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The Macro Impact of Microfinance in Bangladesh: A CGE Analysis

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I. INTRODUCTION

Much has been written on the impact of microfinance on the welfare of borrowers, but not much is known about its impact on the economy as a whole.[1] In the early days of microfinance, when its reach was limited, the relative neglect of its macro impact was understandable. But with rapid expansion of microfinance, this issue has become increasingly relevant. This is especially true for Bangladesh, where microfinance penetration has been the strongest in the world, covering more than half of the rural population and increasing proportion of urban population as well. According to a recent study, some 55 percent of rural households have taken microfinance at some stage in their lives, and almost 46 percent hold the status of current borrowers (as of 2010).[2] With such huge expansion, microfinance is bound to have direct and indirect repercussion on the overall economy. The present study makes a pioneering attempt to assess the macroeconomic impact of this expansion – in particular, to estimate the contribution of microfinance to the national income of Bangladesh, as measured by its gross domestic product (GDP), by using a static computable general equilibrium (CGE) model.[3]

A considerable amount of scholarly effort has been expended in the last couple of decades to evaluate the impact of microfinance on the welfare of the borrowers – as measured by economic indicators such as income, consumption and poverty as well as a host of non-economic indicators such as health, education, and women's empowerment. While this literature has at times been riven by heated controversies, the overall conclusion that microfinance has improved borrowers' welfare remains valid – especially in Bangladesh, where borrowers had a much longer exposure to it than anywhere else in the world.[4]

Not much is known, however, about the macro-level impact of microfinance. The motivation for the present paper stems from the recognition that if the macro impact of microfinance is to be significantly visible in any country, it must be in Bangladesh because of the manner in which the size and structure of the microfinance sector has undergone some radical transformation in recent years.

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[1] The term microfinance has a broader connotation than microcredit in so far as it also includes savings and insurance in addition to credit, although credit is by far the biggest component of microfinance almost everywhere, including Bangladesh.

[2] See Osmani *et al.* (2015). This study was based on a nationally representative household survey covering the whole or rural Bangladesh and was carried out in 2010 by the Institute of Microfinance in Dhaka.

[3] Although the paper is related to Bangladesh, the methodology adopted for the purpose of estimating the macro impact of microfinance may be applicable in other countries as well, with suitable modifications in light of country-specific features of both the microfinance sector and the economy in question. It should be noted, however, that the magnitude of the impact that might be found in other countries may not be as large as we have found for Bangladesh for the simple reason that in no other country has the reach of microfinance extended as far as it has in Bangladesh.

[4] See, for example, Mahmud and Osmani (2016) who arrive at this conclusion after an extensive review of the relevant evidence.

This transformation includes the following features: (i) microfinance has expanded enormously in both scope and scale in Bangladesh, covering more than half of the rural population; (ii) almost one third of the microcredit is invested in micro enterprises creating full-time employment opportunities for some 10 million individuals; (iii) increasingly, larger loan sizes are being offered by the Microfinance Institutions (MFIs) to the more enterprising borrowers; (iv) microcredit is invested in diversified activities including non-financial activities; and (v) non-financial services like training and education have increasing presence in microfinance program design in Bangladesh.

These transformations have had a profound impact on the lives of the poor. Longitudinal studies in Bangladesh show that microfinance has contributed to (i) creating substantial amount of full time employment; (ii) increasing the intensity of financial inclusion; (iii) improved productivity in microenterprises, (iv) accumulation of assets, and (v) sustained reduction in poverty, especially for those who have had a long exposure to microfinance.[5]

When an intervention positively affects the economic lives of close to half of a country's population, there is a good *a priori* reason to believe that it will have a positive effect on the overall economy as well. However, the magnitude of the macroeconomic impact cannot be obtained simply by aggregating the impact on borrowers because the intervention also has direct and indirect repercussion on the rest of the economy, many of which would be positive but some could be negative as well. It is necessary to adopt a general equilibrium approach in order to capture these diverse effects on the overall economy encompassing both borrowers and non-borrowers, as distinct from the partial equilibrium approach that underlies the evaluation of the direct impact on borrowers' welfare. This is the approach the present paper adopts.

A useful vantage point from which to adopt a general equilibrium approach to the macro effect of microfinance is the concept of financial development, because expansion of microfinance constitutes an important dimension of overall financial development of an economy. There exists a burgeoning literature on both the theory and empirics on how financial development affects the real economy through a variety of channels.[6] The present paper captures a number of such channels through which microfinance has affected the GDP of Bangladesh – viz., capital accumulation, productivity improvement, and reallocation of labor and capital across sectors. For this purpose, the study uses a CGE model based on an updated version of the Social Accounting Matrix (SAM) of Bangladesh with the base year of 2012.[7] The model is simulated to derive a measure of GDP that would have obtained in Bangladesh in the counterfactual scenario in which there were no microfinance at all. The difference between this counterfactual GDP and the actual GDP is taken as the contribution of microfinance to GDP. Our estimates suggest that microfinance has contributed somewhere in the range of 9-12 percent to the GDP of Bangladesh. As pointed out in the concluding section, however, partly because of data

[5] The relevant evidence is discussed in section II below.

[6] See Pagano (1993) for an illuminating discussion of the channels through which financial development can affect the real economy. See also Masudova (2010) for discussion of the transmission channels in the context of microfinance.

[7] Conventionally, SAM refers to a single representative year (a year of normal representative economic activities and free from any major external and internal shocks), providing a picture of the structure of the economy. The reason for using 2012 as the reference year for the present study is that it is the latest year for which a SAM is available for the Bangladesh economy. But it should be noted that the broad conclusions of the study do not apply to that particular year alone. Since 2012 is representative of a 'normal' year in Bangladesh, the results of the paper can be seen as reflecting the macro effects of microfinance in Bangladesh in recent years.

limitations and partly because of the exploratory nature of the present exercise, it was not possible to incorporate a number of transmission mechanisms that could potentially affect national income – some positively and some negatively. A further limitation stems from the static nature of the CGE model that has been used in the paper; while a static model is useful for an exploratory exercise, a dynamic model is needed to fully capture the longer-term impacts of microfinance. Future research could be fruitfully directed towards addressing these limitations.

The rest of the paper is organized as follows. Section II provides an overview of the microfinance sector in Bangladesh so as to set the context in which the modeling exercise has been undertaken later in the paper. Section III offers an analytical review of the existing literature on the macroeconomic impact of microfinance with a view to extracting some lessons for our own modelling exercise. Section IV explains the methodology and modelling assumptions adopted in this study. Section V presents the results; and finally, some concluding remarks are offered in section VI.

II. OVERVIEW OF THE MICROFINANCE PROGRAM IN BANGLADESH

The microfinance sector in Bangladesh has undergone some major transformations over the past two decades. MFIs started as non-government voluntary social organizations with the basic objective of providing microfinance services to poor households. The most well-known of them, the Grameen Bank, started formally in 1983 under the Grameen Bank Ordinance. According to the latest available statistics, some 740 MFIs are operating with a network of around 19,000 branches, employing over 250,000 people and serving over 34 million borrowers (CDF, 2014).

Although Bangladesh has a long history of microfinance dating back to 1978, the sector essentially took off in 1992 with the establishment of *Palli Karma Sahayak Foundation* (PKSF), which acts as a wholesale provider of funds to the MFIs (Faruqee and Badruddoza, 2012). Since microfinance services are provided in a manner that minimizes the risk of default despite the absence of collateral, increasingly a number of commercial banks have also ventured to come forward to finance microfinance operations through wholesale lending to MFIs. These banks are now an important provider of external fund. However, member savings and reserves (generated out of surplus) remain the major source of financing of the total assets held by the MFIs.[8]

From the very inception of the microfinance sector in Bangladesh, access to both savings and credit has been recognized as essential pre-requisites for alleviating poverty. In order to enhance the savings rate, the act of saving was invariably linked with micro lending. The original Grameen Bank model introduced compulsory weekly savings as a precondition for access to microcredit (Khandker, 1998). Following the devastating flood of 1988 and 1998, flexible savings schemes were introduced. Other large MFIs, such as BRAC[9], have also emphasized savings. The greater emphasis on member savings was based on the notion that access to own savings will reduce dependency on microcredit.

[8] For more on the structure and evolution of the microfinance sector in Bangladesh, see chapters 2 and 3 of Mahmud and Osmani (2016).

[9] BRAC was established in 1972 as the "Bangladesh Rehabilitation Assistance Committee". Later the name was changed to "Bangladesh Rural Advancement Committee" keeping the acronym unchanged. Currently, however, the name BRAC stands for itself, rather than as an acronym.

All the MFIs have followed essentially the same 'microfinance' model, with some minor variations. However, with the increase in loan size and volume of loans, many MFIs have begun to introduce micro insurance schemes, especially since 2000. As a result, the microfinance model currently contains all three essential elements of finance – namely, credit, savings and insurance.

The MFIs operate in almost all parts of the country with the exception of some inaccessible areas. Table 1 shows the outreach of MFIs operating in Bangladesh over the period 1996-2014. A structural change has occurred, in terms of growth of outreach, at around 2006. Since that year, the sector has experienced exponential growth in terms of membership mobilized, annual loans disbursed, loans outstanding and net savings. Membership increased rapidly since 2006, reaching the figure of 34 million by 2014. Compared to the period 1996-2000, average annual number of members during the period 2011-14 was 3 times higher. During the same period, average annual loans disbursement increased by almost 15 times and average net savings by 17 times.

The increase in savings mobilization has drastically reduced MFIs' dependency on external finance; by the end of 2014, net savings constituted 55 percent of loans outstanding. It has also strengthened the capability of borrowing households to invest in productive activities, and has better equipped them to cope with shocks.[10]

Table 1: Average Outreach of MFIs, 1996-2014 (taka in million)

Period	Number of Members	Annual Disbursement	Loans Outstanding	Net Savings
1996-2000	10,974,659	36,533	24,387	11,163
2001-2005	18,595,932	84,810	55,234	33,335
2006-2010	33,004,304	290,973	155,422	108,031
2011-2014	32,839,003	538,112	337,220	190,997

Source: Credit Development Forum (CDF), *Bangladesh Microfinance Statistics* (various years)

A growing body of evidence shows that increased access to credit and savings has had a positive impact on poverty alleviation, income, and return on investment.[11] By using long-term panel data, Khandker *et al.* (2016) have recently shown that with access to credit alone, some 2.5 million households graduated sustainably from poverty by the end of 2010. With increasing loan size and access to non-financial services offered by the MFIs, the number of graduating households and the rate of poverty reduction would be even higher. This is demonstrated in Osmani *et al.* (2015), which shows that by sustainably improving the wealth level of borrowers microfinance has contributed to 29 percent reduction in poverty. Khalily *et al.* (2014) have shown that households with access to credit and non-financial interventions like training and health services had higher rate of graduation from extreme poverty than the counterfactual groups with access to microfinance alone in areas chronically affected by seasonal hunger.

It is instructive to note that all of the recent studies mentioned above reveal a much higher level of impact of microfinance on poverty reduction compared to the studies prior to 2010 (which

[10] A recent study has found that households with access to savings have higher probability of being out of poverty (Khalily *et al.*, 2015).

[11] There are some critical studies questioning the positive findings of early papers on the impact of microfinance in Bangladesh. But as discussed in section III below, and explained more fully in Mahmud and Osmani (2016, chapter 7), most of these critiques lack credibility, especially in the light of more recent studies. Hence we mention only the more recent studies in this section.

include, for example, Zohir *et al.*, 2001; Rahman *et al.*, 2005; Khandker, 1998). The reasons for the bigger impact found in more recent studies can be traced to some of the transformations that have occurred in the microfinance sector in recent years. These transformations relate to rising loan size, changing loan use pattern, and provision of non-financial services, among others.

(a) Loan size: The emergence of Microcredit Regulatory Authority (MRA) in 2006 has changed the structure of the microfinance market in a significant way. While more active regulation has imposed a cost on the licensed MFIs, on the positive side the MRA has allowed them to lend as high as 50 percent of the loanable fund. This has enabled the MFIs to offer larger-sized loans for micro enterprises. For example, in 2014, as much as 28 percent of the loans disbursed were accounted for by micro enterprises. Although one may argue about this might indicate possible drifting of the MFIs from their social mission of poverty alleviation, financing micro enterprises has been linked to inclusive economic growth – in particular, creation of new employment opportunities. Muneer and Khalily (2015) showed that these enterprises generated average economic returns of 64 percent, and created around two full time employments per micro enterprise. They further showed that it has also had a positive impact on total factor productivity (TFP).[12] Considering the number of micro enterprises and income generating activities of microcredit borrowers, it has been estimated that some 10 million new employments have been created in Bangladesh.

(b) Loan use: Loans that are offered by MFIs are utilized by borrowers for multiple purposes. Because of the fungibility of funds, it is very difficult to trace the actual use of borrowed funds. Nevertheless, careful estimates of actual uses made by households (as distinct from declared uses recorded in MFIs' books) have recently been made using detailed surveys of loan use. Based on two separate nationally representative household-hold surveys, it has been estimated by Osmani *et al.* (2015) and Khalily *et al.* (2015) that some 47-48 percent of microcredit is currently used for productive purposes. In the early stage of microfinance development in Bangladesh, by far the major part of the microcredit was used for off-farm economic enterprises, with very little of it going to agriculture. This has changed dramatically in the recent years. During the past three years (2012-14), more than 25 percent of the loans were used for agriculture – most of it for crop cultivation.

(c) Non-financial services: It is widely recognized that microfinance alone cannot eliminate poverty because of the existence of deep-rooted structural poverty. A multi-pronged strategy is required involving education, housing and wealth accumulation, among others. A small amount of credit may be a step towards poverty alleviation, but the impact of microfinance is magnified when the borrowers have necessary skills to utilize it. In recognition of this complementarity between finance and skills, provision of relevant training has become an increasingly important feature of the microfinance sector in Bangladesh. Although data is not available for all years on the number of members receiving training, recent statistics show that, on an average, every year more than two percent of the members received training, more than 25 percent of which was related to livestock and poultry (CDF, 2014). Not all the MFIs are, however, engaged in providing training because of the lack of appropriate infrastructure and low level of operations. Nonetheless, more than half of the MFIs provide training to their clients. It is plausible to argue that increased provision of training has raised the potency of microfinance in enhancing its impact on borrowers' income. This is evident from Khalily *et al.*

[12] Similar results were also reported by Osmani *et al.* (2015), Khalily and Khaleque (2013) and Khandker *et al.* (2013).

(2014) who showed that microfinance combined with non-financial interventions like training have contributed 15 percent more income compared to pure microfinance without any training in the relevant areas of investment.

Because of the multi-dimensionality of poverty, anti-poverty interventions will also require interventions for social or community development, which will empower participating poor households, and ensure access to different socio-economic institutions. Bearing this in mind, more than 74 percent of the MFIs are engaged in social development programs with major focus on education and related supports, water and sanitation, health and treatment, women's empowerment and development in general (CDF, 2014).

All the elements of the transformation of the microfinance sector described above have had a positive impact on the livelihoods of the borrowers. First, access to non-financial services has reduced vulnerability of the households and enabled them to earn higher income from their investments on a sustained basis. Second, higher average loan size has enabled households to invest in microenterprises, with higher returns. Third, increasing presence of micro insurance has helped reduce adverse impact of negative shocks. Fourth, creation of multiple income sources through use of credit, savings and occupational trainings has helped raise the level of household income. The present study seeks to estimate the magnitude of these impacts at the aggregate level by measuring the impact on national income.

III. REVIEW OF LITERATURE ON THE MACROECONOMICS OF MICROFINANCE

Before considering the macroeconomic effect of microfinance, it is worth noting that if the reach of microfinance is extensive and if it is found to improve the economic condition of the average borrower, it would be reasonable to argue that the macroeconomic impact cannot but be positive. The existing vast literature on the microeconomic impact of microfinance on borrowers' welfare is, therefore, relevant in the macroeconomic context as well. As is well known, however, this literature has been rife with controversies. The pioneering studies such as Pitt and Khandker (1998), which claimed to show through careful econometric analysis that microfinance exerted a positive impact on borrowers' welfare, were subsequently subjected to severe criticism on methodological grounds (e.g., Roodman and Morduch, 2014). The critical view was further strengthened by a spate of studies that claimed that once the effects of other factors were effectively controlled for with the help of randomized controlled trials (RCTs), microfinance appeared to have very little impact on borrowers' economic condition.[13] The intellectual impact of these critical studies has been quite strong, resulting in skepticism in some quarters regarding the efficacy of microfinance as a tool for poverty reduction.

More recent research has shown, however, that this skepticism is unwarranted, for a number of reasons.[14] First, the critical studies which took issue with the early findings of positive impact on methodological grounds were themselves methodologically flawed. Second, the RCT-based studies, which were otherwise methodologically sound, had the inherent limitation that they could observe the impact only over a short period of time, whereas both commonsense and empirical evidence suggest that it is only after a prolonged exposure to microcredit that poor people can begin to capture appreciable economic benefits from it. Third, several recent studies,

[13] The findings of these studies are summarised in Banerjee (2013) and IPA (2015). It should be noted that none of these studies was related to Bangladesh.

[14] Mahmud and Osmani (2016, chapter 7) provides an extensive review of this research.

which avoid the early methodological criticisms by using panel and quasi-panel data as opposed to cross-section data, demonstrate quite conclusively that prolonged exposure to microfinance makes significantly positive contribution to the economic lives of the poor.

These empirical findings are in line with a simulation exercise carried out by Rashid *et al.* (2011) using the framework of agent-based modeling (ABM). The study simulated a large number of alternative scenarios through parametric variation of agent's behavior and the circumstances in which they operate. In all of the simulations, the average wealth level of the poor was found to decline for a while, because it takes time to make products, engage in trade and then gain the fruits of microenterprise; but after a certain period of time the wealth of the poor begins to increase and maintains a higher rate of increase.

It is sometimes contended that even if microfinance is helping the poor now, there is a danger that this would no longer be the case as the scale and reach of microfinance expand, because such expansion will allegedly lead to over-indebtedness, rising defaults and hence higher interest rates. Lahkar and Pingali (2016) have shown, however, that this apprehension too may be unwarranted. Using a standard screening model, they show that, even if expansion of microfinance leads to higher interest rates, screening effects will lead to higher borrower welfare. This will happen because, firstly, all borrowers previously denied credit would be able to obtain loans, and, secondly, screening costs for pre-existing borrowers will go down.

There is thus a strong empirical basis for the claim that microfinance has had a positive effect on borrowers' welfare. And if these borrowers happen to constitute a large percentage of the population, as is the case in Bangladesh, one should expect the macro effect to be positive as well. Of course, the magnitude of the macro effect cannot be deduced simply by aggregating individual welfares of borrowers because of the presence of general equilibrium effects on the overall economy. In the end, the macro effect must be deduced from a macro-analytical perspective.

One such perspective is to view the expansion of microfinance as part of the process of financial development of an economy. From this perspective, there is a simple intuitive reason for taking the view that microfinance should in principle make a positive contribution towards the growth of national income. Theoretical research as well as a growing body of empirical evidence lends strong support to the view that financial development exerts a positive impact on economic growth.[15] By reducing the costs of information, enforcement and transaction, a well-functioning financial system promotes growth through a number of channels: viz., savings mobilization, provision of investment information, better monitoring/governance, risk management, and facilitation of exchange of goods and services.

In the context of financial development of Bangladesh, the positive savings effect was found by Sahoo and Das (2013) and more direct evidence on the positive effect on growth and poverty reduction was found by Uddin *et al.* (2014). In general, however, empirical studies on the relationship between financial development and growth have sometimes come up with conflicting evidence; while the vast majority of studies have found a positive effect, some have found little effect and a few have found even a negative effect. Such diversity of results can arise from (a) non-linearity (in particular, the presence of threshold effects) in the relationship between financial development on economic growth – as modeled, for example, in Eggoh and Villieu (2014) and (b) from the fact that the impact of financial development on growth depends

[15] For a comprehensive review of the relevant theory and evidence, see Levine (2005).

on various other factors – such as the level of development, degree of openness of an economy, and the size of the government, as found by Herwartz and Walle (2014). In fact, it is entirely possible that there is an optimal level of financial development corresponding to the level of overall economic development, and excessive financial development, relative to the optimal, may be just as harmful as less than optimal development (Bhattarai, 2015).

None of this, however, detracts from the central message that financial development does in general promote economic growth, other things remaining the same. Since the spread of microfinance contributes to the process of overall financial development by correcting a market failure at the lower end of the financial market, it stands to reason that growth of microfinance should also facilitate economic growth.

The same conclusion emerges directly from some recent evidence related specifically to the macro impact of microfinance. This literature recognizes that one of the problems in empirical testing of the relationship between microfinance (and finance in general) and economic growth is that causality can run both ways: just as the spread of microfinance can affect growth, there can also be a reverse causation from growth to the spread of microfinance.[16] The statistical methodologies employed to study the impact of microfinance on growth must be nuanced enough to be able to isolate the true effect of microfinance from the vitiating effect of reverse causation. The study by Masudova (2010) tried to do precisely that by employing the Granger causality test. Applying this test to cross-country data from 102 countries she found evidence that greater spread of microfinance helps achieve faster economic growth, although the strength of the impact depends (positively) on the underlying level of development of the economy. A more recent study applied the generalized method of moment to isolate out the effect of reverse causation, and found evidence for the growth-promoting effect of microfinance in a sample of 71 developing countries (Donou-Adonsou and Sylwester, 2015).

Despite such support from both theory and evidence, some critics of microfinance continue to remain highly skeptical about the growth-enhancing effect of microfinance. In fact, critics such as Bateman and Chang (2009) go so far as to suggest that while bringing a measure of short term relief to some of the poor people, microfinance may eventually prove to be a barrier to long-term sustainable development. Their argument seems to rest on two premises. First, the enterprises supported by microfinance (to the extent that microfinance supports enterprises at all rather than being diverted to unproductive uses) are inherently less efficient than larger enterprises supported by the mainstream financial market owing to the absence of scale economies and other reasons. Second, spread of microfinance is tantamount to diversion of funds from mainstream finance. Together, these two premises lead to the conclusion that spread of microfinance leads to less efficient use of resources overall and thus stymies economic growth. No evidence is adduced, however, to support either of the premises. In fact, the second premise is completely at odds with the current reality of the microfinance sector in Bangladesh in which, as noted in section II, some 55 percent of outstanding loans are financed from within the sector itself – i.e., from the borrowers' savings and only 28 percent of loans outstanding is financed by external borrowing from banking sector.[17]

In contrast to the outlandish claims made by critics such as Bateman and Chang, a much more nuanced point has recently been made by a number of theoretical studies on the macroeconomics of microfinance. These studies have made a fairly compelling case for

[16] For evidence on the existence of reverse causation, see Ahlin *et al.* (2011).

[17] In the case of Grameen Bank, the largest MFI in Bangladesh, internal savings in fact exceeds the amount of loan outstanding.

recognizing that in theory at least there may exist some channels through which microfinance may exert a negative effect on growth. The import of these studies is not to assert that microfinance will necessarily act as an impediment to growth but to alert us to the fact that there are multiple channels through which microfinance can affect growth and while some of those channels may transmit a positive impact (for example, those emphasized by the standard literature on finance and growth) some others may act as a conduit of negative impact. In so far as the negative channels operate in a particular empirical context, the potentially positive impact of microfinance may be attenuated to some extent, and may in extreme cases be completely offset.

An example of studies in this vein is that of Emerson and McGough (2010), which examines the impact of microfinance on growth via investment in human capital. In the standard literature, it is common to assume that by ensuring greater access to finance at reasonable cost, microfinance would enable poor households to spend more on the schooling of children, thereby contributing to the growth of human capital, which in turn would promote growth.[18] The study by Emerson and McGough, however, highlights the existence of a mechanism that may subvert this positive impact. Their argument is based on the premise that by raising the returns to household-based enterprises microfinance will also raise the opportunity cost of schooling. This will have the effect of discouraging parents from sending children to the school, even as greater access to credit encourages them to do so. Two conflicting forces would thus be in operation. The net effect is ambiguous. However, by building on models of household decision-making in the presence of microfinance, as developed by Wydick (1999) and Maldonadoa and González-Vega (2008), the authors show that there exists a range of microfinance amounts that would result in a net reduction of schooling, especially given the manner in which microfinance currently operates by demanding early and frequent repayment. The authors then postulate the existence of externalities in education to argue that even though the decision to reduce schooling may be beneficial for the borrowing households themselves, it might hurt overall economic growth.[19]

The idea of conflicting effects operating through alternative channels is a recurring theme in other studies of this genre. An early example is the study by Ahlin and Jiang (2008), who examined the long-run effects of microfinance on development in an occupational choice model similar to that of Banerjee and Newman (1993). A crucial feature of this model is the distinction between self-employment and entrepreneurship. Assuming that entrepreneurship is more efficient than self-employment, the model postulates a hierarchy of three occupations characterized by three distinct technologies ranked by productivity and scale; in ascending order, they are subsistence, self-employment, and entrepreneurship. Given this framework, microfinance's contribution to national income would depend on the rate at which it enables the labor force to move up the occupational-cum-technological scale. The study asserts that given the nature of microfinance as it currently operates, its positive impact derives almost entirely from the graduation from subsistence to self-employment but hardly anything at all from the potentially much more productive graduation from self-employment to entrepreneurship. In fact, the model even allows for the possibility of a negative effect on the latter account when general equilibrium effects are considered. The negative effect can arise because of the impact on the wage rate. As the labor force moves from subsistence to self-

[18] A whole genre of theories linking income distribution with growth has been developed in the last couple of decades based on this presumed relationship between access to credit and human capital formation. For an excellent review of the literature, see Voitchovsky (2009).

[19] Although conceptually possible, the empirical relevance of this argument would be limited in Bangladesh, where primary and secondary education is free and also education of children is one of the core goals of MFIs.

employment, the wage rate would rise because of the reduction of labor supply in the market for wage labor. Higher wage rate in turn may reduce entrepreneurial profits and thereby cause attrition of unsuccessful entrepreneurs from the entrepreneurial class. This will have a negative effect on growth, which in extreme cases may even swamp the positive effect emanating from the transition from subsistence to self-employment.

The general equilibrium effect operating via the labor market is also the key for the study by Buera *et al.* (2012), who gave a quantitative assessment of both aggregative and distributional effect of microfinance focused on small businesses. They employed a general equilibrium model to capture the indirect effects of microfinance operating via the wage rate and used some empirical parameters drawn from the experience of microfinance in developing countries in order to derive their quantitative estimates. Conceptually, the impact of microfinance on national income can be decomposed into two routes – namely, impacts on TFP and capital accumulation. The study finds that the two routes can affect national income in opposite directions: the impact on TFP makes a positive contribution to GDP while the impact on capital accumulation makes a negative contribution. TFP rises by 4 percent, with the majority of the gain coming from a more efficient distribution of capital among entrepreneurs. At the same time, however, by inducing higher wages microfinance redistributes wealth from higher-ability entrepreneurs with higher saving rates to lower-productivity individuals with lower saving rates. As a result, aggregate saving rates fall, bringing down aggregate capital by 6 percent. This offsets most of the increase in TFP, and output increases by less than 2 percent. In short, the positive impact of the increase in TFP is counterbalanced in part by lower capital accumulation resulting from the redistribution of income from high-savers to low-savers. Nevertheless, the vast majority of the population is positively affected through the increase in equilibrium wages. As a result, the redistributive impact of microfinance is found to be much stronger than its aggregative impact.

Thus, as in the model of Ahlin and Jiang, this model too postulates two potentially conflicting effects on national income. The channels through which microfinance is allowed to affect national income are very different in the two models, but in both cases the negative effect emanates from the general equilibrium effects of higher wages. It is important to note, however, that unlike in the model of Buera *et al*., the negative effect is not inevitable in the Ahlin-Jiang model. As microfinance enables the self-employed people to save and accumulate, it is possible that some of them would eventually graduate to the stage of entrepreneurs, which may conceivably offset any attrition effect emanating from higher wages. In that case, the positive effect of a net increase in the entrepreneurial class would reinforce the positive effect of transition from subsistence to self-employment. The success of microfinance in improving national income would thus depend crucially on how well it enables the borrowers to save and accumulate.

It is clear from the preceding discussion that the macroeconomic effect of microfinance is a much more complicated issue than it is commonly believed. Just because access to microfinance enables borrowers to raise their own level of production, it would be facile to conclude that therefore microfinance would necessarily lead to higher national output. Equally, however, it would be facile to argue to the contrary – a lá Bateman and Chang, for example – that microfinance would necessarily impede growth by diverting resources to less efficient entrepreneurs. It is important to recognize that the spread of microfinance can affect national income through multiple channels, some of which are undoubtedly positive but some may be negative as well. The possible negative effects become especially evident when the general equilibrium effects are taken into account. This does not mean that all general equilibrium

effects are negative, some may be positive too – for example, if higher level of borrowers' expenditure made possible by microfinance-generated higher income promotes greater production of goods and services in the rest of the economy through linkage effects, or if higher wage rate caused by microfinance induces entrepreneurs to adopt superior labor-saving technologies, an idea common in the literature on induced innovation but not considered at all in the models discussed above. The point remains valid, however, that the macroeconomic impact of microfinance cannot be reliably examined without embracing a general equilibrium approach. This is what motives the methodology adopted in the present study.

IV. METHODOLOGY

For the purpose of estimating the macro impact of microfinance, this paper uses a CGE model, constructed by using what is known as the 'Partnership for Economic Policy' (PEP)-standard static model (Decaluwe *et al*., 2009), with further developments and modifications. A brief description of the structure and rationale of the CGE model, the key equations of the CGE model and a brief description of the SAM of Bangladesh, that provides the empirical foundation of the model, are presented in the Appendix. Below, we describe how microfinance was introduced into the CGE model and how the SAM was modified for this purpose.

In this paper, a simple but intuitive approach is adopted to introduce microfinance in the CGE model. An important assumption of this approach is that not all of microfinance contributes to the creation of GDP – only the part that helps build capital or helps improve productivity is relevant for this purpose. Thus the only relevant parts are (a) loans that are used for directly productive purposes, creating either fixed or working capital, and (b) loans that are used to build or augment the housing stock. These loans add to the GDP not only directly by enabling the borrowers to produce more goods and services (including housing services) but also indirectly through consumption linkages as the borrowers spend their enhanced income. By contrast, the amount of loans used for consumption purposes is not considered relevant for the creation of GDP. These loans will of course create additional output indirectly through consumption linkages, even though they do not create any output directly in the first round; however, these linkage effects will be cancelled out when the borrowers reduce their consumption at some stage to repay the loans. Therefore, a net positive effect on GDP can only emanate from the part of microfinance that is devoted to augmenting capital. On this assumption, a natural way of introducing microfinance in the CGE model is to enter it as a part of capital. Accordingly, we have modified the SAM so as to distinguish between MFI capital and non-MFI capital. Also, both rural and urban households are split between MFI recipient households and non-MFI recipient households. Therefore, in the modified MFI-SAM, we now have four categories of households: rural MFI recipient households, rural non-MFI recipient households, urban MFI recipient households and urban non-MFI recipient households.

The process of splitting the capital stock between MFI capital and non-MFI capital involved the following procedure. Since there is no macro-level information on the size of MFI capital stock in the country, we followed an indirect route by combining information from household survey on the uses of MFI loans with available data on MFI loan disbursement as well as investment at the national level. For household-level information on the uses of MFI loans, we relied on the database generated by the Institute of Microfinance (InM) in its two rounds of survey carried out for its project on Access to Finance. These are nationally representative household surveys covering both rural and urban areas, and were conducted by applying essentially the same sampling design as used by the Bangladesh Bureau of Statistics (BBS) for its *Household Income and Expenditure Surveys* (HIES) and by using a sample size of roughly

similar magnitude. The two rounds of the InM Survey were carried out in the years 2010 and 2014 respectively. Since the base year of our SAM is 2012, we decided to use the average of the information contained in the two rounds of the survey. The share of MFI capital in total capital stock was then estimated in two steps.

In the first step, we noted from InM Surveys that, on average, around 47 percent of MFI loans was used for productive purposes. By applying this ratio to total MFI loan disbursement, as obtained from national-level data, we estimated the absolute amount of loans used for productive investment. By comparing this amount with the size of total national investment, we found that MFI investment amounts to about 5 percent of total investment. On the simplifying assumption that MFI's share in investment is equal to its share in capital, we then designated 5 percent of total capital stock as MFI capital.

In the second step, we made adjustment for the fact that the simplifying assumption of equating share of investment with the share of capital does not actually hold. This is because the part of investment that borrowers make out of their own resources – rather than out of loans – would, under the simplifying assumption, be treated as non-MFI investment, but in reality at least a part of such so-called 'own-resource' investment is attributable to microfinance because the borrowers would have built up their own capital partly out of additional income generated by loan-financed activities in the past. As a result, a part of the apparently non-MFI investment in any given year must be attributed to MFI. Using the information from the InM Survey database, we find that around 20 percent of the non-MFI capital owned by the MFI recipient households is the result of accumulated MFI capital over the years. We therefore, added this to the MFI-capital stock. With this adjustment, the MFI-capital stock becomes 9.9 percent of the total capital stock in the economy in 2012.

The InM database was used for two other purposes. First, information on the ratio between borrower and non-borrower households was used to split the rural and urban households into MFI-recipient households and non-MFI-recipient households. Secondly, detailed information on the actual use of loans as reported by the households was utilized to allocate MFI capital among various sectors.

Table 2: Sectoral Shares of MFI loans (2011-2013 average): Mapping with SAM sectors

Sectors	**Share (%)**
Grains and Crops	25.74
Livestock, Fisheries and Meat Products	19.24
Mining and Extraction	0.00
Processed Food	0.00
Textiles and Clothing	0.00
Light Manufacturing	3.83
Heavy Manufacturing	0.00
Utilities and Construction	0.00
Transport and Communication	6.42
Other Services	44.77
Total	100.00

Source: InM database and SAM 2012

Table 2 presents the sectoral distribution of the MFI capital across 10 different sectors in the SAM. Out of those 10 sectors, MFI capital is used in 5 sectors. Services of various kinds (captured under 'other services' in the SAM) account for 44.8 percent of total MFI capital. 'Grains and crops' and 'livestock, fisheries and meat products' have shares of 25.7 percent and

19.2 percent respectively. The shares of 'light manufacturing' and 'transport and communication' are very small; only 3.8 percent and 6.4 percent respectively.

V. ESTIMATING THE CONTRIBUTION OF MICROFINANCE TO GDP: THE TRANSMISSION MECHANISM

The basic methodology of estimating the contribution to GDP is to ask the question: what would have been the GDP in Bangladesh in the base year 2012 if there were no microfinance? We call this the counterfactual GDP. The contribution of microfinance to GDP is then defined as the difference between actual GDP and the counterfactual GDP. The actual GDP is obtained directly from the SAM. The counterfactual GDP is derived by simulating the CGE model after letting the MFI capital vanish completely. While running the scenario with zero MFI capital, we made adjustments on two counts.

Firstly, from the InM Survey, we find that out of the total use of microfinance in rural and urban areas, some 15 percent was spent on "construction or maintenance of house". We consider this amount as investment on housing, which is around 6.4 percent of the total investment on housing in SAM 2012. Accordingly, we eliminated this part of housing capital while setting MFI capital to zero.

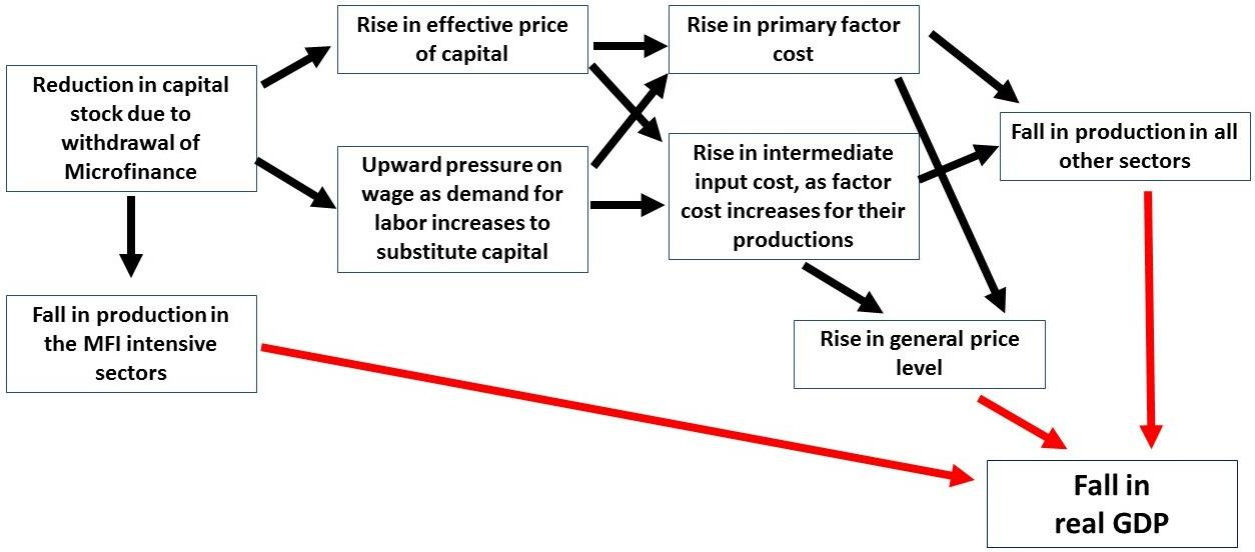
Secondly, we recognize that simply setting MFI capital to zero would not adequately capture the contribution of microfinance. The loss of output would be bigger than what would entail simply from vanishing capital since the reality is that MFI loans improve the efficiency of resource use by easing the credit constraint faced by the borrowers. Estimates from the InM Survey show that TFP in income generating activities was 3.53 percent higher for micro enterprises with access to microfinance compared to those without access to it (Muneer and Khalily, 2015). Therefore, as we simulate the CGE model by setting MFI capital to zero, we also account for the reduction in TFP associated with that capital stock.

We run the simulations under three different closures of labor market, reflecting different assumptions about how the labor market works: (i) flexible wage rates of both skilled and unskilled labor; (ii) fixed wage rate of unskilled labor and flexible wage rate of skilled labor; and (iii) fixed wage rates of both skilled and unskilled labor.

Figure 1 presents the transmission mechanism through which the reduction in capital stock (associated with the counterfactual with no microfinance) works through the economy. The immediate adverse effect of the reduction in capital stock would fall on the MFI-intensive sectors; output in these sectors would fall, and this would directly contribute to the fall in real GDP. There would be two other effects in the economy as the effective price of capital would increase, and there would be an upward pressure on wage as demand for labor would increase to compensate the fall in capital stock, and its magnitude would depend on the degree of substitutability between capital and labor. In the next step, higher effective prices of capital and labor would lead to a rise in the primary factor cost in the production process in the overall economy. The intermediate input cost would also rise as factor cost increases for their production. This rise in primary factor cost and intermediate input cost would in turn lead to a fall in production in all sectors of the economy (including the non-MFI-intensive ones) resulting in a fall in nominal GDP – and hence also a fall in real GDP at a given price level. At the same time, however, higher cost would also push up the general price level, which would

lead to a further fall in real GDP. Other effects (not shown in the diagram) include changes in the real exchange rate and domestic export prices caused by a rise in the general price level.

Figure 1: **The transmission mechanism of the impact of setting MFI capital to zero**



Source: Authors

Table 3 presents the results of the simulations with respect to the impacts on real GDP and other macro indicators under three different labor market assumptions. In the counterfactual scenario, in which microfinance is withdrawn, we find negative impacts on real GDP, gross output, exports and domestic sales. These negative impacts are in the range between 8.9 percent and 11.9 percent for real GDP, between 8.8 percent and 12 percent for gross output, between 6.9 percent and 11.7 percent for exports and between 9 percent and 12.1 percent for domestic sales.

Table 3: Impact of withdrawal of microfinance on real GDP and other macro indicators (% change from the base)

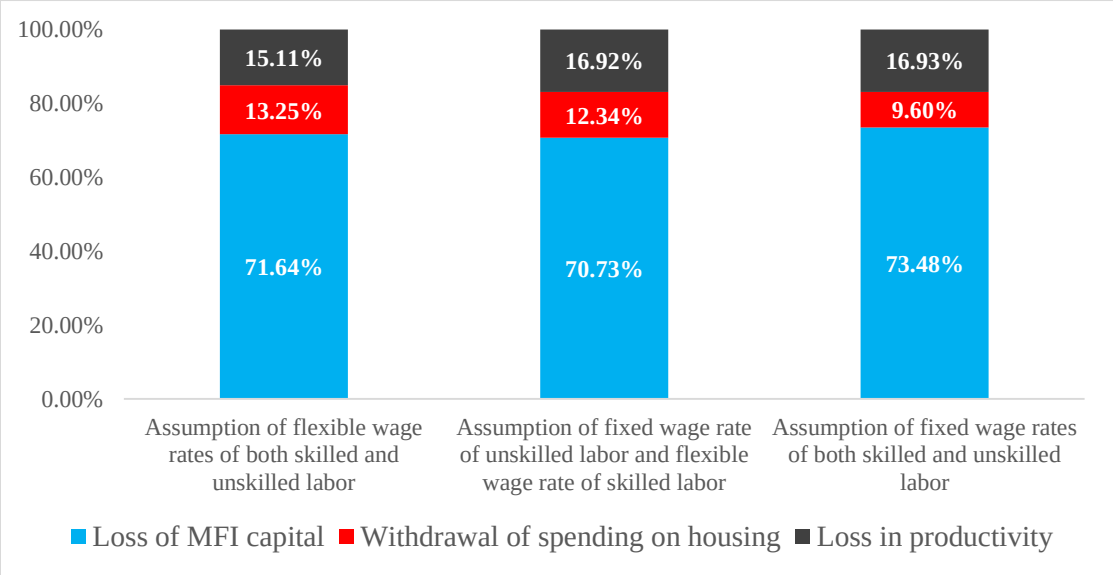
	Assumption of flexible wage rates of both skilled and unskilled labor	**Assumption of fixed wage rate of unskilled labor and flexible wage rate of skilled labor**	**Assumption of fixed wage rates of both skilled and unskilled labor**
Real GDP	-11.9	-10.0	-8.9
Volume of gross production	-12.1	-9.9	-8.8
Volume of exports	-11.7	-8.6	-6.9
Volume of domestic sales	-12.1	-10.1	-9.0

Source: Authors' CGE simulations

As discussed earlier, in our framework the adverse effect of the withdrawal of microfinance occurs on three accounts: (a) loss of MFI capital, (b) loss of spending on housing by households with access to loans, and (b) loss of improved TFP enjoyed by micro enterprises with access to loans. The loss of real GDP that occurs in the counterfactual scenario owing to the withdrawal of microfinance will occur for all three reasons. The decomposition of the loss of real GDP into the three components is presented in Figure 2. The loss of GDP due to loss of MFI capital is by far the largest component under all three assumptions about the labor market, accounting

for more than 70 percent of total loss of GDP. The effect of withdrawal of spending on housing is between 10 and 13 percent, and the productivity effect is between 15 and 17 percent.

Figure 2: Decomposition of the effect of withdrawal of microfinance on real GDP



Source: Calculated from the CGE simulation results

The distribution of the loss of output across broad economic sectors is shown in Table 4. Under all three scenarios, all three broad sectors experience fall in output. However, the largest negative impact falls on the agricultural sector. The relative impact on industry and services differ depending on the assumption made about the labor market.

Table 4: Impact of withdrawal of microfinance on the volume of output by broad sector (% change from the base)

	Assumption of flexible wage rates of both skilled and unskilled labor	Assumption of fixed wage rate of unskilled labor and flexible wage rate of skilled labor	Assumption of fixed wage rates of both skilled and unskilled labor
Agriculture	-20.5	-18.7	-18.5
Industry	-10.7	-7.7	-6.4
Services	-10.1	-8.6	-7.3
All sectors	-12.1	-9.9	-8.8

Source: Authors' CGE simulations

Table 5 shows the impact on volume of output by disaggregated sectors. The largest negative effects are observed, under all three scenarios, for 'grains and crops' and 'livestock, fisheries and meat products' sectors. Interestingly, though microfinance is not channeled to the 'processed food' 'textile and clothing', and 'heavy manufacturing' and is channeled to 'light manufacturing' only in a very small proportion (see Table 2), all these sectors are affected by sizeable margins. These impacts reflect the indirect, general equilibrium effect of microfinance on the economy. Similar observations hold for the services sectors.

Table 5: Impact of withdrawal of microfinance on the volume of output by sectors (% change from the base)

	Assumption of flexible wage rates of both skilled and unskilled labor	Assumption of fixed wage rate of unskilled labor and flexible wage rate of skilled labor	Assumption of fixed wage rates of both skilled and unskilled labor
Grains and Crops	-26.3	-24.1	-23.8
Livestock, Fisheries and Meat Products	-29.5	-27.8	-27.6
Mining and Extraction	-2.2	-1.2	-0.9
Processed Food	-8.7	-5.9	-4.7
Textiles and Clothing	-10.7	-7.4	-5.7
Light Manufacturing	-16.5	-13.9	-12.7
Heavy Manufacturing	-7.9	-6.2	-5.2
Utilities and Construction	-6.8	-6.1	-5.7
Transport and Communication	-10.9	-8.3	-6.9
Other Services	-12.1	-10.7	-8.8

Source: Authors' CGE simulations

The transmission mechanism depicted in Figure 1 suggests that the impact of microfinance on the real GDP operates via a number of prices – viz., the price of capital, nominal wages, primary factor cost, intermediate input cost, and general price level or the GDP deflator. Two other prices are also affected – the real exchange rate and the domestic price of exports. The impact on these prices resulting from the withdrawal of microfinance in the counterfactual scenario, are shown in Table 6 and the impact on sector-specific prices of capital are shown in Table 7. It may be seen that the withdrawal of microfinance induces an increase in the price of capital under all three assumptions about the labor market, with the agricultural sector experiencing the largest rise in the price of capital and the industrial sector the smallest. Nominal wage rises under the first two scenarios, but remains unchanged in the third scenario since we assume fixed wage rates of both skilled and unskilled labor in this case. Both the primary factor cost and intermediate input cost rise, leading to the rise in GDP deflator. The fall in real GDP, caused by the withdrawal of microfinance in the counterfactual scenario, is mediated by these price changes. It is also evident from Table 6 that real exchange rate appreciates under all three scenarios and domestic export price rise as a result of the rise in primary factor cost and intermediate input costs. The result is a loss in competitiveness of the export sector and reduction in the value of exports.

Table 6: Impact of withdrawal of microfinance on various prices (% change from the base)

	Assumption of flexible wage rates of both skilled and unskilled labor	Assumption of fixed wage rate of unskilled labor and flexible wage rate of skilled labor	Assumption of fixed wage rates of both skilled and unskilled labor
Price of capital	17.9	18.2	17.6
Nominal wage	3.9	1.9	0.0
Primary factor cost	14.5	13.4	12.1
Intermediate input cost	8.1	6.9	6.1
GDP price deflator	14.8	13.8	12.5
Real exchange rate	12.9	12.1	11.1
Domestic export price index	4.9	3.4	2.7

Source: Authors' CGE simulations

Table 7: Impact of withdrawal of microfinance on sectoral prices of capital (% change from the base)

	Assumption of flexible wage rates of both skilled and unskilled labor	Assumption of fixed wage rate of unskilled labor and flexible wage rate of skilled labor	Assumption of fixed wage rates of both skilled and unskilled labor
Agriculture	33.1	33.0	33.4
Industry	1.1	0.9	0.6
Services	19.9	20.2	19.2
All sectors	17.9	18.2	17.6

Source: Authors' CGE simulations

Since microfinance is heavily concentrated in the rural areas, it is also of interest to estimate the contribution of microfinance to rural GDP separately. Since there is no readily available information on the size of rural GDP in Bangladesh, we have calculated the contribution of rural microfinance to rural GDP by using information from the HIES of 2010 carried out by BBS. Data from HIES 2010 show that around 60 percent of the total factor incomes are generated in the rural area.[20] On that basis, we assumed that 60 percent of the GDP in Bangladesh in 2012 originated from the rural area. Also, data from InM surveys show that the average shares of rural and urban MFI loans in total MFI loans were 70 percent and 30 percent respectively. Using these ratios, we allocated the total loss of real GDP (caused by withdrawal of microfinance in the counterfactual scenario) between rural and urban areas. The results are reported in Table 8, where we also present the effect on total GDP for ease of comparison. Our estimates show that withdrawal of microfinance reduces rural GDP in the range of 12.6 and 16.6 percent. This figure is substantially higher than the loss of total GDP, which is in the range of 8.9 and 11.9 percent; this is understandable in view of the fact that microfinance is more heavily concentrated in the rural areas.

Table 8: Impact of withdrawal of microfinance on rural GDP (% change from the base)

	Assumption of flexible wage rates of both skilled and unskilled labor	Assumption of fixed wage rate of unskilled labor and flexible wage rate of skilled labor	Assumption of fixed wage rates of both skilled and unskilled labor
Rural real GDP	-16.6	-14.0	-12.6
Real GDP	-11.9	-10.0	-8.9

Source: Authors' CGE simulations

Since the negative impact of withdrawal of microfinance can be interpreted as the positive impact of microfinance on the economy, we may thus conclude that microfinance contributes somewhere in the range of 8.9 – 11.9 percent of national GDP and in the range of 12.6 – 16.6 percent of rural GDP (as of 2012).

VI. CONCLUSION

This paper has made the first systematic attempt at measuring the contribution of microfinance to the GDP of Bangladesh. In recognition of the fact that microfinance's contribution to GDP would arise not just from the difference it makes to the incomes of the borrowers but also from

[20] It should be noted that rural factor income does not refer to income derived only from agricultural activities. The data collected by HIES included factor income earned by rural households from all kinds of productive activities, including industry, transport and services. That is why we refer to it as rural GDP rather than as agricultural GDP.

its indirect repercussions on the rest of the economy, a general equilibrium approach was adopted. For this purpose, a CGE model was used, the empirical content of which was derived from an updated SAM of Bangladesh with base year of 2012, supplemented by household survey data on the reach and uses of microfinance.

Microfinance is used for a variety of purposes, including enterprise financing, asset accumulation, consumption smoothing, meeting unexpected shocks, etc. It was assumed for the purpose of the present study that only the part of microfinance that adds to the capital stock (both fixed and working capital) and improve productivity would contribute to the GDP by enhancing the capacity to generate more goods and services. As such, only the share of microfinance devoted to enterprise financing and housing development was considered relevant for the present study. This share was obtained from household survey data and is based on information given by the borrowers as to how they actually used the loans rather than what they declared on paper to the MFIs.

By considering only the capital-augmenting part of microfinance, it was possible to introduce microfinance in the CGE model as a part of the capital stock of the country. We thus made a distinction between MFI capital and non-MFI capital. By combining household-level information with national-level data, we estimated that MFI-capital accounted for some 9.9 percent of total capital stock of the country in 2012.

The issue of microfinance's contribution to GDP then boiled down to the following question: what would have been the GDP of Bangladesh if microfinance did not exist? The question was answered by simulating the CGE model to construct a counterfactual scenario in which microfinance did not exist. The difference between the actual GDP of the base year 2012 and the counterfactual GDP was taken as a measure of microfinance's contribution to the GDP of Bangladesh. We derived a range of estimates by using alternative assumptions about how the labor market behaves. Our estimates suggest that microfinance has contributed somewhere in the range of 8.9-11.9 percent of the GDP of Bangladesh and somewhere in the range of 12.6-16.6 percent of rural GDP.

The contribution has two parts. Firstly, there is a direct effect, raising the production of goods and services in the sectors in which microfinance is used for productive purposes. Secondly, there is an indirect general equilibrium effect on the rest of the economy. The latter effect operates by changing the prices of capital and labor. By adding to the capital stock, microfinance first brings down the effective price of capital. As producers substitute cheaper capital for labor, the effective price of labor also falls. Reduction in the effective prices of capital and labor then reduces the cost of production in all sectors of the economy, albeit to varying degrees, which in turn stimulates more production of goods and services.[21]

Finally, it is necessary to point out that there is scope for improving upon the work presented here. In particular, there is scope for considering additional transmission mechanism through which microfinance can potentially affect GDP. Mainly because of lack of necessary information but also because of the exploratory nature of the exercise, the model used in this study is not comprehensive enough to capture all possible transmission mechanisms. Examples of several such mechanism are given below.

[21] In section V above, this transmission mechanism was described to explain how GDP would fall if microfinance ceased to exist. In this paragraph, we have described the same transmission mechanism in reverse – to explain how GDP rises because of the introduction of microfinance.

First, the model we have used does not allow for the existence of underemployment. Yet, one of the contributions of microfinance is that it enables under-employed people engaged in self-enterprises to make fuller use of their time as greater access to credit allows them to produce more goods and services. Second, we have assumed that the part of microfinance that is used for consumption purposes does not contribute to the GDP. But this is not necessarily true. When access to credit allows households to ensure consumption smoothing, they may be encouraged to undertake investments that are riskier but yield higher returns on the average. Third, as higher income earned by productive borrowers enables them to spend more on the education and healthcare of their children, the stock of human capital would improve in the future which should help achieve greater output in the long run. The static nature of our model is not capable of capturing such dynamic gains. Fourth, insofar as access to microfinance leads to greater empowerment of women, this too should result in dynamic gains in output in the long run since empowered women are known to be better able to allocate household resources in favor of better education and healthcare of children. Most of the limitations discussed above stem essentially from the static nature of the model used in this paper, which is admittedly of an exploratory nature. Future research in this area should try to address these limitations by using a more comprehensive dynamic general equilibrium model.

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Appendix

The CGE model

The CGE model used in this paper has been built using the PEP standard static model (Decaluwe *et al*., 2009), with further developments and modifications. The model assumes that a representative firm in each industry maximizes profits subject to its production technology. Sectoral output follows a Leontief fixed-coefficient production function. Each sector's value-added consists of returns to composite labor and composite capital. Different categories of labor (and capital) are assumed to be imperfect substitutes of each other. For the sake of analytical convenience, the degree of substitution is assumed to be constant; this allows both composite labor and composite capital to be aggregated following a constant elasticity of substitution (CES) technology. It is further assumed that intermediate inputs are perfectly complementary; as such, they are combined following a Leontief production function.

Household incomes come from labor income, capital income, and transfers received from other agents. Subtraction of direct taxes from gross income yields household's disposable income. Household savings are assumed to be a linear function of disposable income, which allows the marginal propensity to save to differ from average propensity. Corporate income consists of its share of capital income and of transfers received from other agents. Deducting business income taxes from total income yields the disposable income of each type of business. Business savings are the residuals that remain after subtracting transfers to other agents from disposable income. The government draws its income from household and business income taxes, taxes on products and on imports, and other taxes on production. Income taxes for both households and businesses are described as a linear function of total income. The current government budget surplus or deficit (positive or negative savings) is the difference between its revenue and its expenditures. The latter consists of transfers to agents and current expenditures on goods and services. The rest of the world receives payments for the value of imports, part of the income of capital, and transfers from domestic agents. Foreign spending in the domestic economy consists of the value of exports and transfers to domestic agents. The difference between foreign receipts and spending is the amount of rest-of-the-world savings, which are equal in absolute value to the current account balance but are of opposite sign.

The demand for goods and services, whether domestically produced or imported, consists of household consumption demand, investment demand, demand by government, and demand as transport or trade margins. It is assumed that households have Stone–Geary utility functions (from which derives the Linear Expenditure System). Investment demand includes both gross fixed capital formation (GFCF) and changes in inventories.

Producers' supply behavior is represented by nested constant elasticity of transformation (CET) functions. On the upper level, aggregate output is allocated to individual products; on the lower level, the supply of each product is distributed between domestic market and exports. The model departs from the pure form of small-country assumption by allowing that a local producer can increase his/her share of the world market only by offering a price that is advantageous relative to the (exogenous) world price. The ease with which this share can be increased depends on the degree of substitutability of the proposed product for competing products; in other words, it depends on the price-elasticity of export demand. Commodities demanded on the domestic market are composite goods, i.e. combinations of locally produced goods and imports. The imperfect substitutability between the two is represented by a CES

aggregator function. Naturally, for goods with no competition from imports, the demand for the composite commodity is the same as the demand for domestically produced good.

The system requires equilibrium between the supply and demand of each commodity in the domestic market. The sum of supplies of every commodity made by local producers must equal domestic demand for that locally produced commodity. Finally, supply to the export market of each good must be matched by demand. Also, there is equilibrium between total demand for capital and its available supply. In the case of labor, the model assumes two alternative equilibrium rules: (a) equality between demand and supply of labor with no unemployment or (b) flexible supply of labor with fixed wage rates allowing for unemployment.

In the model, the CES elasticity for composite capital is considered to be 0.8, CES elasticity for composite labor is 0.8, CES elasticity for value added is 1.5, CET elasticity for total output is 2, sectoral CES elasticity for composite commodity ranges between 1.6 and 2, sectoral CET elasticity between exports and local sales ranges between 1.6 and 2, and sectoral price elasticity of the world demand for exports of products ranges between 2 and 3. These elasticity estimates are frequently used in the CGE models for developing countries like Bangladesh and are derived from Decaluwe *et al.* (2009).

Key equations used in the CGE model are provided below:

Production block

1. $VA_j = v_j XST_j$
2. $VA_j = B_j^{VA}\left[\beta_j^{VA} LDC_j^{-\rho_j^{VA}} + \left(1-\beta_j^{VA}\right) KDC_j^{-\rho_j^{VA}}\right]^{-\frac{1}{\rho_j^{VA}}}$
3. $LDC_j = B_j^{LD}\left[\sum_l \beta_{l,j}^{LD} LD_{l,j}^{-\rho_j^{LD}}\right]^{-\frac{1}{\rho_j^{LD}}}$
4. $KDC_j = B_j^{KD}\left[\sum_k \beta_{k,j}^{KD} KD_{k,j}^{-\rho_j^{KD}}\right]^{-\frac{1}{\rho_j^{KD}}}$

Income block

5. $YH_h = YHL_h + YHK_h + YHTR_h$
6. $YG = YGK + TDHT + TDFT + TPRODN + TPRCTS + YGTR$
7. $YROW = e\sum_i PWM_i IM_i + \sum_k \lambda_{row,k}^{RK}\left(\sum_j R_{k,j} KD_{k,j}\right) + \sum_{agd} TR_{row,ag}$

Demand block

8. $C_{i,h}PC_i = C_{i,h}^{MIN} PC_i + \gamma_{i,h}^{LES}\left(CTH_h - \sum_{ij} C_{ij,h}^{MIN} PC_{ij}\right)$
9. $GFCF = IT - \sum_i PC_i VSTK_i$

Producer Supplies of Products and International Trade block

10. $XST_j = B_j^{XT}\left[\sum_i \beta_{j,i}^{XT} XS_{j,i}^{\rho_j^{XT}}\right]^{\frac{1}{\rho_j^{XT}}}$
11. $XS_{j,i} = B_{j,i}^{X}\left[\beta_{j,i}^{X} EX_{j,i}^{\rho_{j,i}^{X}} + \left(1-\beta_{j,i}^{X}\right) DS_{j,i}^{\rho_{j,x}^{X}}\right]^{\frac{1}{\rho_{j,i}^{X}}}$

12. $Q_i = B_i^M \left[\beta_m^M IM_i^{-\rho_i^M} + (1-\beta_i^M) DD_i^{-\rho_i^M}\right]^{\frac{-1}{\rho_i^M}}$

Price indexes block

13. $PIXGDP = \sqrt{\frac{\sum_j PVA_j VAO_j \sum_j PVA_j VA_j}{\sum_j PVAO_j VAO_j \sum_j PVAO_j VA_j}}$
14. $PIXCON = \frac{\sum_i PC_i \sum_h C_{i,h}^0}{\sum_{ij} PC_{ij}^0 \sum_h C_{ij,h}^0}$

Gross Domestic Product block

15. $GDP^{BP} = \sum_j PVA_j VA_j + TIPT$
16. $GDP^{MP} = GDP^{BP} + TPRCTS$
17. $GDP^{IB} = \sum_{l,j} W_l LD_{l,j} + \sum_{k,j} R_{k,j} KD_{k,j} + TPRODN + TPRCTS$
18. $GDP^{FD} = \sum_i PC_i\left[\sum_h C_{i,h} + CG_i + INV_i + VSTK_i\right] + \sum_i PE_i^{FOB} EXD_i - e\sum_i PWM_i IM_i$

Equilibrium block

19. $Q_i = \sum_h C_{i,h} + CG_i + INV_i + VSTK_i + DIT_i + MRGN_i$
20. $\sum_j LD_{l,j} = LS_l$
21. $\sum_j KD_{k,j} = KS_k$
22. $IT = \sum_h SH_h + \sum_f SF_f + SG + SROW$
23. $\sum_j DS_{j,i} = DD_i$

Where,

$C_{i,h}$: Consumption of commodity i by type h households
$C_{i,h}^o$: Consumption of commodity i by type h households
$C_{ij,h}^o$: Consumption of commodity i from sector j by type h households
$C_{ij,h}^{MIN}$: Minimum consumption by type h households of commodity i produced by sector j
CG_i: Public consumption of commodity i
DD_i: Domestic demand for commodity i produced locally
DIT_i: Total intermediate demand for commodity i
$DS_{j,i}$: Supply of commodity i by sector j to the domestic market
$EX_{j,i}$: Quantity of product i exported by sector j
EXD_i: World demand for exports of product i
IM_i: Quantity of product i imported
INV_i: Final demand of commodity i for investment purposes
$KD_{k,j}$: Demand for type k capital by industry j
KDC_j: Industry j demand for composite capital
KS_k: Supply of type k capital
$LD_{l,j}$: Demand for type l labor by industry j
LDC_j: Industry j demand for composite labor
LS_l: Supply of type l labor
$MRGN_i$: Demand for commodity i as a trade or transport margin
Q_i: Quantity demanded of composite commodity i
VA_j:Value added of industry j
VAO_j: Initial Value added of industry j
$VSTK_i$: Inventory change of commodity i

$XS_{j,i}$: Industry j production of commodity i
XST_j: Total aggregate output of industry j
e: Exchange rate; price of foreign currency in terms of local currency
$P_{j,i}$: Basic price of industry j's production of commodity i
PC_i: Purchaser price of composite comodity i (including all taxes and margins)
PC_{ij}: Purchaser price of composite commodity i produced by sector j (including all taxes and margins)
$PC_{i,j}^{o}$: Initial purchaser price of composite commodity i produced by sector j (including all taxes and margins)
PE_i^{FOB}: FOB price of exported commodity i (in local currency)
$PIXCON$: Consumer price index
$PIXGDP$: GDP deflator
PVA_j: Price of industry *j* value added (including taxes on production directly related to the use of capital and labor)
$PVAO_j$: Initial price of industry *j* value added (including taxes on production directly related to the use of capital and labor)
PWM_i: World price of imported product i (expressed in foreign currency)
$R_{k,j}$: Rental rate of type k capital in industry j
W_l: Wage rate of type l labor
CTH_h: Consumption budget of type h households
GDP^{BP}: GDP at basic prices
GDP^{FD}: GDP at purchasers' prices from the perspective of final demand
GDP^{IB}: GDP at market prices (income-based)
GDP^{MP}: GDP at market prices
$GFCF$: Gross fixed capital formation
IT: Total investment expenditures
SF_f: Savings of type f businesses
SG: Government savings
SH_h: Savings of type h households
SROW: Rest-of-the-world savings
TDFT: Total government revenue from business income taxes
TDHT: Total government revenue from household income taxes
TIPT: Total government revenue from production taxes (excluding taxes directly related to use of capital and labor)
$TPRCTS$: Total government revenue from taxes on products and imports
$TPRODN$: Total government revenue from other taxes on production
$TR_{row,ag}$: Transfers from rest of the world account to agent ag
YG: Total government income
YGK: Government capital income
$YGTR$: Government transfer income
YH_h: Total income of type h households
YHK_h: Capital income of type h households
YHL_h: Labor income of type h households
$YHTR_h$: Transfer income of type h households
$YROW$: Rest-of the-world income
B_j^{KD} : Scale parameter (CES – composite capital)
B_j^{LD} : Scale parameter (CES – composite labor)
B_i^{M} : Scale parameter (CES – composite commodity)

B_j^{VA} : Scale parameter (CES – value added)
$B_{j,i}^{X}$: Scale parameter (CET – exports and local sales)
B_j^{XT}: Scale parameter (CET – total output)
$\beta_{k,j}^{KD}$: Share parameter (CES – composite capital)
$\beta_{l,j}^{LD}$: Share parameter (CES – composite labor)
β_i^M : Share parameter (CES – composite commodity)
β_j^{VA} : Share parameter (CES – value added)
$\beta_{j,i}^{X}$: Share parameter (CET – exports and local sales)
$\beta_{j,i}^{XT}$: Share parameter (CET – total output)
$\gamma_{i,h}^{LES}$: Marginal share of commodity i in type h household consumption budget
$\lambda_{row,k}^{RK}$: Share of type k capital income received in the rest of the world account
ρ_j^{KD} : Elasticity parameter (CES – composite capital); $-1 < \rho_j^{KD} < \infty$
ρ_j^{LD} : Elasticity parameter (CES – composite labor); $-1 < \rho_j^{LD} < \infty$
ρ_i^M : Elasticity parameter (CES – composite commodity); $-1 < \rho_m^M < \infty$
ρ_j^{VA} : Elasticity parameter (CES – value added); $-1 < \rho_j^{VA} < \infty$
$\rho_{j,i}^{X}$: Elasticity parameter (CET – exports and local sales); $-1 < \rho_{j,x}^{X} < \infty$
ρ_j^{XT} : Elasticity parameter (CET – total output); $-1 < \rho_j^{XT} < \infty$
v_j : Coefficient (Leontief – value added)

A Brief description of the Social Accounting Matrix (SAM) of Bangladesh for 2012

At the core of a SAM lies the structure of production in an economy. This core is then supplemented by information on: (a) the distribution of value added to institutions involved in production activities; (b) formation of household and institutional income; (c) the pattern of consumption, savings and investment; (d) government revenue collection and associated expenditures and transactions; and (e) the role of the foreign sector in the formation of additional incomes for household and institutions. In particular, the accounting matrix of a SAM identifies economic relations through six accounts: (1) total domestic supply of commodities; (2) activity accounts for producing sectors; (3) main factors of productions (e.g. labor types and capital); (4) current account transactions between main institutional agents such as households and unincorporated capital, corporate enterprises, government and the rest of the world and the use of income by the representative households; (5) transactions with the rest of the world; and (6) one consolidated capital account (domestic and rest of the world) to capture the flows of savings and investment by institutions and the rest of the world respectively.

A SAM can serve two basic purposes: (i) as a comprehensive and consistent data system for descriptive analysis of the structure of the economy and (ii) as a basis for macroeconomic modeling. As a data framework, a SAM is a snapshot of a country at a point in time (Pyatt and Thorbecke, 1976). To provide as comprehensive a picture of the structure of the economy as possible, a particular novelty of the SAM approach has been to bring together macroeconomic data (such as national accounts) and microeconomic data (such as household surveys) within a consistent framework. The second purpose of a SAM is the provision of a macroeconomic database for policy modeling. The framework of a SAM can often help in establishing the sequence of interactions between agents and accounts which are being modeled. A SAM provides an excellent framework for exploring both macroeconomic and multi-sectoral issues and is a useful starting point for more complex models (Robinson, 1989).

The construction of the 2012 SAM of Bangladesh is based on several data sets drawn from diverse sources. They are as follows: (i) the Input-output Table 2007; (ii) a SAM for Bangladesh for 2007 developed by Raihan and Khondker (2010); (iii) the supply-use table of Bangladesh obtained from ADB (2012); (iv) the input-output table from the GTAP database version 8; (v) data on various components of the demand side as collected from the BBS[22]; (vi) the matrix of private consumption data and the matrix of factor income data are further distributed among two representative household groups using the unit record data of HIES 2010; (vii) export and import data from UN COMTRADE and UN Service trade; (viii) information on direct and indirect taxes and subsidies as collected from National Board of Revenue and the Finance division, Ministry of Finance.

The updating/construction of SAM proceeded in two steps. In the first step, a 'proto-SAM' 2012 was constructed. Since the data came from different sources, in line with expectation, the estimated 'proto-SAM' was unbalanced especially in the 'institutional accounts'. In the second step, the SAM was balanced by adjusting the household accounts (i.e. private consumption and savings).

The 2012 SAM for Bangladesh has the following accounts: (1) total domestic supply of 10 commodities; (2) production accounts for 10 activities; (3) 4 factors of productions: two labor types and two capital categories; (4) current account transactions between 4 current institutional agents – households, corporate enterprises, government, and the rest of the world; the household account includes 2 representative groups (1 rural and 1 urban); and (5) one consolidated capital account. A summary description of the Bangladesh SAM is described in Appendix Table A.1.

Appendix Table A.1: Description of Bangladesh SAM Accounts for 2012

Set	Description of Elements
Activity (10)	Grains and Crops, Livestock, Fisheries and Meat Products, Mining and Extraction, Processed Food, Textiles and Clothing, Light Manufacturing, Heavy Manufacturing, Utilities and Construction, Transport and Communication, Other Services
Commodity (10)	Grains and Crops, Livestock, Fisheries and Meat Products, Mining and Extraction, Processed Food, Textiles and Clothing, Light Manufacturing, Heavy Manufacturing, Utilities and Construction, Transport and Communication, Other Services
Factors of Production (4)	Unskilled labor, Skilled labor, Capital and Land
Households (2)	Rural Households and Urban Households
Other Institutions (4)	Government; Corporation; Rest of the World and Capital

Source: Bangladesh SAM 2012 from Raihan (2014)

The structure of the economy as in 2012 SAM

Appendix Table A.2 presents the structure of the Bangladesh economy in 2012 as reflected in the SAM. In terms of value addition, among the agricultural sectors, the leading sector is 'grains and crops' with 11.3 percent share. Among the manufacturing sectors, the leading sector is 'textile and clothing' (7.6 percent share). Among the services sectors, the leading sector is 'transport and communication' (27.7 percent share). The textile and clothing sector is highly

[22] In particular, data on public consumption, gross fixed capital formation, and private consumption have been obtained from BBS.

export oriented. The export basket is highly concentrated as 88.1 percent of exports come from 'textile and clothing'. The heavy manufacturing sector is highly import-dependent. As for tariff rates, agricultural sectors have much lower tariff rates than the manufacturing sectors.

Appendix Table A.2: Structure of the Bangladesh economy as reflected in the SAM 2012

	1	2	3	4	5	6
Sectors	**Vi/TV**	**Ei/Oi**	**Ei/TE**	**Mi/Oi**	**Mi/TM**	**TAR**
Grains and Crops	11.33	0.42	0.56	9.09	8.05	4.52
Livestock, Fisheries and Meat Products	1.25	0.07	0.01	2.25	0.25	8.22
Mining and Extraction	6.60	0.16	0.08	2.20	0.75	7.61
Processed Food	1.34	1.53	1.59	15.96	10.87	13.38
Textiles and Clothing	7.55	51.68	88.12	17.57	19.70	25.33
Light Manufacturing	1.74	2.41	1.44	20.83	8.22	19.59
Heavy Manufacturing	0.99	1.17	1.26	60.96	43.16	11.77
Utilities and Construction	16.86	-	-	-	-	-
Transport and Communication	27.65	2.87	6.30	2.42	3.49	-
Other Services	24.69	0.28	0.63	3.65	5.52	-
Total	100.00	—	100.00	—	100.00	—

Note: Vi=sectoral value added, TV=total value added, Ei=sectoral export, Oi=sectoral output, TE=total export, Mi=sectoral import, TM=total import, TAR=tariff rate, All figures are expressed in percentages.
Source: Raihan (2014)