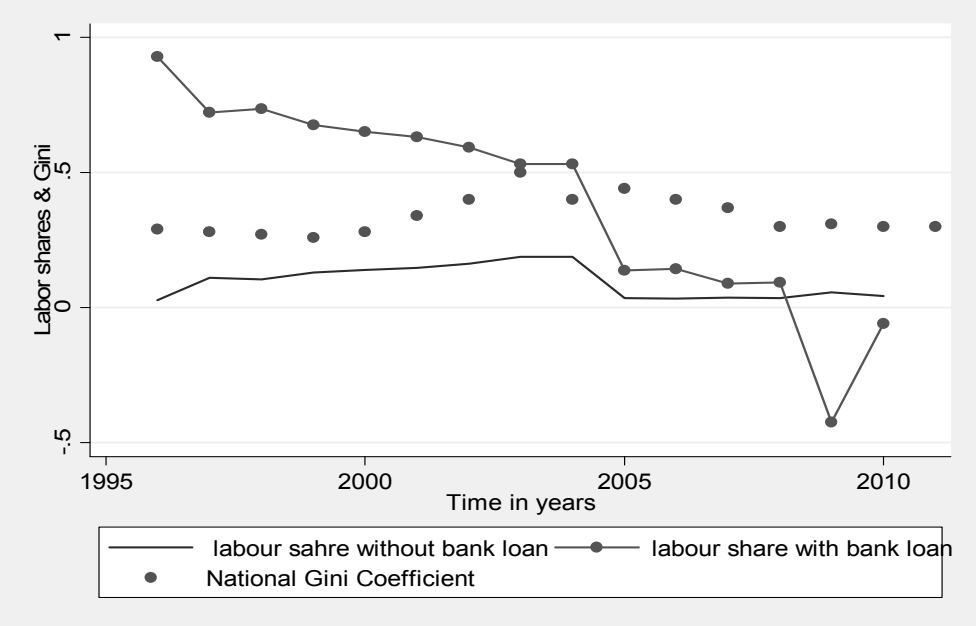

Figure 5. Functional income distribution and personal income distribution

It is informative from the superimposed plots in Figure 5 that in the early years, the labor's share was higher which started declining later. This can be explained on the ground that the early years were a transition period from state planning to free market where the publically owned manufacturing firms were under the process of privatization. Under public ownership, the focus was not profits; rather it was on supplying goods to society. So during those years while labor enjoyed a relatively higher share, the enterprises were relatively at a disadvantaged economic position, even to the extent of

facing bankruptcy. More interesting is that under all conditions, labor's share when firms had access to bank loans was greater than without access to bank loans.

However, the decline in labor's share during the latter periods could be attributed to private ownership of firms and the motive to receive a lion's share of the output which is the nature of modern capitalist production systems; this is also the basis of contemporary debates on conflicts arising from income inequalities.

We can also observe an association between functional and personal income distributions in Figure 5. Initially, when labor's share was relatively higher, personal income distribution (the Gini measure) was low. However, gradually as labor's share deteriorated, personal income distribution also deteriorated (the Gini coefficient rises). This is in line with the theoretical argument that functional income distribution drives personal income distribution. There could be many economic and institutional factors responsible for the evolution of this phenomenon. Our next task is to investigate if firms' access to bank loans is one such factor.

Table 1.Correlation matrix: Labor share and sources and uses of finance

	LSHBL	LGINOWCFOF	LGINFCFOF	LGINOWCFBL	LGINOFCFBL
LSHBL	1				
LGINOWCFOF	-0.8885*	1			
LGINFCFOF	0.9008*	0.9566*	1		
LGINOWCFBL	-0.6366*	0.8137*	0.6790*	1	
LGINOFCFBL	0.5363*	0.5776*	0.6859*	0.2133	1

Source: Own computation,* indicates significance at 5 per cent.

The size and sign of the correlation coefficients between functional income distribution (REALSH), sources and uses of funds by firms provide us important information on the association between bank loans and functional income distribution (seeTable1).Functional income distribution is positively correlated to investment in fixed capital from own funds (LGINFCFOF*)* and investment in fixed capital from bank loans (LGINOFCFBL). But the functional income distribution is negatively correlated to investments in working capital from own funds (LGINOWCFOF*)* and investment in working capital from bank loans *(*LGINOWCFB*).* The correlation coefficients are significant at the 5 per cent level. Using Figure 5 and Table 1 enables us to draw the following findings:

First, access to bank loans affects firms' performance in general and functional income distribution in particular. When firms have access to bank loans, there is improvement in the share of output received by the labor.

Second, not only access to bank loans but also firms' performances are affected by their financial structures. More specifically when both bank loans and/or internal funds are used for investments in fixed capital, we observe improvements in functional income distribution whereas when bank loans and/or internal funds are used for working capital, we observe deterioration in functional income distribution. We may explain this phenomenon from the point of view of the firms' capacities for expansion and /or operations at full capacity. When firms invest in fixed assets, they expand their operations

which enable them to employ more labor which increases labor's share. However, when firms invest in working capital, it is an indication of operations below full capacity. Operations below full capacity may be due to constraints such as shortage of raw materials, problems related to demand for their produce and poor market infrastructure. Under such circumstances firms are forced to reduce expenditures say by laying-off temporary workers (in Ethiopia firms cannot lay-off permanent workers by law) and prohibiting overtime work. Such decisions by firms must reduce the labor's share.

Third, since there is a very close association between functional and personal income distribution, we conclude that both access to bank loans and firms' financial structures affect personal income distribution (using Figure 2 and Table 1).More importantly, under the condition where firms have access to bank loans and when bank loans and internal funds are employed for financing investment projects, by first improving functional income distribution this also improves personal income distribution.

The conclusion that if firms' access to bank loans and firms' financial structures are correlated to functional income distribution and functional income distribution is correlated to personal income distribution, then firms' access to bank loans and firms' financial structures are correlated to personal income distribution may seem at first a conclusion drawn by transitivity property. However, we know that this correlation is not transitive. To investigate if our conclusion can be supported by more convincing evidence, we resort to first, theoretical intuition and second, from real data.

The assertion that firms' access to bank loans improves functional income distribution in favor of labor requires meaningful interpretation and explanation. One intuitive explanation is that if firms' access to bank loans enables them to operate at full capacity, the probability that they will be profitable is high so that they have financial capacity to increase the wages and salaries of their employees. The relatively increased incomes enable workers to have relatively better access to public and private services like education for their children, access to improved healthcare, access to modern communication networks and facilities whose cumulative effect is to foster the income of the working population which in turn creates better opportunities for them. This will further improve personal income distribution at the national level.

In sequel, we explore information from the CSA dataset to see if access to bank loans is a binding constraint or at least one of the binding constraints. CSA data tells us that about 61.3 per cent of the firms reported that they had attempted to get bank loans and had not been successful. Where evidence exists, their direct association or their link to the mechanisms deriving functional income distribution is examined. This is achieved by investigating the yearly CSA survey containing questions and their respective responses relevant for our purpose. It is interesting to learn that the nature and type of questions and responses to them show a clear pattern in problems changing over the period and this by itself may indicate some evidence. In each survey, firms are asked to respond on the major problems which they see hindering their operations. We realize that the questionnaire is changed from time to time hinting at changes in the business environment under which the firms operate because had there not been changes in the business environment, including changes in the nature of the constraints and obstacles, there would not have been changes in the nature of the survey.

From the list of responses, the ones related to bank loans are of interest to us. The general outline of the questions is: the major problems, the three major problems, the first major

problem, the second major problem and the third major problem to which the firms respond according to the order of importance.

- 1996-2000: Three major problems that prevented operating at full capacity, first major problem faced by the establishment at present, second major problem faced by the establishment at present, third major problem faced by the establishment at present.
- 2001-2002: First major problem which prevented the establishment from operating for a full year. Second major problem which prevented the establishment from operating for a full year, third major problem which prevented the establishment from operating for a full year.
- 2003-2005: Reason for not solving the loan problem, first major problem faced by the establishment at present, second major problem faced by the establishment at present, third major problem faced by the establishment at present, problems faced during exports, reasons for using imported raw materials.
- 2006-2010: Three major problems that prevented operating at full capacity, reason for lack of market, factory made attempts to take loans, reason for not solving the loan problem, reason for using imported raw materials.

According to this identification strategy, lack of a market, lack of working capital, problems of bank loans and shortages of electricity were among the top barriers for firms. The remaining barriers related to shortage of raw materials and problems related to workers. Regarding barriers related to loans, firms reported insufficient loan amounts, stringent loan requirements and long loan procedures. Thus, we confirm that firm information is in line without previous arguments.

Table 2. Firms' responses to loan related constraints

Reasons for not solving the loan problem	Percent
Permitted loan was not sufficient	36.2
Unable to provide loan requirements	14.8
High interest rate	4.3
Loan duration is short	3.0
Loan procedure takes a long time	19.7
Others	22.0

Source: Own compilation from CSA data.

The information extracted from the dataset indicates that an inadequate loan size ranked as a major reason (about 36.2 per cent of the responses) (see Table 2 and Figure 6).

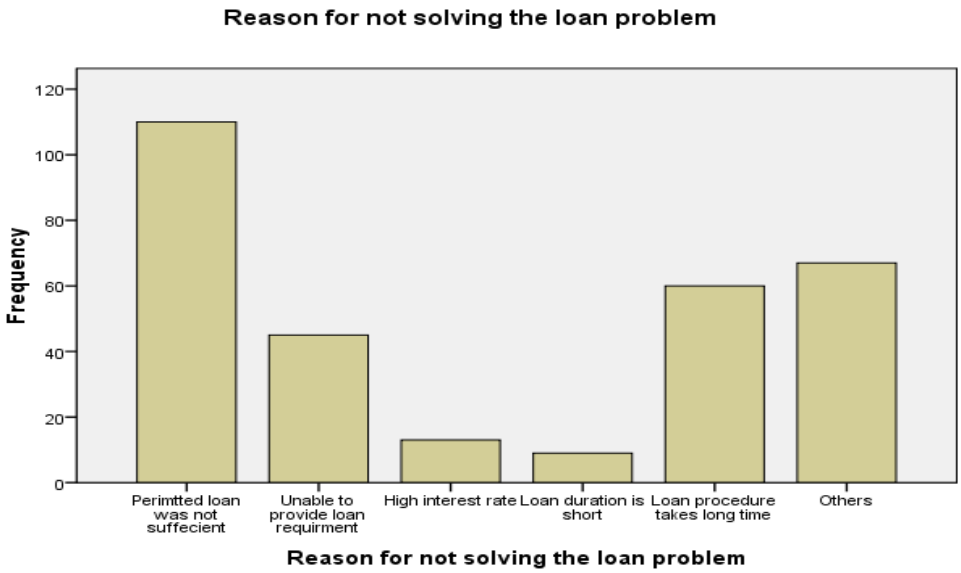

Figure 6. Firms' responses on reasons for not solving the loan problem

3.3 Econometric validation

As explained in Section 3, the ACE and econometric approaches can learn from one another. Thus, in this section we examine if our findings from descriptive and graphical validation techniques are supported by the econometric method. In sequel, the key variables involved in our econometric validation technique are explained (see Table 3).

Wages (WAGES, dependent variable): Is the annual wage payment to workers at the firm level. It entered the regression with log transmutation. The purpose is to examine if the evolution of wages is linked to sources and uses of bank loans and the rest of the variables. The explanatory variables are now discussed.

Labor productivity, lagged (TFPQ): Is computed at the firm level in physical terms. The rationale is to see how labor incomes are linked to productivity. In Ethiopia, there is no wage indexation and in the simulated economy wages are negotiated between the owners of capital and the trade union. Again it entered the model with its log transformation.

Firm market share within industry (MARKSHARE): Firms' market share ACE model was taken as one factor responsible for evolution of prices. It would be interesting to see if market share can enable firms to increase production, employ more labor and subsequently to pay more wages.

Table 3. GMM estimation result: Dependent variable log of wages

Variable	Coefficient	Robust std.err	Z	P >[z]
LWAGES (L1)	0.135	0.040	3.38	0.001
LAGLGTFPQ	0.020	-1.41	0.158	0.158

DELTFP	-0.033	0.010	-3.23	0.001
MARKSHARE	0.212	0.133	1.59	0.111
LGINFCBL	0.424	0.053	7.90	0.000
LGINFCOF	1.073	0.1218	8.81	0.000
LGINVWCBL	0.123	0.013	9.40	0.000
_cons	7.152	0.582	12.28	0.000

Arellano-Bond dynamic panel-data estimation Number of obs = 5,770
Group variable: eid Number of groups = 1,401
Time variable: year
Obs per group: min = 1
Avg = 4.1184
max = 12

Number of instruments = 84 Wald chi2(7) = 275.44
Prob > chi2 = 0.0000

Investments in fixed assets from bank loans (INFCBL): We have argued that if bank loans are used for investments in fixed assets it will encourage more employment and subsequently more labor income. Again, it entered with logarithmic transformation.

Investments in working capital from bank loans (INVWCBL): Investments in working capital are about operations at full capacity. If firms are unable to finance their operations from their own funds, they resort to bank loans. This should have a positive impact on more labor work hours say in terms of prolonged work hours(through over time) or more employment. In all cases, the labor's share should improve.

Examining the econometric results indicated in Table 3, we tried to draw some evidence in support of our statistical and graphical validation. To start with, the evolution of the wages equation was a positive factor of the previous period's wages in an adaptive fashion. The estimated parameter result entered with a positive and significant sign. We may accept this without ambiguity.

Results from Table 1 and Table 3 are consistent with regard to the sign and size of the correlation coefficient (Table 1) and the estimated parameter (Table 3). Thus, the interpretation on the effect of the use of bank loans for investments in fixed assets is direct, that is, the labor's share is affected positively both in an economic and statistical sense. Since investments in fixed assets means expanding existing operations, a firm either creates more employment opportunities or facilitates condition for the existing labor force to earn higher wages thereby improving functional income distribution. Subsequently, this has a positive effect on personal income distribution at the national level.

However, the use of bank loans for working capital did not appear consistently in both validation techniques, that is, where it affected negatively in the simple correlation a positive value was reported in the econometric results. This will remain an issue for further investigation.

Now does our ACE model fit the criteria proposed by Mark (2007)? Using the criteria described in Section 2, we answer this question affirmatively. We investigate each case turn by turn.

We cannot accept the first criterion because the model is not completely useless as it has something to say about the real world phenomenon that existed in real data. The second case cannot hold either because the model displays some real world phenomenon behavior that occurred historically. The fifth case cannot be accepted because the model cannot be claimed complete and accurate. This should be valid because there is no model in economics that matches real world data on a one-to-one basis and there is no data in economics which perfectly matches economic model/models on a one-to-one basis. However, we need to discuss the third and fourth criteria. Consider the third criterion. We noted that the ACE simulation result indicated a positive association between firms' access to bank loans and functional income distribution and this result is supported by real data.

However, we also noted that there are obstacles such as electricity, marketing problems and shortage of materials other than bank loans which hinder firms from operating at full capacity. Looking at the fourth criterion, the model is not complete because it does not tell us every story in the real data. The model also says something which has already happened and hence we cannot accept the fourth criterion. Therefore, we can conclude that the third criterion can best judge our model as accurate but incomplete.

However, how can one draw a robust conclusion about personal income distribution by studying functional income distribution? The full question to be asked is: what is the justification for studying functional income distribution which is concerned with a predominantly industrial population to draw a conclusion about personal income distribution at the national level which also includes the non-industrial population, predominantly the agricultural population? One may provide two explanations for this question: first, from economic theory, and second, from the Kuznets income distribution puzzle which is based on historical evidence.

First, theoretically the drivers for variations in income distribution in the agricultural and industrial sectors are different. More specifically, the factors are more homogenous in the agricultural sector than they are in the industrial sector. Agricultural technologies, once innovated and diffused, take longer to innovate the next generation of technologies and expand the technological frontier further, that is, the technological cycle is long. During the intervening period, variability in productivity remains constant across the agricultural population leaving less variability in income distribution. Secondly, Kuznets (1955) provided two sources of a puzzle in secular income distribution. The first source of the puzzle relates to the concentration of savings in the upper-income brackets. Kuznets argued that other conditions being equal, the cumulative effect of such an inequality in savings would be the concentration of an increasing proportion of income-yielding assets in the hands of the upper groups-- a basis for larger income shares of these groups and their descendants. The second source of the puzzle in a secular income structure which according to Kuznets lies in the industrial structure of income distribution. Kuznets discusses, first, all other conditions being equal, the increasing weight of urban population means an increasing share for the more unequal of the two component distributions. Second, the relative difference in per capita income between rural and urban populations does not necessarily drift downward in the process of economic growth; there is some evidence to suggest that it is stable at best, and tends to widen because per capita productivity in urban pursuits increases more rapidly than in agriculture. If this is so, inequality in the total income distribution should increase (Kuznets, 1955).

3.4 Further evidence on income distribution from firm-level data

Jacobson and Occhino (2012) state that income inequality increases when labor and capital incomes become more dispersed, or when labor's share of the income declines in favor of capital income. To measure the size of these effects, they proposed to decompose the Gini index as the weighted average of the concentration indices of labor and capital income with the weights equal to the two income shares.

The concentration index measures how concentrated labor or capital income is at the top of income distribution. The ratio pertaining to total income is a weighted average of concentration ratios of the components of income (with weight equal to the proportion of a component of income in total income). These two decompositions of concentration ratio are of help in judging the importance of different sub-populations or of different components of income as sources of inequality in the distribution of income in a population (Rao, 1969).

The inequality index may be decomposed into different income components:

(1) $$GINI = \sum_{n=1}^{k} (SHARE_n \; X \; CONCI_n)$$

In Eq 1, $SHARE_n$ and $CONCI_n$ stand for the share of income component n in the total income and concentration indices of income component n respectively. Here, n ranges from k = 1, 2. We expand Eq 1 as:

(2) $$GINI = (SHARE_{LI} \; X \; CONCI_{LI}) + (SHARE_{CAI} \; X \; CONCI_{CAI})$$

The first and the second terms on the right hand side of Eq 2 stand for the components of the Gini coefficient from labor and capital incomes respectively. Finally, the Gini index for the whole industrial population is computed under both scenarios, that is, when firms have access to bank loans and when they do not have access to bank loans. This will enable us to understand how functional income distribution is linked to and can influence personal income distribution and the role of bank loans in this process.

Table 4 indicates the shares of incomes from labor and capital and their respective concentration indices. It is constructed by computing yearly shares of labor and capital incomes and concentration indices of each income complement from 1996 to 2008.

In Table 4, SHAREL and SHARECA are shares of labor and that of capital incomes in total incomes respectively. CONIL and CONCI are concentration indices of labor and capital incomes respectively. WBL and WOBL stand for firms with and without access to bank loans respectively. The following paragraphs summarize some important results on how income inequality evolved over the study period.

Table 4. Decomposition of Gini coefficient by income source and factors shares using the Rao (1969) approach

Year	SHAREL		SHARECA		GINI	
	WBL	WOBL	WBL	WOBL	WBL	WOBL
1996	0.929	0.0281	0.070	0.971	0.539	0.771
1997	0.723	0.110	0.276	0.889	0.544	0.798
1998	0.736	0.105	0.263	0.894	0.528	0.795

1999	0.675	0.129	0.324	0.870	0.554	0.747
2000	0.650	0.139	0.349	0.860	0.549	0.767
2001	0.632	0.147	0.367	0.852	0.537	0.811
2002	0.592	0.163	0.407	0.836	0.591	0.738
2003	0.531	0.187	0.468	0.812	0.636	0.745
2004	0.531	0.187	0.468	0.812	0.636	0.745
2005	0.137	0.034	0.862	0.965	0.600	0.808
2006	0.144	0.034	0.855	0.965	0.633	0.793
2007	0.088	0.036	0.911	0.963	0.740	0.895
2008	0.093	0.036	0.906	0.963	0.691	0.774

First, as indicated in column 2 of Table 4, the share of labor was higher in the earlier years. However, it started declining with time. This may be owing to the fact that Ethiopia was a centrally planned economy before 1991, the year when the incumbent military government was replaced by the current government. Even if society was poorer than it is now, income disparities were also less. Further, the previous economic environment was characterized by the existence of trade unions which were relatively stronger than the firms' managements. This was due to the fact that there was a very strong connection between the leaders of the trade unions and the government's ideology, which enabled trade unions to be very influential when it came to negotiating for salary increments. However, as the new government started gradual liberalization which included privatizing publically owned enterprises, the trade unions under the new economic policy become weaker relative to firms' managements as compared to the previous regime. The new economic policy gave priority to expansion than to distributional concerns and this speeded up the evolution of income inequality.

Second, additional information that can be tracked from the dataset is that the labor's share is greater than the capital share when firms have access to bank loans than when they do not. This is reflected in columns 2-3 in Table 4 respectively. However, capital share tends to decline with access to bank loans and tends to increase without it. In all cases the concentration indices of labor are less than those of capital (see Figure 7).

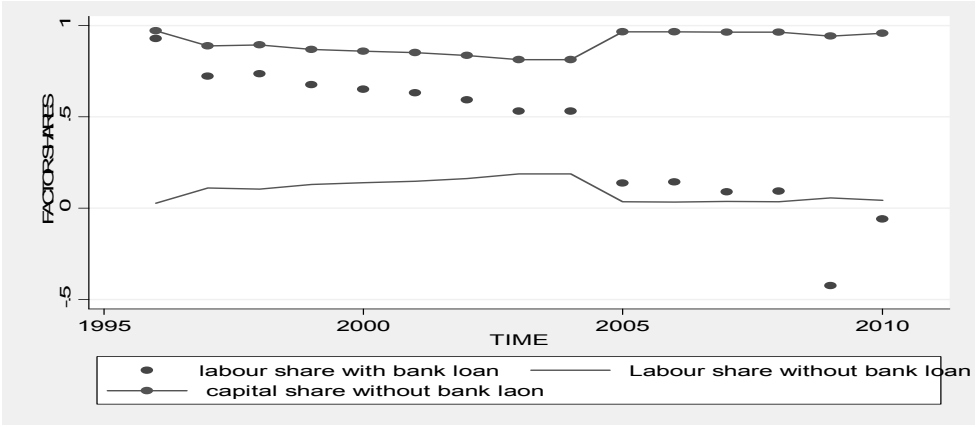

Figure 7. Labor and capital shares with and without access to bank loans

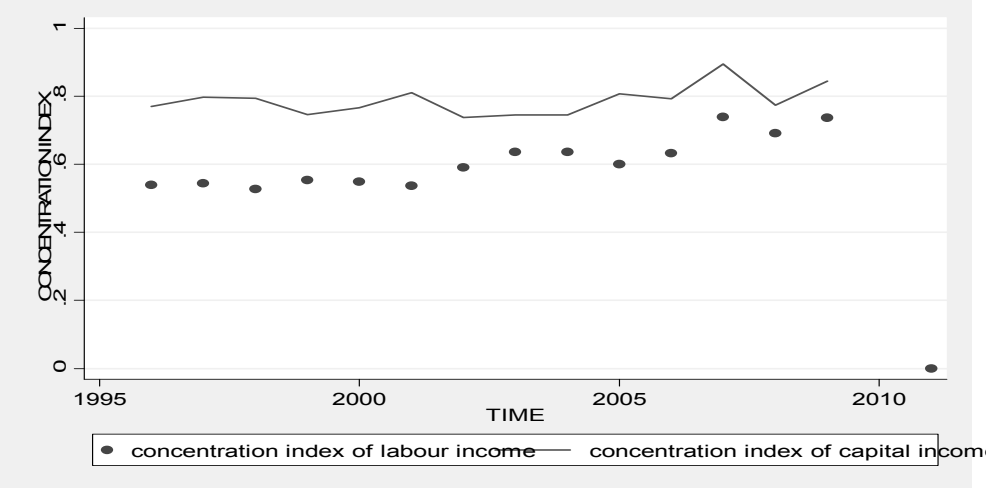

Figure 8.Concentration indices of labor and capital incomes

Related to this is, the concentration index of incomes from capital are greater than those of incomes from labor. This may loosely mean that incomes from capital are more concentrated at the top of the income distribution than incomes from labor. This should be a sound observation because the wage earning groups are less likely to have income from other sources such as capital (see Figure 8).

Third, the personal income distribution measured by the Gini index is less when there is access to bank loans than without it, implying access to bank loans improves income distribution.

Fourth, more generally, disregarding the limited applicability of the Gini coefficient, the measure of inequality increased from 0.771 to in 1996 to 0.845 in 2008, that is, inequality increased by 10.59 per cent from 1996 to 2008.

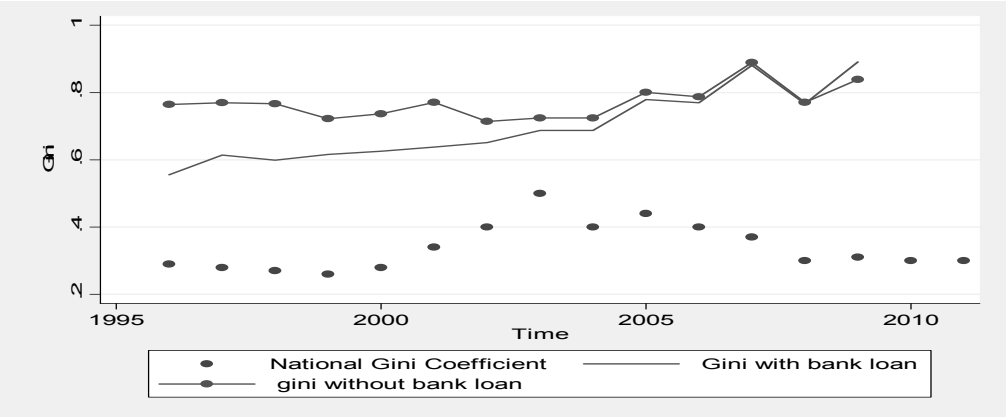

Figure 9: Gini obtained from the national dataset (scattered) and computed from functional income distribution (line and connected)

The final observation is that Gini coefficients from the Ethiopian national MoFED dataset and the one obtained by decomposing from wage and capital incomes and their respective concentration indices follow the same pattern. However, the two Gini coefficients differ in size in that the computed one is greater than the official figure. This is indicated in Figure 9.

From Figure 9 we can track an important argument that functional income distribution is strongly associated with personal income distribution. However, the one obtained from firm-level data is greater than the nationally available personal income distribution. For example, the mean of national income distribution and the one obtained by decompositions are 0.34 and 0.69 with standard deviations of 0.07 and 0.1 respectively. The correlation coefficient between the two is 0.34implying that functional income distribution is closely associated with personal income distribution which has very strong policy content.

3.5 Empirical evidence from other studies

Generally, empirical literature on bank loans and income inequalities is scarce. An empirical study focusing on firm data by Ayyagari, Demirgüç-Kunt, and Maksimovic (2008)shows that indirectly affecting their growth, access to finance ranks as one of the top three barriers for growth (the other two being crime and political instability) with finance as the most robust of the three. They also note that limited finance appears to hurt smaller firms more as compared to their larger counterparts. They report that estimates of the effects of lack of financing constraints suggest that small, medium and large firms grew slower by 10.7, 8.7 and 6.0 percent respectively in 1996-99. (Beck, Demirgüç-Kunt, and Maksimovic, 2005). This lower growth suggests that lack of access to financing increases inequality indirectly.

Clarke, Xu,and Zou (2006) investigated panel of 91 countries between 1960and 1995 to study the macro-level; they used private credit to GDP ratio to measure financial sector developments. They reported that there was a negative and possibly a non-linear relation between the log (Gini) and log (private credit).

More empirical evidence is provided by Claessens and Perotti (2007) who in general conclude that the number of firms that complain about lack of financing generally declines as financial development measured by private credit to GDP increases.

4. Summary, conclusions, policy recommendations and future areas of research

In this paper and the previous one, it was shown that it is possible to understand how income distribution is associated with firms' access to bank loans. We viewed firms' access to bank loans as one mechanism that shapes the evolution of personal income distribution through functional income distribution. Unlike most previous studies where monetary aggregates are considered for understanding the link between financial development and economic performance, the innovation in this paper is that it tries to understand the mechanism that links bank loans to income distribution using firm level and national data.

This paper empirically answered the question on the possibility of a positive association between firms' access to bank loans and functional income distribution, which was already answered by our ACE model positively. We explored the use of the external validation technique, the most commonly used methodology for validating ACE models of the type we used in the first paper.

Our major finding is that firms' access to bank loans is one mechanism that derives functional income distribution in favor of labor share. Using CSA and the national dataset we found that access to bank loans is among the most frequently encountered constraints by firms. When firms have access to bank loans, there are two uses: investments in fixed capital and investments in working capital. Whether the source is a bank loan or own funds, if there are investments in fixed capital, the labor's share is positively associated with it. However, when both sources are utilized for working capital the labor's share declines. The use of funds for working capital may be viewed as working under full capacity which forces firms to reduce payroll expenditures by cutting overtime work and laying-off temporary workers. These decisions have direct negative effect on functional income distribution implying the role of financial structures of firms in addressing distributional problems if the government has to use monetary policy instruments such as credit policy to create a society with distributional justice.

We can find empirical support for these findings. However, since they link monetary aggregates to GDP ratio (which is the usual measure of financial development) to income distribution, it is vague in understanding the underlying mechanisms that create the distributional phenomenon.

Doing economics is doing science. To do science is to find patterns, and scientists are always looking for patterns that they can use to structure their thinking about the world around them. Guided by our ACE model, we tried to understand how access to bank loans at the micro-level is linked to inequality at the macro-level.

The policy implication of this paper is that financial access matters. More specifically, when firms are not financially constrained, their motive for expanding operations or operating at full capacity can promote equality. Therefore, monetary policies in addition to their stabilization role, should consider this dimension of inclusiveness through their credit policies.

Future research should focus on more sophisticated empirical methods which are necessary for estimating agent-based models directly.

References

Atkinson, A.B. and F. Bourguignon, (2000). Income distribution and economics. *In Handbook of income distribution*, Volume 1, 1-58 Amsterdam: Elvesier.

Atkinson, A.B. and F. Bourguignon (2001). *Income Distribution, International Encyclopedia of the Social and Behavioral Sciences*, 7265–71, Amsterdam: Elsevier.

Ayyagari, M., A. Demirguc-Kunt, and V. Maksimovic (2008). How Important Are Financing Constraints? The Role of Finance in the Business Environment. *The World Bank Economic Review,* 22(30) 483-516.

Atkinson, A. (2009). Factor shares: the principal problem of political economy? *Oxford Review of Economic Policy*, 25(1), 3-16.

Beck, T., A. Demirgüç-Kunt, and V. Maksimovic. (2005). Financial and Legal Constraints to Firm Growth: Does Firm Size Matter? *Journal of Finance,* 60(1), 137–77.

Bianchi, C., Cirillo, P., Gallegati, M. and Vagliasindi, P. (2007). Validating and Calibrating Agent-Based Models: A Case Study. *Computational Economics*, 30(3), 245-264.

Blaug, M. (1996). *Economic theory in retrospect*. 3rd edn Cambridge: Cambridge University Press.

Chen, S., Chang, C. and Du, Y. (2012). Agent-based economic models and econometrics. *The Knowledge Engineering Review,* 27(02), 187-219.

Chen, S.-H., Huang, Y.-C., and Wang, J.-F. (2008). Bounded Rationality and the Elasticity Puzzle:An Analysis ofAgent-based Computational Consumption Capital Asset Pricing Models. Working paper, AI-ECONResearch Center, National Chengchi University.

Claessens, S. and Perotti, E. (2007). Finance and inequality: Channels and evidence.*Journal of Comparative Economics,* 35, 748–773.

Clarke, G., Xu, L. and Zou, H. (2006). Finance and Income Inequality: What Do the Data Tell Us? *Southern Economic Journal,* 72(3), 578-596.

Delli Gatti, D., Desiderio**,** S., Gaffeo**,** E., Cirillo**,** P., Gallegati**,** M. (2011).*Macroeconomics from the bottom-up*. Milan: Springer.

Eichengreen, B. (2007). *The European economy since 1945*. Princeton: Princeton University Press.

Fagiolo, G., Moneta, A. and Windrum, P. (2007). A Critical Guide to Empirical Validation of Agent-Based Models in Economics: Methodologies, Procedures, and Open Problems. *Computational Economics,* 30(3), 195-226.

Felipe, J. (1998). Does the aggregate production function imply anything about the laws of production? A comment. *Applied Economics Letters*, 5(9), 543-547.

Felipe, J. and Holz, C. (2001). Why do Aggregate Production Functions Work? Fisher's' simulations, Shaikh's identity and some new results. *International Review of Applied Economics*, 15(3), 261-285.

Fox, D. (1989). Conditional multivariate calibration, *Communications in Statistics*18, 2311–2330.

Francese, M. and Mulas-Granados, C. (2015). Functional Income Distribution and Its Role in Explaining Inequality. *IMF Working Papers*, 15(244), p.1.

Friedman, M. (1953). Choice, Chance, and the Personal Distribution of Income. *Journal of Political Economy*, 61(4), 277-290.

Gallegati, M., Delli Gatti, D., Gaffeo, E., Giulioni, G., Kirman, A., Palestrini, A., and Russo, A. (2007). Complex dynamics and empirical evidence. *Information Science*, 177, 1202–1221.

Glyn, J .and R. Sutcliffe. (1972). *British Capitalism, Workers and the Profits Squeeze*. Harmondworth: Penguin Books.

Glyn, A. (2009). Functional Distribution and Inequality**.** *In Oxford Handbook of Economic*

Hogrefe, J. and Kappler, M. (2013). The labour share of income: heterogeneous causes for parallel movements? *The Journal of Economic Inequality*, 11(3), 303-319.

Janssen, M. and Ostrom, E. (2006). Empirically based, agent-based models. *Ecology and Society,* 11(2), 37, 1-13.

Johnson, H.G. (1973). *The theory of income distribution*. London: Gray-Mills

Kaldor, N. (1955). Alternative Theories of Distribution. *The Review of Economic Studies,* 23(2), 83-100.

Kuznets, S. (1955). Economic Growth and Income Inequality. *The American Economic Review*, 45(1), 1-28.

Loewenstein, G. (1999). Experimental economics from the vantage-point of behavioural economics. *The Economic Journal,* 109, 25–34.

Mankiw, N. G. (2007). *Macroeconomics*, 6thedition. New York, Worth

Marchal, J., and B. Ducros. (1968). *The Distribution of National Income.* London: Macmillan.

McCombie, J. S. L. (1987**).**Does the Aggregate Production Function Imply Anything about the Laws of Production? A Note on the Simon and Shaikh Critiques. *Applied Economics*, 19(8), 1121-36.

Mark, B. (2007). Validating simulation models: A general framework and four applied examples*. Computational Economics,* 30(3), 265-290.

Reynolds, A. (2006). *Income and wealth*. Westport, Conn.: Greenwood Press.

Sahota, Gian S. (1978) Theories of Personal Income Distribution: A Survey. *Journal of Economic Literature*, 16 (1), 1-55.

Schram, A. (2005). Artificiality: The tension between internal and external validity in economic experiments. *Journal of Economic Methodology,* 12(2), 225-237.

Stoker, T. (1993). Empirical approaches to the problem of aggregation over individuals. *Journal of Economic Literature*, 31(4), 1827–1874.

Temple, J. (2006). Aggregate Production Functions and Growth Economics. *International Review of Applied Economics,* 20(3), 301-317.

Tesfatsion, L. (2006). Empirical Validation and Verification of Agent –Based Models. . .http://www2.econ.iastate.edu/tesfatsi/empvalid.htm.

Walker, D. (2007). Patterns of income distribution among world regions. *Journal of Policy Modeling*, 29(4), 643-655.