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Technical Efficiency Analysis

Highlights

Capital Adequacy Regulations

Rural Household Vulnerability

Discovering Thoughts, Inventing Future

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Capital Adequacy Regulations in Hungary: Did It Really Matter?

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Abstract- The main purpose of this paper is twofold. First, it aims to estimate the effect of the tightening of regulatory capital requirements on the real economy during credit upswing. Second, it intends to show whether applying a countercyclical capital buffer measure, as per the Basel III rules,could have helped decelerate FX lending growth in Hungary, mitigating the build-up of vulnerabilities in the run-up to the global financial crisis. To answer these questions, we use a Vector Autoregression-based approach to understand how shocks affected to capital adequacy in the pre-crisis period.Our results suggest that regulatory authorities could have slowed the increase in lending temporarily.They would not, however, have been able to avoid the upswing in FX lending by requiring countercyclical capital buffers even if such a tool had been available and they had reacted quickly to accelerating credit growth. Our results also suggest that a more pronounced tightening might have reduced FX lending substantially, but at the expense of real GDP growth. The reason is that an unsustainable fiscal policy led to a trade-off between economic growth and the build-up of new vulnerabilities in the form of FX lending.

Keywords: *FX lending, capital adequacy, bank regulation, counterfactual analysis.*
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Capital Adequacy Regulations in Hungary: Did It Really Matter?

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Abstract- The main purpose of this paper is twofold. First, it aims to estimate the effect of the tightening of regulatory capital requirements on the real economy during credit upswing. Second, it intends to show whether applying a countercyclical capital buffer measure, as per the Basel III rules,could have helped decelerate FX lending growth in Hungary, mitigating the build-up of vulnerabilities in the run-up to the global financial crisis. To answer these questions, we use a Vector Autoregression-based approach to understand how shocks affected to capital adequacy in the pre-crisis period.Our results suggest that regulatory authorities could have slowed the increase in lending temporarily.They would not, however, have been able to avoid the upswing in FX lending by requiring countercyclical capital buffers even if such a tool had been available and they had reacted quickly to accelerating credit growth. Our results also suggest that a more pronounced tightening might have reduced FX lending substantially, but at the expense of real GDP growth. The reason is that an unsustainable fiscal policy led to a trade-off between economic growth and the build-up of new vulnerabilities in the form of FX lending.

Keywords: FX lending, capital adequacy, bank regulation, counterfactual analysis

I. Introduction

The global financial crisis (GFC) shed light on the importance of the so-called macro-financial linkages through which financial sector activity could have a meaningful impact on economic activity. At the same time, it was also made clear that neither pre-crisis financial supervisory practices nor monetary policy succeeded in ensuring financial stability. As part of a general reassessment of economic policies, macroprudential policies gained traction and have become a part of the overall policy response to the challenges the crisis posed.

Several factors have complicated the adoption of these policies.[1] First, macroprudential policies should be motivated by externalities and market failures. However, there is no clear guidance on the design of these policies. Second, given that most countries resorted to macroprudential policies only recently, there is limited experience and empirical analysis to judge their efficiency.

Hungary, like other countries, also had to realize the importance of macro-financial linkages. In contrast to several other countries that experienced an asset price boom and/or excessive credit growth in the pre-crisis period, however, the main source of vulnerability was the currency mismatch stemming from the foreign currency, mostly Swiss franc, borrowing by households and corporations as well as the maturity mismatch of banks. Specifically, the banking sector financed its long-term foreign currency lending with short-term off-balance sheet transactions (mostly FX, but also currency interest rateswaps). The GFC impacted the banking sector in at least three key ways. First, increased risk aversion in global financial markets prompted a flight to safe assets, including the Swiss franc. The rising debt service of households and corporations stemming from the appreciation of the Swiss franc then led to an increase in bank losses on their loan portfolio. Second, banks had to meet margin calls on their FX swaps due to the depreciation of the Hungarian forint. Third, a few banks had difficulties in rolling over their short-term FX swaps during the crisis.

In this paper, we apply a counterfactual analysis to assess whether excessive credit growth and the build-up of FX loans could have been prevented by the use of macroprudential policies.[2] Specifically, by estimating the historical relationship between aggregate capital adequacy, lending and a set of macroeconomic variables, we calculate an alternative scenario of pre-crisis lending based on a hypothetical capital adequacy regulation.

The structure of the paper is as follows. Section 2 reviews the literature. Section 3 gives an overview on the motivation of the analysis. Sections4 and 5 describe the data and the estimation technique, respectively. Section 6 summarizes the estimation results and section 7 concludes.

II. Related Literature

Given the brief history of the application of macroprudential policies, there is only a small number of empirical papers analyzing the efficiency of these tools. Estimating the effect of macroprudential rules is complicated for at least two reasons: (i) they rarely existedbefore the GFC; and (ii) those already in place (especially the capital adequacy ratio) were broadly stable in the pre-crisis period.

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[1] SeeClaessens (2014).

[2] Based on IMF (2000), aggregate capital adequacy ratio is considered to be a macroprudential indicator.

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Based on the applied method, we can group the existing literature into two categories:

1. Bottom-up approach, i.e. estimations using micro-level data

   Bridges et al. (2014) analyzed the effect of changes in the regulatory capital requirements on lending, based on bank-level data. They used estimation results from panel regressions of lending to different sectors on regulatory capital requirements and observed capital ratios to build impulse responses with the aim of understanding the effects of a permanent 1 percentage point increase in capital requirements. Although the results vary across sectors, they found that an increase in capital requirements reduces loan growth with a lag of one year and a recovery within three years. The cumulative effect of a 1 percentage point increase in the regulatory capital on loan volumes is -3.5 percent after 12 quarters.Brun et al. (2014) used loan-level data in France with the aim of estimating the effect of an easing of the capital requirement on corporate lending. Theirtime span covered the transition from Basel I to Basel II in order to estimate the elasticity of corporate lending to capital requirement. They found a relatively large effect of capital requirements on lending, i.e. a 1 percentage point decrease in capital requirements led to a 0.75 percent growth in outstanding corporate loans.Berrospide et al. (2010) examined the effect of capital injection programs in the U.S., such as that ofthe Capital Purchase Program (CPP). They carried out both panel regression and VAR-based analysis, and found only a modest effect of capital on lending. According to their results, a 1 percentage point increase in the capital-to-assets ratio triggered an increaseof 0.7-1.2 percentage point in lending growth.

2. Top-down approach, i.e. estimations using aggregated data

   As a part of their impact studies for Basel III, BIS (2010) implemented two different one-step top-down approaches for estimating the effect of increasing capital requirements.First, they used DSGE models that explicitly incorporated the banking sector. The results are modest, with a 1 percentage point increase in the target capital adequacy ratio leading to a decrease of 0.14 percentin output after 18 quarters. Second, they estimated VAR models that included standard macroeconomic variablessuch as real GDP growth, GDP deflator and interest rates as well asbanking sector variables such as aggregate bank loans and capital/asset ratios. The results from these estimations were more pronounced, with a 1 percentage point increase in the target capital ratio leading to a 0.4 percentdecrease in output. Noss and Toffano (2014) assessed the impact of changes in capital requirements on lending in the United Kingdom, by estimating a SVAR model. They assumed that an increase in banks' capital requirements would have a negative effect on lending at least in the short run. This assumption is necessary to understand to what extent the change in bank lending behavior was a result of the increasing capital requirement, rather than broader macroeconomic developments. They found that a 15 basis point increase in capital requirements during an economic upswing is associated with a 1.4 percentage point decrease in lending after 16 quarters. At the same time, its effect on GDP was found to be insignificant.

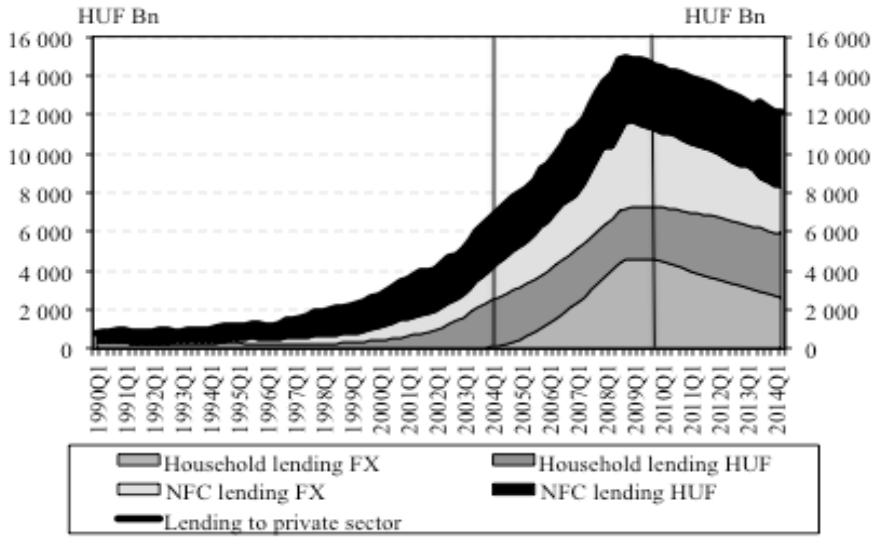
A few studies aimed to estimate the effect of changes in regulatory capital in Hungary. Following the introduction of regulations based on Basel II, Zsámboki (2007) investigated their potential consequences, in particular on financial stability. He pointed out that given the procyclical nature of the regulation, banks should build up capital reserves above the regulatory minimum requirements during an economic upswing in order to be able to cover any future losses. Although the analysis drew attention to the procyclical nature of the Basel II regulation, it did not examine its potential effect on the real economy. Szombati (2010) analyzedthe macroeconomic effect of Basel III rules. She found that a 1 percent(equivalent to around 13 basis points) increase in the capital requirement is associated with a decrease of 0.63-1.05 percent in real GDP after 32 quarters. These results assumed that (i) the banking sector adapts to the new regulationin equal measure with capital increases and asset reductions; (ii) the adjustment would be faster in corporate lending than in household lending; and (iii) banks with larger capital buffers could take over loans from other banks with lower capital buffers.

Tamási and Világi (2011) andHosszú et al. (2013) estimated a Bayesian VAR model for the Hungarian economy and applied sign restrictions to identify macroeconomic and credit supply shocks. Assuming that different types of credit supply shocks might require different policy responses, they analyzed the effect of changing risk assessments of financial institutions as well as that of changing regulatory requirements (credit spread shock). They found that the impact of the two shocks differs substantially. For changing risk assessment, the response of credit portfolio and real GDP are much more pronounced and permanent than foracredit spread shock. Their results show that changing risk assessment indicates a 1 percent decrease in lending and 0.21 percent decrease in real GDP, while changing regulatory requirements has a negative effect of 0.18 percent on real GDP. The order of magnitude and the permanence of the response ofreal variables could be explained by the fact that the underlying VAR model contained only corporate loans whose duration is typically lower than that of households.

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III. Motivation: Excessive Borrowing in Foreign Currency?

Private sector borrowing increased substantially between 2004 and 2009 mostly driven by foreign currency (Swiss franc) denominated loans (Figure 1). Both non-financial corporations and households increased their foreign currency borrowing;however, the borrowing was more pronounced in the household sector.



Note: Household FX lending has been corrected for the effect of the early repayment scheme (starting in 2011 Q4). Data are adjusted for changes in the exchange rate.

Source: Central Bank of Hungary

Figure 1: Lending to private sector

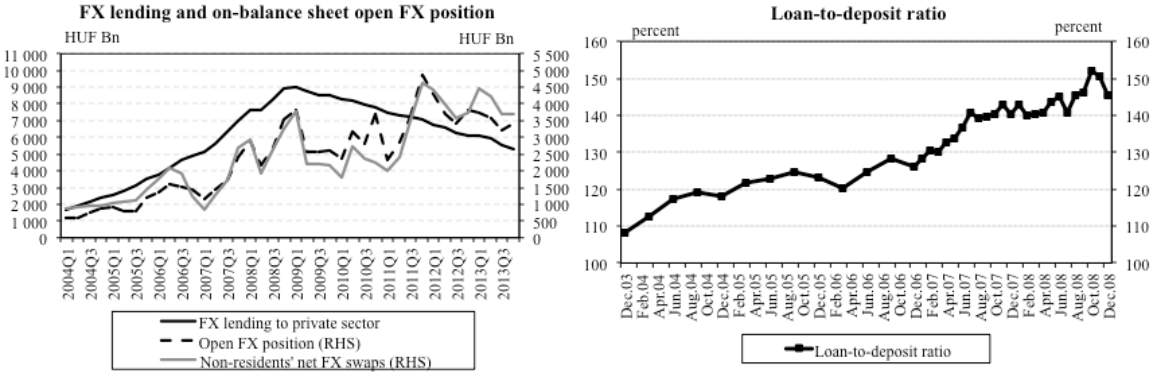
Using four different trend-filtering methods, Hosszú et al. (2015) showed that in the early 2000s, the initially negative credit gap turned into a significant positive credit gap both in the household and corporate sectors. Their results are mostly in line with that of Holló (2012). He found that the imbalances in the Hungarian banking system, namely the excessive credit growth and the sharp increase in the ratio of total liabilities to stable funds, started to emerge in the last quarter of 2005 and lasted until the onset of the financial crisis. Kiss et al. (2006) concluded that although credit growth between 2004 and 2005 was somewhat faster than its equilibrium rate,[3] this can be justified by convergence. It implies that it was not the speed of lending growth per se that should have given rise to concerns but rather its currency composition; i.e. the excessive lending in foreign currency.

There are several possible explanations why foreign currency lending gained momentum in Hungary. To find explanations, we first try to identify whether the motivation originated from the demand or the supply side.

Bethlendi et al. (2005) found that the increase in FX lending, which started in 2004,was mostly due to rising demand, possibly reflected bythe opening of Hungarian banks' on-balance sheet FX position and their increasing loan-to-deposit ratio (Figure 2).

[3] The equilibrium level is identified by some fundamental macroeceonomic variables for developed countries based on a longer time frame.

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Source: Central Bank of Hungary

Figure 2: FX lending, on-balance sheet open FX position and loan-to-deposit ratio of Hungarian banks

Bethlendi et al. (2005),Rosenberg and Tirpák (2008) and Csajbók et al. (2010)identified the following factors on the demand side that presumably contributed to the increase in FX lending. The first three are more relevant for households, while the fourth concerns mostly non-financial corporations.

- Interest rate differentials: The increasing share of FX lending in the private sector stems from a portfolio allocation decision based on the uncovered interest rate parity. Specifically, the domestic interest rate is equal to the sum of the foreign interest rate, the expected depreciation of the exchange rate and the exchange rate risk premium. As long as the risk awareness of borrowers is the same as the sum of expected exchange rate movements and exchange rate risk premium, changes in interest rate differential do not induce substitution between domestic and foreign currency loans. Substitution only happens if exchange rate expectations are not homogenous. Since households had relatively good experiences with consumer FX loans, their risk sensitivity against exchange rate and interest rate was probably quite low. The substantial interest rate differential thus led households to borrow in foreign currency.The latterwas also an important factor for non-financial corporations operating in the non-tradable sector (Bodnár, 2006), therefore they became exposed to exchange rate risks to a similar extent as households.
- 'Fear-of-floating' factor: Given lack of fixed-rate domestic currency loans, borrowers might weigh the risks associated with floating-rate domestic currency loans against foreign currency loans. Specifically, to the extent domestic currency interest rate volatility exceeds exchange rate volatility, borrowers might find foreign currency borrowing more attractive. This can be reinforced by the monetary authority, if it uses interest rate policy to smooth exchange rate movements.
- Liquidity constraint: Ifa household is only able to pay more than a certain proportion of its income to service its debt,the size of the monthly debt service and its variance arecrucial factors. Most households could not afford the high monthly repayment of HUF loans. Households with stronger liquidity constraints typically generated demand for cheaper FX loans. Moreover, the longer the maturity of the loan, the larger the effect of the interest rate differential on the monthly repayments.
- Regulatory changes: The tightening of the eligibility criteria of subsidized mortgage loans in 2004 could also have prompted households to switch to cheaper FX loans.
- Hedging FX deposits: Non-financial corporations that have FX revenues borrowed in foreign currency in order to hedge their FX income.

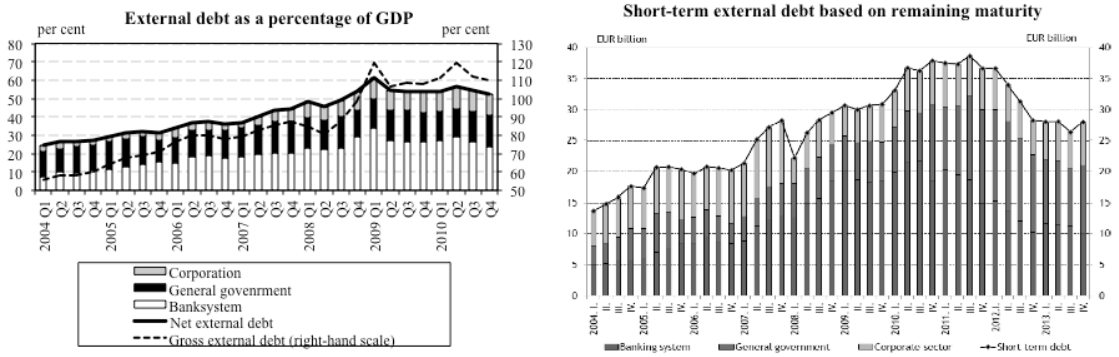
On the supply side, the authors mention that the availability of foreign funds stemming fromstrong financial ties between domestic commercial banks and their parent banks residing in the EU might also have influenced the currency composition of loans.

The private sector's increasing demand for FX loans increased the banking sector's need for FX funds. Hungarian banks collecting mostly HUF deposits had two possibilities to fulfil this need:

1. On-balance sheet foreign currency financing, typically from parent banks,
2. Off-balance sheet swap transactions.

Both forms of FX funding contributed to the build-up of macroeconomic vulnerabilities. First, risks related to on-balance sheet FX fundingstem from a country's increasing external debt (Figure 3). Moreover, banks typically financed long-term mortgage FX loans with short-term foreign funds, leading to a maturity mismatch and thus substantial roll-over risks as well as potential reliance on emergency FX liquidity facilities.

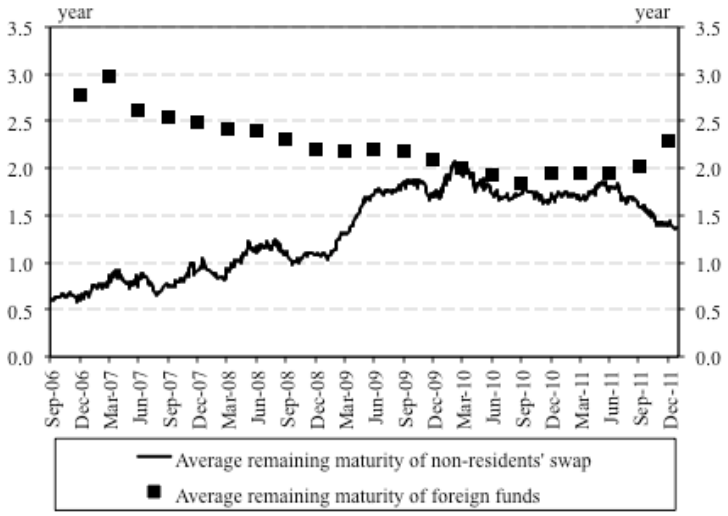
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Source: Central Bank of Hungary, Central Bank of Hungary (2014)

Figure 3: External debt as a percentage of GDP and short-term gross external debt based on remaining maturity and by sector

Second, synthetically creating FX exposure through swaps is even riskier. In addition toincreasing the country's external debt, it has further drawbacks: (i)while foreign funds enhance liquidity, bolstering the balance sheet of the banking sector, FX swaps only change the denomination of existing liquidity without any change in total liquidity and balance sheet; (ii) the maturity of FX swaps has been generally shorter than that of foreign funds (Figure 4). As a result, the rollover risk is even higher than in the case of foreign funds.

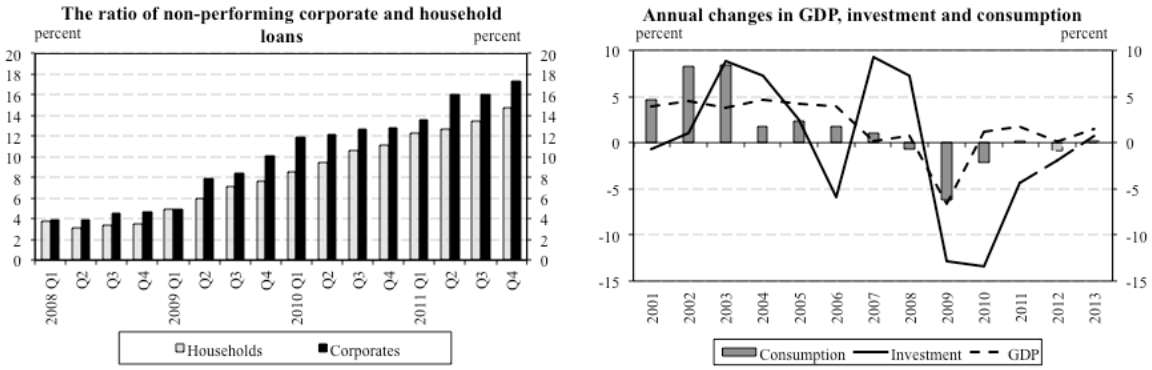


Note: Data for the remaining maturity of the banking sector's foreign funds are available from 2006.
Source: Central Bank of Hungary

Figure 4: Average remaining maturity of foreign funds and gross foreign swaps

These vulnerabilities had serious consequences for Hungary during the crisiswhen risk aversion intensified and investorsflew to safe-haven currencies, such as the Swiss franc. First,the weakening of the Hungarian forint against the Swiss franc substantially increased the monthly repaymentsfor households. Eventually, this resulted in increasing non-performing loan (NPL) ratios as well as decreasing consumption and investments(Figure 5).

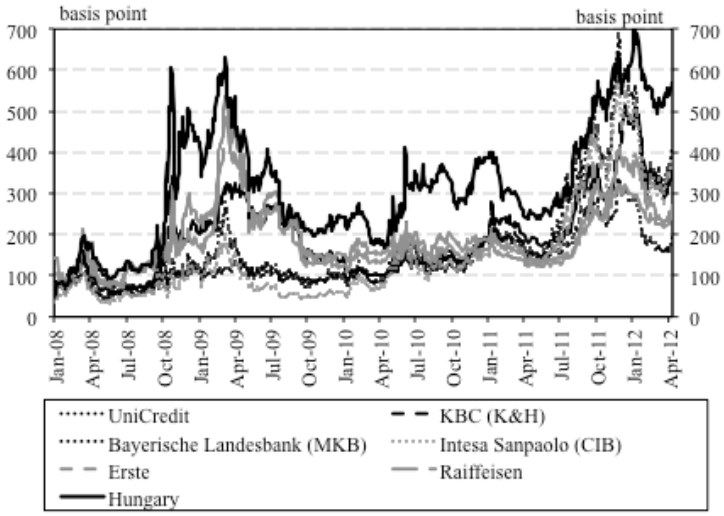
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Source: Central Bank of Hungary

Figure 5: Ratio of non-performing corporate and household loans within total loan portfolio and annual changes in GDP, investment and consumption

Second, the renewal of foreign fundsand swaps became more expensive as the country's and the parent banks' CDS spreads, the most important pricing component, increased substantially (Pálesand Homolya, 2011) (Figure 6).

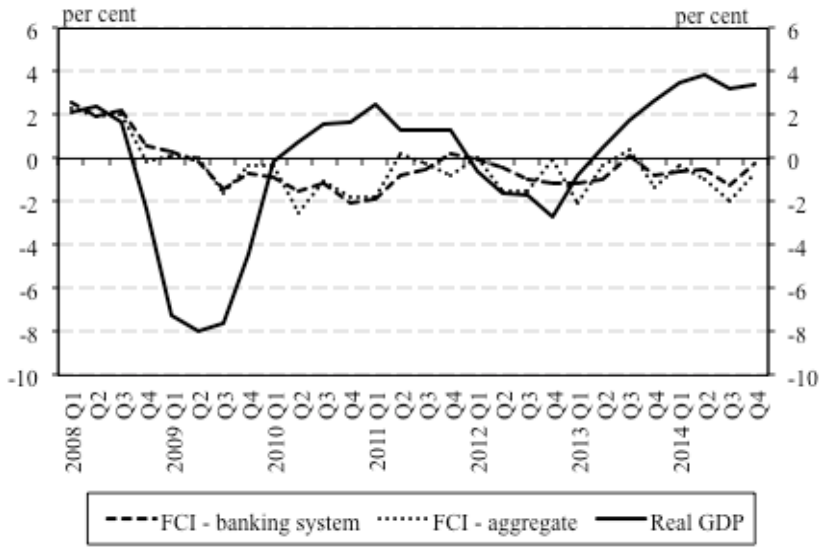


Source: Central Bank of Hungary, Bloomberg

Figure 6: 5-year CDS spreads of Hungary and parent banks

The prevalence of FX loans played an important role in the deepening of the crisis. Increasing funding costs and NPL ratios put pressure on the banking sector's income-generating capabilities,limiting its ability to contribute to real GDP growth (Figure **7**). As such, it is of great importance to examine whether the excessive FX lending could have been avoided by requiring a countercyclical capital buffer as per Basel III rules and if so, at what macroeconomic costs.

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Note: The annual growth rate of FCI shows the contribution of the financial intermediary system (banking sector) to the annual growth rate of real GDP. While the banking sector sub-index only contains the variables related to lending, the 'overall' index also contains the monetary conditions, i.e. the interbank rate and the exchange rate. A revision was made on the time series because of the transition of the model to a transactional basis.
Source: Central Bank of Hungary

Figure 7: Financial Conditions Index (FCI) and annual real GDP growth

In this paper, using a Vector Autoregression Model (VAR), we estimate the effect of changes in regulatory capital requirements based on the pre-crisis relationship between aggregate capital adequacy ratio and other macroeconomic variables. The results could provide policy makers with a sense of themacroeconomic effect of changes in macroprudential capital requirements.

IV. Data

In the previous chapter, we identified 2004-2009 as a period of credit upswing in Hungary. The year 2004 was chosen as the start because households had hardly done any FX lending before that year. Lending to the private sector increased on a year-to-year basis even after the onset of the GFC until the end of 2009, therefore we consider it the turning point. In the estimation the following quarterly variableswere used:

1. Real GDP growth: The source of the data is the Hungarian Central Statistical Office.Seasonally adjusted growth rates were used for the estimation.
2. Growth rate of real lending to private sector: Data published by the Central Bank of Hungary. We adjusted growth rates seasonally and for exchange rate changes.
3. Alternative funding sources (growth rate): Theserefer to non-financial corporations (NFCs) and include loans from non-financial entities, other financial corporates, public institutions, households and foreign entities as well as bonds issued by non-financial corporates. The data, published by the Central Bank of Hungary, were seasonally and exchange rate adjusted.Since bank financing is by far the most dominant form of funding for corporates in Hungary, the explanatory power of this variable might be limited. However, given its importance in some segments of the economy, we decided to include it in the baseline model. More importantly, the inclusion of alternative funding is necessary to simulate a credit supply shock.
4. Hungarian sovereignCDS spread represents the FX funding costs of the Hungarian banking sector. Páles et al. (2011) showed that before the onset of the crisis, Hungarian banks were able to obtain foreign funds at levels corresponding to those of their parent banks and Hungarian sovereign CDS spreads. Between the onset of the crisis and 2009, both the funding costs of parent banks and Hungarian sovereign CDS spreads increased substantially. Although the funding costs of Hungarian banks remained at the level of those of theirparent companies during this period, they started to decouple significantly at the beginning of 2010. As a result, the Hungarian sovereign CDS spread seems a good proxy for the funding costs of banksbetween 2004 and 2009. CDS spreads were downloaded from Bloomberg.
5. Hungarian 3-month money market rate (BUBOR):Similarly to CDS spreads, this variable is used to capture Hungarian banks' HUF funding costs.BUBOR is expected to have an impact through the substitution channel, i.e. the higher HUFborrowing costs, the more households move

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toward borrowing in FX. The Central Bank of Hungary publishes data on a monthly basis.

6. Real Effective Exchange Rate (CPI based REER):This variable measures the country's competitiveness compared to its main international trade partners. Time series are published by the Central Bank of Hungary.
7. Capital Adequacy Ratio (CAD ratio):Data are coming from regulatory reports submitted to the Central Bank of Hungary. The denominator of the ratio is the risk weighted assets of the banks and is calculated according to Basel II rules.[4]Although there are arguments for using total assets instead of risk weighted assets in order to filter out the effect of any potential attempts made by banks trying to alter their balance sheet, the official CAD ratio still seems a better alternative given that the main purpose is to quantify the effect of changes in the CAD ratio. The capital adequacy ratio required under Pillar II by the authoritiesdiffers from bank to bank, but we assume that there is no bank with a higher required capital adequacy ratio than the sector average. This assumption ensures that an increase in the required capital ratio would lead to a decrease in banks' capital buffer.

The first three variables are expressed as growth rates, in the case of BUBOR and REER, their levels are used, while CDS spreadsand the aggregate capital adequacy ratio are in first difference in order to ensuretheir stationarity. As a preliminary attempt, the levels of these variables were used, but the estimated VAR did not satisfy the stability criteria.

Table 1shows descriptive statistics of the variables, while Table **2** contains their correlation matrix. The correlation matrix reveals thatreal GDP is positively correlated with real lending, alternative funding and the aggregate CAD ratio (albeit only weakly in the latter case), while it is negatively correlated with the Hungarian sovereign CDS spreads. Real lending is negatively correlated with alternative funding, CDS spreads, BUBORand the CAD ratio. Notwithstanding the intuitive relations between the variables, the contemporaneous correlationsdo not differ significantly from zero in most cases suggesting that lagged values might have better explanatory power.

Table 1 : Descriptive statistics, quarterly data, 2004Q1 – 2009Q4

	CAD ratio	Real lending	Real lending growth	Real GDP growth	Alternative funding sources*	Alternative funding sources growth rate	CDS spread	CDS spread change	BUBOR 3M (real)	REER
Mean	11.80	11 110.5	3.61	0.57	11 460.5	4.77	106.4	0.18	2.85	75.87
Std Dev	0.80	2 865.8	4.66	1.51	3 526.9	3.17	141.0	0.60	2.59	4.43
Min	10.06	6 748.3	-5.32	-3.54	6 379.8	-1.02	14.6	-0.33	-3.58	66.30
Max	13.35	15 355.0	10.26	3.62	18 412.2	13.75	490.1	2.03	6.99	84.24

Note: It contains bond issuance, other non-FI loans and loans from abroad of NFC.

Source: Central Bank of Hungary, author's calculations

Table 2 : Contemporaneous pairwise correlation, quarterly data, 2004Q1 – 2009Q4

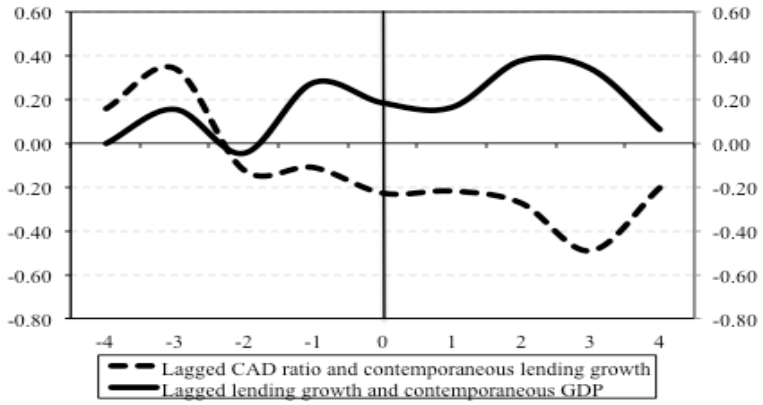
	Real GDP	Real lending	Alternative funding	CDS spread	CAD ratio	BUBOR 3M	REER
Real GDP	1.00000						
Real lending	0.18400	1.00000					
Alternative funding	0.15910	-0.04400	1.00000				
CDS spread	-0.29210	-0.31430	-0.21450	1.00000			
CAD ratio	0.01000	-0.22110	-0.60240	-0.05410	1.00000		
BUBOR 3M	-0.23430	-0.24310	-0.31190	0.04870	0.23010	1.00000	
REER	0.19400	0.23510	-0.00330	-0.13250	-0.06570	0.15570	1.00000

Source: Central Bank of Hungary, author's calculations

Figure 8 shows the correlation of lagged lending and contemporaneous GDP,i.e. the correlation between lending growth in period t + lag and GDP growth in period t, as well as between lagged CAD ratio and lending growth. Lending growth in any period has the highest correlation with GDP growth two quarters

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earlier, suggesting that corporations and households tend to arrange credit facilities during economic upswings, so that they have liquidity buffers during downturns. The relationship between the lagged CAD ratio and lending growth seems to confirm the pro-cyclical behavior of the banking sector:banks increase their leverage during upturns by increasing lending.

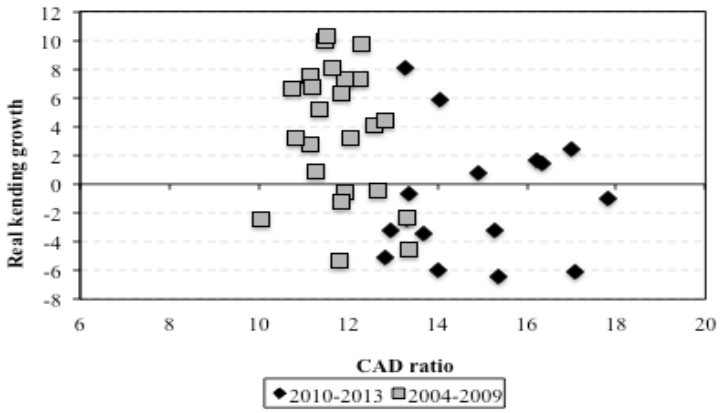


Note: Calculated using the level of CAD ratio.

Source: Central Bank of Hungary, author's calculations

Figure 8: Correlation between lagged and contemporaneous lending growth, GDP growth and CAD ratio, quarterly data, 2004Q1-2009Q4

The intuitive relationship between banks' capital adequacy ratio and real lending is also supported by post-crisis data. Between 2004 and 2009 capital ratios decreased as lending expanded, while in recent years the situation reversed (Figure 9).



Source: Central Bank of Hungary

Figure 9: Real quarterly lending growth versus aggregate capital adequacy ratio

V. Model

Our first goal is to understand the impact of changes in capital requirements on banks' funding costs. Based on the Modigliani-Miller (M&M) theorem (Modigliani and Miller, 1958), an increase in the regulatory capital requirement does not change banks'overall funding cost. However, this statement is conditional on a number of underlying assumptions, including the absence of frictions and taxes. In reality,the M&M theory does not hold for the following reasons:

1. Taxes: Since interest payments on debt are tax-deductible, banks have an incentive to operate with higher leverage.

Admati and Hellwig (2013) highlight two additional factors that create incentives for banks to increase leverage:

2. Explicit state guarantee: Deposit insurance schemes reimburse losses not covered by banks' assets, thereby lowering banks' funding costs. Moreover, during the recent financial crisis, governments extended guaranteeseven for non-deposit liabilities of banks.
3. Implicit state guarantee: By reducing the funding costs of too-big-to-fail institutions, itprovides these banks with an advantage over other banks.

As a result of these factors, banks' funding costs are lower than they would otherwise be.

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During the pre-crisis period, investors' risk perception related to the financial sector was very small. As a result, banks were able to borrow at low rates. In this environment, an increase in capital requirements was considered to be a credit supply shock, i.e. itwould have caused banks' funding costs to increase. Possible responses could have included the following: (i) decrease lending;(ii) increaseretained earnings;or(iii) raise capital. However, the first option seems the most likely outcome given some constraints associated with the second and third responses. Specifically,an increase in retained earnings is constrained by sticky dividend payments and banks' reluctance to reduce spending during economic upswing. Similarly, banks tend not to raise capital during those periods when they usually accumulated liquidity buffers. The reason is that investors are aware of the fact that a bank does not need to issue new equity, but if it does so, it would be a sign of the firm being overvalued (Myers and Majluf, 1984).

The above relationship between banks' funding costs and the level of the regulatory capital ratio, however, changed after the crisis. Specifically, it changed from positive to negative, i.e. higher capital requirements are associated with lower funding costs. The GFC revealed significant imbalances in the financial sector that were overlooked by investors in the pre-crisis period. In such an environment, an increase in the regulatory capital level could increase investors' confidence in the banking sector, by supporting banks'resilience as well as their ability to increase lending (Noss and Toffano, 2014).

Due to the above-mentioned ambiguous effect of an increase in the regulatory capital on lending, following Noss and Toffano (2014) we estimated two different models:(i) an unconstrained VAR model in which there are no assumptions regarding the impact of a capital adequacy shock; and (ii) a Structural VAR (SVAR) where we introduced a sign restriction on lending and on alternative funding growth, i.e. an increase in capital requirements is associated with a reduction in lendingand an increase in alternative funding. The latter reflects the assumption that the relationship between capital requirements and lending was negative before the crisis. This way, the results stemming from the two models could serve as a reasonable range for policy makers to estimate the effect of macroprudential regulation on the real economy regardless of the economic cycle.

The approach has strengths, specifically in identifying capital adequacy tightening-like situations in the past to gauge the impact of future changes when such policy action is not present in the historical data. Butit also has several caveats. Change in the regulatory minimum, for example, does not necessarily require banks to increase their capital adequacy ratios since they typically hold buffers above that minimum. As a result, the shock that we apply in the model could be interpreted in the following ways:

- Provided banks intend to keep their buffers constant in longer terms, an increase in the regulatory capital requirement has a one-to-one effect on the capital adequacy ratios. Bridges et al. (2014) showed that regulatory capital requirements impact bank capital ratios, i.e. banks typically rebuild their buffers following a tightening of capital regulations.
- The change can reflect a rise in the applicable risk weights for FX loans that leads to an increase in the capital requirement and a decrease in capital buffers.
- The tightening can also be considered as implementation of a countercyclical capital buffer as per the Basel III rules.

The primitive form of the Vector Auto Regression (VAR) model can be defined as follows (Enders, 2010):

$$\boldsymbol{B x_t = \Gamma_0 + \sum_{i=1}^{p} \Gamma_i x_{t-i} + \varepsilon_t}$$

where

p is the number of lags

x_t is a vector of the endogenous variables

$$x_t = \begin{pmatrix} realgdp_t \\ reallending_t \\ cdsspread_t \\ alternativefundingsources_t \\ CADratio_t \end{pmatrix}$$

B contains the contemporaneous effect of a unit change of an endogenous variable on another endogenous variable.

$$B = \begin{pmatrix} 1 & \cdots & b_{1p} \\ \vdots & \ddots & \vdots \\ b_{p1} & \cdots & b_{pp} \end{pmatrix}$$

Γ_0 is the constant

$$\Gamma_0 = \begin{pmatrix} b_{10} \\ b_{20} \\ b_{30} \\ b_{40} \\ b_{50} \end{pmatrix}$$

Γ_1 is a p x p matrix that contains the coefficients of the lagged endogenous variables

$$\Gamma_1 = \begin{pmatrix} \gamma_{11} & \cdots & \gamma_{1p} \\ \vdots & \ddots & \vdots \\ \gamma_{p1} & \cdots & \gamma_{pp} \end{pmatrix}$$

ε_t is the error term

$$\varepsilon_t = \begin{pmatrix} \varepsilon_{realgdp\ t} \\ \varepsilon_{reallending\ t} \\ \varepsilon_{CDSspread\ t} \\ \varepsilon_{alternativefundingsources\ t} \\ \varepsilon_{CADratio\ t} \end{pmatrix}$$

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Multiplying equation (1) by B^{-1}allows us to obtain a VAR model in standard form:

$$\boldsymbol{x_t = A_0 + \sum_{i=1}^{p} A_i x_{t-i} + e_t}$$

where

$$A_0 = B^{-1}\Gamma_0,\ A_1 = B^{-1}\Gamma_1, \text{ and } e_t = B^{-1}\varepsilon_t.$$

In this paper two lags were used in the estimation of the VAR. According to the standard information criteria, three lags should have been included in the model, but the resulting VAR did not satisfy the stability criteria. Moreover, the selection of two lags reflects the low degrees of freedom arising from having relatively few observations, relative to the number of variables in the model.

Sign restrictions were introduced in the following way based on Fry and Pagan (2007).

The relationship between residuals from the standard form and those from the primitive form of the VAR is as follows:$e_t = B^{-1}\varepsilon_t$. If there is an S matrix with the estimated standard deviations of the ε_t on the diagonal and zeros elsewhere, we could express residuals as $\mathrm{e_t = B^{-1}SS^{-1}\varepsilon_t = T\eta_t}$, where $\mathrm{\eta_t = S^{-1}\varepsilon_t}$ has unit variances.

Assuming that there is a Q matrix such that $\mathrm{Q'Q = QQ' = I}$, we can rewrite residuals as follows:

$$\mathrm{e_t = TQ'Q\eta_t = T^*\eta_t^*}$$

This results in a new set of estimated shocks $\mathrm{\eta_t^*}$with a covariance matrix I since $\mathrm{E(\eta_t^*;\eta_t^*) = QE(\eta_t;\eta_t')Q' = I}$.As a result we have a combination of the shocks $\mathrm{\eta_t^*}$ that have the same covariance matrix as $\mathrm{\eta_t}$, but a different impact on $\mathrm{e_t}$, hence the $\mathrm{x_t}$.

To create the above impulse responses and Q matrices, we take the following steps:

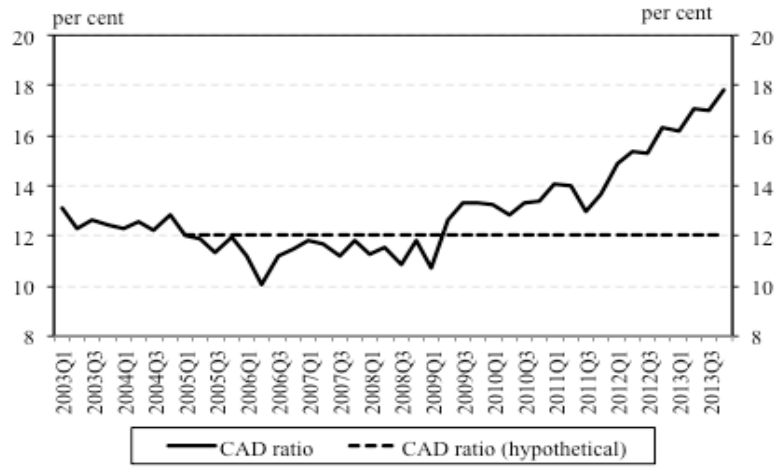
1. We compute $\mathrm{E(e_t;e_t') = \Sigma}$ and assume that $\mathrm{B^{-1} = chol(\Sigma)}$,[5] such that $\mathrm{e_t = B^{-1}\varepsilon_t}$;
5. We then repeat these steps 1,000 times and keep the results that satisfy the sign restrictions.

Interpreting the impulse responses that satisfy the scheme of imposed restrictions is not straightforward, since the model that produced the median response for one variable might not be the same for the other variables. Fry and Pagan (2007, 2011) suggest a solution to this problem that chooses those impulses that are the closest to the median responses (Median Target Method). To implement it, we first need to standardize our results by subtracting the median from each impulse response value and dividing it by its standard deviation over all models that satisfy the sign restrictions. These standardized impulses are placed in a vector $\phi^{(l)}$ for each impulse response value $\Theta^{(l)}$. Subsequently we choose the l that minimizes $\mathrm{MT} = \phi^{(l)\prime}\phi^{(l)}$ and then use $\Theta^{(l)}$to calculate impulse responses. This process does not necessarily provide a unique l, but in our case, the closest impulse response to the median came from the same model for all variables.

VI. Estimation Results

The VAR(2) model described in the previous section was estimated for a seven-equation system. The coefficients were jointly significant in each equation.

The magnitude of the shock was chosen such that policymakers would have intervened to maintain capital adequacy ratios at their 2005Q1 level (12.04 percent) (Figure 10). This choice seems plausibleas (i) it is greater than levels observedin the pre-crisis period but lower than levels seen in the aftermath of the crisis; and (ii) it is reasonable toassume that if a countercyclical capital buffer measure had been available, the authorities would have had enough time (four quarters after the start of the credit upswing) to react to increasing lending by requiring additional capital.



Source: Central Bank of Hungary

Figure 10: Aggregate CAD ratio

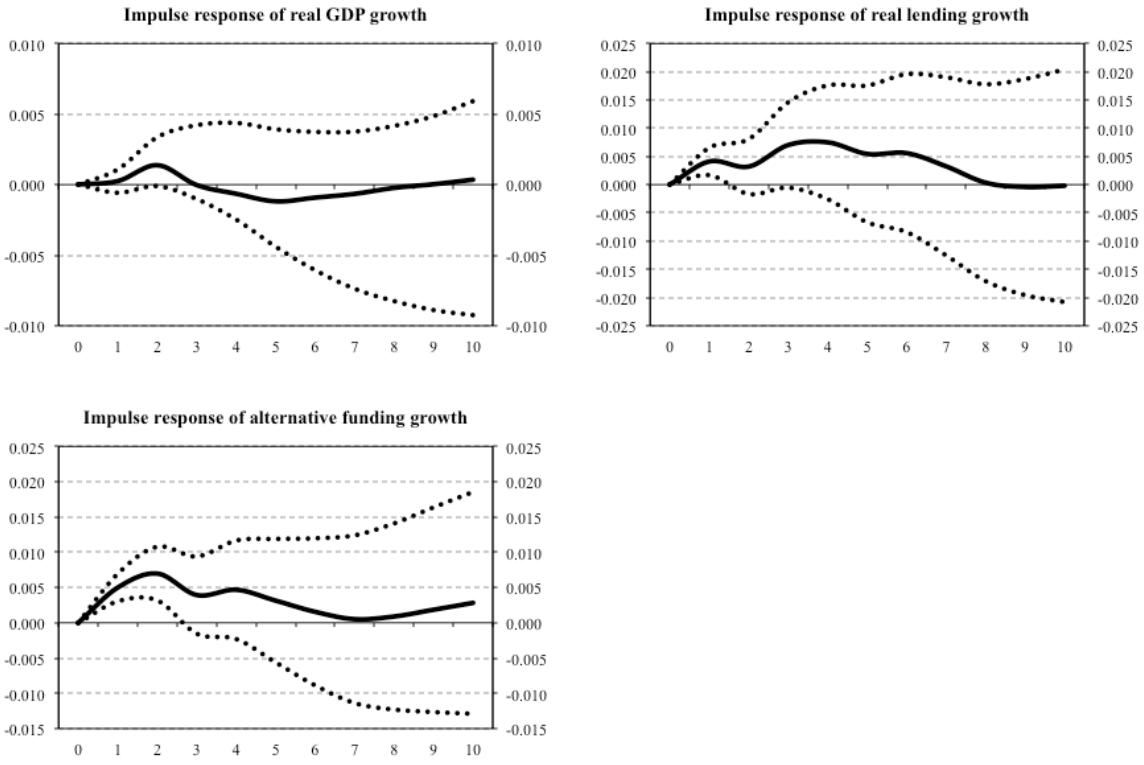
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In the remainder of this section, we describe the impact of changes in capital requirements based on the results of both the unconstrained and the constrained models.

Figure 11 shows the unconstrained effects of a macroprudential tightening on real GDP growth, real lending and alternative funding growth. As we mentioned earlier, the unconstrained model intends to simulate the post-crisis behavior of the banking sector and investors, i.e.a tightening of capital requirements does not necessarily induce a credit supply shock. The response of real GDP growth to an increase in the capital adequacy ratio is moderate; following a temporary increase, it returns to its pre-shock levelafter 10 quarters. The overall effect on real lending growth is similar to that on real GDP, i.e. it returns to its initial level after 10 quarters,albeit the initial increase proves to be more persistent.

The reason for the increase in real GDP and lending as a response to increasing capital requirements is at least twofold. First, as we argued in section 3, demand-side factors appear to be the main drivers of lending growth, in particular FX lending growth. Our estimation results seem to confirm this. Specifically, the positive impact of higher capital adequacy on lending suggests that strong demand could actually have resulted in an even higher lending growth rate. In other words, the latter was prevented by credit supply. As a result, an increase in capital adequacy could have allowed banks to better satisfy loan demand and thus could have led to higher lending growth. Second, as indicated in section 5, the relationship between capital adequacy and lending is ambiguous. Specifically, if higher capital adequacy improves investor confidence in the banking sector, it leads to lower funding costs, i.e. it could make it easier for banks to finance a further expansion in their loan portfolio.

Noss and Toffano (2014) found similarly weak positive responses for lending when they excluded the sign restriction. They explained it as lending being the only potential transmission channel for macroprudential capital requirements. It seems plausible in periods of credit upswing, when banks' cost of debt is insensitive to their capital level.



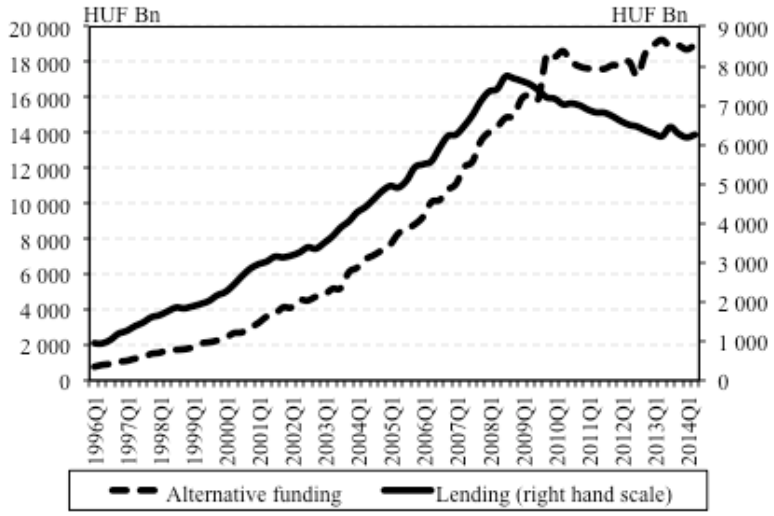
Source: author's calculations

Figure 11: Impulse responses of a 13 basis point shock to the change in the aggregate CAD ratio

[5] B^{-1} is usually indicated with A in econometric software.

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The reaction of alternative funding growth to an increase in the capital requirement seems puzzling at first glance as an increase in the supply of bank lending is associated with a increase in alternative funding, i.e. companies do not substitute bank funding with alternative sources. However, taking a closer look at the historical relationship of real lending growth and alternative funding growth could explain this. As it is shown in Figure 12, lending to corporations and funding from alternative sources moved together until the onset of the GFC. Two factors could be behind this: either (i) corporations faced a scarcity of bank funding, i.e. bank and alternative funding complemented each other; or (ii) they used other funding channels for specific reasons (e.g., the signaling effect of bond issuance in the case of listed companies).Given that the model was estimated for the pre-crisis period, it captures this positive relationship between bank and alternative funding. As a result, a change in capital adequacy affects these funding sources in the same directions. However, the GFC revealed that this relationship can change during periods of distress. As the figure shows, bank funding decreased during the crisis, while alternative funding increased slightly, suggesting that companies that have access to alternative sources of funding substituted for bank lending to some extent.



Note: Alternative funding contains bond issuance and loans from non-bank entities, such as households, public institutions, other-financial institutions, other corporations and foreign entities.

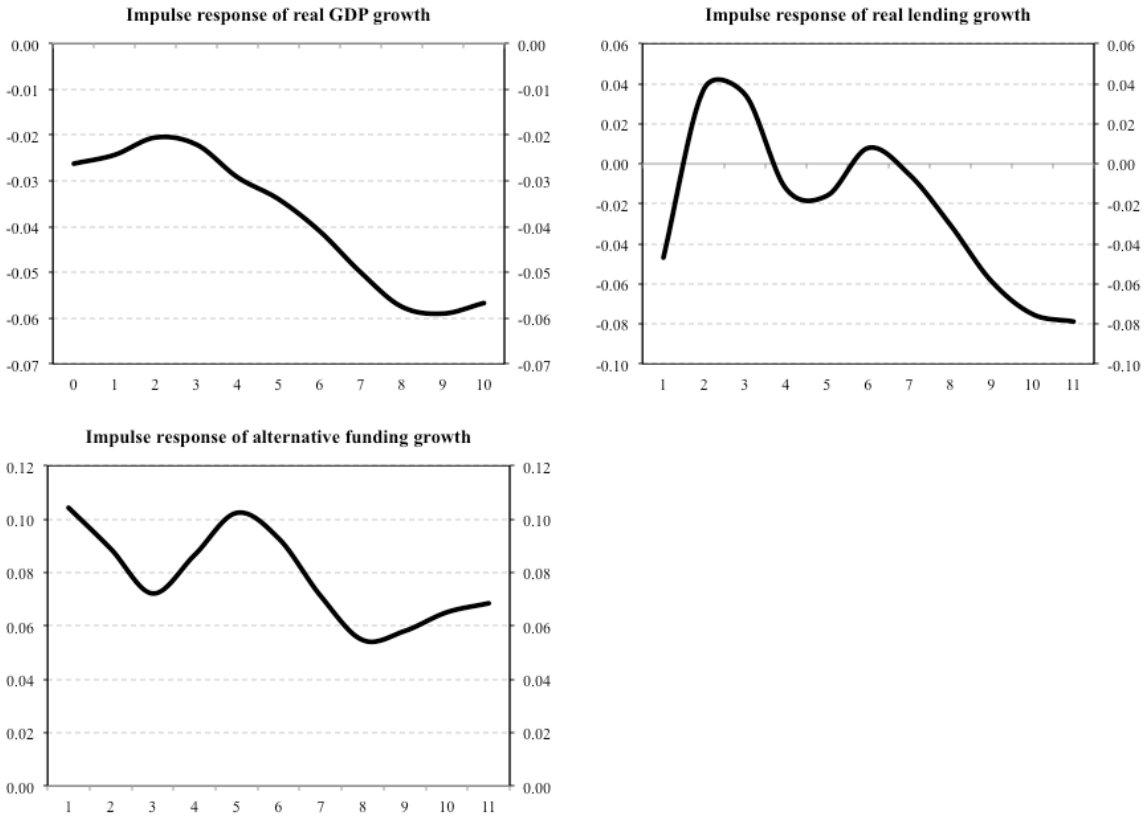
Source: Central Bank of Hungary

Figure 12 : Lending to corporations and alternative funding sources

Figure 13 shows the results from the SVAR model, i.e. where sign restrictions were introduced in order to simulate a credit supply shock. Specifically, an increase in the regulatory capital requirement is expected to lead to a decrease in lending and an increase in alternative funding growth. In line with our prior expectations, such a policy change has a stronger impact on real variables than the unconstrained VAR; however, its overall effect remains modest.

Real GDP growth has a relatively modest immediate response; however, it strengthens after 10 quarters. This pace of reaction could be due to a number of factors. An increase in capital requirements immediately restricts banks' risk-taking ability and thus reduces the availability of bank lending for companies. The resulting cancelation or postponement of leveraged investment projects might have a more pronounced impact on GDP as investments are partly financed with own resources. Moreover, the cancelation of investment has a multiplier effect on GDP.According to our results, lending growth also falls sharply in the third quarter and, after a temporary recovery, it continues to decrease afterwards. Alternative funding shows an opposite moving pattern, suggesting that companies seek for other funding sources as access to bank lending decreases. However, the demand for alternative funding fades after 10 quarters as real GDP growth declines.

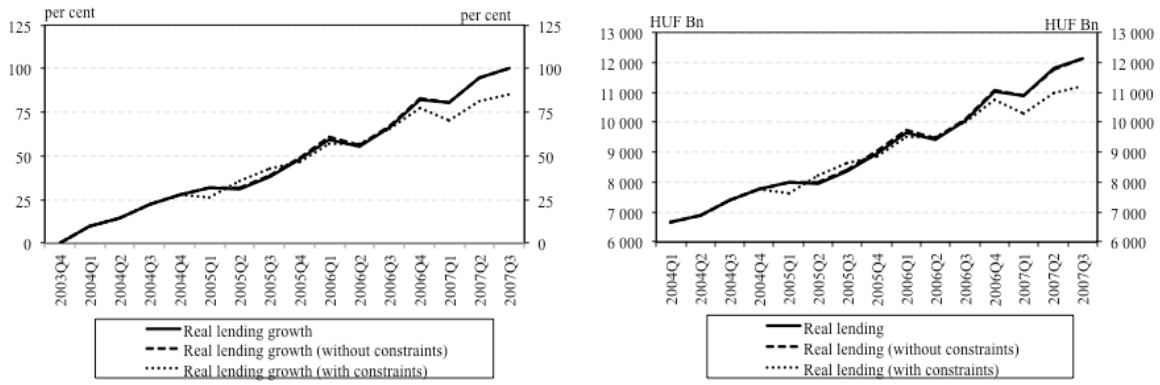
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Source: author's calculations

Figure 13: Impulse responses of a 13 basis point structural shock to the change in the aggregate CAD ratio

Using our estimation results, we conducted a counterfactual exercise. Specifically, we calculated the hypothetical evolution of real GDP and lending in the presence of a shock to capital adequacy at the beginning of 2005. The alternative paths of real lending can be seen in Figure 14. An increase in capital requirements would have had a modest effect on lending:the difference between actual and counterfactualoutstanding loans would have been in the range of aroundHUF -900 billion (constrained model) and HUF 5 billion (unconstrained model) at the end of the period. While actuallending to the private sector doubled in real terms during this period,it would have increased by 86 percent in the constrained counterfactual scenario, i.e. increasing capital requirements would have had only a moderate impact on lending.

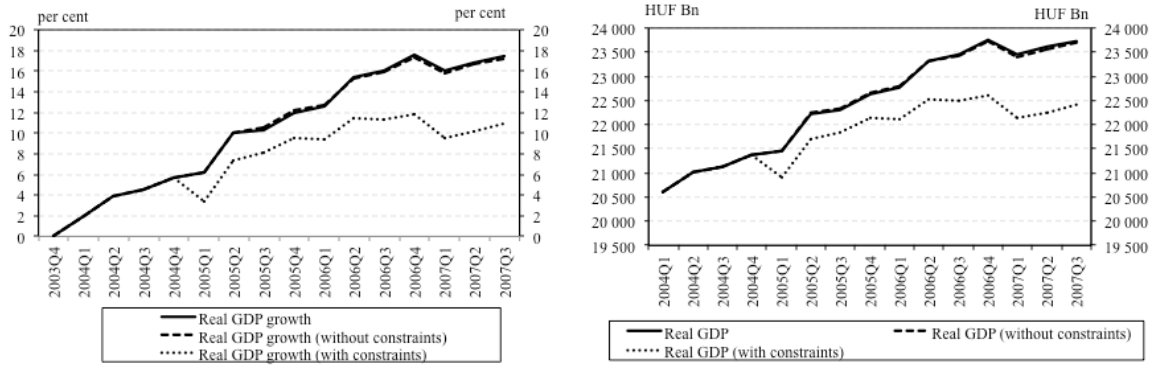


Source: Central Bank of Hungary, author's calculations

Figure 14: Growth and level of real lending in the alternative scenarios

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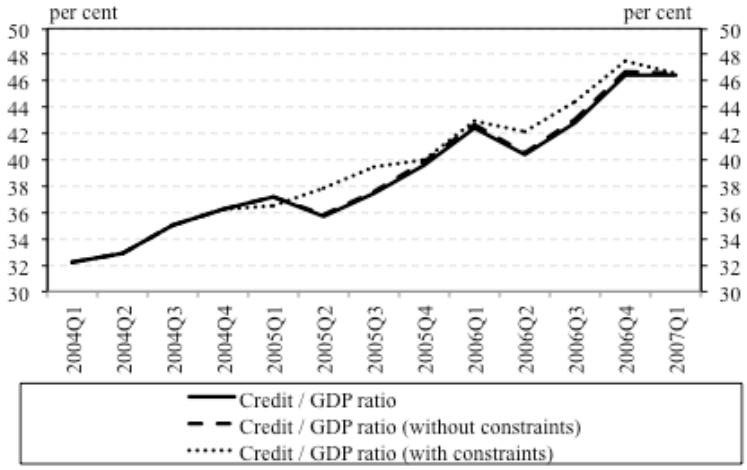
Given that real lending would not have changed notably, tightening the regulatory capital requirements would also have had a minor impact on real GDP growth. Specifically, the difference between the actual and counterfactual cumulative real GDP growth isin the range of+0.2 to -6.5 percentage points after 10 quarters(Figure 15).



Source: Central Bank of Hungary, author's calculations

Figure 15: Growth and level of real GDP in the alternative scenarios

The overall effect of an increased regulatory capital level could not have slowed the increase of the credit-to-GDP ratio. Although it could have held back lending growth, but it would have inferred an equal drop in real GDP growth (Figure 16). As a result, the difference in the ratio would have beenonly +0.1 percentage points after 10 quarters.



Note: Credit-to-GDP ratio is calculated by using level of real lending and real GDP.

Source: Central Bank of Hungary, author's calculations

Figure 16: Credit / GDP ratio

The total impact of our hypothetical regulatory tightening would have been modest in preventing the build-up of vulnerabilities in the banking sector. Even if regulatory authorities had reacted quickly, the use of countercyclical capital buffer would not have been able to significantly lower either the level of lending or its growth rate.

Although the overall impact of an increasing regulatory capital requirement is found to be modest, it is also interesting to see how this measure would have affected lending to different sectors. Since sectoral lending was not included in the VAR models due to identification difficulties (i.e. the number of variables in VAR would have been too large relative to the number of observations), we ran a "satellite model", in which we regressed the structural shocks of the capital adequacy ratioon changes in lending to different sectors:[6]

$$\textbf{sectoral lending growth}_t = \alpha * \textbf{sectoral lending growth}_{t-1} + \beta * \textbf{structural shock}_t + \varepsilon_t$$

where,

[6] See also *Noss and Toffano (2014)*.

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sectoral lending growth$_t$ includes lending to households and corporations in local and foreign currency.

The results of these regressions can be seen in Table 3. The second column shows that the regression coefficients on the structural shock are negative and significant at 10 percent level for each category except for household lending in HUF, i.e. an increase in capital requirement is associated with a reduction in growth in lending in the specific sectors. The lagged variables were used to simulate whether the impact of the shock fades over time. Although the signs are all positive in line with our prior expectations, they are not significant in the case of lending in HUF either in the household or in the corporate sector.

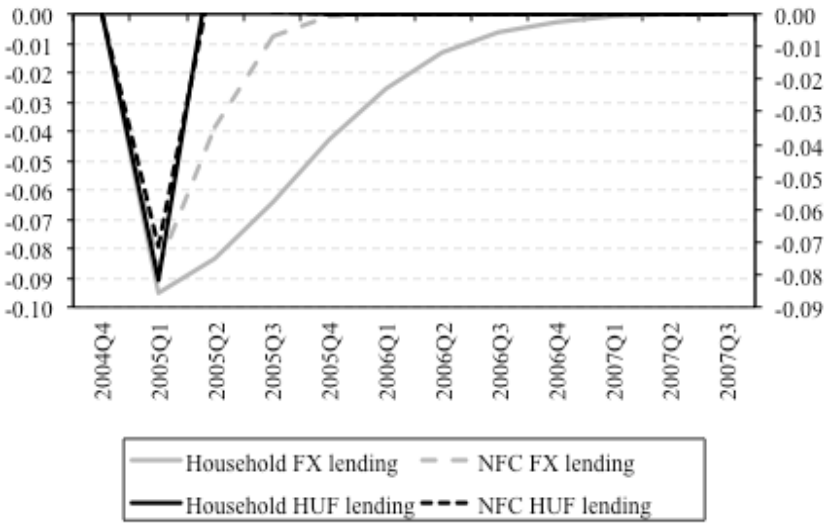
Table 3: Estimation results from the regression of sectoral lending growth on the series of structural shocks

	Lagged sectoral lending growth (α)	Contemporaneous structural shock (β)
Household FX lending	0 .8754***	-0.0951*
	(0.0000)	(0.0970)
NFC FX lending	0.4427**	-0.0778**
	(0.0260)	(0.0390)
Household HUF lending	-0.2893	-0.0817
	(0.1930)	(0.1500)
NFC HUF lending	-0.2182	-0.0715*
	(0.2720)	(0.0770)

*Note: *, ** and *** indicate significance at the 10, 5 and 1 percent level, respectively.*

Source: author's calculations

Using these estimation results, our calculations suggest that 53 percent of the total decrease in lending would have materialized in foreign currency lending (both in households and the corporate sector) and 47 percent in HUF lending (Figure 17). In the foreign currency segment, lending to households would have decreased roughly equally in lending to households and corporates. In contrast withthe intuitive assumption that adjustment is faster in the corporate segment, our results thus suggest that the banking sector would have reacted more intensely in the household segment.



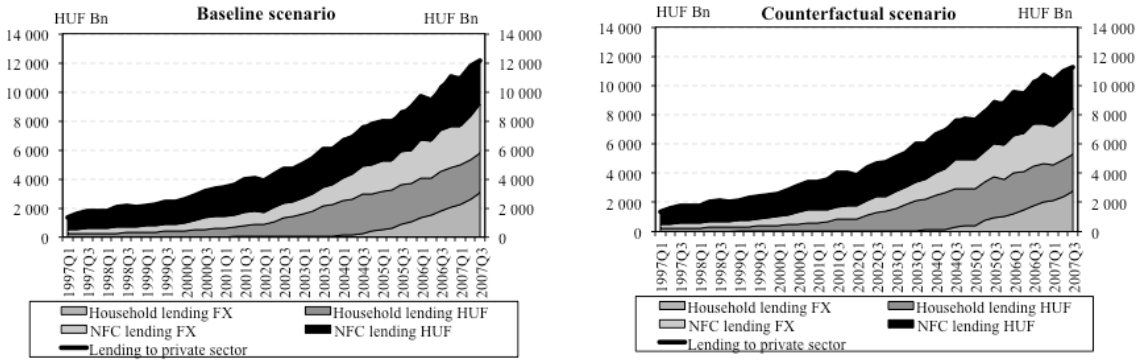
Source: author's calculations

Figure 17: Impulse responses of a 13 basis point shock to the change in the aggregate CAD ratio on growth of lending to different sectors

Based on the results of the SVAR model and the above regression, Figure 18demonstrates the alternative evolution of lending to the private sectorin the most pessimistic case, i.e. where the increase in the capital

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requirement was considered to be a credit supply shock. It shows that even if regulatory authorities hadreacted to the increasing (FX) lending by requiring a countercyclical capital buffer, they would have been able to only temporarily slow the build-up of FX loans. The outstanding amount of household loans denominated in HUF and FX would have been lower by around8 percent in both cases, while the reduction in corporate loans denominated in HUF and FX would have been 6 percent for both categories, at the end of the period.



Source: Central Bank of Hungary, author's calculations

Figure 18: Lending to private sector under different scenarios

VII. Conclusions

The main purpose of this paper was twofold. First, it aimed to estimatethe effect of the tightening of the regulatory capital requirements on the real economyduring credit upswing. Second, it intended to show whether applying a countercyclical capital buffer measure as per the Basel III rules could have helped decelerateFX lending growth in Hungary,reducing the build-up of vulnerabilities in the run-up to the GFC. To answer these questions, we used a VAR based approachto understand how shocks affected capital adequacy in the pre-crisis period. An increase in the regulatory capital requirement is typically considered to be a credit supply shock since it increasesbanks' funding costs. However, this relationship could have changed during the recent GFC.Specifically,stricter regulations could lower funding costs,by improving investor confidence.

Since the relationship between regulatory capital and lending growth is ambiguous, we estimated two VAR models. The unconstrained version aimed to provide the upper bound for the effect of macroprudential tightening on the real economy,as the shock need not be a supply shock. It allows, therefore, for the post-crisis assumption of the changed relationship between lending and capital. In contrast with this, in the SVAR model we introduced sign restrictions on lending and alternative funding growth (negative sign for the former and positive for the latter) in line with our assumption about their pre-crisis behavior. The results of this estimation serve as the lower bound for the possible effects on the real economy.The analysis concludes that an increase of 13 basis points in aggregate capital adequacy ratio, i.e. keeping the ratio at its 2005 Q1 level, is associated with a decline of 0-14 percentage points in cumulative real lending growth compared to actual growth after 10 quarters. Given that actual cumulative growth was 100 percent between 2004Q1 and 2007Q3, our estimation results thusindicate only a modest slowdownto 86 percent.Our results have three important implications.

First, regulatory authorities could not have avoided the upswing in FX lending by requiring countercyclical capital buffers even if such a tool had been available and they had reacted quickly to accelerating credit growth. By using this tool, they could have slowed the increase in lending only temporarily;however, after 4 quarters it would have regained its momentum.

Second, a more pronounced tightening might have eliminated FX lending, but at the expense of real GDP growth. Macroeconomic fundamentals were fragile when FX lending started,with the significant fiscal vulnerabilities requiring the central bank to keep the policy rate at elevated levels. Due to the highdifferential between HUF and FXinterest rates and households' low risk awareness regarding exchange-rate volatility, FX lending became very popular and contributed significantly to real GDP growth in the pre-crisis period. The bottom line is that an unsustainable fiscal policy led to a trade-off between economic growth and the build-up of new vulnerabilities in the form of FX lending.

Third, the results support the post-crisis conventional wisdom about the inadequacy of pre-crisis regulatory frameworks. Therefore, it points toward providing the authorities responsible for financial stability with more power and flexibility so that they can identify systemic risks and respond to them quickly and efficiently.

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Role of Ship-breaking Industries in Bangladesh and ILO Guidelines: A Critical Discussion

By Morshedul Hoque & Dr. Md Masum Emran
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Introduction- Ship-breaking is a risky, dirty, intensively labour-manipulating and hazardous industry. 'A ship's life lasts for an average of 25 to 30 years after which they are no longer considered safe to sail. Each year between 200 and 600 sea-going ships are dismantled worldwide. A peak is expected in 2010 when around 800 single-hull tankers will have to be phased out' (European Commission Report, 2007). It is only few decades earlier that European countries and the United States had the sole authority of both ship-sailing and ship-breaking around the world. Therefore, they made profits in both ways. During the last two decades, developed countries has lost its sole authority over ship dismantling business because of increasing wage rate, increasing awareness towards global environment, raising safety and health consciousness among workers of developed countries. A report of the European Commission mentioned that 'a worker on demolition site in Bangladesh and India earns just one to two dollars per day, and employers' expenses for safety and health are negligible; while the cost in the Netherlands can be estimated at around $250 per day for a worker in the Netherlands, and $13 in Bulgaria (EU Reports, 2007).

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Role of Ship-breaking Industries in Bangladesh and ILO Guidelines: A Critical Discussion

Morshedul Hoque [α] & Dr. Md Masum Emran [σ]

I. Introduction

Ship-breaking is a risky, dirty, intensively labour-manipulating and hazardous industry. 'A ship's life lasts for an average of 25 to 30 years after which they are no longer considered safe to sail. Each year between 200 and 600 sea-going ships are dismantled worldwide. A peak is expected in 2010 when around 800 single-hull tankers will have to be phased out' (European Commission Report, 2007). It is only few decades earlier that European countries and the United States had the sole authority of both ship-sailing and ship-breaking around the world. Therefore, they made profits in both ways. During the last two decades, developed countries has lost its sole authority over ship dismantling business because of increasing wage rate, increasing awareness towards global environment, raising safety and health consciousness among workers of developed countries. A report of the European Commission mentioned that 'a worker on demolition site in Bangladesh and India earns just one to two dollars per day, and employers' expenses for safety and health are negligible; while the cost in the Netherlands can be estimated at around $250 per day for a worker in the Netherlands, and $13 in Bulgaria (EU Reports, 2007). Lawrence Summers, the Chief Economist of the World Bank in 1992, discussed the economic rationale of migrating dirty industries to developing countries and criticised severely. The Summers' prescription is actually implemented through 'migrating the ship-breaking industry in South Asian countries like Bangladesh, India and Pakistan where more than 90 percent ship-breaking activities around the world take place nowadays'.

a) *Socio-economic Status of Ship-breaking Area in Bangladesh*

We grew up in Chittagong and used to take a rickshaw down the very road, where the ship-breaking yards are, several times a week. To be sure, it is a hard, back-breaking task. But we sometimes wonder when the Westerns get on our high horse about $1 a day, and on children working, how we dare judge! We know nothing about that life and what it takes to survive. The owner or the ship-breaking company spoke correctly when he said, if the kids do not work here they will work somewhere else because they have no other means of living. Our best friend started working when he was 14 because otherwise his siblings would have gone without food. Should he have said, no, just because he was so young and allowed his family to suffer? He worked hard and we are proud of him for his strength and perseverance! And has anyone stopped to think how much $1 a day is worth in the economy of Bangladesh? Sure, here in the States it is nothing. But there it is a fairly normal wage for a day labourer. Our heart breaks for our friends who cannot break out of the poverty that so plague this country, but we will not judge them for what they have to do to survive.

The quotation gives us a bird's eye view of socio-economic conditions of workers around the ship-breaking industry. This is the history of the head of a coin of ship-breaking industry but the tail of the coin is opposite. The ship-importers, ship-breaking contractors, groups related to ship-breaking business are making affluent amount of capital that is quite unimaginable. 'A person's family (anonymous) has become extremely wealthy bringing ships onto these beaches. He pays millions of dollars for each ship and makes profits from the steel he sells' (*Thomas Paino's Corner*, 2006). It is just an example and we know very well the people related with this business have made huge profits only in 20 to 25 years – a one third lifetime of a generation. Is it possible to make this huge amount of wealth in any other country of the world except Bangladesh?

b) *Objectives of the Paper*

The Ship-breaking industry in Bangladesh is a threat for human and environment but it is a necessity for economic development of the country.

We have visited the ship-breaking yards of Chittagong and were horrified at the conditions in which these people work. Sadly, we were taken there as though it were a tourist attraction. Unfortunately, these yards are listed as tourist attractions in very well known travel guides. People are quite aware of these yards. They exist in many other countries as well, Bangladesh being only one of many. The steel provided by these ships literally builds the country and banning the practice altogether would greatly jeopardize the economy. We only hope more awareness will be brought to these yards and that health and environmental regulations will be enforced.

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We do not want to jeopardise the economy by banning ship-breaking activities, imposing some strict environmental rules and regulations, which are done currently by some non-government organisations working in Bangladesh. In our view, abiding by all strict environmental restrictions regarding this industry would be a luxury for a poor economy. It would break down overall economic development and make the economy more dependent on foreign aid, which would have much worse impact than the present environmental degradation impact. Our first objective is, therefore, arguing and finding out the necessity of ship-breaking activities in Bangladesh.

There is no doubt that ship demolition activities is the most hazardous, dirty and risky job and it imposes huge threats to the health of human being and environment. Workers in this sector might suffer long-term diseases and the quality of soil, water, air and sea resources must be deteriorated by its chemical, mechanical wastages. We would like to briefly identify the consequences of ship-braking activities on workers and the nature.

Thirdly, we would like to discuss critically the guidelines of the International Labour Organisation (ILO) for safety and health of ship-breaking workers; to identify its drawbacks; and to provide a suitable suggestion to make it more effective. Moreover, our objective is also to provide some policy ideas that could be considered by the policy makers for mitigating the negative consequences of the activities in Bangladesh and other countries.

We want to organise the paper as follows: Section 2 covers contributions of ship-breaking industry in economic development. Section 3 deals with its consequences on human, environment, and natural resources, while section 4 discusses a critical discussion on guidelines of the ILO entitled 'Safety and Health in Ship-breaking: Guidelines in all Asian Countries and Turkey 2004, Geneva' and some suggestions for mitigating its bad consequences and the last section goes for conclusions.

II. Contributions of Ship-breaking Industry

We want to start our discussion with the contributions of ship-breaking industry in the economic development of Bangladesh – a country, poor in economic condition but rich in total population.

a) Infrastructural Mine of Bangladesh

The ship-breaking industry is used to be called the 'floating steel mine' of Bangladesh that has no natural ore mine. Around 80 to 90 percent raw materials (scrap iron) of the country's steel production comes solely from this industry. The rest of the 10 to 20 percent comes from direct import, which needs huge foreign currency. Bangladesh requires more than 8 million tons of steel per year for its construction activities and only the ship-breaking industry provides more than 7 million tons. In December 2007 fines' ore price per metric ton was $185, which implies that Bangladesh would have to spend $1.3 billion only for last year's infrastructural development, which is around 25 percent of the last year's development budget of Bangladesh and 10 percent of the total import expenditure of this country. We would therefore like to call the ship-breaking industry as an 'Infrastructural Mine' of Bangladesh.

b) Largest Recycler of the World

The industry is not only an infrastructural mine, but also the largest recycler of the world. An old, out-dated ship is a liability of its owner if it is not dismantled. This industry has made it possible by purchasing old, out-dated ships that were previously a liability, are now an asset of the international shipping company. Moreover, around 97 percent materials of a ship are either recycled or resold to a third party. The ten miles long roadside shops provide kitchen items, toilet items, bed-room furniture, drawing-room furniture, all types of metallic products; scrap copper, bronze, aluminium, electric cable, life jacket, lifeboat, boiler, propeller, power generator, careen and what not. Nothing goes to waste. Urchin children collect even the last drop of oil drips from the ship tankers on the earth and reuse for cleaning different items. The industry is, therefore, recycling the world garbage and saving the world's natural resources.

c) Second Highest Taxpayer in Chittagong Division

After the Chittagong Port of Bangladesh, ship-breaking industry is the second largest revenue-contributing industry in Chittagong Division. Each year the industry pays directly more than $150 million in government exchequer through import duty, yards tax, land tax, sales tax and other forms of fees. The ship-product reselling business groups also indirectly contribute more than $50 million in the government exchequer through income tax, sales tax, municipality tax and others.

d) The Largest Single Job Zone after CEPZ

The industry employs more than 30 thousand unskilled, illiterate, manual workers directly to perform different activities of breaking a ship. Indirectly, ship-breaking industry and reselling businesses of ship-materials jointly employ more than 250,000 workers round the year. The technological state in ship-breaking yards is highly labour-intensive and 100 percent contract-based. Around 98 percent of the work forces in scrapping yards are illiterate and has a lack of formal training, and there is no worker welfare union.

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III. Consequences of Ship-breaking Industry

Ship dismantling activities are considered as 'dirty and dangerous' (an ILO Discussion Paper). Moreover, diseases related to long-term infection attack the workers of this industry because of the industry depots' huge amount of hazardous paints containing lead, cadmium, organ tins, arsenic, zinc, chromium, sealants containing printed circuit boards, asbestos and several types of oils. We therefore should give priority on the consequences of safety and health of the workers in this industry.

a) Safety and Health of Workers

The workers in this industry are very vulnerable and deprived by the ship breakers. They are the least paid among the world's risky and hazardous industries. It is fact that Bangladesh, unlike India, does not even require "gas-free-for-hot-work" certification in practice to operate a ship-breaking firm. So the cost of dismantling ship in Bangladesh is lower than any other countries; and for the high frequency of lethal explosions at the dismantling yards, compensation cost is less in Bangladesh. The Basel Convention – 2006 reported that more than 400 workers had been killed and 6,000 seriously injured over the last 20 years. It implies that on average 20 workers died in a year. At this point, we would like to provide with a relevant statistics of occupational accidents in the garment industry – the largest exporting industry in Bangladesh. In February and March 2006, there were four unexpected accidents occurred in the garment sector that caused 115 lives of workers and 257 serious injuries. Studies show that most of the labour-intensive industries like garment, leather, construction, cement etc. are health hazardous industries like ship-breaking industry. When a manual worker can work in any garment industry, tannery industry or construction industry, why cannot he or she work in ship dismantling industry? The economic theory of wage tells us that the higher the job hazard, the higher the risk premium. The difference between ship-breaking and the other industries is that the former does not take any initiative to mitigate health hazards, to raise health safety and to compensate sufficiently to the victims but the others do a bit. In fact, we would like to introduce exact risk premium in this industry but not to close down the industry.

b) Impacts on Biodiversity

There is no doubt that the ship breaking activities tremendously affect the biodiversity of Bangladesh. Does it not affect biodiversity of any other area of the world rather than Bangladesh? The answer is, yes, it does; and it varies in different degrees of precautionary measures adopted in the area where the activities are taking place. Hossain (2006) gives detail consequences on biodiversity due to ship-breaking activities in Bangladesh.

The ship breaking activities contaminate the coastal soil and sea water environment and thus impair ecological settings by discharging ammonia, burned oil spillage, floatable grease balls and metal rust (iron) and various other disposable refuse materials together with high turbidity of sea water. The high pH of seawater and soil observed may be due to the addition of ammonia, oils and lubricants. …oil spilling may cause serious damage by reduction of light intensity, inhibiting the exchange of oxygen and carbon dioxide across the air-sea water interface, and by acute toxicity. As a result the growth and abundance of marine organisms especially plankton and fishes may seriously be affected. …..

Pollution caused by ship breaking activities severely hampers the primary productivity. Oil floating over vast area inhibits light penetration reduces photosynthesis. ……..

Phytoplankton is the primary food producers of the aquatic habitat and plays an important role in the food chain. Phytoplankton is generally considered to be the best index of the biological productivity. Phytoplankton makes their food by photosynthesis using solar light. Phytoplankton suffers from the reduction of light intensity, beneath an oil film, which inhibits photosynthesis.

Drifting small floating animals in the water body are collectively known as zooplanktons on which the whole aquatic life depends directly or indirectly. They are largely governed by the interactions of a number of physical, chemical and biological conditions of the ocean. As zooplanktons are very sensitive to the optimum condition, the coastal pollution due to ship-breaking activities may have profound effects on its survival and occurrence.

The bottom living organisms – the benthos play an important role in the food chain (as food of fish) especially in the intertidal zone and it is also well recognized that the richest fisheries of the world are closely related to the benthic community. The abundance and distribution of benthos is influenced by soil properties as well as on the organic matter retained in the soil – the relatively low occurrence of benthos in the intertidal zone of the ship-breaking area of Chittagong (Siddiquee, 2004).

The fishery resources of the area seems to be affected by the ship-breaking activities as revealed by increased fishing efforts, reduced species diversity, increased amount of trash fish ……..it was revealed that the following fish species were not available in the catch. To make concrete assessment about the status of threatened, endangered and extinct species of that area, it needs further research.

We would strongly support all of his comments regarding biodiversity if we were marine biologists. We are positive economists and always try to justify any

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impact of an action by evaluating static cost-benefit and inter-temporal cost-benefit analyses. We would like to evaluate the environmental consequences based either on 'Hedonic Price Method' or on 'Willingness to Pay Method' not based on 'Dose Response Method'. We have yet not found any research using one of these techniques to evaluate the environmental consequences of ship-dismantling activities in Bangladesh. In our view, the opportunity cost of giving up this industrial activity from Bangladesh to protect our biodiversity would be a luxurious decision for a poor country. Actually we need to mitigate the environmental consequences as much as possible. Conceiving this objective, we would like to suggest introducing and implementing the following policies strictly at an earliest convenience.

IV. A Critical Discussion on the ILO Guideline

Reducing health hazards, fatality and injury should be the prime objective of a policy maker if he likes to promote ship-breaking activity in any particular area like Bangladesh. Our objective, therefore, should go to improve occupational safety and health in this industry in such a way that would not make the industry less competitive among the world along with the workers would not be deprived like present time. We should always consider the socio-economic conditions of our unskilled and manual labour force as well as their opportunity cost and the supply elasticity of this labour force.

The International Labour Organization (ILO) has developed a policy report entitled 'Safety and Health in Ship-Breaking: Guidelines for Asian Countries and Turkey – 2004' in Geneva and advised to implement this guideline in all Asian countries where ship-breaking activities have become prospective industries. The fundamental objective of this guideline is to uphold occupational health and safety (OHS) in this industry. Not almost all Asian countries have followed the OHS rules and regulations from the very beginning of their operations, the activities in this industry involve huge occupational risks and health hazards. We therefore need some specific policy guidelines to protect workers in this industry. We appreciate the ILO initiative. The guideline is very innovative, effective and necessary for the workers in this industry, and all stakeholders in this industry have reached consensus while developing this report. Unfortunately, one serious issue, according to our view, is missing in the whole guideline that has made it a worthless piece of policy instruments.

a) Introducing Workers' Registration System

The missing issue in the 'Safety and Health in Ship-Breaking: Guidelines for Asian Countries and Turkey – 2004' is that there is no clause regarding the hiring policy of a worker. A licensed ship-breaking contractor can hire any daily worker who is looking for an unskilled and manual job without keeping any record of the worker's identification even they do not need to write the name of a hired worker in any register or official notebook. To the best of our knowledge, there is no suitable way of tracking a worker's identification in ship-breaking industry in Bangladesh, and no authority is still concerned about the issue and the ILO did so without having any clause in its guideline. In any other industry even in Bangladesh, which needs to hire unskilled, manual and day labour like garment, construction, mining, tannery and jute industries a worker requires to submit at least a photo and to fill up an identity form covering the name and permanent address to get the job. The exception, we have seen, only in ship-breaking industry where no registration system is required for hiring a worker. This provision of recruiting workers gives several types of benefits to the employer, such as avoiding minimum wage rate and benefits, evading tax, employing child labour etc. We would like to explain how this limitation makes all objectives in the guidelines ineffective and blundered. In the following section of this paper, we would like to argue logically and clause by clause the importance of worker registration system for implementing 'Safety and Health in Ship-Breaking: Guidelines for Asian Countries and Turkey – 2004' more effectively.

b) Shortcomings of the ILO Guidelines

The clause 3.8.2 (b) says the contractors must be registered or licensed but there is no provision of registering new workers in the profession. Using this loophole, contractors take advantages by not reporting occupational injury or fatality of workers and also not paying minimum amount of compensation to the victims. In Bangladesh, most of the ship-importing and ship-breaking firms have same proprietors with different trade names and licenses. If sometimes the ship-importing firms and ship-breaking contractors happen to be different they also prioritise their business relations and overlook most of the required rules in the guidelines making some negotiation between them to get rid of penalty or compensation for casualties and to uphold their business reputations.

The clause 4.3.1(e) says that before starting work, employers or contractors should review safety and health conditions of the working place by analysing previous data. The employers or contractors have never performed this data analysis yet because most of the workers do not have any registration with their employers or contractors. The employers or contractors hire most of the workers as daily basis so that they need not to keep health data for the workers as well as not to pay any health care facilities or compensation to this casual labour force. Since labourers start working on the daily basis, they are not aware of the health hazards of the working place and not used to with the safety instruments for doing the assigned jobs. Casual workers

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therefore want to work without using any safety tools knowing that if some accidents happen they would not get any financial compensations, or insurance benefits from the employers or contractors and even they would not be entitled to receive any legal support from the government police service or any institutional body. Only some lump-sum compensation the victims receive on humanitarian ground by the request of fellow workers if the employer would be very much philanthropic.

The clauses 4.3.2 and 4.4.1 emphasize initial review and data analysis to develop systematic process of safety measure and occupational safety and health (OSH) policy in the ship-breaking industry but both would be hopeless until workers would not register themselves with a contractor or a ship-breaking firm. As a profit maximizing labour-contracting or ship-breaking firm it always tries to minimize production costs by exploiting its workers if there is any scope. Recruiting unregistered daily workers gives them opportunities to exploit labourers where in Bangladesh, the wage-elasticity of unskilled labour supply is infinite.

The clause 4.4.1 is the guidance for prevention and protection of reducing hazards, which is a fixed cost both for ship-importing firms and for ship-breaking contractors. Since the ship-importing and ship-dismantling firms in Bangladesh are small capitalists and their major share of capital comes from bank loans, they are not capable of bearing the huge amount of fixed costs to adopt necessary measures of reducing hazards. They therefore prefer to pay lump-sum compensation than to adopt prevention and protection measures. These fixed costs are much higher than the lump-sum compensation cost which needs not to be paid for each accident. If any international funding agency or ship-exporting company supports them to bear a part of these fixed costs this policy guideline could possibly be implemented. Had the protective measures been mentioned in clause 4.4.3 (d), it could have been implemented if the workers were registered with either a contracting-firm or a ship-importing firm.

Section 4.6 clause 4.6.1 (a), (b), (c) and (d) discuss about the emergency preparedness, protections and safety measures, which are possible to be introduced only if the workers are registered as permanent workers in this industry. It is feasible to the employers to provide all these necessary trainings to a permanent worker not to a casual daily labourer.

Reporting, recording and notification of work-related injuries and diseases, ill health and incidences are discussed in section – 5 by clauses 5.1.2 (a), (b), (c), (d) and (e), and clauses 5.1.3 (a), (b), (c), (d), (e) and (f). All these clauses are easy to be implemented by the regular supervision of monitoring authority when the workers are registered. Otherwise employers would be reluctant to introduce any of these provisions because of their own spending.

A profit-maximizing firm would never like to spend any additional cost for its workers if there is an abundant supply of unskilled, needy and illiterate labour force like Bangladesh. We must bind them to follow this guideline by introducing the policy of hiring registered workers in this industry. One might say that this policy would adversely affect the huge unemployed workers but our argument is – although it might make recruiting process a little bit time consuming, that it should come into effect for safety and health security of the labour force, which is not unusual all over the world.

c) Some Policy Guidelines for Facing Environmental Consequences

The above pros and cons of the industry suggest us to go in favour of its existence in Bangladesh. We do believe that Bangladesh is the only country in Asia which badly needs the existence of this industry at least for the next two more decades. The other large scale ship-breaking countries like India, Pakistan and China – all have natural ore mine. These countries can therefore impose ban on ship-breaking industry or follow strict rules of protecting environmental degradation. That is why they are sometimes more liberal than Bangladesh. Moreover, since the oceanic world is interconnected, one country polluting its sea area can disseminate the neighbouring area, which is impossible to be protected from its effects. Thus, even if we are giving up these industrial activities from our country, we will not be able to secure our marine resources from the danger of water contamination done by adjacent countries. However, we would lose a potential source of our economic development.

One might get us wrong and can keep us out of this conference of environmental awareness. But we would ask for a chance to explain our view to mitigate world's environmental problems generated from this industry and simultaneously to improve socio-economic conditions of a poor country like Bangladesh.

Most vessels contain large amounts of hazardous materials, such as asbestos (in particular if built before the 1980s), oils and oil sludge, PCBs (polychlorinated biphenyls), and heavy metals in paints and equipments. So when sent for dismantling, these ships represent one of the major streams of hazardous waste from industrialized countries to the developing world. In 2004, a study for the Commission (DG TREN) estimated that oil sludge from end-of-life ships alone will total between 400,000 and 1.3 million tonnes per year until 2015. Of the hazardous waste in dismantling facilities every year, asbestos will amount to 1,000 – 3,000 tonnes, TBT 170 – 540 tonnes and environmentally harmful paints 6,000 – 20,000 tonnes. (*GREEN PAPER on better ship-dismantling,* Commission Commission of the European Communities, Brussels, 2007)

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What will an old, out-dated ship owner (usually from a developed country) do with his liability? Should it be possible to keep all old vessels in museum? After making a huge amount of profit, the old ship turns into garbage as well as a burden for the owner and that is why the owner needs to pay some cost to shift his burden to somebody else and to remove this garbage from his territory as we do as an owner of a household. This is formally called 'Pollutant Pay System'. It is highly expensive to do in the premises of the developed world, so poor Asian countries could be the only destination for recycling the developed world's garbage. However, we the poor countries badly need to use this garbage as the fertilizer in our economic development. So we are buying their garbage, removing their burden, making their business more profitable abiding by their set of rules and regulations, otherwise being criticized. If the Asian countries and Turkey made an alliance and we would not have bought this garbage anymore, how would it have been possible for these old vessel owners to remove their garbage and clean their air and water? We therefore would like to say that we the poor Asian world and the developed Western world, do not have the beggar and donor relationship, rather we are development partners for each other. So we need to cooperate each other for the betterment of both of our environment and our future. What should we do for saving our environment?

d) Creating Fund for Green Ship-Breaking

The International Waste Shipment Law and the Basel Convention defines a ship as a waste if has not been properly emptied and imposes ban on dismantling if it is not pre-cleaned. Therefore, the owner of these waste ships is unable to dismantle in the EU water territories, hence tries to dismantle in Asian countries where rules are not too strong. To implement the rules strictly through all over the world, the Basel Convention – 2006 proposed that 'a future EU maritime policy should support initiatives at the international level to achieve binding minimum standards on ship-recycling and promote the establishment of clean recycling facilities'. (*GREEN PAPER on better ship-dismantling,* Commission of the European Communities, Brussels, 2007)

Bangladesh needs to take this advantage by raising an environmental awareness 'Fund for Green Ship-breaking'. The 'Fund for Green Ship-breaking' organisation could be constituted with 19 member executive body – (a) Four representatives – each coming from the International Labour Organization, the United Nations Environmental Program, the International Maritime Organization, and the United Nations Development Program. (b) Five government representatives – each coming from Bangladesh, India, Pakistan, China and Turkey. (c) Five representatives – each representing these countries' ship-breakers association. (d) Five representatives – each representing five major ship-seller countries around the world. All representatives must have expertise on the relevant field. The 'Fund for Green Ship-breaking' would be created by the following ways of contributions:

1. The vessel owner would pay the total cleaning cost of an old ship into this fund.
2. The four international organizations would jointly contribute the same amount of fund for making the earth green. It would not be a burden for the international organizations. It is their contribution for sustainable development of the world.

The fund would be allocated and monitored annually among the ship-breaking countries according to the proportion of the number of ships each country dismantles every year. The more ships a country dismantles, the more funds it receives. The 'Fund for Green Ship-breaking' organization would set up cleaning and dismantling criteria and also monitor the ship-breaking countries' activities. If some country needs financial support to develop necessary technological facilities, this organization would grant sufficient loans at minimum service charges, directly to the government of that country to develop only those particular technological facilities, not any other services at all. The ship-breaking firms hire the necessary service facilities from their own country's resources. In 2003, the UNDP granted $1.2 million for ship-breaking purpose in Bangladesh for the safe and environment friendly ship-recycling project (The New Nation, 19 November 2003). The project had been completed by 2006 but we can undoubtedly say that not too much change could have been made with the help of this huge grant. That is why we suggest creating 'Fund for Green Ship-breaking' that would only be used for technical project development to increase the country's feasibility of "safe and environment friendly ship-recycling".

e) Developing Green Forest Belt Recycling Area

In Bangladesh, ship-breaking recycling area is situated at the coastal area of Chittagong, which is 10 miles long. The area is very much suitable for developing forest belt as well. Actually, in early twentieth century, it was covered by mangrove forests. The ship-breaking activities and urbanization process destroyed all these renewable resources. The government of Bangladesh could take an initiative to develop a 'Green Forest Belt' in this area. It would not be expensive for the government because it has allocated ship-breaking plots for each firm working in this industrial sector. The government could impose a rule that each ship-breaking firm must cultivate a 'Green Forest Belt' area of twenty metres width at the front of each firm except the access road by the ship-breakers' at own cost; otherwise the firm would not get either recycling permit

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or the plot. If the Bangladesh government could successfully implement the law, the area would have become the best 'Green Forest Belt Recycling Area' in the world. Moreover, it would mitigate air pollution resulted from ship-breaking in the surrounding area, which indirectly improves the health standard of the working people in this industry and its neighbourhood.

f) Establish Green Ship Recycling Research Cell

It is essential to establish a 'Green Ship-Recycling Research' cell near the ship-breaking area. The Bangladesh Ship-Breakers' Association with the cooperation of different international environmental awareness institutions would finance this research cell. The primary objective of this research would be collecting, maintaining and analyzing ship-breaking related data of the whole industry. These data must cover workers' safety and health conditions, wages and fringe benefits, production and value additions, environment and natural resources' information. The cell must have at least one research expert in each of these sections. Any national and international scholars interested to work on this field must be patronized and encouraged. The government of Bangladesh and the Bangladesh Ship-Breakers' Association must offer at least four post-graduate level scholarships to research in this area.

V. Conclusions

Operating ship-breaking activities is a dirty way of developing Bangladesh by sacrificing huge amount human and environmental costs and by depriving future generations. It is the responsibility of current generation to provide higher level of income to future generations. Current generation must develop future human resources by investing higher amount of money on education and training of future generation. Current generation should also create renewable resources for future generation at least the amount of non-renewable resources this generation has exploited. Keeping these three goals in mind, we tried to highlight four policy measures viz. introducing workers' registration policy, creating fund for green ship-breaking, developing green forest belt and establishing green ship-breaking research institution to mitigate bad human and environmental consequences of this industrial operation in Bangladesh.

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Agrarian Crisis India: an Aftermath of the New Economic Reforms

By Pauline Ahoy

Abstract- The National Crime Records Bureau of India reported in its 2012 annual report that 135,445 people committed suicide in India, of which 13,754 were farmers (11.2%). Of these, 5 out of 29 states accounted for 10,486 farmer's suicides (76%) – Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh and Kerala. In 2011, a total of 135,585 people committed suicide, of which 14,207 were farmers. In 2010, 15,963 farmers in India committed suicide, while total suicides were 134,599.In 2012, the state of Maharashtra, with 3,786 farmers' suicides, accounted for about a quarter of the all India's farmer suicides total (13,754). From 1995 to 2013, a total of 296,438 Indian farmers committed suicide. During the same period, about 9.5 million people died per year in India from other causes including malnutrition, diseases and suicides that were non-farming related, or about 171 million deaths from 1995 to 2013.Farmer suicides rates in Bihar and Uttar Pradesh – two large states of India by size and population – have been about 10 times lower than Maharashtra, Kerala and Pondicherry. In 2012, there were 745 farmer suicides in Uttar Pradesh, a state with an estimated population of 205.43 million.

Keywords: agrarian crisis, farmer suicides, indian agriculture, agriculture indebtedness, new economic reform.

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Abstract- The National Crime Records Bureau of India reported in its 2012 annual report that 135,445 people committed suicide in India, of which 13,754 were farmers (11.2%). Of these, 5 out of 29 states accounted for 10,486 farmer's suicides (76%) – Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh and Kerala. In 2011, a total of 135,585 people committed suicide, of which 14,207 were farmers. In 2010, 15,963 farmers in India committed suicide, while total suicides were 134,599.In 2012, the state of Maharashtra, with 3,786 farmers' suicides, accounted for about a quarter of the all India's farmer suicides total (13,754). From 1995 to 2013, a total of 296,438 Indian farmers committed suicide. During the same period, about 9.5 million people died per year in India from other causes including malnutrition, diseases and suicides that were non-farming related, or about 171 million deaths from 1995 to 2013.Farmer suicides rates in Bihar and Uttar Pradesh – two large states of India by size and population – have been about 10 times lower than Maharashtra, Kerala and Pondicherry. In 2012, there were 745 farmer suicides in Uttar Pradesh, a state with an estimated population of 205.43 million. In 2014 there were eight farmer suicides in Uttar Pradesh. According to IFFRI study number of suicides during 2005–2009 in Gujarat was 387, Kerala 905, Punjab 75 and Tamil Nadu 26. While 1802 farmers committed suicide in Chhattisgarh in 2009 and 1126 in 2010.As per National Crime Records Bureau, the number of suicides by farmers and farm laborers increased to 12,360 in 2014 against 11,772 in 2013. Activists and scholars have offered a number of conflicting reasons for farmer suicides, such as monsoon failure, high debt burdens, genetically modified crops, government policies, public mental health, personal issues and family problems. My paper will be focusing mainly on the government policies leading to agrarian crisis.

Keywords: agrarian crisis, farmer suicides, indian agriculture, agriculture indebtedness, new economic reform.

I. Introduction

Since independence in 1947 due to the inward looking restrictive form of governance India was in complete isolation .Overall backwardness and inefficiency of the economy was the aftermath. India was almost at the brink of economic crisis in July 1991. Foreign currency reserves had dwindled to almost $ 1billion which was not adequate to support import of food grains even for a fortnight , inflation had roared to an annual rate of 17%, fiscal deficit had rose to astronomical heights, foreign investors and NRI's had lost confidence in the Indian economy. The second oil shock crisis in 1979 and the Gulf War in 1990-91 added fuel to the fire. Capital was flowing out of the country and we were close to defaulting on loans. Default on debt servicing appeared imminent and the Government of India was in real trouble. Default could be avoided only if credit was made available from IMF or World Bank. Help was provided by them but on their own terms and conditions. India had no alternative but to adopt the structural adjustment programme of the IMF and World Bank as the last resort. These bottlenecks at home called for a change in the economic policies and programs. The new economic reforms popularly known as **LPG (liberalization, privatization and globalization)** model initiated by the then finance minister Dr Man Mohan Singh in the early nineties included –

a) Devaluation of Indian currency by 18 to 19% against major foreign currencies in the international foreign exchange market

b) Disinvestment where most of the public sector undertakings (PSUs) were sold to private sectors.

c) Foreign Direct Investment (FDIs) where wide range of sectors were opened for the foreign investors namely telecom, roads, ports, airports, insurance, defence industries, pharmaceuticals, petroleum, manufacturing, chemicals, aviation , seed markets etc.

II. Review of Literature

a) *Examining Farmer Suicides in India: A Study of Literature by Mukherjee, Sanchita (2009):* Farmer's suicides are not a phenomenon by itself; rather it is an extreme manifestation of the underlying agrarian crisis prevailing within the country for a long period of time. In recent time period this menace has turned out to be an epidemic, which has rocked the whole country. According to official records, around 160,000 farmers have committed suicide since 1997 .These numbers are enough to pass a chill down the spine! According to literatures most affected states are: Maharashtra (Vidharbha), Andhra Pradesh (Telengana, Warrangal, Rayalaseema, etc), Karnataka (Northern Karnataka), Kerala (Wayanad) and Chhattisgarh. The reasons cited by the literatures highlights rural indebtedness as one of the major factor. Policies associated with the process of liberalisation imposed stress on peasantry of the country by withdrawing formal

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supports towards the sector, which in turn made farmers dependent on non-institutional sources such as private moneylenders and private agents. Seed sector liberalisation has not only brought private players in agriculture but also encouraged monoculture of hybrid cash crops requiring costly inputs, which eventually gets transformed into debt. This situation coupled with crop failure due to pest attack, climatic change and lack of irrigation led to mismatched expectation of farmers and indebtedness. Agonized farmers found solution to all these woes in the forbidden path of committing suicide.

b) *Agricultural Growth Deceleration in India: A Review of Explanations: Kakar Lapudi, Kiran Kumar(2010):* Since the inception of economic reforms, Indian economy has achieved a remarkable rate of growth. This fantabulous performance, to a large extent, was driven by service sector and improvements in the secondary sector. However, this growth process bypassed the agricultural sector, which showed sharp deceleration in the growth rate (3.62 percent during 1984/85 - 1995/96 to 1.97 percent in 1995/96 – 2004/05). Given the relevance of the sector for employment and rural development the declining trend in agricultural growth has emerged as a major concern for researchers and policymakers. The sector has recorded wide variations in yield and productivity and there was a shift towards cash crop cultivations. Moreover, agricultural indebtedness pushed several farming households into poverty and some of them resorted to extreme measures like suicides. In this context, the present paper reviews the performance of the Indian agriculture since reforms and compares it with pre-reforms conditions. The review also concludes that much of the slowdown in agriculture is caused due to factors such as infrastructure, technology and environmental factors, lack of political commitment and poor implementation of policies.

c) *The political economy of farmer suicides in India: indebted cash crops farmers with marginal landholdings explain state-level variation in suicide rates---Jonathan Kennedy and Lawrence King:* The liberalization of the agricultural sector in the early 1990's led to an agrarian crisis and that consequently farmers with certain socio-economic characteristics, cash crop cultivators with marginal landholdings and debt are at particular risk of committing suicide.

III. Sources of Data and Methodology

In the present study an attempt has been made to study the impact of globalization on the agricultural sector of India. The study has been based on secondary information and sees the picture of post globalisation in India through the lens of agriculture.

IV. Results & Discussion

The reforms sought to gradually phase out government control from the market (liberalization), privatize public sector undertakings (privatization) and reduce export subsidies and import barriers to enable free trade (globalization).There was considerable amount of debate in India at the time of the introduction of the reforms, it being a dramatic departure from the protectionist, socialist nature of the Indian economy until then. In the years since its independence, India has made immense progress towards food security. Indian population has tripled, but food-grain production more than quadrupled; there has thus been substantial increase in available food-grain per capita. Prior to the mid-1960s India relied on imports and food aid to meet domestic requirements. However, two years of severe drought in 1965 and 1966 convinced India to reform its agricultural policy, and that India could not rely on foreign aid and foreign imports for food security. India adopted significant policy reforms focused on the goal of food grain self-sufficiency. This ushered in India's Green Revolution. It began with the decision to adopt superior yielding, disease resistant wheat varieties in combination with better farming knowledge to improve productivity. The Indian state of Punjab led India's green revolution and earned itself the distinction of being the country's bread basket. The initial increase in production was centered on the irrigated areas of the Indian states of Punjab, Haryana and western Uttar Pradesh. With both the farmers and the government officials focusing on farm productivity and knowledge transfer, India's total food grain production soared. A hectare of Indian wheat farms that produced an average of 0.8 tons in 1948 produced 4.7 tons of wheat in 1975 from the same land. Such rapid growths in farm productivity enabled India to become self-sufficient by the 1970s. It also empowered the smallholder farmers to seek further means to increase food staples produced per hectare. By 2000, Indian farms were adopting wheat varieties capable of yielding 6 tons of wheat per hectare. With agricultural policy success in wheat, India's Green Revolution technology spread to rice. However, since irrigation infrastructure was very poor, Indian farmer innovated tube-wells, to harvest water. When gains from the new technology reached their limits in the states of initial adoption, the technology spread in the 1970s and 1980s to the states of eastern India — Bihar, Orissa and West Bengal. The lasting benefits of the improved seeds and new technology extended principally to the irrigated areas which account for about one-third of the harvested crop area. In the 1980s, Indian agriculture policy shifted to "evolution of a production pattern in line with the demand pattern" leading to a shift in emphasis to other agricultural commodities like oilseed, fruit and vegetables. Farmers began adopting improved methods and technologies in dairying, fisheries and livestock, and meeting the diversified food needs of India's growing

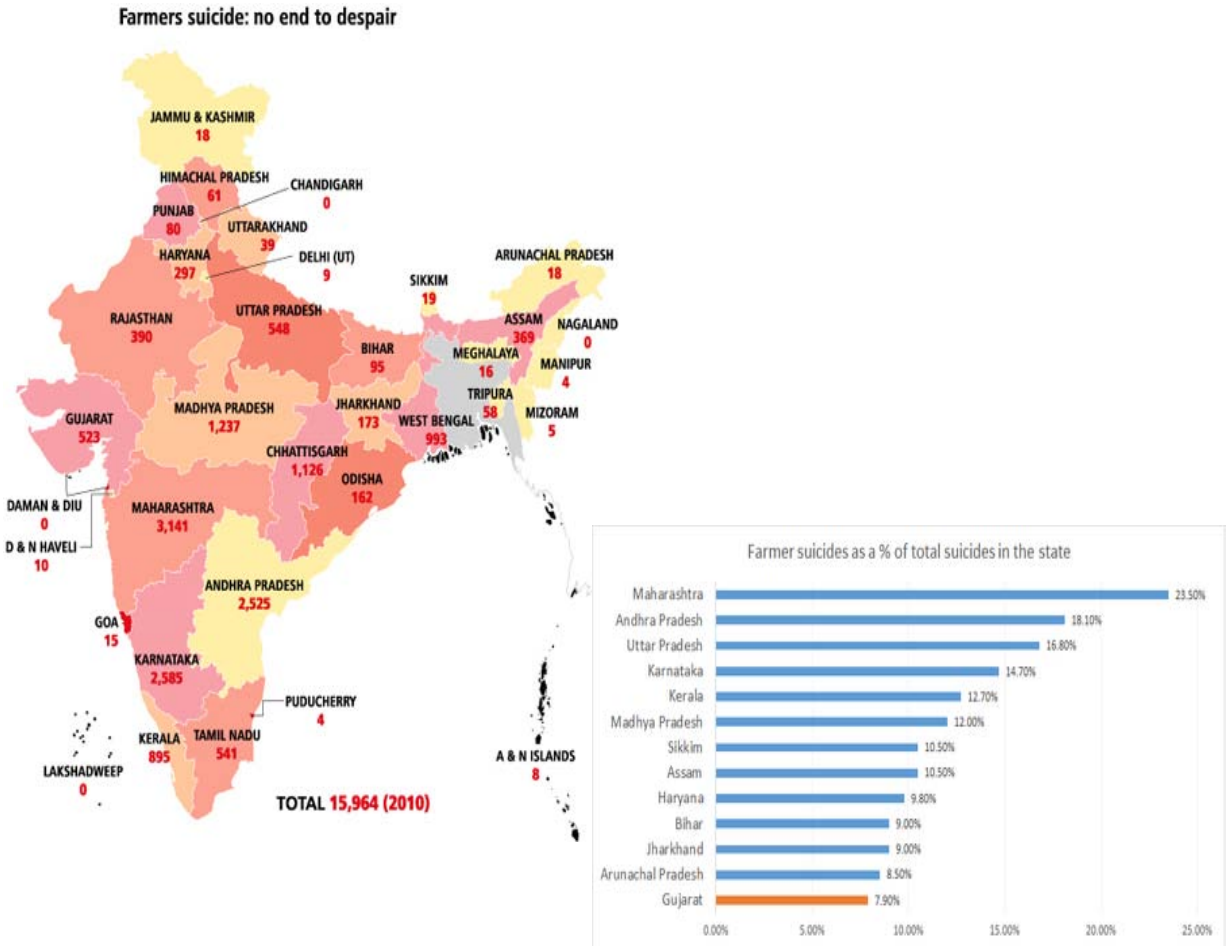
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population. As with Rice, the lasting benefits of improved seeds and improved farming technologies now largely depends on whether India develops infrastructure such as irrigation network, flood control systems, reliable electricity production capacity, all season rural and urban highways, cold storage to prevent food spoilage, modern retail, and competitive buyers of products from the Indian farmer. This is increasing the focus of Indian agriculture policy. India's agricultural economy is undergoing structural changes. Between 1970 and 2011, the GDP share of agriculture has fallen from 43% to 16% and further to 13.7% in 2013. This isn't because of reduced importance of agriculture but is largely due to the new economic reforms -- LPG (liberalization, privatization and globalization).

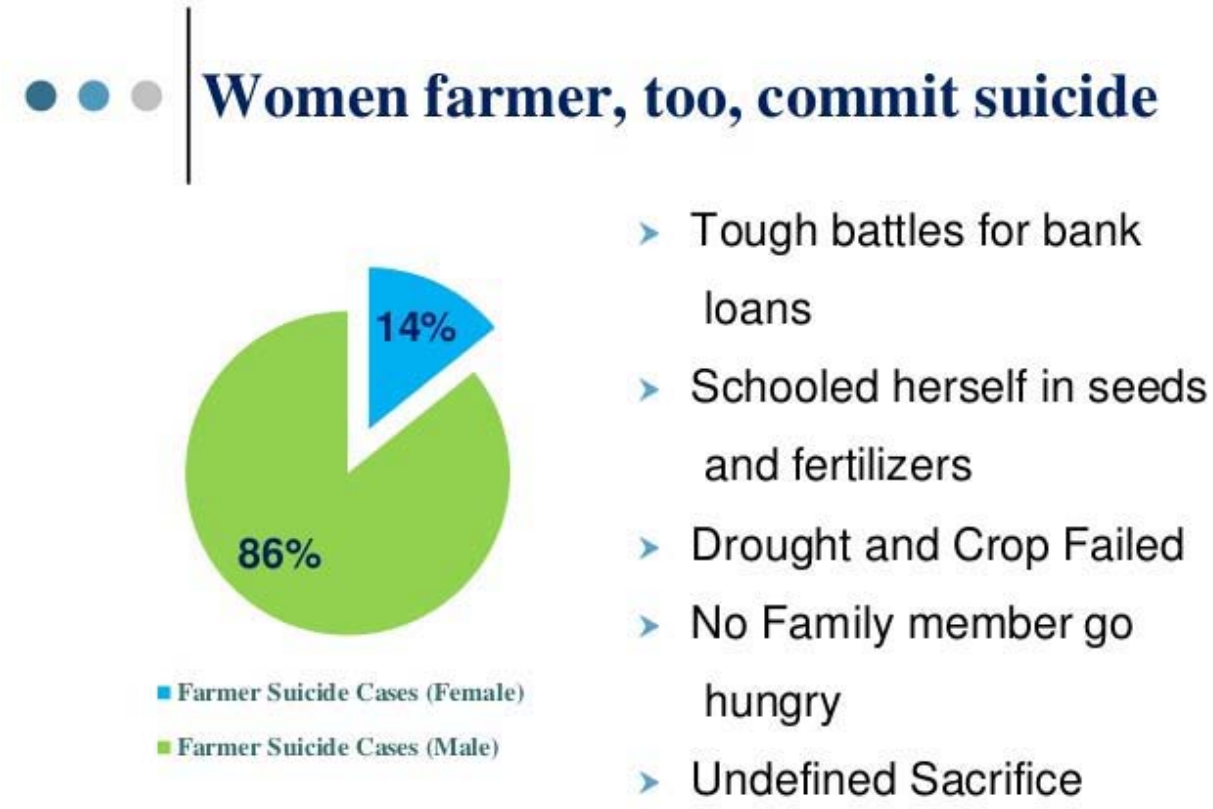
Reforms in the agricultural sector in particular came under severe criticism in the late 1990s, when 221 farmers in the south Indian state of Andhra Pradesh committed suicide. Agriculture employs 60% of the Indian population today, yet its contribution to GDP is poor. Agricultural production fell by 12.6% in 2003, one of the sharpest drops in independent India's history. Agricultural growth slowed from 4.69% in 1991 to 2.6% in 1997-1998 and to 1.1% in 2002-2003. (Agricultural Statistics at a Glance, 2006) This slowdown in agriculture is in contrast to the 6% growth rate of the Indian economy for almost the whole of the past decade. Farmer suicides were 12% of the total suicides in the country in 2000, the highest ever in independent India's history. (Unofficial estimates put them as high as 100,000 across the country, while government estimates are much lower at 25,000. This is largely because only those who hold the title of land in their names are considered farmers, and this ignores women farmers who rarely hold land titles, and other family members who run the farms).

Agriculture seems to be at an advanced stage of crisis, the most extreme manifestation is in the rise in the number of suicides amongst farmers. On an average one Indian farmer committed suicide every 32 minutes between 1997 and 2005. Since 2002, this has become one suicide every 30 minutes.

Is this an "incredible "India ?



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Source: http://WWW.downtoearth.org.in

a) Reasons for Agrarian Crisis

1) *High input costs:* The biggest input for farmers is seeds. Before liberalisation, farmers across the country had access to seeds from state government institutions. The institutions produced its own seeds, were responsible for their quality and price, and had a statutory duty to ensure that seeds were supplied to all the regions in the state, no matter how remote. The seed market was well regulated, and this ensured quality in privately sold seeds too. With liberalization, India's seed market was opened up to global agribusinesses like Monsanto, Cargill and Syn Genta. Also, following the deregulation guidelines of the IMF many state government institutions were closed down in 2003. These hit farmers doubly hard: in an unregulated market, seed prices shot up, and fake seeds made an appearance in a big way. Seed cost per acre in 1991 was Rs. 70 but in 2005, after the dismantling of state organizations, the price jumped to Rs. 1000, a hike of 1428%, with the cost of genetically modified pest resistant seeds like Monsanto's BT Cotton costing Rs. 3200 or more per acre, a hike of 3555%. Expecting high yields, farmers invested heavily in such seeds but alas 35% of their investments in seeds were a waste. The claims of Monsanto that their seeds produce higher yields and are pest resistant are highly disputed. Output is not commensurate with the heavy investment in the seeds, and farmers are pushed into debt. The abundant availability of spurious seeds is another problem which leads to crop failures. Tempted by their lower price farmers invest heavily in these seeds, and again, low output pushes them into debt. Earlier, farmers could save a part of the harvest and use the seeds for the next cultivation, but some genetically modified seeds, known as Terminator, prevent harvested seeds from germinating, hence forcing the farmers to invest in them every season.

2) *Cutback in agricultural subsidies and low output cost:* Farmers were encouraged to shift from growing a mixture of traditional crops to export oriented 'cash crops' like chili, cotton and tobacco. These need far more inputs, pesticide, fertilizer and water than traditional crops. Liberalisation policies reduced pesticide and fertilizer subsidy (another explicit condition of the IMF agreement) . Fertilizer prices have increased by 300% and electricity tariffs have also been increased .Pre-liberalisation, subsidised electricity was a success, allowing farmers to keep costs of production low. These

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costs increased dramatically when farmers turned to cultivation of cash crops, needing more water and higher consumption of electricity.

3) *Reduction on import barriers:* With a view to open India's markets, the liberalization reforms also withdrew tariffs and duties on imports, which protect and encourage domestic industry. By 2001, India completely removed restrictions on imports of almost 1,500 items including food. As a result, cheap imports flooded the market, pushing prices of crops like cotton and pepper down. Import tariffs on cotton now stand between 0 - 10%, encouraging imports into the country. This excess supply of cotton in the market led cotton prices to crash more than 60% since 1995. As a result, most of the farmers in Maharashtra who were concentrated in the cotton belt committed suicides (after which paddy farmers followed the suicide trend). Similarly, Kerala, which is world renowned for pepper, has suffered as a result of 0% duty on imports of pepper from SAARC5 countries. Pepper, which sold at Rs. 27,000 a quintal in 1998, crashed to Rs. 5000 in 2004, a decline of 81%. As a result, Indian exports of pepper fell by 31% in 2003 from the previous year. Combined with this, drought and crop failure has hit the pepper farmers of Kerala hard, and have forced them into a debt trap. Close to 50% of suicides among Kerala's farmers have been in pepper producing districts.

4) *Paucity of credit facilities:* After 1991 the lending pattern of commercial banks, including nationalised banks, to agriculture drastically changed with the result that loan was not easily available and the interest was not affordable. This has forced the farmers to rely on moneylenders who charge exorbitant rate of interest sometimes even up to 24% a month and has thus pushed up the expenditure on agriculture. When the farmers were not able to pay back loan with high interest, they fell into the debt trap. Studies show that most of the farmer's suicides were due to the debt trap. It is part of the policy of privatisation that banks, even nationalised banks, look for profit over their social responsibilities to the people. Credit extended to farmers was reduced dramatically, falling to 10.3% in 2001 against a recommended target of 18%.

5) *Decline of government investment in rural development:* Studies show that after the economic reforms the government's expenditure and investment in the agricultural sector has reduced drastically. This is based on the policy of minimum intervention by the government enunciated by the policy of globalisation. The expenditure of the government in rural development, including agriculture, irrigation, flood control, village industry, energy and transport, declined from an average of 14.5 per cent in 1986-1990 to six per cent in 1995-2000. When the economic reforms started, the annual rate of growth of irrigated land was 2.62 per cent; later it got reduced to 0.5 per cent in the post-reform period. India has very poor rural roads affecting timely supply of inputs and timely transfer of outputs from Indian farms. Irrigation systems are inadequate leading to crop failures in some parts of the country because of lack of water. In other areas regional floods, poor seed quality and inefficient farming practices, lack of cold storage and harvest spoilage cause over 30% of farmer's produce going to waste. The Indian farmer receives just 10 to 23% of the price the Indian consumer pays for exactly the same produce, the difference going to middlemen who are the parasites for the society. Irrigation facilities are inadequate, as revealed by the fact that only 52.6% of the land was irrigated in 2003–04, which result in farmers still being dependent on rainfall. Primary education in rural areas is mismanaged and is of bad quality and there is no system which helps agricultural workers find alternative employment.

6) *Restructuring of the Public Distribution System (PDS):* As part of the neo-liberal policy, the government restructured the PDS by creating two groups—Below Poverty Line (BPL) and Above Poverty Line (APL)—and continuously increased the prices of food grains distributed through ration shops. As a result, even the poor people did not buy the subsidized food grains and it got accumulated in godowns to be spoiled or sold in the open market. As the in-take from PDS was less it has affected the food security of the poor, especially in the rural areas, and this has indirectly affected the market and the farmers.

7) *Special Economic Zone:* As part of the economic reforms, the system of taking over land by the government for commercial and industrial purposes was introduced in the country. As per the Special Economic Zones Act of 2005, the government has so far notified about 400 such zones in the country. Very often it is fertile land which has been acquired. The government has acquired five million hectares of land for purposes other than agriculture between 1991 and 2003. This is almost half of what was acquired during the last 40 years. It was in the news that the government decided to acquire 10,120 hectares of land near Mumbai (almost one-third area of Mumbai) for the Reliance Company and reduced it to 5000 hectors due to public pressure. Since the SEZ deprives the farmers of their land and livelihood, it is harmful to agriculture. In order to promote export and industrial growth in line with globalisation the SEZ was introduced in many countries.

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b) Suggestions for improvement of agricultural sector

1) Necessary import duty and quantitative restrictions should be imposed on imported goods to protect our farmers.
2) Subsidy and concessions given to agriculture but removed in the post-reform period should be restored.
3) Bank loans should be easily made available to the farmers on favorable terms and conditions. The government should seriously think of restoring the low rate of interest to farmers given by banks and other financial institutions as it had done before the reform period. M.S. Swaminathan Commission for Agriculture has recommended a low rate of four per cent interest for the farmers.
4) The government should augment its investment and expenditure in the farm sector. One reason for the agricultural stagnation is low government expenditure. Investment in agriculture and its allied sectors, including irrigation, transport, communication and farm research, should be drastically increased. Development of marketing, storage, and rural godown, cold storage infrastructure must be advocated.
5) The government should revise the policy on Special Economic Zones as it goes against the interest of farmers and the agricultural sector. It should not acquire fertile agricultural land for SEZs. When it does take over land for essential public utilities, it should give just compensation and initiate comprehensive rehabilitation measures.
6) The rural economy, particularly agriculture, will greatly benefit if programmes meant for economically backward sections, including the Integrated Child Development Schemes, mid-day meals for school children and the National Rural Employment Guarantee Scheme, are effectively implemented. Food security of the poor will be ensured if the public distribution system is efficiently run.
7) Bold steps should be taken to implement land reforms which were not implemented in most States. Feudal structures and landlordism based on large holdings of land by high caste and class people even now tend to keep a majority of the people, especially Dalits and backward castes, in the rural areas under their control and domination. Neo-liberal policies with privatisation will only reinforce and strengthen these unjust and exploitative structures. Therefore, there is a need for conscious efforts and positive steps from the government side to implement land reforms. Surplus land acquired thus should be distributed to the Dalit and adivasi farmers.

V. Conclusion

The agricultural sector in India is facing a crisis today. The LPG process, which started in the 1990s, is the main reason for this crisis. The solution of the problem is not in a few "packages" but in drastic changes in the present economic policies related to agriculture. For this, the government should be ready to take bold steps. It is high time that the government and the people realise that India can become a real "superpower" only when the vast majority of the people, especially the farmers in the rural areas, become prosperous and are really empowered. The words of Dr M.S. Swaminathan are relevant here: "In a country where 60 per cent of people depend on agriculture for their livelihood, it is better to become an agricultural force based on food security rather than a nuclear force."

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Technical Efficiency Analysis of Cambodian Household's Rice Production

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Abstract- The aims of this study are to measure the technical efficiency (TE) of Cambodian household's rice production and its main influencing factors using SFA model. Primary data was collected from 301 rice farmers in three selected districts of Battambang by structured questionnaires. The empirical results indicated the mean TE is 0.34 which means famers produce 34% of rice at best practice at the current level of production inputs and technology, reveling that rice output has the potential of being increased further by 66% at the same level of inputs if farmers had been technically efficient. Evidence also reveals that land, fertilizer, and pesticide are the major influencing input factors of household's rice production. However, between 2013 and 2015 TE recorded -14.3% decline rate due to highly affected of drought during dry season of 2015.

Keywords: *agricultural productivity, battambang, cambodia, rice production, stochastic frontier production function (sfa model), technical efficiency.*

GJHSS-E Classification: *FOR Code: 149999*



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Technical Efficiency Analysis of Cambodian Household's Rice Production

Sokvibol Kea [α], Hua Li [σ] & Linvolak Pich [ρ]

Abstract- The aims of this study are to measure the technical efficiency (TE) of Cambodian household's rice production and its main influencing factors using SFA model. Primary data was collected from 301 rice farmers in three selected districts of Battambang by structured questionnaires. The empirical results indicated the mean TE is 0.34 which means famers produce 34% of rice at best practice at the current level of production inputs and technology, reveling that *rice output* has the potential of being increased further by 66% at the same level of inputs if farmers had been technically efficient. Evidence also reveals that *land*, *fertilizer*, and *pesticide* are the major influencing input factors of household's rice production. However, between 2013 and 2015 TE recorded -14.3% decline rate due to highly affected of drought during dry season of 2015.

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I. Introduction

World population is increasing energetically from around 6.1 billion in 2000 to more than 7.2 billion in 2014, and expected to reach 9 billion by 2050 (FAOSTAT 2015). As a result of this rapid growth which is causing threat to food security, there is a need to understand agricultural growth and productivity for increasing agricultural outputs in order to meet the high demand for food. Agriculture remains fundamental in the 21st century for economic growth. According to World Bank (2014), agriculture accounts for one-third of gross domestic product (GDP) and three-quarters of employment in Sub-Saharan Africa. Agriculture, however, is more vulnerable to climate change than any other sector. A warming climate could cut crop yields by more than 25%. Agriculture and land use change are also responsible for 19-29% of global greenhouse gas emissions (World Bank 2014).

Agriculture is the traditional mainstay of the Cambodian economy. It remains as the dominant sector over the country's history. In 1985, agriculture accounted for 90% of GDP and employed approximately 80% of the work force (Nesbitt 1997). Although contribution of agricultural sector to national GDP have been decreased, growth in agricultural sector still played a crucial role in the development of Cambodia (Asian Development Bank 2014). This sector continues to make a rising contribution to the growth of the Cambodian economy. The sector grew 4.3% in 2012 and accounted for 4.75 million workers out of a labor force of 8 million in 2011 (OECD 2013). Industry, agriculture, and services are three main essential sectors of GDP composition with the share of 24.5%, 34.8%, and 40.7% in 2013 respectively (Central Intelligence Agency CIA 2014).

Rice cultivation stands as the most essential segment of Cambodian agricultural sector and plays a major role in the national economic growth (contributing to 15% of the national GDP). It is not only the most important food crop playing an unprecedented role in combating food insecurity for the nation, but also a key production economic crop. The production of rice is the most organized food production system in the country, occupies more than 80% of total cultivated land and is the most essential exported agricultural commodities (Yu and Diao 2011). Rice farming has an important role as a sector producing staple food for almost all of the population and provides a livelihood for millions of people in rural areas. Moreover, the value-chain of rice is one of the four major mainstays of Cambodian economy, along with textile, tourism and the construction industry. Unfortunately, the exportable surplus of Cambodian rice (3 to 4 million tons a year) are processed in Vietnam or Thailand today, which represents an important loss in terms of added-value for the sector (Agence Française de Développement AFD 2011).

Rice is the « White Gold » for Cambodian people. The Royal Government of Cambodia (hereafter, RGC) has declared that supporting the development of the national rice value-chain is one of its first priorities. With the strongly support of RGC, rice production has grown rapidly since 2003, which has firmly changed the country's position from rice deficit to surplus (Yu and Diao 2010). Nevertheless, growth of rice production in Cambodia has decelerated since 2012 and given the land area constraint, its recovery will depend from now on more on increases in rice productivity and quality than on area expansion (World Bank 2014). Therefore, productivity and efficiency use of existing resources might be another source of rice development potential in Cambodia. Nevertheless, although significant

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productivity gains have been achieved in the country since the end of the conflict, the average rice yield still remains below those reached by neighboring countries.

In the recent years, although the studies of productivity and efficiency have been taken the attention of most economists and policy makers around the world (Sawaneh, Latif et al. 2013), agricultural productivity and efficiency studies (particularly rice production efficiency studies) in Cambodia still seem to be very rare. Only research works conducted by the related government agencies such as MAFF[1], CDRI[2], CARDI[3], etc. could be found these days, while the studies of the scholars still remain identical infrequently to see. Given the scarcity of literature on efficiency in Cambodia, the study consequently seeks to supplement literature and contribute in many ways to bridge the gap and supplement the shortage.

This study attempts to contribute to productivity literature of Cambodian agriculture by exploring the distribution of technical efficiency (hereafter, TE) among rice production households operating in the northwest region (specifically Battambang province) which is the high potential region of rice production. The aims of this study are to measure the TE of household's rice production and trying to determine its main influencing factors for explaining the possibilities of increasing productivity of rice, which might be the useful information for rice producers as well as policy makers of the government and related parties for improving Cambodian rice production for sustainable economic and social development at large.

The rest of this paper is organized as follow: Section 2 converses methodology and analytical frameworks of the study. Section 3 presents sources of data and descriptive statistics of input and output variables, while results are presented and discussed in Section 4. Finally, conclusion remarks are given in Section 5.

II. Research Methodology

Theoretically, *productivity* is the ratio of output(s) that produces to input(s) that uses (Coelli, Rao et al. 2005). *Efficiency*, alternatively, is defined as the level of operation that produces the greatest amount of output(s) with the lowest amounts of input(s). It is the main factor determining productivity. Efficiency score range between 0.00 and 1.00. The maximum score (1.00) represents the highest efficiency while the scores of 0.00-0.99 show a firm's inefficiency, indicating the relative displacement from the *frontier*[4] (Ueasin, Liao et al. 2015). Most references to the concept of efficiency are based directly or indirectly on Farrell (1957) which states that "the efficiency can be measured in relative terms as a deviation from best practices of producers compared with producer groups". The production process is technically efficient if and only if the maximum quantity of output(s) can be achieved for a given quantity of input(s) and technologies (Haryanto, Talib et al. 2015). More importantly, Farrell (1957) also suggested to measure TE by estimating frontier production function.

Technical efficiency (TE) is measured as the ratio between the observed output(s) to the maximum output(s) under the assumption of fixed input(s) (called *output-oriented TE* "OO"), or as the ratio between the minimum input(s) to the observed input(s) under the assumption of fixed output(s), called *input-oriented TE* "IO" (Farrell 1957, Coelli, Rao et al. 2005). There are some basic differences between OO and IO models which further details in Hong and Yabe (2015) and Coelli, Rao et al. (2005). Furthermore, *TE in production* is defined as the ability of the producer (i.e. firm, factory, or farmer) to produce at the maximum output at the given quantities of inputs and production technology (Aigner, Lovell et al. 1977). *Production efficiency* is concerned with the relative performance of the process used in transforming input(s) into output(s). The greater the ratio of production output(s) to the factor input(s), the greater the magnitude of TE and vice versa (Balde, Kobayashi et al. 2014).

The present study implement the *stochastic frontier production function* (hereafter, *SFA model*) which is originally proposed by Aigner, Lovell et al. (1977), and Meeusen and Van den Broeck (1977) for measuring the *technical efficiency (TE)* of Cambodian rice farmers in the northwest region. The study applied *FRONTIER 4.1c* (Coelli 1996), the most commonly used package for estimation of *SFA model*, with the logarithmic form of *translog production function*. *FRONTIER 4.1c* was widely applied in different fields of research in the recent years, especially in agricultural studies like Battese and Coelli (1995), Balde, Kobayashi et al. (2014), Heriqbaldi, Purwono et al. (2014), Haryanto, Talib et al. (2015), Kabir, Musharraf et al. (2015), Nehal Hasnain (2015), Ueasin, Liao et al. (2015), Kea, Li et al. (2016), Shinta, Setiawan et al. (2016) .etc. for instance.

Technical efficiency of i^{th} household can be estimated by the ratio of observed output for i^{th} household relative to the potential output defined by *SFA model*, as follow:

$$\boldsymbol{TE_{it} = y_{it}/f(x_{it}, t) = exp(-u_{it}) \leq 1} \qquad (1)$$

[1] MAFF : Ministry of Agriculture, Forestry and Fishery
[2] CDRI : Cambodia Development Resource Institute
[3] CARDI : Cambodia Agricultural Research and Development Institute
[4] According to Coelli, T. J. (1995). "Recent Developments in Frontier Modeling and Efficiency Measurement." Australian Journal of Agricultural Economics **39**(3): 219-245. "Frontier" refers to a bounding function, which provided benefits of heavily influencing of the best performing firms in in a field (of economics), that always reflect the technology they are using. Additionally, the frontier function represents a best-practice technology against which the efficiency of firms within the industry can be measured.

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Technical efficiency changes (hereafter, *TEC*) of i^{th} household between period t and $t+1$ are measured as the ratio of one household's efficiency scores in period $t+1$ to its efficiency scores in period t, which can be expressed as:

$$\boldsymbol{TEC_i^{t,t+1} = TE_i^{t+1}/TE_i^t} \quad (2)$$

According to Aigner, Lovell et al. (1977) and Meeusen and Van den Broeck (1977), the general form of *SFA model*:

$$\boldsymbol{Ln\, y_{it} = Ln\, f(x_{it}, t\,;\, \beta) + v_{it} - u_{it}} \quad (3)$$

where y_{it} and x_{it} are output and input vector of rice production of i^{th} household within period t respectively; Ln indicates the natural logarithm function form; β represent the estimated coefficients; v_i is two-side random error term which represented statistical noise assumed to be normal distribution, $v_i \sim N(0, \sigma_v^2)$; u_i denotes technical inefficiency, is one-side error term that assumed to be independent to v_{it} with half-normal distribution, $u_{it} \geq 0$, $u_i \sim |N(0, \sigma_u^2)|$; v_i and u_i are independent; $i = 1,2, \ldots \ldots, N$; N is number of total samples, and t is time variable measured as year, $t = 1,2, \ldots, T$.

Translog production function of *SFA model* can be written as:

$$\boldsymbol{Ln\, y_{it} = \beta_0 + \sum_j \beta_j Lnx_{jit} + \beta_t t + \frac{1}{2}\sum_j \sum_k \beta_{jk} Lnx_{jit} Lnx_{kit} + \frac{1}{2}\beta_{it} t^2 + \sum_j \beta_{jt} Lnx_{jit} t + v_{it} - u_{it}} \quad (4)$$

where x_{ji} is rice production input j^{th} of i^{th} household; J is number of inputs variables; β_0, β_j and β_t represent estimated coefficients; v_{it} and u_{it} are same as above notation.

The *technical inefficiency (TI) model* for rice production of i^{th} household can be expressed as:

$$\boldsymbol{u_{it} = \delta_0 + \sum_{k=1}^{n} \delta_k z_{kit} + \omega_{kit}} \quad (5)$$

where u_{it} is the inefficiency effects that could be estimated by 2-stage estimation technique in *FRONTIER 4.1c* extemporaneously; ω_{kit} is the stochastic noises; z_{kit} denotes exogenous variables that are factors affecting the households' rice production TE scores; δ_0 represents the intercept term; δ_k is the parameter for k^{th} independent variables to be estimated; if δ_k is negative indicates positive relationship between affecting factor variables and efficiency scores, conversely, if δ_k is positive shows negative relationship between efficiency scores and affecting factors.

The parameters estimation of *SFA model* can be achieved by applying *Maximum-Likelihood (ML)* estimation method which estimates the likelihood function in terms of two variance parameters, see Coelli (1995):

$$\boldsymbol{\gamma = \sigma_u^2/\sigma_s^2 \;;\; \sigma_s^2 = \sigma_v^2 + \sigma_u^2} \quad (6)$$

Gamma (γ) takes value between zero and one, reflects validity of the random disturbances (v_i, u_i) proportion. If γ is closer to zero, it indicates that gap between actual output and maximum possible output mainly comes from uncontrolled pure random factors, makes use of *SFA model* meaningless. In contrast, if γ is closer to one, it shows gap comes mainly from *technical inefficiency* due to effects of one or more exogenous variables, indicates using *SFA model* is more appropriate (Coelli and Battese 1996, Coelli, Rao et al. 2005).

III. Data and Descriptive Statistics

Primary data were collected from random sample of 301 rice production households in three selected districts of Battambang province (*the rice bowl of Cambodia*) using structured questionnaires. The district of Thmar Koul, Moung Russei, and Sangkhae were purposively selected as the study areas based on their total rice production area and total number of *rice farmers*[5] in 2014, which ranked from first to third among all 14 districts of Battambang. Field surveys were conducted in February and December of 2015 gathered 3-years data of households' rice production (2013, 2014 and 2015).

The *SFA model* was constructed by one output (i.e. *quantity* of rice) and five inputs included *land*, *labor*, *fertilizer*, *pesticide*, and *other capital*. Output was the total quantity of un-milled rice produced by households within the year (hereafter, *household rice output*), unit in kilograms (kg). *Land* input was the annual area of rice actually harvested in hectares (ha), expected to have positive effect on *household rice output* since *land* always plays as an important input in production of agricultural crops, particularly rice. Farmers harvested larger *land* of rice tend to be able to produce higher amount of *rice output* than farmers harvested smaller *land*. Alternatively, *labor* input measured as total annual working days of adult family members (18-65 years old) on the rice field(s), unit in days/person/year. In developing countries like Cambodia, *labor* tends to have negative relationship with *rice output* as there were plenty of unskilled and low productivity labors existing since most of them were not well educated yet, unskilled labors often spend longer time than productive labors to produce the same level of output(s). Therefore, *labor* was expected to have negative effect on *household rice output*. Furthermore, *fertilizer* input was total amount of chemical and organic fertilizers' quantity using by households in rice production annually (in kg), while *pesticide* input measured as total amount of poisons for insects and grass's quantity (both chemical and organic) using by households, in kg. These two input

[5] Rice farmers : farmers with rice farming as primary occupation

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variables were expected to be positively related to *household rice output* as followed by green revolution concept (Wikipedia 2016). Additionally, another input was determined as *other capital* investment on rice production, included investments on agricultural machineries, seeds and other rental expenses within the year, measured as sum of depreciation of agricultural machineries (i.e. tractors, walking tractors or *koryons*, pumping machines, pesticide prayers) owned by households altogether with total expenses on seeds purchasing and other rentals such as wage paid for labors or equipment rentals during various stages of rice production. Annual depreciation of machinery was calculated as the division of its bought price by expected usage life. Expected usage life of tractors, *koryons*, pumping machines, and pesticide prayers were assumed to be 15, 10, 5 and 5 years respectively according to observations in the study area. *Other capital* investment was also expected to have positive effect on *rice output*, as farmers with more capital were believed to be able to generate higher opportunities for improving their rice production rather than farmers with lower available capital. Table 1 provides summary statistics of the output and inputs of households' rice production of Battambang from 2013 to 2015.

Table 1: Output and input summary statistics for households' rice production in Battambang, 2013-2015

Variables	2013		2014		2015	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
Output						
Quantity (kg)	16,651.16	1,244.43	18,065.78	1,422.06	15,569.77	1,235.43
Input						
Land (ha)	6.99	0.53	7.07	0.53	7.05	0.52
Labor (days)	108.27	5.58	110.45	5.66	106.69	5.32
Fertilizer (kg)	771.73	55.02	792.09	55.98	790.72	55.87
Pesticide (kg)	70.84	6.64	72.03	6.75	71.95	6.70
Capital (USD)	857.18	59.49	879.05	59.31	823.37	55.72

Source: Calculated by Ms. Office Excel 2016, "S.E" = Standard Error

Output *quantity* of households' rice produc-tion was higher in 2014 than 2013 which increased 8.5% in average from 16.7 thousand kg to 18.1 thousand. Nevertheless, *household rice output* has been decreased by 6.5% between 2013-2015 as the results caused by disasters occurred in 2014 (flood) and 2015 (drought) which reduced *rice output* to 15.6 thousand kg/household (in 2015). Annual rice area harvested by farmer households ranged from 1 ha to 82 ha. During the study period, in average farmers harvested around 7 ha (included both wet and dry season) in 2013, and increased by 1.2% to 7.1 ha in 2014. However, average households' rice harvested area in 2015 has been slightly reduced to 7.05 ha. Furthermore, average annual working days of adult family members was 108 days/person in 2013, and increased to 110.5 days in 2014, then reduced to 106.7 days in 2015. Conversely, *fertilizer* input increased by 2.5% between 2013-2015 from average of 772 kg (2013) to 791 kg (2015), while between the same period *pesticide* input also increased by 1.6% from 70.8 kg to 72 kg in average. In the study period, the level of households' *other capital* investment showed the impressively deduction by 4%, particularly during 2014/2015 (decreased 12.6%), indicated the farmers' response to effects of natural disasters that reduced availability of rice area to be harvested.

Figure 1 illustrates the percentage changes of output and input statistics of rice production of farmer households in Battambang for the periods 2013-2014, 2014-2015, and 2013-2015. The percentage changes within output and input variables indicated that entire inputs had been increased for 1% to 2.6% between 2013 and 2014 which leaded *rice output* to increase by 8.5%. However, between 2014 and 2015 all inputs tended to decrease (particularly in *labor* and *other capital* input which decreased by 6.8% and 12.6% respectively) due to effects of natural disasters, caused *household rice output* to decrease greatly by almost 30% compared to the production of 2014.

In the *technical inefficiency (TI) model*, there were twelve influencing factors of household's rice production TE to be considered. $\mathbf{z}_{1it}$ is *age of household head* (years old). The age of household head might indicate the possibility of a farmers (younger or older) to adopt innovation such as new ideas and techniques in rice cultivating, and also proxy for experience which represents human capital, revealing that farmers with more years of experience in farming will have more technical skills in management and thus higher efficiency than younger farmers (Balde, Kobayashi et al. 2014). However, rice production in Cambodia still seems to be labor-intensive which most works often depends on man-power. Thus, older farmers often have lower body strength (man-power) than younger farmers. $\mathbf{z}_{2it}$ represents *household head's sex* is the gender dummy variable which value of zero if household head is male and one if female. $\mathbf{z}_{3it}$ is the *education of household head*, i.e. education dummy variable with value of one if

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household head is illiterate, two if has primary school education, three if has secondary school education, four if has high school education, five if has bachelor education, six if has graduated education (Master or Ph.D.), seven for other type of education, such as vocational training or informal education system. Both education and age (which proxy for farming experience) are important variables that help to improve the managerial ability of the farmer (Abedullah and Mushtaq 2007). z_{4it} represents *family size*. z_{5it} denotes *female labor*, is the total female family member in the household age 18-65 years old (persons). z_{6it} is *other crops' cultivated area*, i.e. total production area of other crops beside rice such as corn, sugarcane, cassava, cucumber, pepper, wax melon, bitter melon, bean, eggplant, and other vegetables, measured in square meters (m^2). z_{7it} is the *irrigated areas* measured as the percentage of rice production land located near water sources or benefited from irrigation systems to total annual rice cultivated land. z_{8it} symbolizes *distance to water sources*, is the distance of rice production land from water source dummy variable with value of zero if production land is near (0-1 km), one if 1-2 km, two if 2-3 km, three if 3-4 km, four if 4-5 km, five if the production land is far (≥5 km). z_{9it} represents *distance to district* is the variable of distance from the village to the district center, in kilometers (km). z_{10it} is *number of plot area*, i.e. the total number of plot lands owned and cultivated rice crops by farmers. z_{11it} denotes *number of cultivation per year* is the number of annual cultivation times that farmers can cultivate their rice crops. *Disaster* is symbolized by z_{12it}, is the dummy variable with the value zero if farmers' rice fields did not affect by floods, droughts, or insects during the study period, and one if farmers' rice fields affected by floods, droughts, or insects.

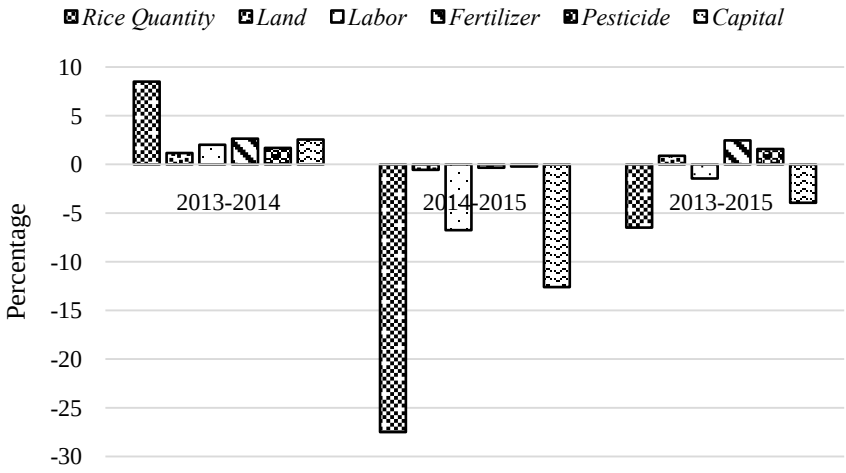


Figure 1: Percentage changes in output and input statistics for households' rice production in Battambang for the periods 2013-2014, 2014-2015, and 2013-2015

Descriptive statistics of *TI model*'s parameters between 2012 and 2015 are given in Table 2. Most of variables remain insignificant changed between this three years period. The overall statistics reveal that average *age of household's head* was 49.4 years old in 2015 ranged from 21 to 83 years old, in which 17% were female household head. Moreover, average *education level* was 2.33, indicating that most of rice farmers' household head just only giant education at secondary school (i.e. grade 7-9 in Cambodian education system). The results also reveal that average *family size* of rice farmers in Battambang is about 5.17 persons/household (ranged from 2 to 12 persons/household), while existing *female labor* in average was about 1.63 persons/household.

The average *cultivated area under other crops* beside rice was about 485 m^2 in 2013. However, this amount had been decreased (by almost 50%) to 247 m^2 in 2014 and 2015. Furthermore, *irrigated areas* were about 16.8% in 2013 average and had been increased to 17.35% in 2014. Water shortage in 2015, nonetheless, had been leading this percentage to decrease to 17.3% (in average). These percentages disclose the lack of irrigation facilities and water management policies, since almost 85% of farmers' rice cultivated areas still not benefit from irrigation systems and remain as rain-fed agricultural lands. In average, rice production lands of rural farmers located around 2.91 km from the nearest water sources (or irrigation systems). This distance is quite far and often causes inability for farmers to use water from existing water sources or irrigation systems. Likewise, the results also show that only 39% of farmers' rice fields located less than 1 km from water sources (or the nearest irrigation systems), thus other more than 60% of rice fields still located far from the water sources. *Distance to district*, on the other hand, is the proxy variable of farmers' accessibility to information sources related to rice production such as price information as

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well as adoption of new production techniques. Within the study areas, most villages located in average of 15.9 km from the center of district (ranged from 1 km to 28 km).

Table 2: Descriptive statistics of technical inefficiency model's parameters, 2012-2015

Variables	2013		2014		2015	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
Household head's Age	47.39	0.69	48.39	0.69	49.39	0.69
Household head's Sex	0.17	0.02	0.17	0.02	0.17	0.02
Household head's Education	2.33	0.05	2.33	0.05	2.33	0.05
Family size	5.16	0.11	5.17	0.11	5.17	0.11
Female labor (18-65 years old)	1.63	0.05	1.63	0.05	1.63	0.05
Other crops' cultivated area	485.02	241.36	247.14	106.52	247.14	106.52
Irrigated areas	16.82	1.22	17.35	1.23	17.30	1.24
Distance to water sources	2.91	0.14	2.91	0.14	2.91	0.14
Distance to district	15.89	0.43	15.89	0.43	15.89	0.43
Num. of plot area	1.48	0.04	1.52	0.04	1.52	0.04
Num. of cultivation per year	1.44	0.03	1.44	0.03	1.44	0.03
Disaster	0.06	0.01	0.07	0.01	0.74	0.03

Source: Estimated by Ms. Office Excel 2016. "S.E": Standard Error

Rice farmers in Cambodia in average cultivated on 1.48 plot lands (in 2013), and increased to 1.52 in 2014 and 2015. The statistics reveal that around 63% of farmers cultivated on only one plot land of rice, and about 44% of farmers able to cultivate rice crops more than once per year. More importantly, between 2013 and 2014, only 6-7% of rice farmers reported the affecting by natural disasters (i.e. droughts, floods, and insects) on their rice fields. Nevertheless, in 2015, almost 75% of famers' rice fields had been reported affecting by natural disasters, particularly the drought during 2015's dry season.

IV. Results and Discussions

a) Estimation of SFA Model

In *SFA model*, a test whether there is TE exist or not can be conducted by testing the null hypothesis $H_0: \gamma = 0$, versus alternate hypothesis $H_1: \gamma \neq 0$. Coelli (1995) argued that *Maximum-Likelihood (ML)* shall be estimated by the calculation of critical value for one-sided *likelihood ratio (LR) test*. The critical value for a test of size α is equal to the critical value of x^2 distribution for a standard test of size 2α. Thus, one-sided *LR test* has suitable range where H_0 is rejected when $LR \geq x^2(2\alpha)$ for a test of size α. At α=1%, $x^2(2\alpha)$ has value of 100.62. In the present study, however, *LR test* has value of 171.80 which is bigger than $x^2(2\alpha)$. Therefore, the null hypothesis $H_0: \gamma = 0$ was rejected, indicates that TE effect exists in the model.

Table 3 lists parameters estimation results by implementing the *ML* estimation in *FRONTIER 4.1c* econometrics software of Coelli (1996). The variance ratio parameter, gamma (γ), had a value of 1.00 significant at $\alpha = 1\%$, shows that the variation of composite error term was mainly from the TE (u_i) almost 100%, and the variation of random error (v_i) less than 1%, indicated that the efficiency of households' rice production between 2013 and 2015 mainly comes from TE of production. Almost all estimated coefficients have the expected signs. *Land* input had positive coefficient and significant at 1%, while *fertilizer* and *pesticide* input both had positive coefficients but significant at 5%, indicates positive contribution of these inputs to *household rice output*. These results designated enlarging harvested *land*, increasing quantity used of *fertilizer* and *pesticide* could cause the increasing of *household rice output*. Furthermore, with the estimated coefficient of 0.83, annual area of rice actually harvested was the main input factor driving extra output for household's rice production compared to *fertilizer* and *pesticide*, which means farmers who cultivate additional lands have the ability to maintain reasonable levels of the necessary inputs. Yu and Diao (2011), Smith and Hornbuckle (2013) and some researches of Asian Development Bank (ADB 2012, ADB 2014) also have similar results. Cultivated land can be increased by expanding irrigation that permits multiple season cropping. Rice is predominately grown in the wet season produces 80% of the total crop, and irrigation is mainly used for dry season rice and to complete wet season rice if necessary. Furthermore, it is also an essential component to ensure that farmers can crop during the dry season, and helps to better regulate water inputs which is essential for improved yields (Eng 2004, Smith and Hornbuckle 2013). Production efficiency, nevertheless, is constrained by low rates of irrigation (ADB 2014). Most Cambodian farmers are able to cultivate rice only once in a year because of inadequate irrigation system and good water management practices. Lack of water during dry season rice farming is significantly constraint and has occasionally caused conflict among farmers (CDRI 2012). Yu and Diao (2011) argued that Cambodia has a huge potential to increase rice production since it is known for its abundant agricultural land and water resources. Such natural resource potential has been

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underutilized less than 30% of potential arable land is under cultivation, and a much smaller portion of area suitable for irrigation is actually irrigated. Thus, expansion of farmland area and irrigation development can be a straightforward way to increase rice production.

Table 3: Parameters estimated for the SFA model

Variables	Coefficient	Standard Error	t-ratio
Constant	8.2818 ***	1.0064	8.2288
ln(land)	0.8276 ***	0.2232	3.7085
ln(labor)	-0.0485	0.2297	-0.2112
ln(fertilizer)	0.0945 **	0.0402	2.3490
ln(pesticide)	0.0694 **	0.0339	2.0494
ln(capital)	0.0323	0.1892	0.1708
t	0.1083	0.0971	1.1152
Land x Labor	0.0341	0.0433	0.7876
Land x Fertilizer	-0.0248	0.0210	-1.1796
Land x Pesticide	0.0089	0.0189	0.4701
Land x Capital	-0.0054	0.0269	-0.1992
Labor x Capital	-0.0034	0.0425	-0.0801
t.t	-0.0163	0.0248	-0.6570
γ	1.0000 ***	0.0994	10.0565
σ^2	0.0993 ***	0.0047	20.9696
	log likelihood function		-235.2186
	LR test of the one-sided error		171.8042

*Source: Estimated by FRONTIER 4.1c. * indicates significant at 10%, ** at 5%, and *** at 1%*

Besides farmland expansion and irrigation development, rice yield can also substantially be increased through crop intensification techniques including both increased use of *fertilizer* and better farming practices such as *System of Rice Intensification* (SRI[6]). Increase of *fertilizers* and *pesticides* application are the main characteristics of Green Revolution in rice agriculture, which spread throughout the Southeast and East Asia during the past 30 years, could increase productivity of rice (Eng 2004, ADB 2012, Smith and Hornbuckle 2013, ADB 2014). This is undoubtedly supported by the sturdy significant of *fertilizer* and *pesticide* inputs in *SFA model* of the current study. Nonetheless, *labor* input has negative coefficient but not significant at any α level, reveals that there was no significant relationship between *labor* and *household rice output* in Battambang during the study period. Furthermore, the present study also established no significant relationship between household *rice output* and level of household's *other capital* investment in household's rice production.

Table 4 illustrates the input elasticity of household's rice production in Battambang between 2013 and 2015. It is clearly demonstrated that all inputs (except *labor*) have had the increasing return to scale. *Land* input had the highest elasticity among entire inputs, following by *pesticide* and *fertilizer*. Elasticity of *land* had the value of 0.83 in average indicating that 1% increase of harvested *land* (of rice) could cause *household rice output* to increase by 83%. Similarly, with the average elasticity of 0.083 and 0.056 respectively, revealing 1% increase in *pesticide* and *fertilizer* could cause the increasing of *household rice output* by 8.3% and 5.6% (respectively). The elasticity of *other capital*, on the other hand, had value of 0.0086 in average showing 1% increasing in capital investment to rice production could also cause the increasing of household rice output (by 0.86%).

[6]System of Rice Intensification (SRI) was introduced by Ministry of Agriculture, Forestry and Fisheries (MAFF) of Cambodia with the support of CEDAC (Cambodian Center for Study and Development in Agriculture: Centre d'Etude et de Dévelopment Agricole Cambodgien). Under SRI, various rice cultivation techniques with less utilization of modern inputs and inexpensive method of planting in relatively dry area could result in an average yield of 3.6 ton/ha, while under a similar situation the yield with traditional farming practice is only 2.4 ton/ha CEDAC (2008). Report on the Progress of System of Rice Intensification in Cambodia 2007. Phnom Penh, Cambodia, Cambodian Center for Study and Development in Agriculture (Centre d'Etude et de Dévelopment Agricole Cambodgien)..

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Table 4: Input elasticity of household's rice production in Battambang province, from 2013 to 2015

Year	Ln(Land)	Ln(Labor)	Ln(Fertilizer)	Ln(Pesticide)	Ln(Capital)
2013	0.8259	-0.0175	0.0562	0.0831	0.0087
2014	0.8256	-0.0171	0.0559	0.0833	0.0085
2015	0.8253	-0.0169	0.0559	0.0833	0.0086

The negative elasticity of *labor* not only explained the overused of labors in rice production but also viewing inefficiency performance of existing labors in rice fields. Although *labor* input were not significantly affecting *household rice output* in the present study, its negative coefficient in the *SFA model* also clearly revealed the over and inefficient used of labor forces. Therefore, additional special policies or regulations might be needed for snowballing efficiency of rice production's existing labor forces in the purpose of improving Cambodian rice production for sustainability social development as large.

b) Technical Efficiency Analysis

The *technical efficiency (TE)* and *technical efficiency change (TEC)* between 2013-2014 and 2013-2015 of household's rice production is being showed in Table 5. The findings revealed the overall mean TE of rice production is estimated at 0.34 (ranged from 0.097 to 0.913) indicated that households produce 34% of rice at best practice at the current level of production inputs and technology. In other words, *household rice output* could have been increased further by 66% at same levels of inputs if farmers had been technically efficient. Households in Battambang produce 35.2% of rice at best practice in 2013. In 2015, however, due to affecting of the natural disasters (particularly drought in 2015) and other influencing factors (will be discussed in the next section), TE of household's rice production in Battambang had been decreased gradually from 0.352 (in 2013) to 0.302 in 2015, indicating that in 2015 rice farmers produced only 30.2% of rice at best practice at their existing inputs level and technology. Thus, there is still a huge gap for improving rice productivity in the high potential province of rice production like Battambang, since *household rice output* of rice farmers in this province still have been able to increase further by almost 70% at the current levels of inputs.

Sangkhae district had the highest TE score among three selected districts in all years of the study period. In 2013, rice farmers in Sangkhae district produced 38.2% of rice at best practice while farmers in Thmar Koul and Moung Russei district produced only 35.5% and 32.7% of rice respectively. In 2015, rice farmers in Sangkhae district continued to be able to utilize their resources in rice production more efficiently than farmers in the other two districts by produced almost 40% of rice at best practice, while the rice production of farmers in Thmar Koul and Moung Russei district became worse in which respectively produced only 29.7% and 24% of rice. Between 2013 and 2014, TE of farmers' rice production in Moung Russei district increased by 2.98% from 0.327 to 0.336, claimed as the highest increasing percentage among three districts (between this two-years). Nonetheless, in 2015 the TE of rice production in this district declined sharply to 0.24 (diminished by 27% between 2013-2015). However, during the study period farmers' rice production in Thmar Koul district had the decreasing trend of TE from 0.355 (2013) to 0.342 (2014), then continued to decrease to 0.297 in 2015 (decreased by 16.3% between 2013-2015). In contrast with the situation in Thmar Koul district, household's rice production of farmers in Sangkhae district had the increasing trend of TE from 0.383 in 2013 to 0.387 in 2014, and still continued to increase to 0.389 in 2015 (1.65% increased between 2013-2015).

At the commune-level, statistical results reveal that production of rice of farmers' household in Reang Kesei commune had the highest TE score among all communes in Sangkhae district during the study period by producing around 50% of rice at the best practice. Farmers' rice production in Thmar Koul district, on the other hand, the commune that have had the highest TE score in all years between 2013 and 2015 was Boeng Pring commune which produced around 26-36% at the best practice. Likewise, the production of rice in Prey Svay commune of Moung Russei district was also the commune production with the highest TE score in the district, by producing 26-35% at best practice (at the existing level of inputs and technology).

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Table 5: Technical efficiency (TE) and technical efficiency change (TEC) of household's rice production in Battambang province, from 2013 to 2015

District	2013		2014		2015		TEC (%)	
	Mean	S.E.	Mean	S.E.	Mean	S.E.	2013-14	2013-15
Moung Russei	0.3267	0.01	0.3364	0.01	0.2396	0.01	2.98	-26.66
Moung	0.3056	0.02	0.3086	0.02	0.2054	0.01	0.98	-32.79
Prey Svay	0.3503	0.01	0.3614	0.01	0.2673	0.01	3.17	-23.70
Ruessei Krang	0.3287	0.02	0.3238	0.02	0.2502	0.02	-1.49	-23.89
Kakaoh	0.3220	0.01	0.3517	0.01	0.2354	0.01	9.21	-26.89
ThmarKoul	0.3550	0.01	0.3415	0.01	0.2971	0.01	-3.80	-16.31
Anlong Run	0.3273	0.02	0.3296	0.02	0.2808	0.02	0.72	-14.20
Ta Meun	0.3528	0.02	0.3291	0.02	0.2857	0.02	-6.70	-19.01
Boeng Pring	0.3840	0.02	0.3651	0.02	0.3239	0.02	-4.94	-15.66
Sangkhae	0.3827	0.02	0.3865	0.02	0.3890	0.02	1.00	1.65
Ta Pon	0.3370	0.03	0.3407	0.02	0.3338	0.02	1.10	-0.94
Kampong Preah	0.3067	0.02	0.3205	0.02	0.3359	0.02	4.51	9.53
Reang Kesei	0.5044	0.03	0.4983	0.03	0.4973	0.03	-1.21	-1.41
All households	0.3520	0.01	0.3529	0.01	0.3016	0.01	0.27	-14.30

Source: Estimated by FRONTIER 4.1. "S.E." = Standard Error

Figure 2 illustrates the TE distribution of Cambodian household's rice production in Battambang from 2013 to 2015. The study indicates that individual household's TE ranged from a low of 12.6% to a high of 82.5% with a mean TE of 35.2% in 2013, while in 2014 household's TE ranged from 14.6% to 86.7% with a mean TE of 35.3% (increased 0.27%). TE of household's rice production in 2015, on the other hand, ranged from 9.7% to 91.3% with a mean TE of 30.2% (decreased 14.3% between 2013-2015). Thus, rice production of farmers in Battambang performed better during 2013 and 2014 than 2015 for which around 33-37% of households had TE score between 0.31-0.40 compared to 2015 that had only 25% (due to affecting of drought). However, in 2015 most households had TE score between 0.21-0.30 (accounted for almost 38%). These percentages indicated a huge gap (between 62-75%) of rice farmers in Battambang to increase their production using the current levels of inputs and technologies.

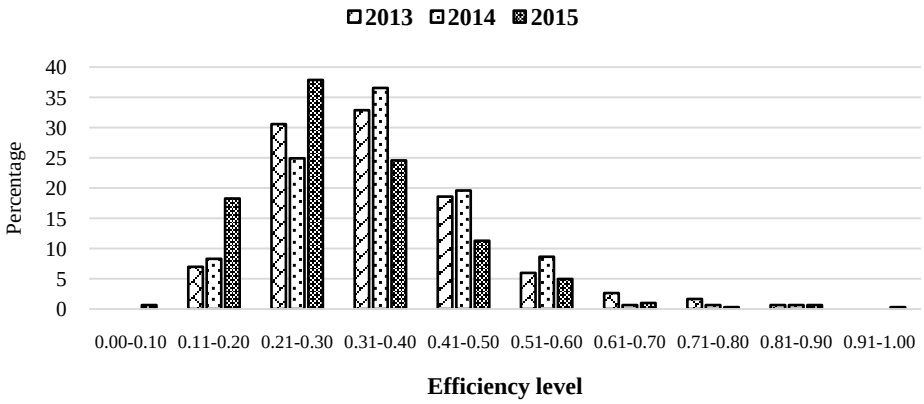


Figure 2: Technical efficiency distribution of household's rice production in Battambang, 2013-2015

c) Technical Inefficiency Model and Affecting Factors

The *Maximum-Likelihood (ML)* estimates coefficients of explanatory variables in the *TI model* of household's rice production in Battambang, and these estimated coefficients are of interest and have implication as shown in Table 6. A negative sign on a parameter explaining the positive effect of the variable on TE means the variable is improving TE, while for a positive sign the reverse is true. It is noticeable that *disaster* and *other crops' cultivated area* both had positive coefficient signs and significant at 1%, while *education of household head* and *family size* also had positive coefficient signs but significant at 10%, indicating negative relationships of these factors to TE of household's rice production. With the highest coefficient of 0.27, *disaster* was the core influencing factor leads to decreasing TE, while *education of household head* and *family size* are the second and third factors with

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estimated coefficient value of 0.03 and 0.01 respectively. These results indicate 1% increasing in *disaster*, *education of household head* and *family size* will cause the decreasing of TE by 27%, 3% and 1% respectively. The impact of education level of household's head is negatively significant on the efficiency of household's rice production, implying less educated rice farmers are more efficient than better educated farmers. It means being an educated rice farmer was not enough to significantly attain greater levels of efficiency. This result is consistent with the finding of Balde, Kobayashi et al. (2014), who found that education level was significant and negatively affecting TE of Mangrove rice production in the Guinean coastal area. Kabir, Musharraf et al. (2015) who estimate the impact of bio-slurry to Boro rice production in Bangladesh, also found the same negative sign of coefficient of education relation to production inefficiency of rice. Besides, *family size* also has a negative and significant impact (on TE). This result implies that farmers with fewer family members seem to perform better than those with more members. Additionally, the negatively significant of *other crops' cultivated area* variable indicates reducing rice's cultivated area for growing other crops beside rice might cause the TE to decrease. However, the value of this coefficient is quite tiny, reflecting the very little effect of other crops' cultivated area on TE.

The *irrigated area* had negative coefficient sign and significant at 1%, while *number of plot area* and *sex of household head* also had negative coefficient signs but significant at 5%, indicating the positive impact of these factors on TE of household's rice production. With the similar estimated coefficient value of 0.07, *number of plot area* and *sex of household head* are two core factors increasing TE, signposted 1% increase in these factors could cause TE to increase by 7%. The key messages from this finding are farmers who cultivated on additional plot lands might have extra opportunities to obtain further benefits from their rice production. The positively significant of *sex of household head*, on the other hand, is not only explain the imperative roles of female in rice production and family management, but also reveals the limited abilities of existing male household's head and inefficiency used of male labors in their household's rice production. Thus, further extraordinary procedures might need to put in place to enhance the efficiency of labor utilization or allocation.

Table 6: Rice production technical inefficiency model parameters

Variables	Coefficient	Standard Error	t-ratio
Constant	1.3048 ***	0.2213	5.8954
Household head's Age (years old)	0.0007	0.0010	0.6266
Household head's Sex (0:male/1:female)	-0.0657 **	0.0327	-2.0097
Household head's Education	0.0295 *	0.0159	1.8614
Family size	0.0123 *	0.0070	1.7672
Female labor (18-65 years old)	0.0161	0.0139	1.1639
Other crops' cultivated area	0.0000 ***	0.0000	3.4658
Irrigated area	-0.0087 ***	0.0017	-5.2380
Distance to water sources	-0.0264	0.0210	-1.2547
Distance to district	0.0004	0.0017	0.2602
Number of plot area	-0.0678 **	0.0273	-2.4867
Number of cultivation per year	-0.0581	0.1091	-0.5322
Disaster	0.2664 ***	0.0344	7.7360

*Source: Estimated by FRONTIER 4.1. * indicates significant at 10%, ** at 5%, and *** at 1%.*

Strongly significant of *irrigated area*, showing the greater percentage of irrigated rice land could lead to increasing TE. This result highlights the important of irrigation systems in Cambodian rice production, particularly in high potential province like Battambang. Therefore, focusing on irrigation development and good water management are the key factors to increase rice productivity in the northwest region of Cambodia that might need to be concerned and developed gradually.

V. Conclusions

The aims of this study are to measure TE of household's rice production in the northwest region of Cambodia and to determine its main influencing factors using *SFA model*. The study utilized primary data collected from 301 rice farmers in three selected districts of Battambang province by structured questionnaires. The empirical results indicated that level of *rice output* varied according to differences in production techniques and efficiency of production processes. The mean TE is 0.34 (ranged from 0.097 to 0.913) which means famers in Battambang produce 34% of rice at best practice, indicates that *rice output* has potential of being increased further by 66% at the same level of inputs if farmers had been technically efficient. Furthermore, during the study periods the TE of household's rice production recorded a -14.3% decline rate due to highly affected of drought in 2015.

Three main conclusions emerged from the study's results. First, based on decomposing of *SFA*

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model, increasing harvested *land* (particularly in dry season through development of irrigation systems and good water management practices for gaining benefit from multi-cropping systems) is the major influencing factor of household's rice production in Battambang, while increased *fertilizers* and *pesticides* application are the second and third influencing factors respectively. Second, calculation of input elasticity reveals that all inputs, except *labor*, have had the increasing return to scale, while *land* input had the highest elasticity value among entire inputs following by *pesticide* and *fertilizer*. The negative input elasticity of *labor* are not only explained the overused of labors for household's rice production but also showing the inefficiency performance of existing *labors* in the rice fields. Finally, the decomposing of *TI model* reveals that core influencing factors lead to decreasing TE of household's rice production are *disaster* (i.e. droughts, floods, and insects), *education of household head*, *family size* and *other crops' cultivated area*, while the main influencing factors lead to increasing TE are *irrigated area*, *number of plot area* and *sex of household head*.

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Rural Household Vulnerability to Poverty in South West Ethiopia: The Case of Gilgel Gibe Hydraulic Dam Area of Sokoru and Tiro Afeta Woreda

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Abstract- This study was proposed to measure the extent of vulnerability to poverty as well the effect of socio-economic characteristics on household susceptibility to poverty using Feasible Generalized Least Squares (FGLS) estimation and logistic regression methods. The results revealed that, sizable fractions of non-poor households (51.3%) were vulnerable to poverty and 53.2 % of the sampled poor households have a probability of 50 percent and above to fall in to poverty in the near future again. Household livestock holding, crop diversification, Household head education level and household's access to credit and their exposure to idiosyncratic shocks are found to be important variables in examining the determinants of rural household vulnerability to poverty. The results suggested that since poverty and vulnerability to poverty are different signs of the same coin, policies directed towards poverty reduction need to consider not only the current poor but also the vulnerability of current non-poor households.

Keywords: *poverty, poverty line, vulnerability, vulnerability to poverty, vulnerability threshold.*

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Rural Household Vulnerability to Poverty in South West Ethiopia: The Case of Gilgel Gibe Hydraulic Dam Area of Sokoru and Tiro Afeta Woreda

Sisay Tolla [α], Dr. Wondaferahu Mulugeta [σ] & Mr. Yilkal Wasse [ρ]

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I. Introduction

More than 2.2 billion people of the world are either near or living in poverty. That means around 30 percent of the world's people remain vulnerable to multidimensional poverty which covers lack of the basic necessities such as food, education, health services, fresh water and hygiene which are essential for human continued existence. At the same time, nearly 80 percent of the global population requires comprehensive social protection. About 842 million people of the world suffer from chronic hunger, and nearly half of all workers or more than 1.5 billion are in precarious employment (UNDP, 2014).

According to Damas and Israt (2004), Poverty is generally associated with deprivation of health, education, food, knowledge and the many other things that make the difference between truly living and merely surviving. Another universal aspect of poverty, which makes it principally painful and difficult to escape, is: Vulnerability. Unlike poverty, vulnerability reflects what households or individuals future prospects are and it is an ex ante anticipations of a household or individuals welfare. Thus, the perceptive of the concepts of poverty, vulnerability and their linkage is essential in the efforts to escape from the challenges of impoverishment since vulnerability to poverty is a central manifestation of human deprivations.

Mounting evidences show that households in developing countries particularly poor families are more vulnerable than any other group to health hazards, economic down-turns, natural catastrophes and man-made violence. Poor households are repeatedly hit by severe idiosyncratic shocks such as death, pests or diseases that affect livestock or crops, injury or unemployment shocks and this all affect the wellbeing of these households adversely. For example, WB (2014) indicated that adverse shocks such as illness, injury and loss of livelihood have dreadful impacts, and are significant causes of destitution then this shocks play major role in pushing households below the poverty line and keeping them there.

Several countries, especially in Sub-Saharan Africa, have made poverty reduction and hence improvement in income and welfare their main goals in their growth and development agenda. And most policy interventions adopted by these countries have only focused on poverty at a point in time. For instance, the first MDG only considers the current poor but neglects the future poor or vulnerable (Novignon, 2010).

However, currently non-poor households, who face a high probability of large adverse shock, may experience hardship and become poor tomorrow. Hence, the currently poor households may include some who are only transitorily poor as well as other who will continue to be poor in the future. In other words, a household's observed poverty status is defined in most cases simply by whether or not the household's observed level of consumption expenditure is above or below a pre-selected poverty line is an ex-post measure of a household's well-being. In line with this, Chaudhuri, et.al (2002) noted that for development and policy purposes, what really matters is the ex-ante risk that a

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household will fall below the poverty line or will continue in poverty. Thus, the current poverty status of a household is not enough and potential for analyzing household's vulnerability of being poor in the future. Moreover, for appropriate forward-looking anti-poverty interventions, the critical need is to go beyond a cataloging of who is currently poor and who is not, to an assessment of households' vulnerability to poverty.

In order to achieve sustainable economic growth and reduce poverty, the Ethiopian government introduced Agricultural Development Lead Industrialization (ADLI) in 1992 as its main policy program accompanied with many poor targeting interventions. Since then the government is constantly pursuing development efforts in addressing mainly rural poverty. Accordingly, Ethiopia has achieved economic growth since 2004 and the country becomes among the fastest growing non-oil producing economies in Africa (UNDP, 2012).

Although Ethiopia has come a long way in reducing poverty, widespread poverty and food insecurity still persist. The country is prone to drought, which has serious implications on vulnerability and food security as most of the agriculture is dependent on rain. More importantly, structural factors such as land degradation, population pressure, undeveloped farm technology, low levels of household assets and limited opportunities to diversify income make millions of Ethiopians vulnerable to poverty (WFP, 2014). Likewise, Alemayehu and Addis (2014) pointed out that the Ethiopian economy and the country's poor are extremely vulnerable to shocks, which may include conflict, rainfall variability or drought, world price fluctuations of coffee and fuel as well as change in aid and remittances. Hence, the chances of slipping back into poverty both in rural and urban areas following shocks such as drought or the death of the head of the household are very high.

In many developing countries like Ethiopia the principal economic policies have been focused on reducing just the level of poverty which may not be a wholly satisfactory approach to bring sustainable development. However, many development economists suggested that to trace the root factors that will determine destitution needs further investigation on the notion of vulnerability to poverty other than the crude issue of poverty. For example, Amartya Sen portrayed that the challenge of development includes not only the elimination of persistent and endemic deprivation, but also the removal of vulnerability to sudden and severe destitution.

In the view of these facts, the researchers believed that the adoption of innovative and appropriate onward looking anti-poverty perspectives, that is not only improving the well-being of households who are currently poor but also preventing people from becoming poor in the future, is necessary and timely to realize the universal visions of achieving sustainable development passing through poverty alleviation.

Since the detection of vulnerable and poor households together with determinants of vulnerability to poverty is a requirement for triumphant anti-poverty policies, this study, therefore, tried to provide an understanding concerning rural household vulnerability to poverty in Sokoru and Tiro Afeta woreda of south west Ethiopia.

II. Materials and Methods

The study of vulnerability to poverty at the household level should ideally be attempted with panel data of sufficient length and richness. However, as a second best alternative to examine household vulnerability to poverty, a cross-sectional household surveys with detailed data on household characteristics, consumption expenditures, asset of household, household access to saving and credit services, shocks experienced by household can potentially be informative about the future in a case where panel data are rare which is the feature of developing countries. Vulnerability measurement assumes general perspectives which include the time prospect and the wellbeing measure. The welfare in vulnerability measurement mostly explained in terms of consumption.

a) Description of the Study Area

The Gilgel Gibe project is one of the most attractive potential hydroelectric developments in Ethiopia and it is located 250 Kms Southwest of Addis Ababa and 75 Kms Northeast of Jimma town. The Dam covers an area of 51 square Kms at an altitude of 1670 meters above sea level, and holding around 668 million cubic meter of water. The four woreda bordering the dam are Omonada, Sokoru, Tiru Afeta and Kersa which is majority of the population practice farming as their main means of livelihood (Alemeshet Y. et al, 2011). And this study was conducted in South West of Ethiopia at Gilgel Gibe hydraulic Dam Area of Tiro Afeta and Sokoru woreda, which is found in Jimma Zone of Oromia Regional State. The agro ecology of the study area is entirely midlands or woinadega with undulating and plains topography. Vegetation coverage consists of bush scrubs. The principle crops grown are maize, sorghum, teff and coffee. The largest earning cash crops are maize, coffee and peppers. The main livestock kept are cattle, goats, sheep, donkeys and chickens.

Part of the Jimma Zone, Sokoru woreda has 38 kebeles and among these, 36 kebeles are rural district. The altitude of this woreda ranges from 1160 to 2940 meters above sea level. Persistent rivers include the Gilgel Gibe a tributary of the Gibe and the Kawar. A survey of the land in this woreda shows that 36.6% is arable or cultivable, 16.8% pasture, 17.2% forest, and the remaining 29.4% is built-up or degraded (OLZR, 2007).

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Tiro Afeta woreda has 27 rural kebeles among 32 districts as one woreda in Jimma Zone of the Oromia Region State. The altitude of this woreda ranges from 1640 to 2800 meters above sea level. Persistent rivers include the Gilgel Gibe, the Busa, the Nedi and the Aleltu. A survey of the land in this woreda indicates that 26% is arable, 8.3% pasture, 14% forest, and the remaining 51.7% is considered built-up, degraded or otherwise unusable (OLZR, 2007).

These two woredas are principally affected by chronic threats such as trypanosomiasis, blackleg and stalk borer which harms cattle and crops. Additionally, periodic crop pests like stalk borer and cattle diseases such as trypanosomiasis and blackleg affect these two woreda every 2-3 years (OLZR, 2007).

b) Source and Type of Data

Primary sources of data were the most beneficial instruments for the researchers since the study was focused on the micro-level context of a country. Households are the major units of analysis. Multipurpose and Structured questionnaires were used to collect information on household demographic compositions, consumption expenditure, physical capital variables of household including livestock holding and grown crop types, human capital variables, household access to saving and credit services, shocks that the household faced. The data collection process held through a personal interview with the rural households. The data was collected by trained high school completed persons who have experience and knowledge about the culture, language and ethics of the study areas' society. The data collectors trained for two days and principal investigators strictly supervised data enumerators and checked the completeness of the questionnaire. The study also included essential secondary data from responsive office of Jimma zone planning and program office.

c) Sampling Procedures

To meet the overall objective of the study and because of lack of prior information on the vulnerability to poverty status of households in Sokoru and Tiro Afeta woreda, the target populations were households whose conditions suggest that they could be poor in the future even if they are above the poverty line today. Sokoru and Tiro Afeta woreda were selected purposively from Jimma zone of south west Ethiopia. Because these selected woreda are represented by a dominantly subsistence farming community where high land degradation, soil erosion and drought problems pose a serious threat on households' wellbeing (Amsalu and Wondimu, 2014).

To select the appropriate sample size needed from a total of 55679 rural households in Sokoru and Tiro Afeta woreda, the following sample size determination formula (Noel, et al., 2012) was used:

$$n \geq \frac{N}{1 + (N-1)(\frac{2d}{z})^2} = 266$$

Where, N = The total population
N = The required sample size,
d = 0.06 Margin of error,
z = 1.96 for a 95 % confidence interval.

The margin of error d is taken as percent point error term and is often calculated for d=1%, d=2%, d=5% and d=6%. Marginal error of 0.06 is tolerable with 95% confidence interval.

d) Methods of Data Analysis

The study utilized descriptive tools as well as econometric models of data analysis. Using Stata13.0 software, the data analyzed via applying a three-stage feasible generalized least squares (3FGLS) technique to identify the extent of rural household vulnerability to poverty and to describe disseminations of poverty and vulnerability to poverty in the study area. And logistic regression method was employed to assess the determinants of rural household vulnerability to poverty in the study area.

e) Specification of the Consumption Process

In the most developing countries, consumption rather than income approach is preferred as a measure of welfare indicators. Because in consumption approach, current consumption provides information about incomes at past or future dates that makes it a good indicator of long-term average well-being. It is regular that consumption fluctuates less than income, due to households or individuals smoothing their consumption. Households' not only financed their current consumption but also they responds to fluctuation in income by saving in the boom periods and dis-saving during lean periods in order to smooth their consumption. Lastly but not the least, consumption contains smaller measurement error as compared to income; there is a belief that households are more willing to reveal their consumption behavior than they are willing to reveal their income (Lipton et al, 1993). Consumption reflects the ability of household's access to credit and saving at times when their income is very low. Hence, consumption reflects the actual standard of living than other relative proxies for measuring household wellbeing.

For this study purpose, consumption was adjusted for difference in the calorie requirement of different household members (for age and gender of adult members). This adjustment is made by dividing household consumption expenditure by an adult equivalent scale that depends on the nutritional requirement of each family member. Therefore, throughout this paper, consumption expenditure per

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adult equivalent per month is used as the measure of household welfare.

Chaudhuri (2003) defined vulnerability to poverty as a forward looking or ex ante measure of household well-being and he articulated that the level of vulnerability to poverty at time t is defined in terms of household consumption scenario at some point in time t+1 to distinguish the notion of vulnerability to poverty and poverty. These concepts of vulnerability to poverty indicate the possibility of examination of household vulnerability to poverty without direct reference to the current poverty incidence.

Since the study of household's vulnerability to poverty is principally determined via applying inferences from the future consumption prospects, measuring vulnerability to poverty from cross section data requires a number of factors include: household demographic compositions, consumption expenditure, physical capital variables, human capital variables, household access to socio-economic services and shocks that the household faced, etc.

Conceptually, the following reduced form of the future consumption prospect shows the specification of consumption process.

$$Cht = f(Xi, Sit, eit)$$

Xi is a vector of household characteristics including socio-demographic characteristics, and livelihood sources and endowments of assets.

Sit represents observed locally idiosyncratic shocks experienced by household between t-1 and t.eit t is error term and represents unobservable household and community characteristics, as well as unobserved idiosyncratic shocks and covariate shocks that contribute to differential welfare outcomes of otherwise observationally equivalent households.

f) Econometric Techniques

There are three main approaches in measuring vulnerability include; measuring vulnerability as expected poverty (VEP), vulnerability as low expected utility (VEU) and finally vulnerability as uninsured exposure to risk (VER).

For the purpose of this study, vulnerability is defined as expected poverty (VEP) which has measurement advantage for ex-ante information that measures vulnerability to poverty using cross sectional data. Also this method has an advantage on identifying households at risk who are not poor that can be estimated with a single cross sectional data. This approach is adopted by different researchers including (Dawit,2015;Tesfaye, 2013; Novignon, 2010; Imai et al, 2011; Jamal, 2009;Oni and Yusuf, 2007;Alayande et al, 2004; Deressa et al, 2009; Chaudhuri, 2003;Jalan et al,2002) to estimate household vulnerability to poverty from a single cross sectional data. To estimate the extent of rural household vulnerability to poverty, this study followed an approach developed by Chaudhuri et al (2002).This method is commonly used in a number of developing country contexts when only cross-sectional data are accessible.

As outlined by Lachlan (2011), estimating vulnerability as the probability of experiencing future poverty reflects three main advantages. Firstly, it produces results that are corresponding to more established poverty measures. Secondly, it sheds light on the connection between vulnerable and poor households; by expressing vulnerability in terms of the probability of being poor. Thirdly, this approach is applicable when only cross-sectional data are available.

Following Chaudhuri et al. (2002), measure of vulnerability as expected poverty is the probability of household, h finding itself to be consumption poor at time t+j can be expressed as :

$$vht = pr\left(lnch < \frac{lnZ}{xh}\right) \quad (1)$$

Where, Vht represents vulnerability of household at time t, lnCh measures household's per adult equivalent consumption expenditure at time t+j and Z is poverty line of household consumption.

The possibility that a household will find itself poor in the future depends on its expected or mean consumption and variance of its consumption stream. And a household's vulnerability to poverty defined as a probability condition representing its inability to attain a certain minimum level of consumption in the future. Therefore, household expected consumption and the variance of its consumption are required to quantify the level of household's vulnerability to poverty

The consumption generating process can be specified as;

$$lnch = xh\beta + eh \quad (2)$$

Where, Ch is a log normally distributed per adult equivalent consumption expenditure, Xh is represents a bundle of household characteristics, observed experiences of shocks and other covariates, and β is the K×1 vector of parameters of interest and eh is F×1 vector of unobservable or error term. This error term is a mean zero disturbance term have that captured unobservable household characteristics and idiosyncratic shocks, and covariate shocks that would have contributed to different per capita consumption expenditures of households and assumed to be normally distributed.

By and large, there is high possibility consumption volatility among the poor households. Thus, Chaudhuri (2003) assumed that the variance of the disturbance term is not identically distributed across a household which rather depends upon some observable household characteristics. And this notion

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raises the prospect of formulating heteroscedasticity. Hence, the following (equation (3)) implies the functional form of heteroscedasticity via applying the variance of eh. The variance of eh is assumed to be represented by:

$$\sigma^2 eh = Xh\theta \quad (3)$$

In case of mean zero disturbance term ,, which is heteroscedastic, using standard regression techniques can yield estimates that are inefficient. Therefore, a three-stage Feasible Generalized Least Squares (FGLS) procedure as suggested by Amemiya (1977) is used to estimate β and θ.

According to FGLS procedure, equation (2) is first estimated using the Ordinary Least Squares (OLS) procedure. Then the OLS estimation of residuals from equation (2) is used to determine the following OLS estimation of the residuals:

$$\hat{e}^2 ols, h = Xh\theta + \mu h \quad (4)$$

The predicted values from this supplementary regression $Xh\theta$ are then used to transform equation (4) into:

$$\frac{\hat{e}^2 ols,h}{xh\hat{\theta} ols} = \left(\frac{xh}{xh\hat{\theta} ols}\right)\theta + \frac{\mu h}{xh\hat{\theta} ols} \rightarrow xh\hat{\theta} FGLS + ui \quad (5)$$

$xh\hat{\theta} FGLS$ is a consistent estimate of the variance component from equation (3),and this transformed equation is again estimated using OLS, and the estimated coefficients from equation (5) are the asymptotically efficient FGLS estimator of the variance of household consumption. Subsequently the estimate from the variance can be modified as:

$$\hat{\sigma} e, h = \sqrt{Xh\hat{\theta} FGLS} \quad (6)$$

Then this estimated variance $Xh\hat{\theta} FGLS$can be used to transform equation (2) into:

$$\frac{lnCh}{\sqrt{Xh\hat{\theta} FGLS}} = \left(\frac{Xh}{\sqrt{Xh\hat{\theta}\ FGLS}}\right)\beta + \frac{eh}{\sqrt{Xh\hat{\theta} FGLS}} \quad (7)$$

OLS estimation of equation (7) leads to a consistent and efficient estimate of β.Then after using the estimates of that acquired from equation (7), it is possible to determine expected log consumption and variance of log consumption for each household.

The expected log consumption:

$$\hat{E}[(lnCh/Xh)] = Xh\hat{\beta} \quad (8)$$

The variance of log consumption:

$$\widehat{Var}[lnCh/Xh] = \hat{\sigma}^2 e, h = Xh\hat{\theta} \quad (9)$$

And the log normally distributed consumption is an estimate of the probability a household to either be poor or not known as vulnerability as expected poverty is specified by:

$$\hat{V}h = \Phi\left(\frac{lnZ - Xh\beta\widehat{FGLS}}{\sqrt{Xh\hat{\theta}\ FGLS}}\right) \quad (10)$$

$\Phi(.)$ reflects the cumulative normal distribution function, Z represents the poverty line, $Xh\beta\widehat{FGLS}$ is the expected mean of real household consumption, and $Xh\hat{\theta}\ FGLS$ is the estimated variance in consumption.

Consequently, the measure of household vulnerability as expected poverty depends on the choice of poverty line, the expected level of consumption and the expected variability of consumption.

Besides, for investigating the determinants of household vulnerability to poverty by using vulnerability to poverty index from the data of monthly per adult equivalent consumption expenditures, this study applied binomial logistic regression scheme. When the vulnerability to poverty index is greater or equal to 0.5, the household is clustered as vulnerable group which takes the value of 1 and 0 otherwise (when the vulnerability index is less than 0.5). Hence, the following model is presented to examine the determinants of vulnerability to poverty of each household as expected poverty (VEP) in the study area.

$$Vh = Xh\mu + eh \quad (11)$$
$$= O\ otherwise$$

Where Vh is vulnerability to poverty, μ is a Lx1 vector of unknown parameters, *Xh* is 1xL vector of explanatory variables, and eh are models residuals.

III. Result and Discussion

a) Determination of a Poverty Line in the Study Area

According to the WB (2000),the most widely used method of estimating poverty line is the cost of basic needs (CBN) method because the indicators will be more representative and the threshold will be consistent with real expenditure across time, space and groups.

In the CBN approach, first the food poverty line is defined by choosing a bundle of food typically consumed by the poor. In the case of food poverty line, most practices use the nutritional level of 2200 kilocalories to provide an objective standard for what is considered a minimum. A non-food poverty line is determined by tolerating the necessary allowance for the basic non-food items like clothes and shoes, cooking materials and lighting, household durables, cleaning and personal care items, educational expenses, medical expenses, transportation expenses, etc.

In Ethiopia total poverty line used since 2010/2011 is 3,781 ETB per adult person per year expressed in terms of national average prices. And this poverty line is conducted in the context of the 1995/96 poverty analysis report which based on the cost of 2,200 kcal per day per adult food consumption with an allowance for essential non-food items. The food and total poverty lines used since 1995/96 in the country are

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648 and 1075 ETB respectively at national average prices (MoFED, 2012).

Total poverty refers to a combination of both the food and non-food requirements. To conduct a representative vulnerability study centered on per adult consumption expenditure, the total poverty line of 3,781 ETB per adult person per year used since 2010/2011 is updated at national average prices for the year 2014/2015. Thus, the updated total poverty line used in this thesis is 429 ETB per adult person per month.

b) The Choice of Vulnerability Threshold

The choice of a vulnerability threshold and time horizon is rather arbitrary in the study of vulnerability to poverty providing indication that there is no obvious choice. Most of the empirical studies like (Pritchett, Suryahadi et al. 2000; Chaudhuri, Jalan et al. 2002; Zhang and Wan 2008) adopted the vulnerability threshold of 0.5 and it is the most preferred susceptibility verge. According to Suryahadi and Sumarto (2003), the choice of 0.5 is justified for three reasons. Firstly, it makes instinctive sense to say a household is 'vulnerable' if it faces a 50 percent or higher prospect of falling into poverty in the near future. Secondly, this is the point where the expected consumption coincides with the poverty line. Thirdly, if a household is just at the poverty line and faces a mean zero shock, then this household has a one period ahead vulnerability of 0.5. This implies that as the time horizon goes to zero, then being 'currently in poverty' and being 'currently vulnerable to poverty' coincide (Pritchett et al., 2000).

Thus, this study employed a VEP threshold of 0.5 and time horizon of one year which can indicate the likelihood of poverty in the short run. Appropriate VEP threshold of 0.5 and higher considered as a reasonable threshold to regard one household vulnerable to poverty.

c) The Extent of Rural Household Vulnerability to Poverty

The choice of a vulnerability threshold, that is, a minimum level of vulnerability above which all households are defined to be vulnerable and time horizon are necessary elements in the assessment of household vulnerability to poverty status. And these decisions involve certain degree of arbitrariness. To investigate the distribution of household vulnerability to poverty, following Chaudhuri (2003), this paper adopted a vulnerability threshold of 0.5 which is the most preferred vulnerability verge and a time horizon of one year. Households are then considered to be vulnerable if they have a 0.5 or higher probability of falling into poverty at least once in the next year and households with vulnerability index less than 0.5 are grouped as non-vulnerable group. Applying three stage FGLS regression method specified in the methodology part of this paper, an index of household vulnerability to poverty is generated for each household in Sokoru and Tiro Afeta woreda of south west Ethiopia. A total of 139 (52.25 %) households were vulnerable to poverty among the sampled households, using the total poverty line of 429 ETB per adult person per month.

Table 1: Household Vulnerability to Poverty Estimates

Vulnerability to Poverty Status of Households	Frequency	Percent
Not Vulnerable to	127	47.75
Vulnerable to Poverty	139	52.25
Total	266	100

Source: compute from own survey, 2015

d) Decomposition of Household Poverty and Vulnerability to Poverty Status

Head count poverty index is calculated applying the total poverty line of 429 ETB per adult person per month. Based on the data used for this study, 48.2 % of households in Sokoru and Tiro Afeta woreda were poor. While 52.25 percent of households in this study area were vulnerable to poverty. Arguably, this shows that expected poverty is much higher than the point-in-time estimates of poverty, which connote the importance of forward looking poverty analysis.

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Table 2: Cross-Distribution between Poverty and Vulnerability to Poverty (%)

	Non-Vulnerable to Poverty	Vulnerable to Poverty	Total
Total	47.75	52.25	100
Poor	46.8	53.2	48.2
Non-Poor	48.7	51.3	51.8

Source: compute from own survey, 2015

Table 2 shows that a sizable fraction of non-poor households (51.3%) are vulnerable to poverty and 53.2 percent of the poor households have a vulnerability index greater or equal to 0.5 or have a probability of 50 percent and above to fall in to poverty in the near future. Thus, poverty reduction strategies need to incorporate not just alleviation efforts but also prevention campaigns. It can be seen that, in this case, the poverty rate overestimates the fraction of the population vulnerable to poverty.

e) Determinants of Vulnerability to Poverty

Table 3: Determinants of Rural Household Vulnerability to Poverty (Logistic Regression)

Explanatory variables	*Coefficients*	*Std. Err*	*Z*	*P>|z|*	*[95% Conf.*	*Interval]*
Age of Household Head	*5.144811 ****	*.5862036*	*8.78*	*0.000*	*3.995873*	*6.293749*
Education level of Household Head	*-.104368*	*.3570761*	*-0.29*	*0.770*	*-.8042243*	*.5954883*
Crop Diversification	*-.5320439 ***	*.2561909*	*-2.08*	*0.038*	*-.029919*	*1.034169*
Livestock Holding	*-.8988228 ***	*.4433819*	*-2.03*	*0.043*	*-.0298104*	*1.767835*
Household Access to Credit and Saving Service	*-1.240565***	*.4865841*	*-2.55*	*0.011*	*-2.194253*	*-.286878*
Dependency Ratio	*-.4051436*	*.4275671*	*-0.95*	*0.343*	*-1.24316*	*.4328725*
Exposure to Idiosyncratic Shock Index	*1.470935****	*.4966894*	*2.96*	*0.003*	*.4974412*	*2.444428*
_cons	*-9.139825****	*1.796011*	*-5.09*	*0.000*	*-12.65994*	*-5.619707*
Number of obs = 260				*Log likelihood = -82.061822*		
LR chi2(7) = 196.30				*Pseudo R2 = 0.5446*		
Prob > chi2 = 0.0000						

//** and *** refers to Significant at 5% and 1% Significant level respectively.

Source: Compute from own survey, 2015

The results of the above regression analysis show that the coefficient of the age of household head is statistically significantly at 1 % and positively related to household's vulnerability to poverty. And this implies that the likelihood of a household's becoming vulnerable to poverty increases with an increase in the age of the household head. This could be because of the fact that as household heads get aged, more probably they become economically inactive which in turn affects their productivity and consequently increase their vulnerability. Thus, the extent to which households manage to escape poverty which is headed by aged person would usually depend on changes in important conditions of the household.

It is evident from the results that household access to credit and saving service is a key determinant of vulnerability to poverty. The coefficient of credit and saving service availability is statistically significantly at 5 % and negatively related to vulnerability to poverty. This implies that households with access to credit and saving services are less likely to be vulnerable to poverty. Increased access to credit and saving services

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enhances household's wellbeing through provision of investment and consumption credit and saving services to even household's consumption as well as to boost their income. This result is consistent with the finding of (Hashemi et al, 1996; Baiyegunhi, 2010). Even if formal financial institutions and micro-enterprises are scant in the study area, local savings and credit associations such as Iqqub and Iddirare playing a great role in smoothing consumption and investment. Iqqub and Iddir institution are almost ubiquitous throughout Ethiopia particularly in rural areas regarding their roles in saving purpose and coping mechanisms during shocks at village level. Iqqub is a system of saving where by people form groups and pay periodically a fixed amount of money and it can be formed for various purposes such as; starting or expanding business ventures, consumption purposes that need expending large sum of money at one time or simply for saving (Dejene, 1993). Iddir is an association made up by a group of persons united by ties of family and friendship and has an object of providing mutual aid and financial assistance in certain circumstances.

Number of crops grown and household livestock holding variables appear to have significant and positive effect on household's wellbeing and it reflects that households with diversified crop and enhanced livestock are less likely to be vulnerable to poverty. Possession of a larger number of livestock is one of the determining factors on smoothing consumption and provision of investment since livestock asset is easily and possibly convert to monetary value to positively affect the welfare of households and hence cope up negative shock. This variable affects vulnerability to poverty positively at a 5 % level of significance. Crop diversification determines households' vulnerability to poverty negatively at 5 % significant level. Crop diversification spreads risks of crop failure and creates opportunities to use different soil conditions to their best advantage, hence lower level of susceptibility to poverty. Generally, in Sokoru and Tiro Afeta woreda of south west Ethiopia, livestock holding and crop diversification play a great role on the livelihood of households falling into poverty trap at least for one more year.

The other important variable is household exposure to idiosyncratic shocks. The coefficient of household exposure to household level shock is statistically significantly at 1 % and positively related to household's vulnerability to poverty. This indicates that households exposed to idiosyncratic shock such as illness, job loss, disability, unemployment, crop pest and diseases are vulnerable to becoming poor. This is due to the fact that these unexpected events will erode the households' economic stand and deplete its assets. This result is largely in line with the findings of Morduch (1994).

However, the regression results revealed that dependence ratio and household head education variables are found statically insignificant in determining vulnerability to poverty status of rural households in Sokoru and Tiro Afeta woreda of south west Ethiopia. Dependence ratio and household head education could be significant variables in the determinations of rural household vulnerability to poverty if extensive research is undertaken based on Panel data. This is due to the fact that many researchers (Adepoju et.al, 2012; Oni and Yesuf, 2006; Shafiul, 2011, etc) in their panel data studies found dependency ratio and household head education variables noteworthy in the determination of rural household vulnerability to poverty.

IV. Conclusion and Recommendation

This study estimated vulnerability to poverty of rural households using three stage FGLS procedures and found out that about 52 % of rural households in the study area are vulnerable to poverty which exceed the number of households currently poor (48.2%). It further indicates that a large number of rural households (51.3 %),out of the total sampled non- poor households, are vulnerable to poverty and also 53.2 percent of the poor households are susceptible to poverty again, signifying the importance of forward looking poverty analysis and calls for action oriented policy interventions that reduce vulnerability to poverty.

Therefore, to bring sustained poverty reduction, poverty diminution strategies should focus not only on the current poor households but also on the other part of the population who are currently not poor but are likely to be poor in the future at the time of application of the programme or policies. For example, combinations of strategies like prevention, protection and promotion presumably benefits both poor and non-poor but vulnerable household which would give them a more secure base to diversify their production and consumption activities and decisions. And this is worth full and imperative for policy makers to conscious this fact when designing social policy.

The findings presented in this study indicated that households headed by aged person are more vulnerable to poverty, whereas a household head at more productive age is better dignified to cope up with risk and uncertainty and therefore less vulnerable to poverty. Consequently, investment in human capital along with other means of social protection and promotion such as old age grants could be instrumental for reducing household vulnerability to poverty.

Cognizant of the fact that idiosyncratic shocks determines rural household's vulnerability to poverty significantly through affecting rural household's consumption and productions choices, it is important to assess ex-ante coping strategies that could reduce the exposure of households to various types of idiosyncratic

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shocks that lead to a reduction in their wellbeing. Developing formal credit and saving institutions and informal protection mechanisms like Iddir and Iqqub is essential scheme for improving household's ability on mitigating the adverse effects of idiosyncratic shocks. As well through improving the ex post coping mechanisms of the vulnerable households, it is possible to lessen the impact of susceptibility to poverty. In line with this, puts ahead the importance of social protection and promotion programmes is indispensable for ensuring inclusiveness in the poverty reduction process so that growth becomes more pro-poor.

On the other hand, factors like livestock holding and crop diversification found negatively correlated with the household's vulnerability to poverty at 5 % significant level. As a result, this is an insight that strong efforts should be made to improve rural household's welfare and reduces vulnerability to poverty through expanding and providing effective credit and agricultural extension services in the study area to have productive livestock species and diversified crops.

Furthermore, access to saving and credit services significantly affect household's vulnerability to poverty with the expected signs. Hence, providing and expanding rural saving and credits services with the necessary awareness creation campaign among the rural households in the study district should be one of the main areas of intervention and policy options. Access to credit and saving services help households particularly in rural area for smoothing income and consumption at the time of man-made or natural catastrophes like disputes and drought.

To sum up, a meaningful and a comprehensive suite of practical strategies that consider poor and non poor vulnerable households is needed to free poor and vulnerable households out of poverty circle and sustain pro-poor growth.

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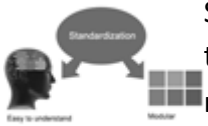


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22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.



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27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.



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Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
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This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.



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Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
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Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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